South East and East of England Regional Air Services Study

Stage Two: Appraisal Findings Report

April 2002

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SERAS - Stage Two: Appraisal Findings Report

Contents

1 Introduction

1.1 Introduction to SERAS

1.1.1 SERAS is the South East and East of England Regional Air Services Study, commissioned by Government. It complements equivalent studies into airports and air services in the other UK regions, which are being co-ordinated in RASCO, the Regional Air Services Co-ordination Study. SERAS and RASCO provide an appraisal of the physical dimension of future airports policy. Government's consideration of future policy relating to airports and air services was set out in the consultation document The Future of Aviation. The Future of Aviation and the SERAS and RASCO Study Reports, and the results of consultation on their findings, will provide major inputs into the development of a forthcoming Air Transport White Paper.

1.1.2 A future Air Transport White Paper was first referred to in The Government's White Paper on the Future of Transport '*A New Deal for Transport: Better for Everyone*', July 1998. This stated:

*As recommended by the Transport Select Committee in May 1996, **we will prepare a UK airports policy looking some 30 years ahead**. This will develop the application to UK airports of the policies set out in this White Paper – of sustainable development, integration with surface transport and contribution to regional growth.*

1.1.3 SERAS had the following objectives:

- To develop a better understanding of the demand for, and constraints on, airports and air service development in the South East and East of England, consider how these might be addressed, and evaluate how any future proposals might impact on the aviation strategies being developed for other parts of the UK.

- To examine options for the sustainable development of airports and air services in the area over the next 30 years as a key input to the preparation of a new national airports policy statement.

- To ensure that full consideration is given in the development of airports and air service provision to the environmental, economic, employment, housing and transport implications, in the light of regional economic and spatial planning objectives for London, the South East and the East of England; and to inform future reviews of Regional Planning Guidance and the Regional Development Agencies' regional strategies for the three regions.

1.1.4 From its outset, for a number of reasons, SERAS was seen to be larger and more complex than comparable studies in the other regions: the size of the region, the scale of the demand it generates, the diversity and status of the airports it contains, and the range of air services which are available. Also, given the capacity constraints which already exist at some of the region's airports, SERAS had to look in greater detail at options for runway and terminal capacity enhancement, together with options for new airports and for no further development and the management of demand. The scale and complexity of SERAS required the study to be taken forward as a series of work streams, described in Chapter 3, and brought together in a comprehensive appraisal of a wide range of options.

1.1.5 SERAS also had to take advantage, where appropriate, of past work, eg RUCATSE, and had to co-ordinate its work with the on-going Multi-Modal studies and with emerging regional and local strategies. SERAS had to consider options against a range of capacity scenarios, including:

- No development beyond that already envisaged in the land-use planning system.
- Development of terminal capacity to make full use of existing runway capacity.
- Development of additional runway and terminal capacity.

1.2 Introduction to the Report

1.2.1 There have been two main appraisal stages in SERAS. In Stage One a number of development options at different airport sites in the South East and East of England were appraised. On the basis of this appraisal, Ministers identified a number of options to be taken forward for further appraisal in Stage Two. In Stage Two selected options have been combined into packages, which combine different development options at a number of airports. This report presents the main findings of this Stage Two appraisal.

1.2.2 This report, together with the Stage Two Methodology Report and their annexes, comprises the principal SERAS Stage Two Report. It is structured as follows.

1.2.3 Chapters 2 to 4 set the background to Stage Two of SERAS. Chapter 2 introduces relevant parts of the most recent plans for airport development in the South East and East and describes the current situation at South East airports. Chapter 3 introduces the other investigations and analyses that have been made in support of SERAS. Chapter 4 introduces Stage One of SERAS: the basis on which it was undertaken, the options appraised at existing and new main sites and at smaller sites, and the selection of options for further appraisal in Stage Two.

1.2.4 Chapters 5 and 6 introduce Stage Two of SERAS. Chapter 5 describes the main options and packages appraised in Stage Two of SERAS. It also describes how smaller airport sites have been treated in Stage Two of SERAS. Chapter 6 introduces the appraisal methodology applied in Stage Two of SERAS. (This is described more fully in the Stage Two Methodology Report and its Annexes.) It describes the appraisal of Representative Cases of options and the appraisal of packages, and sets out the principal techniques and assumptions underlying the appraisal process.

1.2.5 Chapters 7 to 11 describe the appraisal of options at the principal airport sites in Stage Two, one chapter each for Heathrow (chapter 7), Gatwick (chapter 8), Stansted (chapter 9), Luton (chapter 10) and the proposed new site at Cliffe Marshes (chapter 11). These chapters are essentially structured in the same way, describing the options appraised at each airport, their safety risks, their forecast usage, surface access implications, environmental impacts, employment impacts, land use and urbanisation impacts, and their impacts in relation to integration. Appraisal Summary Tables (ASTs), summarising the principal impacts of options at each airport, are presented in a supplementary volume.

1.2.6 Chapter 12 summarises the less detailed appraisal undertaken of a potential airport at Alconbury and Chapter 13 summarises the appraisal of the potential contribution that other small airport sites in the East and South East of England might make to commercial aviation activity.

1.2.7 Chapter 14 describes the appraisal of the agreed packages of options, supplementing the ASTs presented in preceding chapters with those impacts that can only be addressed on a package-wide basis, notably economic and financial impacts. In this chapter, packages are grouped into three categories according to the scale of development and the timescales by which they might be in place: those that do not involve new runways and are regarded as all that are likely to be in place by, say, 2010; those that essentially include one new runway and could be in place soon after 2010 – these are appraised in 2015; and larger packages with two or more new runways which are unlikely to be completed before the second half of the appraisal period to 2030. These are appraised in 2030.

1.2.8 Chapter 15 summarises the appraisal of the implications for accommodating air freight with different packages and chapter 16 describes the appraisal of the implications for the airspace system of the forecast movements to 2030 with different packages.

2 Background to SERAS

2.1 Introduction

2.1.1 Principal elements of the background to the SERAS study are set out in this chapter: the policy background; the current usage of airports in the South East and East of England and major airports on the near continent; forecast growth in demand; and past studies of airport development in the South East. (Note: in this document, the phrase 'South East' may be used to denote London, the South East and East of England Regions collectively.

2.2 Policy Background

2.2.1 The 1998 Transport White Paper *'A New Deal for Transport: Better for Everyone'* is the most recent expression of Government policy in relation to transport generally and to airports and air travel. The principal statements of relevance to SERAS were:

- A UK airports policy to be prepared based on sustainable development, integration with surface transport and ind contribution to regional growth.
- The strategy for sustainable development means aviation should meet the external costs, including environmental costs, that it imposes.
- The new airports policy will take account of the demand for airport capacity for scheduled, charter, business and freight aviation and the related environmental, development, social and economic factors.
- The airports policy will be taken forward in conjunction with airspace capacity issuess and with consideration of surface access provision, particularly better public transport access.
- The new policy will reflect the different roles and competitive strengths of the nation's airports, recognising that each airport cannot be viewed in isolation from other airports.
- Taking account of the emerging findings of studies of regional airports, the growth of regional airports to meet local demand for air travel would be encouraged where consistent with sustainable development principles.

2.2.2 Prior to the 1998 White Paper, the most recent major statement of the Government's airports policy was contained in the 1985 White Paper *'Airports Policy'*. The principal conclusions of that Paper in relation to South East airports were:

- Heathrow: The Government turned down the application for development of a fifth terminal at Heathrow. This would need planning permission.

- Gatwick: The Government reaffirmed its policy that a second runway should not be constructed at Gatwick, because of its environmental consequences and because, on air traffic control and other grounds, it was not certain that a second runway could be fully utilised.

- Stansted: The Government granted permission to develop Stansted up to a capacity of 15 million passengers per annum (mppa), with development of the airport controlled by means of a progressively increasing limit on air transport movements (ATMs). Increases in the limit would require the consent of Parliament, so as to give an assurance to the local population that an appropriate balance would be struck between aviation and local interests in the use of the airport.

- Luton: It was thought that airspace interactions with Stansted would limit movements at Luton, so the strategy for Luton envisaged that traffic would grow only to about 5 mppa with the development of any necessary facilities subject to normal planning procedures.

2.2.3 The 1985 White Paper set out a policy of encouraging the maximum use of airports outside the London system, to meet the demand arising in the regions.

2.2.4 It was envisaged that the decision relating to expansion at Stansted, together with already approved plans for developing Gatwick (Gatwick North Terminal opened in 1988) and Heathrow (Terminal Four opened in 1986), would lead to the provision of enough capacity within the London airports system to the mid 1990s, and the necessary flexibility to enable decisions to be taken at the appropriate time for any development needed thereafter.

2.3 RUCATSE

2.3.1 The last major long-term airport planning exercise for the South East was RUCATSE (Runway Capacity to Serve the South East), carried out by a Working Group led by the Department of Transport. RUCATSE started in 1990 when the CAA advised that another runway's worth of capacity would be needed to serve South East demand by around 2005. RUCATSE looked for a full runway's worth of capacity. It did not seek to optimize a trade-off between variants offering less capacity but with reduced environmental impact.

2.3.2 The Terms of Reference for RUCATSE required the CAA's work to be reviewed from a wider perspective than the need for capacity and the air traffic control implications that had previously been the CAA's focus. Greenfield sites for a new airport were excluded from consideration.

2.3.3 RUCATSE was not asked to recommend a particular site for development, but was asked to have regard to the environmental conditions that had led the Government to its earlier views that second runways should not be built at Gatwick or Stansted.

2.3.4 RUCATSE forecast that even without a new runway, the number of passengers using South East airports might increase to 170 mppa by 2015. If a new runway was provided at Heathrow or Gatwick, where demand would build up most quickly, total mppa at South East airports might be 195 mppa by 2015.

2.3.5 Passenger throughput at airports in the regions and at smaller airports in the South East was expected to increase from 38 mppa in 1992 to 150 mppa by 2020, in the absence of major runway expansion in the South East. With a new runway at Heathrow or Gatwick, the demand at regional and smaller South East airports might be limited to 125 mppa by 2020.

2.3.6 RUCATSE concluded that the capacity of a new runway at Heathrow or Gatwick would be taken up by passenger demand by 2010 and that the benefits to passengers could provide a case for a further runway at Heathrow or Gatwick by 2010, or at Stansted by 2015. The principal impacts of new runways would be as indicated in Table 2.1.

Table 2.1: RUCATSE Principal Conclusions

Airport	Runway option	Principal advantages and disadvantages
Heathrow	New full length runway to the north of the airport	Greatest benefits to air transport industry and passengers Greatest disbenefits: noise, land use, property demolition
Gatwick	New 3500m runway 2850 metres to the north of the existing runway and staggered to the west.	High benefits but substantial environmental problems
Stansted	New runway to the east of the existing runway, which would be shifted laterally and extended to the east	Lower benefits than Heathrow or Gatwick, with environmental problems in many ways similar to Gatwick
Luton	Extension of existing 2160m runway to 2500m	A smaller option that would delay the case for expansion elsewhere by only 3 years Benefits low in absolute terms but high in relation to the size of the project Pressure on Green Belt

2.3.7 While the Terms of Reference for RUCATSE ruled out the investigation of a greenfield site, during the course of RUCATSE the promoters of Marinair, a scheme for building an airport on an artificial island in the Thames Estuary, approached RUCATSE. The scope of the study was extended to cover this proposal. RUCATSE acknowledged the difficulties that would need to be overcome before such an airport could successfully be developed, but also identified potential benefits: principal among them were minimised noise impact, scope for expansion, avoidance of intrusion into existing settlements and congruence with Regional Planning Strategy.

2.3.8 Of significance to SERAS is that, following this appraisal of runway options at each of the principal South East airports in response to the CAA's advice that another runway would be needed by 2005, no runway development or capacity enhancement of any significance has taken place. The runway capacity available in 2005 will consequently fall short of the requirement expressed in 1990.

Current Airport Usage

2.3.9 The use made in recent years of the major airports in the South East providing commercial aviation services is set out in Table 2.2 (Passengers: terminal passenger traffic) and Table 2.3 (Passenger ATMs). The major airports are taken to be Heathrow, Gatwick, Stansted, Luton, and to lesser extent London City. Commercial aviation services are also provided within the South East and East of England at Southampton, Norwich, Cambridge, Manston, Biggin Hill, Southend, Lydd and Shoreham.

Table 2.2: Terminal Passenger Traffic at South East Airports, mppa

Year	Heathrow	Gatwick	Stansted	Luton	London City	Total
1994	51.4	21.0	3.3	1.8	0.5	78.0
1995	54.1	22.4	3.9	1.8	0.6	82.8
1996	55.7	24.1	4.8	2.4	0.7	87.7
1997	57.8	26.8	5.4	3.2	1.2	94.4
1998	60.4	29.0	6.8	4.1	1.4	101.7
1999	62.0	30.4	9.4	5.3	1.4	108.5
2000	64.3	31.9	11.9	6.2	1.6	115.8
Annual average growth, 1994 to 2000, %	3.8	7.2	23.8	22.9	21.4	6.8

Source: CAA statistics

Table 2.3: Passenger ATMs at South East Airports, thousand ATMs

Year	Heathrow	Gatwick	Stansted	Luton	London City	Total
1994	408	176	48	15	17	664
1995	418	187	56	18	18	697
1996	425	206	68	27	26	752
1997	427	225	74	36	33	795
1998	439	239	92	42	38	850
1999	448	243	122	50	42	905
2000	457	249	133	54	50	943
Annual average growth, 1994 to 2000, %	1.9	6.0	18.5	23.8	19.7	6.0

Source: CAA statistics

2.3.10 In 2000, these five airports accounted for 64% of all passenger movements at UK airports. Passenger traffic has grown across these airports at an annual average rate of 6.8% over this period, ATMs at an annual average rate of 6.0%. Growth rates at Heathrow particularly and at Gatwick, where capacity is heavily constrained, have been relatively low: growth rates at Luton and Stansted have been very much higher, reflecting the availability of capacity and the rapid growth of 'no frills' or low cost services over this period. The constrained capacity at Heathrow and Gatwick has led to an increase in the number of passengers per passenger ATM (P/PATM) over this period, by 12% at Heathrow and 7% at Gatwick.

2.3.11 The runway capacity at both Heathrow and Gatwick is very intensively used. Passenger ATMs at Heathrow in 2000 accounted for 95% of all of the 480,000 runway slots estimated to be available, and at Gatwick 96% of the 260,000 slots are used. At both Stansted and Luton, the passenger ATMs in 2000 accounted for around half of the estimated runway capacity, and at London City for around 70% of the maximum capacity of the present runway.

2.3.12 The South East airports cater for different types of passenger traffic. In Table 2.4, estimates of year 2000 passenger movements through each airport are shown by type of air service and type of passenger movement. There are small differences between these estimates and the CAA-derived terminal passenger numbers in Table 2.2.

Table 2.4: 2000 Estimated Passenger Traffic by Type of Air Service, mppa

Air Service	Heathrow	Gatwick	Stansted	Luton	London City
Scheduled international direct flights	37.0	12.5	1.9	0	0.4
Domestic interlining*	4.2	1.3	**	0	0
International interlining*	0.9	1.1	0.5	0	0.1
International to international interlining*	17.8	3.4	0.1	0	0
Sub-total: international scheduled	**59.9**	**18.3**	**2.5**	**0**	**0.5**
International charter	0	11.6	1.5	1.3	0
International low cost	0	0.6	6.6	3.2	0
Sub-total: international	**59.9**	**30.5**	**10.6**	**4.5**	**0.5**
Domestic	3.9	1.5	1.2	0.1	0.8
Domestic low cost	0	**	0.9	1.7	0
Sub-total: domestic	**3.9**	**1.5**	**2.1**	**1.8**	**0.8**
Other	0.3	**	0	0	0
Total	**64.1**	**32.1**	**12.8**	**6.3**	**1.3**

Source: CAA Statistics and Consultants' Estimates

** Domestic interlining refers to a trip between the UK and an overseas destination with interlining at a UK airport. International interlining refers to a trip between the UK and an overseas destination with interlining at an overseas airport International to international (I to I) interlining refers to a trip between two overseas points with interlining taking place at a UK airport.*

*** means less than 50,000*

2.3.13 All of Heathrow's passenger traffic is on scheduled services, most of it international. There is no charter or low cost traffic. The wide range of passenger services available generates a large volume of interlining traffic. Around 28% of Heathrow's traffic in 2000 consisted of I to I interliners, passengers whose only reason to be at Heathrow was to change aircraft. Some 8.4 million passenger movements were domestic, within UK, trips. 3.9 million of these were direct trips, beginning or ending at Heathrow, and 4.5 million were associated with transfers to or from an overseas flight.

2.3.14 36% of Gatwick's passenger movements were charter trips and there were a small number of low cost trips, but most passenger movements were on scheduled services. 11% of trips were I to I interliners. There were some 3 million domestic trips, half ending at Gatwick and half connecting to or from an overseas flight.

2.3.15 Low cost passenger movements accounted for around 70% of Stansted's traffic in 2000 and charter for approximately 12%. Approximately 83% of Stansted's traffic is international, with 2.1 million domestic trips.

2.3.16 Luton is even more dominated by low cost traffic, which accounts for 77% of all passenger movements, with charter accounting for almost all the remainder. Approximately 72% of Luton's traffic is international. There are some 1.8 million domestic trips.

2.3.17 London City's traffic is wholly on scheduled services, with business passengers rather than leisure passengers being the major part of the airport's demand. Just under 40% of traffic is estimated to be international. The airport handled 0.8 million domestic passenger movements in 2000.

Air Cargo

2.3.18 The five airports handled 79% of the 2.3 million tonnes of air cargo handled at UK airports in 2000. Heathrow handled 1.3 million tonnes, of which 1.2 million tonnes were carried in the bellyholds of passenger aircraft. Gatwick handled 0.3 million tonnes, again almost all bellyhold. Stansted handled 0.2 million tonnes, almost all in dedicated cargo aircraft. In 2000, Stansted was second only to East Midlands among UK airports in terms of the volume of freight carried in cargo aircraft. In 2000 there were 14,000 cargo ATMs at Stansted, 6,000 at Luton and around 3,000 at each of Heathrow and Gatwick. The growth in the demand for passenger ATMs at the major airports in recent years has led to air cargo movements being displaced from the busier airports, to Stansted and Luton and further afield.

Current Airport Plans

2.3.19 The principal plans for expansion at South East airports relate to terminal capacity rather than runway capacity. At Heathrow, as this report was being finalised, a decision in favour of T5 was taken following the Public Inquiry and the Inspector's report. It has been assumed in this study that this will increase the airport's passenger capacity to 86 mppa.

2.3.20 Gatwick is envisaged within the land-use planning system as a single runway, two terminal airport with a capacity of 40 mppa. Further planning applications within this framework will be made following the S106 agreement with the local planning authority in November 2000.

2.3.21 A planning application to increase capacity at Stansted to 25 mppa, from the currently approved 15 mppa, was submitted in August 2001. A parallel review of the passenger ATM limit to around 210,000 ATMs will be sought, to enable full use to be made of the proposed terminal capacity.

2.3.22 Ownership of Luton Airport has recently changed hands. The previous owners produced a Development Brief to take capacity up to 10 mppa. The Bedfordshire Structure Plan states that, subject to agreement of the Development Brief, a passenger throughput of 10 mppa may be acceptable.

2.4 Delay Standards

2.4.1 In response to increasing demand for ATM capacity at Heathrow and Gatwick, the number of slots has been increased at the expense of delay criteria and service standards. The twice-yearly process by which the number of slots made available at these two airports is determined has accepted, over time, a relaxation of the delay standard. In order to increase throughput, the runway-related delay standard has been relaxed from the internationally-accepted standard of 5 minutes average delay per movement (arrival or departure) in all half hours in the operating day, to 10 minutes. The operation of airports at ATM levels ever closer to maximum runway capacities increases the variability and unpredictability of delays. The 10 minute average delay standard is associated with peak delay standards of 20 minutes for arrivals and 25 minutes for departures.

2.5 Comparison with Continental Airports

2.5.1 Table 2.5 provides a 1999 comparison of the principal operational statistics at Heathrow and Gatwick with the major near-continent airports of Paris Charles de Gaulle, Frankfurt and Amsterdam. At Heathrow and Gatwick, there were over 220,000 ATMs per runway in 1999, while the highest number of ATMs at any of the three continental airports was 159,000 per runway, at Paris CDG. It may also be noted that average passenger loads are substantially higher at Heathrow and Gatwick than those at any of their continental counterparts.

2.5.2 The three continental airports all have new runways planned or recently operational: a 4th runway at Paris CDG opened in 2001 and new runways are planned at Frankfurt and Amsterdam later in the decade.

Table 2.5: Use of Major South East and European Airports

Airport	Existing runways	Planned runways	1999 ATMs '000	1999 Passengers mppa	Passengers per ATM
Heathrow	2		448	62.0	138
Gatwick	1		243	30.4	125
Paris CDG	4	4th runway opened in 2001	476	43.6	92
Frankfurt	3	4th runway to open by 2006	439	45.9	104
Amsterdam	4	5th runway to open by 2003	410	36.8	90

Demand Forecasts

2.5.3 DTLR's most recent air traffic forecasts were published in May 2000 in *"Air Traffic Forecasts for the United Kingdom 2000"*. Forecasts were made of terminal passenger numbers at UK airports to 2020 by type of journey (international, by UK and foreign residents, leisure and business; domestic; low cost). Low, mid-range and high forecasts were made. The mid-range totals, extended to 2030, are shown in Table 2.6. The forecasts are of unconstrained demand. They incorporate a reduction through time in the rate of growth in demand, as the air travel market matures. Total UK passenger numbers are forecast to increase from around 160 mppa in 1998 to 400 mppa in 2020 and 500 mppa in 2030. Unconstrained demand at the four major South East airports (Heathrow, Gatwick, Stansted and Luton) is forecast to increase from 117 mppa in 2000 to 301 mppa in 2030.

Table 2.6: Forecast Growth in Terminal Passenger Numbers at UK Airports

	Terminal passengers mppa	% growth from 2000	Unconstrained demand for South East airports mppa
2000	181	-	117
2005	230	27	146
2010	277	53	173
2015	335	85	202
2020	402	122	242
2025	454	151	273
2030	501	177	301

Source: DETR and Consultants' Estimates

2.6 September 11th 2001

2.6.1 The events of 11 September clearly had an immediate and major impact on air transport demand, because of the temporary ban on flights to the United States, and reluctance by some people to travel by air soon after the event. They accelerated many of the trends that were previously apparent in the air transport industry, such as reduction in capacity, consolidation, increasing alliances, and the growth of the low cost sector.

2.6.2 BAA's 3rd Quarter performance was substantially affected by the events but passenger traffic has slowly recovered. Traffic on North Atlantic routes was dowm by 31% in October 2001 compared with the previous year, but by March 2002 was down by only 5%. At BAA airports in total, overall demand in October 2001 was 12% below the previous year: in March 2002, the underlying growth in demand, excluding Easter, was 1% higher than March 2001.

2.6.3 The recovery in passenger numbers at UK airports has been helped by a strong leisure market and the rapid growth of low cost carriers, which has helped airports such as Stansted. In March 2002, terminal passenger traffic at Stansted grew by 17% over the previous month.

2.6.4 In the long-term, demand is likely to recover previous growth trends, although it is difficult to be precise on the timing of the recovery. Long-term forecasts already take account of fluctuations in demand, for example those caused by the usual cycles in the global economy. The forecasts also assume slower growth than in recent years, and slightly slower growth in the South East than in other parts of the UK, to reflect the maturing air transport market in the South East.

3 SERAS

3.1 SERAS Terms of Reference

3.1.1 SERAS had the following objectives:

- To develop a better understanding of the demand for, and constraints on, airports and air service development in the South East and East of England, consider how these might be addressed, and evaluate how any future proposals might impact on the aviation strategies being developed for other parts of the UK.
- To examine options for the sustainable development of airports and air services in the area over the next 30 years as a key input to the preparation of a new national airports policy statement.
- To ensure that full consideration is given in the development of airports and air service provision to the environmental, economic, employment, housing and transport implications, in the light of regional economic and spatial planning objectives for London, the South East and the East of England; and to inform future reviews of Regional Planning Guidance and the Regional Development Agencies' regional strategies for the three regions.

3.1.2 From its outset, for a number of reasons, SERAS was seen to be larger and more complex than comparable studies in the other regions: the size of the region, the scale of the demand it generates, the diversity and status of the airports it contains, and the range of air services which are available. Given the capacity constraints which already exist at some of the region's airports, SERAS had to look in greater detail at options for runway and terminal capacity enhancement, together with options for new airports and for no further development and the management of demand. The scale and complexity of SERAS required the study to be taken forward as a series of work streams brought together in a comprehensive appraisal of a wide range of options. These work streams had to:

- Develop profiles of future demand for scheduled and chartered air services, air freight and business aviation in the South East and East of England (SE and EE), under a range of scenarios (including those that both meet and manage demand) covering a 30 year planning period.

- Analyse the role of the SE and EE Airports in meeting demand originating from within the study area, from elsewhere in the UK and from international passengers interlining over SE and EE airports.

- Evaluate current and future airspace and air traffic control capacity issues, airspace integration and possible environmental improvements through design changes in airspace over the South East and East of England.

- Evaluate current, prospective and potential capacity at existing SE and EE airports and their ability to meet a range of demand from different market sectors.

- Assess potential fiscal and regulatory tools for ensuring optimum use of existing runway and terminal capacity serving demand arising at SE and EE airports and their role in managing demand to reflect environmental capacity constraints.

- Identify the potential for both existing and new sites, within or accessible from the SE and EE, to provide additional capacity to meet alternative levels of aircraft and passenger transport movement demand. This requires careful consideration of the environmental, health, engineering, operational, safety, legal, commercial, economic, land-use planning and surface access impacts associated with each.

- Develop a South East Airports Appraisal Framework (SEAFF) based on the approved New Approach to Transport Appraisal (NATA) and sustainability criteria, to facilitate the evaluation of both demand management and enhanced capacity options. This requires consultation on the criteria and indicators to be used, the development of a suite of appraisal tools and the establishment of clearly defined sifting procedures for use at different stages of the study.

- Derive a range of alternative ‘packages’ of runway, terminal and surface access options to provide different levels of capacity over and above that which could be available from existing, or prospective, airport infrastructure.

- Evaluate these ‘packages’ using the agreed appraisal methodology and the presentation of those results for public consultation, to identify the implications in economic, environmental, development and social terms of both meeting, and not meeting, demand.

- Consider what environmental conditions and controls might be a desirable component of the packages.

3.1.3 SERAS was also required to:

- Have regard to emerging land use planning, transport, environmental and economic strategies, and regional sustainable development frameworks, for regions within and adjacent to the study area.
- Take advantage, where appropriate, of the work done in RUCATSE.
- Co-ordinate, so far as practicable, its work with concurrent multi modal corridor studies impacting on the study area.
- Have regard to any relevant Local Authorities' air quality strategies and air quality management area action plans.
- Look for opportunities to facilitate public transport links to airports and to take account of the findings of two studies commissioned by OPRAF and DETR: the Regions to London Airports Study and the inter-London Airports Rail Study.
- Consider options against a range of capacity scenarios, including:
- No development beyond that already envisaged in the land-use planning system.
- Development of terminal capacity to make full use of existing runway capacity.
- Development of additional runway and terminal capacity.

3.1.4 The Government was committed to an approach to SERAS that was as inclusive as possible, but which recognised that considerations of blight and commercial sensitivities imposed strict constraints on the conduct of the study. It was important that location-specific details of the development options being appraised did not become public. The study team had to ensure that potential blight was minimised by making maximum use of data already in the public domain, by taking care in dealing with local authorities and other providers of data, and by dealing with the press/media in a way that minimised media attention.

3.2 Management of SERAS

3.2.1 The technical work of SERAS was undertaken by a team of consultants reporting on a day by day basis to Airports Policy Division of DTLR. A Government Steering Group and a Reference Group met at approximately quarterly intervals during the study.

3.2.2 The Steering Group consisted of representatives of:

- DTLR – Department of Transport, Local Government and the Regions
- DEFRA – Department of the Environment, Food and Rural Affairs
- Government Office for the South East
- Government Office for the Eastern Region
- Government Office for London
- Highways Agency
- Strategic Rail Authority
- CAA, Directorate of Airspace Policy

3.2.3 The composition of the Reference Group was wide-ranging, as set out in Table 3.1. The Reference Group was required to:

- ensure that the SERAS study meets the final approved terms of Reference,
- act as the focus of high level consultation between DTLR and the many interested parties,
- provide external oversight and validation of the approach adopted by the study team, and
- provide a source of external advice and expertise on a wide range of issues relating to the SERAS study.

3.2.4 The Reference Group was restricted in its ability to oversee and validate the study's approach in that location-specific information could not be provided to the Group. Terms of Reference and statements of the methodology to be applied were provided to the Reference Group but no results of the application of the methodology could be provided.

Table 3.1: Reference Group Composition

Area of Interest	Reference Group Members
Airports	BAA, London Luton, London City, AoA
Airport Consultative Committees	Heathrow Airport Consultative Committee, GATCOM, Stansted Airport Consultative Committee, Luton Airport Consultative Committee

Area of Interest	Reference Group Members
Airlines	British Airways, British Air Transport Association, BAR UK, International Air Carrier Association, IATA
Surface Access Bodies	Railtrack, Transport for London, Strategic Rail Authority, Confederation of Passenger Transport Operators
Consumer Interests	Air Transport Users Council, CAA
Local Authority Interests	SASIG (LGA Special Interest Group), SERPLAN, LPAC
Business Interests	TUC, CBI, SEEDA (South East of England Development Agency), EEDA (East of England Development Agency), LCCI, BTA
Environmental Interests	FoE, CPRE, National Society for Clean Air and Environmental Protection, Aviation Environment Federation

3.2.5 The main part of the consultant team involved in SERAS was as shown in Table 3.2.

Table 3.2: SERAS Consultancy Team

Study Area	Consultants
Managing Consultant	Halcrow
Airport Optioneering	BAA Arup Scott Wilson Gibb Sir Frederick Snow & Partners Halcrow
Airspace Planning	CAA Directorate of Airspace Policy NATS
Surface Access	Halcrow Booz Allen
Employment and Labour Market Impacts	Halcrow Londonomics

Study Area	Consultants
Land Use and Urbanisation	Arup Economics & Planning
Regional and Social Impacts	Arup Economics & Planning
Environmental Impacts	Scott Wilson CAA Environmental Research and Consultancy Department (ERCD) AEA Technology Environment Halcrow
Economic and Financial Impacts	Halcrow

3.3 Structure of SERAS

3.3.1 SERAS has had two main phases of technical work: Stage One which began early in 2000 and was reported to Ministers in July 2001 and Stage Two, the findings of which constitute the main part of this report.

3.3.2 Stage One of SERAS is described in full detail in the Stage One reports and its findings are summarised in Chapter 4 of this report. In Stage One an appraisal of a number of development options at individual airports in the South East was undertaken, with the aim of identifying preferred options at each airport to be taken forward to Stage Two. In Stage Two the options taken forward would be combined into packages of options at one or more sites. In Stage One, with the modelling tools then available, little account could be taken of any interaction between airports in the South East airports system. In Stage Two, with enhanced modelling tools available, notably a new passenger allocation model, the definition and appraisal of packages of options allowed more consideration of these interactions.

3.3.3 The airports at which a number of options were appraised in Stage One were:

- the existing, main airports of Heathrow, Gatwick, Stansted, Luton, London City and Southampton,
- a potential new airport at Cliffe Marshes in North Kent, which might be used for a full range of passenger and freight services, and;
- the use of existing military airfields at Alconbury and Hullavington, predominantly for air freight and low cost passenger services.

3.3.4 The potential new sites for commercial air services of Cliffe Marshes, Alconbury and Hullavington emerged from the Site Search Study, summarised later in this chapter.

3.3.5 In addition to the appraisal of a number of options at these sites, the potential contribution that other airfields in the East and South East could make to serving the needs of commercial aviation was assessed in a Small Sites Study, the findings of which are summarised in Chapter 4. The airfields covered are: Biggin Hill, Cambridge, Farnborough, Lydd, Manston, Norwich, Shoreham and Southend.

3.3.6 The appraisal of options at the main sites (those listed in para 3.3.3) in Stage One of SERAS broadly followed the appraisal methodology set out in the published appraisal framework, '*The Appraisal Framework for Airports in the South East and Eastern Regions of England*' DETR, November 2000. In Stage One, some areas of appraisal were necessarily covered only at a coarser level of detail or were omitted. There were two principal reasons for this: either detailed modelling and appraisal tools were not available, or the appraisal of options at individual sites did not allow the effects of interactions between airports, for example in passenger allocation and the assessment of user benefits, to be assessed.

3.3.7 The principal areas of the Stage One appraisal affected in this way were as follows:

- The absence of a suitable passenger allocation model at Stage One did not allow forecasts to be made of the likely use of any development option as an addition to existing capacity, either on its own or in combination with other options. In the absence of forecasts of usage, the appraisal of options was based on the additional capacity, in runway movements and terminal space, provided by the option. The underlying assumption in Stage One was that any option would represent the only addition to capacity and it would be fully used. In Stage Two a passenger allocation model (SPASM) has been developed to give forecasts of the use likely to be made of any option or package of options.

- No detailed noise modelling was undertaken in Stage One but has been in Stage Two. Potential noise impacts in Stage One were identified by the application of the Air Space Design Footprint from the November 2000 Appraisal Framework and judgement based on other known and modelled noise contours. In Stage Two detailed noise modelling has been undertaken.

- No detailed air quality modelling was undertaken in Stage One. The air quality assessment in Stage One was a comparative assessment of four aspects of the air quality impact of each option at an airport leading to a ranking of the options at each airport in terms of their air quality impact, but not permitting any inter-airport comparison. In Stage Two detailed emission and dispersion modelling has been undertaken.

- The surface access models available in Stage One were less detailed and less well validated than those used in Stage Two.

- No airspace modelling was available in Stage One. An understanding of the future airspace capacity in relation to the extra runway capacity and the additional movements associated with some of the development options has been obtained in Stage Two through the initial simulation modelling of selected packages.

- The absence of passenger forecasts and a passenger allocation model in Stage One did not allow economic or financial impacts to be assessed, but they have been in Stage Two.

3.3.8 Stage One of SERAS is summarised in the next chapter of this report.

3.4 Supporting Studies

3.4.1 A number of other studies have been undertaken to inform SERAS or to supplement the technical analysis undertaken in SERAS. Principal among these are the following studies which are summarised below:

- *Site Search Study*, Scott Wilson

- *New Technology Study*, Arthur D Little

3.4.2 In addition, studies were made of a number of the issues associated with the potential new site at Cliffe Marshes. These are summarised in Chapter 11 which presents the appraisal findings at Cliffe Marshes. The studies include:

- *Airline Development Strategy Study*, Booz Allen

- *North Kent Marshes Ecological Study*, Scott Wilson

- *Implications for the Thames Gateway*, Arup Economics & Planning

Site Search Study

3.4.3 Prior to the commencement of SERAS, DTLR commissioned a Site Search Study from Scott Wilson: *Preliminary Site Search of Options for New Airport Capacity to Serve the South East and East of England, Final Report and Appendices*, June 2001. The main objectives of the study were to identify options for siting new airport capacity to serve London, the East and

South Eastern regions, to highlight the most suitable areas for sustaining major development and to recommend a short list of potential sites.

3.4.4 The study evaluated the full range of potential sites, including greenfield, brownfield and offshore possibilities, both new and a number that have been examined by previous studies. In addition, over 400 existing operational and inactive sites, including civil, private and military airfields were reviewed. An Ordnance Survey-based Geographical Information System was used to identify and progressively select potential sites against sets of constraint criteria.

3.4.5 The study was carried out in five stages:

- In Stage One, Areas of Opportunity, that is areas of least constraint, were identified by means of spatial analysis of the whole study region. Constraint criteria included core issues under the following headings: physical, operational and safety; catchment and accessibility; the environment; regional planning; and commercial. Sites were scored against the criteria and the output from Stage One was a mapping of combined constraints and a ranked list of all existing, previously proposed and potential new sites.

- Stage Two tested the robustness of the Stage One rankings by weighting different groups of criteria in turn: construction costs, access, the environment, socio-economic factors and commercial factors. From the Stage Two analysis, Areas of Opportunity, with minimum constraint on airport development, were identified as those in which all weighted analyses produced high opportunity values.

- Stage Three discarded those Areas of Opportunity too small for siting an airport. The remainder were grouped into 19 Zones of Opportunity and investigated in more detail to assess the following: potential demand (including interaction with the existing major airports); compatibility with Regional Planning Guidance criteria; possible noise and safety impacts affecting urban areas; and airspace issues, including interaction with the existing airport system. Eight Zones of Opportunity were selected for further investigation.

- In Stage Four, new sites with maximum potential and least constraint within or close to the eight Zones of Opportunity were identified. The analysis at this stage also extended to offshore areas and existing civil and military airfields in areas with high rankings from Stage One. Fourteen potential new, two-runway airport sites, as listed in Table 3.3, and 16 existing airfields (Table 3.4) were identified.

Table 3.3: Potential New Airport Sites at Stage Four of the Site Search Study

Site	County
Hamilton	Kent
Shadoxhurst	Kent
Hook	Hampshire
Cliffe Marshes	Kent
Sheppey	Kent
The Cant	Offshore (Thames estuary)
Hayes Knoll	Wiltshire
Highworth	Wilshire
Rettendon	Essex
Thurrock	Essex
Epping	Essex
Harlow	Essex
Bedford	Bedfordshire
UK1	South Gloucestershire

Table 3.4: Existing Airfield Sites at Stage Four of the Site Search Study

Airfield	County
Abingdon	Oxfordshire
Alconbury	Cambridgeshire
Boreham	Essex
Boscombe Down	Wiltshire
Bournemouth	Dorset
Cranfield	Bedfordshire
Fairford	Gloucestershire
Hullavington	Wiltshire
Lyneham	Wiltshire
North Weald	Essex

Airfield	County
Oakley	Buckinghamshire
Odiham	Hampshire
Manston	Kent
Thurleigh	Bedfordshire
Waterbeach	Cambridgeshire
Wormingford	Essex

- In Stage Five, all existing and new sites from Stage Four were evaluated against a further, more detailed series of criteria which included: obstacle limitation surfaces; environmental factors; commercial demand; travel times and quality of surface access. The highest ranked sites were:

  Harlow

  Thurrock (South Ockenden)

  Cliffe Marshes

  UK1 (near Bristol)

  Hullavington

  Alconbury

  Rettendon

  Shadoxhurst

  Hayes Knoll

3.4.6 The Site Search study concluded that all of these sites had the capability of major airport development and might be taken forward into SERAS. SERAS was asked to appraise Cliffe Marshes as a possible new airport capable of providing the full range of passenger services – scheduled, charter, low cost – and freight services, including its potential for 24 hour operation. Alconbury and Hullavington were also to be appraised in SERAS as existing airfields capable of being developed to serve air freight and some passenger services, given the likelihood that air freight services would continue to be squeezed out of existing South East airports.

New Technology Study

3.4.7 To inform its air transport policy, particularly in relation to the London Terminal Area with its five airports and busy airspace, DTLR commissioned a study to inform judgements as to the scale and timing of the impact of new aviation technology. The study had two prioncipal objectives. First, to investigate the likely impact of new technology on the demand for, development and operation of air services to, from and within the UK, and, secondly, to inform and increase the Department's understanding of the contribution these technologies can make to enhancing airport capacity and mitigating environmental impact.

3.4.8 Arthur D Little (ADL) were appointed to undertake the study, reported in '*Study into the Potential Impact of Changes in Technology on the Development of Air Transport in the UK, Final Report to DTLR'*, November 2000.

3.4.9 The scope of the study was confined to technologies predicted to enter service by 2030, with the emphasis on technology developments likely to be introduced in the period from 2005 to 2010. Technologies already deployed, in the UK, USA or in Europe, or in the process of being deployed were not considered.

3.4.10 In defining the benefits from future capacity enhancement and environmental mitigation technologies, attention was concentrated on those that address the most significant capacity and environmental constraints facing the industry. Within the study's overall scope, broad commercial realities were addressed and an understanding provided of the implications of future technology take-up for prospective Government policy. The study processes included a thorough desktop review and interviews and workshop exercises with key industry stakeholders.

3.4.11 The study found that in the short-term, incremental improvements in capacity at UK airports are expected, with new technologies being important but not key to these improvements. In the medium- to long-term, technological advances will be fundamental to introducing substantial capacity improvements, especially wake vortex technologies, sophisticated management systems and datalink technologies. The main capacity constraints are the runway and en route airspace. While there are a number of promising capacity enhancement strategies, building additional runway capacity has the greatest potential to add to capacity.

3.4.12 Technology developments to 2030 are predicted to continue to make material improvement to global and local noise and air quality impacts per passenger. Development of new technologies for improved aerodynamics, materials, engine efficiencies and combustors can reduce global emissions, NOx and noise. Future development in CNS (Communications, Navigation and Surveillance) per ATM and operational procedures such as CDA (Continuous Descent Approaches) offer global and local mitigation. ADL concluded that future technologies offer fuel efficiency gains of 2% per year to 2030, while NOx reduction technology was forecast to deliver 80% reduction from current LTO (landing and take off) emissions by 2030.

3.4.13 The take-up of future technologies was thought to be capable of acceleration through the setting of international standards, European level agreements and by ensuring that the positive cost advantages of efficiency projects are explicit and transparent to the key stakeholders. This was thought to be particularly important given the emphasis currently placed on maximising airport throughput, at the expense of increased delay and cost, as opposed to efficiency improvements, which are likely to benefit airlines much more through reduced costs.

3.4.14 The take-up of technologies that address global emissions was thought to be essentially driven by financial incentives that ensure operators aim to cut their fuel costs. A combined market-based approach, encompassing emission trading, environmental charges and voluntary agreements to incentive schemes, could offer a means of accelerating fuel-efficient technologies.

3.4.15 Adoption of technologies that aim to mitigate local noise and air quality impacts can be driven through ambitious standards for NOx and noise, together with incentives that reward best practice.

3.4.16 A number of implications for Government policy were identified. Capacity and efficiency of airports and airspace can be improved by Government introducing mechanisms promoting benchmarking of ATC providers to raise the standard of all to that of the best; investment in long-term as well as short-term ATC solutions; and the promotion of technologies with both capacity and environmental benefits.

3.4.17 Global and local environmental effects can be mitigated through Government working with international bodies to: agree medium- and long-term objectives for the sector; contribute to the development of market-based approaches to encourage fuel efficiency; press for tighter international standards on aircraft noise and engine emissions; and introduce noise and emission-based charges at UK airports as appropriate. Such mechanisms are largely consistent with Government's current programmes, but can be further focussed to accelerate the take-up of technology.

3.4.18 It was concluded that while a reduction in per passenger environmental costs was likely, unconstrained growth in air travel demand would mean that, in absolute terms, the net effect of the aviation industry on the environment is likely to increase. The implications of this are either that growth is managed to what technology will deliver in order to mitigate any deterioration in environmental impacts, or that it is accepted that aviation is a high value added component of the UK's transport system.

3.5 SERAS Documentation

3.5.1 This Stage Two Appraisal Findings Report is supplemented by the Stage Two Methodology Report and a number of supporting documents.

4 Stage One of SERAS

4.1 Introduction to Stage One Options

4.1.1 The principal objective of Stage One of SERAS was to establish the feasible options for the development of airport capacity in the South East, and to appraise those options in order to determine which options should be carried forward to Stage Two. The Terms of Reference issued to the sub-consultants who undertook the optioneering work included a minimum list of development options to be considered. These lists were provided for guidance and were not to be taken as constraining the development possibilities to be explored.

4.1.2 Minimum options were specified in a generic way, defining the number and relationship of runways and other features, without fixing their locations. Options generated were expected to reflect both alternative physical layouts of facilities and different modes of operation. The initial list of development options to be considered typically included:

- Full length runways and Short Take-off and Landing (STOL) runways,
- Dependent, close-parallel runways and independent, wide-spaced runways,
- Runways to be operated in segregated mode or in mixed mode, and
- In some cases, the introduction of taxiways or the realignment of runways.

4.1.3 Following the initial review of the options developed, it was decided to extend the work to include a number of additional options at each of the airports. These were intended either to fill gaps in the spectrum of option capacities provided by the original options or to reduce impacts revealed by them, particularly aircraft noise exposure over residential areas and the displacement of residential properties. Since the options in this second tranche often had an environmental aim, they are labelled with an ‘E’ prefix.

4.1.4 The options appraised in Stage One and the appraisal findings are fully described in the SERAS Stage One Reports. In this chapter the appraisal of the Stage One options at Heathrow, Gatwick, Stansted, Luton and Cliffe Marshes is briefly described. The chapter concludes with a summary of the options developed at London City, Southampton, Alconbury, Hullavington and other small airport sites.

4.2 Heathrow Options

Initial Options

4.2.1 The starting point at Heathrow was the existing situation of the two main runways operated in segregated mode and Terminals 1 to 4 operating to capacity. Terminal 5 was not included. The optioneering identified all practical variations of the use of the existing three runways, and of adding runways up to a total of four. Various configurations and numbers of runways were included, with additional runways of two types: full length, full capability runways of up to 4000m length and 2000m runways capable of handling aircraft up to ICAO Code C size. An initial set of sixteen options, listed in Table 4.1, was drawn up. These schemes, in outline form and with initial estimates of the capacity they would provide, were reviewed and three basic options were identified to be carried forward for full appraisal: schemes 1, 6 and 8. Option 1 uses the existing runways in mixed mode. Options 6 and 8 add, respectively, a short and a full length runway north of the A4.

Table 4.1: Initial Options at Heathrow

Option	Runways	Configuration
Schemes utilising the existing runways		
1	2	Existing runways operated in mixed mode
2	2	Existing runways operated under High Approach Landing System/Dual Threshold Operations (HALS DTOPS).
Schemes including crosswind runways		
3	3	Existing layout retaining short crosswind runway in full use
4	3	As Scheme 3 but crosswind runway extended to full length
4B	4	As Scheme 4 with a second, independent full -length crosswind runway parallel to and east of the existing crosswind runway
Three parallel runway schemes		
5	3	Close parallel runway to the south of 09R-27L
6	3	Short parallel runway 1450m to north of 09L-27R
7	3	Short parallel runway 1450m south of 09R-27L, on Staines Moor
8	3	Full length runway 1450m north of 09L-27R
15	3	Existing parallel runways plus a 2000m runway at Northolt, 8.5 km to north of 09L-27R

Option	Runways	Configuration
9	4	Two pairs of close-parallel runways, 385m separation
10	4	Two pairs of close-parallel runways, 760m separation
11	4	Two pairs, at 760 and 1035m separation, operated independently; arrivals on wider pair, departures on narrower pair
12	4	One pair independent 1450m separation, one pair close 385m
13	4	Three independent runways, plus one short runway 1450m south of 09R-27L, on Staines Moor
14	4	Four independent runways, two 1450m N and S of 09R-27L

Retained Options

4.2.2 For the retained options 1, 6 and 8, outline layouts of terminal/apron and support areas to fit these runway configurations were developed, capacities re-estimated and the surface access infrastructure likely to be necessary to serve them examined in some detail. In the cases of Options 6 and 8, this work led to three sub-options offering different solutions to terminal location and airside and landside access. The retained options are described below.

Option 1 (**Figure 4.1a**)

4.2.3 Option 1 retains the existing parallel runways and assumes their operation in full, permanent mixed mode, giving an estimated capacity of about 105 mppa. The development of Terminal 5 is assumed, to handle the higher throughput generated by the additional runway movements, and the Central Terminal Area (CTA) is largely redeveloped to form a core terminal area. (The assumption that the CTA at Heathrow would be substantially rebuilt during the period to 2030 has been carried forward to all of the options appraised.) In addition to the T5 satellites, the remainder of the area between the runways is occupied by satellites served from this new central area. This requires the displacement of some aircraft maintenance and other support facilities from the east end of the site to a new area developed between the T5 site and the M25. Terminal 4 is retained. The crosswind runway strip is used as a cross taxiway route, but its use as a runway could be retained for severe adverse wind conditions and emergencies.

4.2.4 Option 1 would represent a substantial increase in capacity at relatively low cost, and with modest additional land take. Permanent mixed mode operations would negate the Cranford Agreement, as there would be no opportunity for noise respite periods and aircraft noise exposure would grow in line with increased throughput. Option 1 was seen as an obvious first step in any capacity enhancement scheme for Heathrow.

Options 6A, B and C (Figure 4.1b)

4.2.5 In all versions of Option 6, a new runway is located north of 09L-27R, sufficiently separated for independent operation and with terminal capacity between it and the existing runway. All three runways can operate in mixed mode. The additional runway is 2000m in length and intended for use by aircraft of up to Code C size. It could accept one third of total movements, which is likely to be less than the total proportion of Code C or smaller aircraft in a future Heathrow mix. It was assumed therefore there would be sufficient movements to keep the new runway fully utilised. By freeing this proportion of slots on the existing two runways, which can then be used by larger aircraft, and assuming mixed mode on all three, this option promises a substantial capacity gain in movement and passenger throughput terms. Crossing movements of the centre runway would be limited to a very low level by dedicating the new, northern terminal to the short-haul services using the new runway. The resulting estimated capacity was 132 mppa.

4.2.6 The airport's noise envelope would be expanded over new areas to the north, but traffic here would be made up of relatively quiet types, with the potential for steeper approaches and high manoeuvrability, facilitating early separation of departure routes. The runway and associated terminal/apron areas would cause property displacement north of the A4. If the current provision of aircraft maintenance and support facilities were increased in line with the higher passenger throughput, further land north of the A4 would also be needed to accommodate these uses.

Options 8A, B and C (Figure 4.1b)

4.2.7 Option 8 is similar in all respects to Option 6, except that the third runway is of full length. It is similar in principle to the RUCATSE scheme of 1993. The capacity gain over Option 6 is relatively small, as Option 6 is a good match to the mix of aircraft sizes envisaged. Improvement in Option 8 is largely due to the increased flexibility of assignment of any traffic to any runway, smoothing out imbalances between terminal and runway location and minimising crossings. This scheme could be a further development from Option 6, provided it was planned from the outset. For the capacity gained, the increased property and noise impacts would be substantial.

4.2.8 Sub-options A, B and C are alternative arrangements for the location of terminal capacity to serve the third runway, and are essentially the same in both Options 6 and 8.

4.2.9 The A sub-options focus new terminal capacity on the existing terminal sites, i.e. the CTA and the Terminal 4 area. A major module of terminal capacity is added alongside the existing T4. This location of a high proportion of capacity on the south side of the airport is intended to facilitate a new surface access corridor from the direction of the M3, so spreading demand across three axes; the present M4, the M25 to T5, and the M3 to the T4 area. The major disadvantage of this arrangement is that core terminal processing capacity at the T4 site must serve satellites in the CTA and north of the A4. A very long, high-volume transit link would be required to link these elements, entailing long airside journey times.

4.2.10 Option B seeks to solve this problem by locating terminal core capacity with the satellites between the two north runways. This would improve operations substantially over the alternative. A surface access route from the M3 axis can still be achieved, but that traffic would converge with traffic from the M4/M25 direction. Careful design of internal roads and regulation of flows would be needed to ensure efficient spreading of traffic over the available access routes.

4.2.11 The C options offer a third solution to the access issue. Terminal core capacity to serve the northern satellites is located remotely to the south west, on the Staines Reservoir site. This avoids significant property displacement and facilitates surface access links to the M3, with an additional connection to the M25. Road and rail corridors can also largely avoid developed areas. The disadvantage of a long connection to the satellites, as in option A, remains but high car parking capacity is relatively easy to accommodate and connection to rail at Staines is shortened.

4.2.12 Together with the base case, the Heathrow options taken forward for appraisal were Option 1, Options 6A, 6B and 6C, and Options 8A, 8B and 8C.

Heathrow Additional Options

4.2.13 In the light of the initial optioneering findings, a number of additional options were identified for investigation. All were aimed at ameliorating one aspect or another of the main impacts found in the initial work. These further options are described below.

Options 6D and 8D

4.2.14 The first additional option relates to the siting of terminal capacity in Options 6C and 8C. It was perceived that location on the Staines Reservoir, requiring a large part of it to be filled in, could be problematic in view of the site's wildlife protection status. Options 6D and 8D were therefore developed, relocating the terminal westwards onto Staines Moor. This has no significant impact on capacity or on providing adequate connections to motorway and rail links.

Option E1

4.2.15 This is a variant of Option 1 entailing operation of the existing runways in mixed mode for only a part of the day. The hours from 0700 to 1200 were selected as this would still allow periods of relief from overflights to be afforded to the built-up areas beneath the flight tracks. Overall noise exposure would increase, however, with the resulting rise in throughput. Capacity with this partial mixed mode operation was estimated at 91 mppa. This is approximately 5 mppa greater than the figure for maximum use of the runways in segregated mode, and 14 mppa less than that of Option 1, permanent mixed mode.

Variants of Options 6 and 8

4.2.16 The original Options 6 and 8, with a third runway north of the A4, offer substantial increases in capacity but would have a major impact on the villages lying between the A4 and the M4. Initial estimates of the number of properties that would have to be demolished to accommodate these schemes extend to up to around 2,000 houses and 200ha of commercial properties. The villages of Harmondsworth, Sipson, Langford and Harlington would be affected to varying degrees, but the first two would be largely eliminated in most of the cases. Alternative ways were sought of fitting a third runway into this area while minimising the property impact. It was recognised that, while it might be possible to spare properties from demolition, they would still be exposed to high noise levels due to their proximity to the runway and any taxiways or apron areas associated with it.

4.2.17 The options examined varied in two respects; the length of the third runway and the inclusion or not, adjacent to it, of terminal and stand capacity. The original options located aircraft maintenance and support functions north of the A4. The alternative schemes also relocate this to other parts of the airport site to reduce its property impact. These additional options are described below.

Options E2 and E3 (Figure 4.1a)

4.2.18 These two options provide a 1,200m long third runway. E2 has no stands, satellites or terminal capacity between the current north runway (09L-27R) and the new strip. These are instead located at the west and east extremities of the area between the existing runways. This means that all traffic using the new runway must cross 09L-27R on departure and arrival. A parallel taxiway is therefore provided north of this runway, with multiple crossing points to minimise impact on its capacity. On the basis that the objective of these options is to minimise local impacts, it is assumed that the two existing runways continue to operate in segregated mode. The new runway would carry both arrivals and departures.

4.2.19 The capacity of option E2 was estimated at 102 mppa, allowing for the effect of runway crossings. The number of aircraft types that could use this short runway while carrying an economic payload would, in practice, be limited. The runway would therefore cater for domestic and near European services, the spectrum of routes probably being similar to that seen at London City Airport. It is anticipated that this traffic would derive from:

- Existing services transferred unchanged from the main runways

- Existing services on 'thin' routes, converted to smaller aircraft at higher frequencies and transferred to the short runway
- Existing domestic and European services attracted from other airports, such as London City
- New services to, for example, secondary European cities or regional hubs

4.2.20 The major contribution to increasing the capacity of the airport as a whole, however, would come from the 'back-filling' of the main runway slots freed by transfers to the third runway. Given the high demand for access to Heathrow, it is probable that these would be taken up by long-haul, high-capacity services.

4.2.21 The impact on property north of the A4 is much reduced. Noise impacts would also be reduced from airborne aircraft because of the smaller types able to use the runway and the possibility of steeper than normal approach and climb-out, and from ground activity due to the absence of stands.

4.2.22 Option E3 includes adequate aircraft stands adjacent to the third runway to support the traffic using it. A taxiway crossing of the runway is provided for aircraft access to the rest of the airport, but the number of operational runway crossings would be minimal. This allows an increase in capacity over E2 to approximately 108 mppa.

4.2.23 The inclusion of aircraft stands north of the A4 increases the land required there but has little impact on property, relative to E2. The apron capacity is largely accommodated on undeveloped land between villages. More of the remaining properties would, however, be exposed to aircraft ground noise from the apron areas.

Options E4 and E5 (Figure 4.1a)

4.2.24 Options E4 and E5 are similar to E2 and E3 but provide a 2000m runway, allowing larger aircraft and/or longer route distances to be served. As with option E2, Option E4 has no aircraft stands north of 09L-27R but provision is made for efficient runway crossings. Option E5 has sufficient stands north of 09L-27R to serve the third runway. The longer runway in these options extends the area affected, increasing residential property demolitions and commercial property take.

4.2.25 Capacity estimates based on service transfer and back-filling take account of the wider range of aircraft that could use the longer runway. The overall capacity was assessedat 112 and 115 mppa for E4 and E5.

Option E6 (Figure 4.1a)

4.2.26 This option is in all ways similar to E5 except that it assumes the existing runways to be operated in permanent mixed mode. On the basis of service transfer and back-filling, capacity would be 128 mppa.

Options E7 and E8 (Figure 4.1b)

4.2.27 These two options are based on Option 8, with a full length third runway north of 09L-27R, but seek to reduce aircraft noise impact from that generated by three runways all operating in permanent mixed mode. Option E7 assumes that only one runway would be permanently in mixed mode, with the other two operating in segregated mode. Selection of the mixed mode runway would be based on finding an 'optimum' distribution of noise exposure relative to number of properties exposed, existing exposure patterns and current agreements. Selection of the third runway would limit the capacity to be gained, as there would be an imbalance between its capacity and the capacity of the adjacent terminal facilities. All the possible combinations of use either make less than optimum use of the available runway capacity. Estimated capacity was therefore significantly lower than the otherwise similar Option 8, at a maximum of 127 mppa.

4.2.28 Option E8 provides more flexibility in distributing aircraft noise exposure, and the opportunity to allow respite periods, by rotating the use of one runway in mixed mode. Again, the selection of rotation pattern would take account of exposure distribution and standing agreements. As well as the efficiency losses arising from distribution of traffic across three runways, there would be losses during changes from one configuration to another. The estimated capacity of E8 was therefore lower than E7, at 121 mppa.

Summary of Heathrow Options

4.2.29 Table 4.2 summarises the initial and additional options appraised at Heathrow. Proposed runway locations are indicated on Figures 4.1a and 4.1b.

Table 4.2: Heathrow Options Appraised in Stage One

Option	Configuration	Mode	Hourly PATM capacity	Annual PATM '000	Annual mppa
Existing		Seg.	78	449	62
BASE	Maximum use of planned facilities. Without T5	Seg.	80	464	70
Max. use	Maximum use of existing runways. With T5	Seg.	80	464	86
1	2 wide independent runways	Mixed	95	551	105
6A, B, C	3 all indep. 2000m runway. Stands north of A4 as required	Mixed	120	696	132
8A, B, C	3 all indep. Long runway. Stands north of A4 as required	Mixed	130	754	143
6D	As 6C, but Terminal 6 on Staines Moor	Mixed	120	696	132
8D	As 8C, but Terminal 6/7 on Staines Moor	Mixed	130	754	143
E1	Existing runways, partial mixed, 0700-1200	Varies	83	481	91
E2	3rd 1200m runway, existing runways in segregated mode. No stand capacity north of A4		109	594	102
E3	3rd 1200m runway, existing runways in seg mode. Stands north of A4 to minimise runway crossings		116	636	108
E4	3rd 2000m runway, existing runways in seg mode. No stand capacity north of A4		113	655	112
E5	3rd 2000m runway, existing runways in seg mode. Stands north of A4 to minimise runway crossings		120	696	115
E6	3rd 2000m runway, existing runways in mixed mode. Stands north of A4 to minimise runway crossings		130	754	128
E7	3rd full-length runway, one of 3 in permanent mixed mode		115	667	127
E8	3rd full-length runway, one of 3 in rotating mixed mode		110	638	121

4.3 Gatwick Options

4.3.1 The starting point for the optioneering at Gatwick was the earlier work done for the RUCATSE study, together with the minimum list of options specified in the optioneering Terms of Reference. Within those terms, a broad range of practical capacity development options was developed. A number of further options or variants were added following assessment of the initial work. Two options previously examined as part of the RUCATSE studies were specifically excluded. Both of these were very close parallel runway schemes, with the runways only 200m apart; one utilising the existing parallel taxiway/emergency runway, and the other a new runway to the south. The original studies found that these were likely to generate only a small amount of additional capacity, less than 5 mppa and they were not pursued.

4.3.2 Seven options at Gatwick, six with two runways in parallel configuration and one with three runways, were developed and taken forward to appraisal. Development options at the nearby Redhill Aerodrome, operating as a satellite of Gatwick, were also appraised. The options appraised at Gatwick and Redhill are listed in Table 4.3 and the runway locations are shown on Figure 4.2.

Table 4.3: Gatwick and Redhill Options Appraised in Stage One

Option	Runways	Configuration
Close-spaced parallel runway options		
1	2	New full length runway 385m to south of existing, no stagger
2	2	New runway 485m to south of existing, staggered 1300m east
3	2	New runway 940m to south of existing, no stagger
5	2	New 1800m long runway, 760m south of existing
6	2	As 5, but with stand capacity between runways
Wide-spaced parallel runway options		
4	2	New runway 2900m north, staggered 2000m west, mixed mode
Three-runway options		
7	3	New runway 485m to south of existing, staggered 1300m east, plus new runway 2900m north, staggered 2000m west
Redhill options		
R1	1 + 1	1200m runway at Redhill, various terminal sub-options
R2	1 + 1	1800m runway at Redhill, various terminal sub-options

4.3.3 In 2001, a Section 106 legal agreement between Gatwick Airport Limited and the two planning authorities for the airport, West Sussex County Council and Crawley Borough Council, came into force. This agreement comprises a package of more than 40 obligations, including the reduction of aircraft and ground noise, and emissions, improving landscaping, and implementing community and environmental projects, and transport initiatives. It will remain in force until 2009, but will be reviewed in 2006, with a view to its extension beyond 2009.

4.3.4 At the centre of this agreement is Gatwick's development strategy as a one runway, two terminal airport within its current boundary. New facilities will be built and brought into use as and when justified by demand. Development could take one of two alternative forms: either a pier-based expansion of stand capacity served from the North Terminal, or a mixture of pier and satellite development. Both schemes would occupy essentially the same area of the existing airport site. This development stage constitutes the base case for Gatwick optioneering, but it has been assumed that its capacity could be raised to around 46.5 mppa under pressure of long term demand growth. In the main SERAS work, therefore, the capacity at Gatwick currently envisaged in the land-use planning system was taken to be 40 mppa, while the capacity implied by maximum use of the existing runway was taken to be 46.5 mppa.

Option 1

4.3.5 This option has a close parallel runway pair without stagger, dictating dependent operations, probably with landings on the southern runway. The 385m runway spacing minimises the impact on airport support facilities along the south boundary and commercial and residential property beyond it. It was assumed that independent operations would be feasible in good visibility conditions, increasing the potential capacity gain. As all stand capacity is north of the two runways, capacity losses would arise from the large number of crossings required. The inclusion of a full-length parallel taxiway between the runways, capable of safely holding a number of aircraft, plus multiple crossing points, would substantially ameliorate this effect. The estimated capacity of this configuration was 62 mppa.

4.3.6 Additional terminal capacity is provided in two new satellites connected to an expanded North Terminal core by a transit system. These are connected to the runways by two new taxiway routes. The taxi distances involved are substantial but not much greater than from the most northerly North Terminal stands at present.

Option 2

4.3.7 This close-parallel option has a wider spacing, accommodating a dual parallel taxiway between the strips, and an eastward stagger of the south runway to facilitate independent, segregated mode operations. ICAO regulations require aircraft to land on the nearest of two staggered runways, so landings would be on the south runway during westerly operations and on the north runway during easterlies. A similar number of crossing movements would be required as in

Option 1, but the basic movement rate would be higher with independent operations. Capacity was estimated at 67 mppa.

4.3.8 New terminal space is concentrated in an expanded South Terminal and a single long finger pier running east from it. This location allows access between the new stand areas and the south runway, so reducing the number of crossings of the north runway. A dual taxiway is provided between the runways to accommodate both this direct-access traffic and movements crossing to and from the main terminal areas to the north.

Option 3

4.3.9 Option 3 is based on another close pair without stagger, but with a greatly increased separation. This is to accommodate all the additional stands required, plus a linear satellite, between the runways. This is fed from a core terminal located to the east, between the extended centrelines of the runways. The runway separation makes independent segregated operations permissible, and either runway could be used for arrivals or departures. As there is still a large proportion of stand capacity north of the runways, crossing traffic will again reduce achievable movement capacity, resulting in estimated capacity of 67 mppa, as for Option 2.

Option 5

4.3.10 This option has a 760m separation between runways, allowing independent segregated operations, but the new runway is limited to 1800m length. Its use would therefore be restricted to domestic and short-haul European services. This would constrain the balanced distribution of demand across the runways and dictate operation in partial dependent mixed mode. This factor, and the need for all small aircraft to cross the main runway arriving or departing, would significantly reduce the capacity gain from the second runway. Capacity is estimated as 56 mppa, which is a less than 10 mppa gain over the assumed base case capacity.

Option 6

4.3.11 This option replicates the close parallel runway layout of Option 5, but provides satellite and stand capacity between the two runways. The satellite is served from an expanded South Terminal by a track transit system. The need for runway crossings with this configuration would be somewhat reduced relative to Option 5, giving an estimated capacity of 59 mppa.

Option 4

4.3.12 This is the first wide-spaced parallel runway solution examined in the initial work. The new runway is separated by 2900 m to the north and is staggered by 2000 m, permitting fully independent segregated or mixed mode operations. This is in effect a development of one of the schemes in the RUCATSE study. All terminal capacity lies between the runways, configured in two new terminals serving four large, linear satellites. Mixed mode operations would have a substantial noise impact on the town of Horley, to the east of the northern runway, a factor that RUCATSE took as practically ruling out this operating mode. With mixed mode, however, this option offers the highest capacity of all the two-runway options considered at Gatwick; at 87 mppa almost a 90% gain over the base case, and 30% over the best of the close parallel schemes.

Option 7

4.3.13 This three-runway scheme combines the wide spaced runway of Option 4 with a close spaced pair as in Option 2. The objective here is to achieve a high capacity while using the north runway in one direction only, so avoiding overflight of Horley. As the close spaced pair must operate in segregated mode, with the north runway one way, an imbalance of capacity is created in favour of either arrivals or departures, depending on wind conditions and runway selection. This may be advantageous at certain times but overall capacity has to be assessed on a balanced situation. On that basis the capacity of Option 7 was estimated as 87 mppa, equal to that of the wide spaced, mixed mode configuration of Option 4.

Redhill/Gatwick

4.3.14 Redhill Aerodrome was considered for the development of commercial passenger operations only as an adjunct to the nearby Gatwick Airport. In this scenario, Redhill would act as a satellite of Gatwick, not as a separate airport, and there would be a fixed track transit link to carry users between the two sites. Two main options for runway capacity development emerged from the optioneering study carried out on Redhill;

- Option R1: a 1200m long runway at Redhill
- Option R2: an 1800m long runway at Redhill.

4.3.15 These runway lengths would limit the aircraft types that could use Redhill to those typically used on domestic and short to medium haul European routes. Both cases assume that Gatwick is not developed beyond the capacity of the facilities currently planned there. The use of a new runway at Redhill would be made up of a number of elements;

- Existing services transferred unchanged from Gatwick,
- Existing Gatwick services on ‘thin’ routes, converted to smaller aircraft at higher frequencies and transferred to Redhill,

- Existing domestic and European services attracted from other airports, such as London City or Southampton, and
- New services to, e.g. secondary European cities or regional hubs.

4.3.16 The transfer of services out of Gatwick would leave vacant slots there that could be taken up by other services, with the most likely substitutions being longer haul, higher seat capacity services. The capacity gained by development at Redhill should, therefore, be assessed on the joint capacities of the two airports. The estimated capacities yielded by the two options were estimated as:

- Option R1: Redhill 9 mppa, Gatwick 54 mppa, joint capacity 63 mppa
- Option R2: Redhill 15 mppa, Gatwick 54 mppa, joint capacity 69 mppa

4.3.17 The base case for Redhill is the existing undeveloped aerodrome site (there is currently little infrastructure and only a grass runway), taken in conjunction with the base case at Gatwick, having an overall capacity of 46.5 mppa.

4.3.18 The difference in capacities is mainly due to the larger aircraft and longer routes that can be served from the longer runway, allowing more services to transfer from Gatwick and so freeing more slots there for higher-capacity services. Annual aircraft movements would be in the order of 450,000, divided approximately 260,000/190,000 between the Gatwick and Redhill runways. It is anticipated that about 40% of passengers using Redhill would be interlining between short haul services at Redhill and long haul at Gatwick.

4.3.19 In the consideration of development of a runway at Redhill, particular attention was paid to: its acceptability in environmental terms; surface access implications including the impact of road traffic; and the need for a transit link between Redhill and Gatwick. The nature of the transit link, airside or landside or both, would be influenced by possible locations for the departure and arrival processing of passengers and their baggage.

4.3.20 The study concluded that the most favourable operational arrangement under the scenario of no direct access to Redhill would be to concentrate passenger processing at Gatwick, with only the minimum departure and arrival gate facilities (plus retail space) at Redhill. The transit link in this case would be wholly airside, with baggage carried in separate secure cars. In the scenario allowing partial access to Redhill, the optimum arrangement was considered to be to provide processing at Redhill only for those passengers accessing the site direct, with those accessing via Gatwick processed there. Again, facility requirements at Redhill would be kept to the necessary minimum, and the transit system would be an airside link.

4.3.21 Development would be required at Gatwick, to provide the necessary passenger processing capacity in each case, and access to it from surface connections. This would indicate development close to the South Terminal rail station.

Additional Gatwick Options

4.3.22 In the light of the initial optioneering findings, two additional options were identified for investigation.

4.3.23 Option 4A: Option 4A uses the runways of Option 4 in segregated mode to avoid overflying Horley, thereby reducing noise impact. The northern runway would be used for westerly take-offs and easterly landings, and the southern runway for easterly take-offs and westerly landings. The capacity of this option was estimated at 71 mppa.

4.3.24 Option E1: Option E1 can be seen as a development of Option 4A. It adds another runway to the south of the existing runway and separated from it by 1035m. This separation would allow the existing and new southern runways to be used in independent operation. In practice, the southern runway would be used in segregated mode, as a pair with the northern runway which would be used as in Option 4A to avoid overflying Horley. The existing runway would be operated in mixed mode.

4.3.25 Satellite and stand capacity would be provided between the two southern runways to minimise crossing movements of the existing runway. The capacity of this option is estimated at 115 mppa.

Summary of Gatwick Options

4.3.26 The principal characteristics of the options appraised at Gatwick and Redhill are summarised in Table 4.4 and runway locations are shown on Figure 4.2.

Table 4.4: Gatwick Options Appraised in Stage One

Option	Configuration	Mode	Hourly PATM capacity	Annual PATM '000	Annual mppa
Existing		Mixed	45		**30**
Base	Maximum use of planned facilities	Mixed	48	260	**46.5**
1	2 close dependent, 385m separation	Seg.	70	378	**62**
2	2 close independent, 485m separation and staggered	Seg.	75	405	**67**
3	2 close independent, 940m separation	Seg.	75	405	**67**
4	Wide independent	Mixed	95	513	**87**
5	2 close dependent 1800m runway, 760m separation Dependent arrivals.	Mixed	65	351	**56**
6	As 5 but terminal capacity between runway	Mixed	68	367	**59**
7	2 close, 1 wide. Northern runway avoiding Horley	Seg.	95	513	**87**
4A	Wide independent, avoiding Horley	Seg.	80	432	**71**
E1	1 wide segregated mode and south two at 1035m spacing	Mixed	125	675	**115**
R1	+Redhill 1200m runway (LGW as is)	LGW	48	260	**54**
		RHL	48	180	**9**
R2	+Redhill 1800m runway (LGW as is)	LGW	48	260	**54**
		RHL	48	201	**15**

4.4 Stansted Options

4.4.1 A total of eleven options were defined for Stansted, with up to four runways in various parallel configurations, and four options with the main runways realigned onto an east-west axis. The locations of the runways appraised at Stansted are shown on Figures 4.3a to 4.3e. All the options presented were carried forward for appraisal. In outline terms the options were as follows:

Table 4.5: Stansted Options

Option	Runways	Configuration
Close-spaced parallel runway options		
1	2	New runway 385m to NW, standby runway replaces existing runway
2	2	New runway 385m to NW, staggered to NE by 2500m
Wide-spaced parallel runway options		
3	2	New runway 1800m to SW, staggered to NE by 3500m
4	2	New runway 2450m to SW, staggered to NE by 3500m
5	2	2nd runway 2450m to SE, staggered 3500m NE, three terminals
Three runway options, existing alignment		
11	3	New runway 485m to NW, new runway 2900m south of terminal area
Four runway options, existing alignment		
6	4	Two pairs north and south of terminal area, each one full length and one 1800m runway
7	4	Two pairs of full length runways to north and south of terminals
Options realigned E-W		
8	3	Two new main runways aligned E-W, 2450m separation, existing runway retained as crosswind
9	5	Two new pairs of full length runways aligned E-W, 2450m separation, existing runway retained as crosswind
10	5	Two pairs north and south of terminal area aligned E-W, each one full length and one 1800m runway, existing runway retained as crosswind

4.4.2 The base case for optioneering at Stansted is the scale of development for a capacity of 15 mppa for which the airport was granted consent in 1999. Stansted Airport Ltd has, in August 2001, submitted a planning application to increase capacity to 25 mppa.

4.4.3 It should be noted that current plans for Stansted include the conversion of the existing ‘outer’ taxiway (that running nearest the runway on the south east side) into a standby runway for use when the main runway is undergoing maintenance.

Option 1 (Figure 4.3b)

4.4.4 This option would utilise the standby runway as a 2500m main runway and add a new 3500m runway on the north west side in close-parallel configuration. The present runway would become a parallel taxiway between the two. The close spacing dictates dependent segregated operation, and crossing movements would reduce potential capacity, although multiple simultaneous crossing would be facilitated by the intervening taxiway. Runway length difference would not affect the balanced distribution of traffic as the shorter runway would be used for arrivals in either operating direction. Estimated capacity is 57 mppa. Additional terminal capacity is in a core and satellite configuration, replicating the existing facility.

Option 2 (Figure 4.3a)

4.4.5 This option has the same runway separation as Option 1, but retains the existing full-length runway and staggers the new runway 2500m to the north east. This large stagger permits independent segregated mode; landings would be on the nearest threshold in either direction of operations. Crossing traffic could largely be eliminated as the pronounced stagger opens both runways to direct access from the terminal zones. Capacity would be a significant improvement over Option 1 at 67 mppa. As in Option 1, terminal capacity is in two core and satellite modules.

Option 3 (Figure 4.3a)

4.4.6 Option 3 places the new runway on the other side of the terminal area, giving a wide separation and an even greater stagger than Option 2. Operation in independent segregated or mixed mode would be feasible, but there is not enough land area between the runways to accommodate stand and terminal capacity to support potential mixed mode throughputs. This option is therefore assumed to operate in segregated mode, and its capacity would thus be the same as Option 2.

Option 4 (Figure 4.3a)

4.4.7 The separation between the parallel runways is increased to 2450m, with the same large stagger as in Option 3. As in that case, segregated or mixed mode operation is possible. While in Option 4 there is a greater depth of land available to accommodate terminal and stand capacity between the runways, this would still require large areas of land acquisition. This option was therefore limited to segregated operations, restricting it to a similar capacity to Options 2 and 3. The additional site depth is used, however, to fit in an efficient back-to-back two-terminal layout.

Option 5 (Figure 4.3a)

4.4.8 This option is essentially the same as Option 4 in runway layout terms but is operated in mixed mode. This enables full advantage to be taken of the land area enclosed between the runways for terminal/apron development. There are three terminal units, which would each have to be capable of handling up to 35 mppa. Estimated capacity of the runway layout in mixed mode is 82 mppa.

Option 11 (Figure 4.3b)

4.4.9 This option adopts a similar layout to Option 2, but adds a third full length runway to the south of the terminal area. As in that option, the large stagger of the northern pair allows runway crossings to be minimised. This pair operates in dependent segregated mode and the south runway in mixed mode. Capacity of this configuration is estimated at 102 mppa.

Option 6 (Figure 4.3c)

4.4.10 This is a four-runway layout in two close parallel pairs, one runway in each full length and the other 1800m, at a 400m separation. The layout allows most runway crossings to be avoided. The short runways dictate that each pair operates in independent segregated mode to balance arrival and departure capacity for all aircraft sizes. Capacity would be approximately 116 mppa.

Option 7 (Figure 4.3c)

4.4.11 This again is a four-runway layout in two close parallel pairs, but with all runways full length. This allows more effective distribution of traffic across the runways, giving a higher estimated capacity of 129 mppa.

Option 8 (Figure 4.3d)

4.4.12 In this option, and Options 9 and 10 described below, the main runways are aligned on an East-West axis. This is intended to reduce the airspace interaction between Stansted traffic and that passing to and from other South East airports, notably Luton and London City. Option 8 is the simplest of the three, with a pair of wide spaced runways oriented E-W and the existing runway retained for use in adverse wind conditions. The capacity of this arrangement is effectively that of the main runway pair and is estimated at 82 mppa, assuming they operate in mixed mode (as in Option 5).

4.4.13 The effect of the runway realignment on local aircraft noise exposure would be significant. The substantial settlements of Stansted Mountfitchet and Great Dunmow, which are not currently exposed to high noise levels, lie to the west and east respectively. With this layout Stansted Mountfitchet would lie on the extended centreline of the northern new runway, and Great Dunmow on that of the southern new runway.

Option 9 (Figure 4.3e)

4.4.14 This replicates Option 8 but with two pairs of full length runways on the E-W alignment. Each operates as an independent segregated pair. Traffic would have to cross the inner runways to reach the outer, resulting in crossing losses. Capacity is again determined by the main runway pairs and is estimated at 129 mppa.

Option 10 (Figure 4.3e)

4.4.15 This layout has similarities to Option 6 but on an E-W alignment. Operationally it is the same, with the maximum capacity being generated with each pair in independent segregated mode. As Option 6 that capacity is assessed as 116 mppa.

Options E8A and E8B

4.4.16 These two variants of Option 8 are designed to preserve the potential advantages of the E-W alignment while reducing its impact on Stansted Mountfitchet, Great Dunmow and other, smaller settlements. If operations are limited to segregated mode, this can be done in two ways; by permanently fixing runway use to minimise overflight of the settlements, or by alternating arrival and departure runways to afford them respite periods. Option E8A does the former and E8B the latter. In easterly winds, the crosswind, existing runway can be used for arrivals, reducing taxi distances to the terminal area.

4.4.17 Alternation of runways in E8B is assumed to be on a daily cycle, so no losses are assumed due to change-overs. The capacity of both options is therefore estimated at 67 mppa.

4.4.18 The options appraised at Stansted are summarised in Table 4.6. Runway locations are shown on Figures 4.3a to 4.3e.

Table 4.6: Stansted Options Appraised in Stage One

Option	Configuration	Mode	Hourly PATM capacity	Annual PATM '000	Annual mppa
Existing		Mixed	30	97.5	9.5
BASE	Maximum use of planned facilities	Mixed	38	185	15
Max. use	Maximum use of existing runway	Mixed	48	259	35
1	2 close dependent, 385m separation	Seg.	70	378	57
2	2 close independent, 385m + staggered	Seg.	80	432	67
3	2 wide independent, 1800m separation	Seg.	80	432	67
4	2 wide independent, 2450m Fixed seg.	Seg.	80	432	67
5	2 wide independent	Mixed	95	513	82
6	2 x 1 long/1 short, 400m separation		130	702	116
7	2 x 2 dependent Full length		140	756	129
8	2 x wide aligned E-W, + crosswind	Mixed	95	513	82
9	As Option7 aligned E-W, + crosswind		140	756	129
10	As Option6 aligned E-W, + crosswind		130	702	116
11	2 close, 1 wide		118	637	102
E4	2 wide independent, 2450m Alternating seg.	Seg.	80	432	67
E8A	As Option8 Fixed seg.	Seg	80	432	67
E8B	As Option8 Alternating seg.	Seg	80	432	67

4.5 Luton Options

4.5.1 The dominant feature constraining development at Luton Airport is the topography of the site. It lies within an area of steep ridges and valleys at an elevation of about 150m and there are severe down gradients at both ends of the 2,160m long single runway. The development of more than one runway, or the terminal/apron capacity to match, was considered impractical because of the airport's plateau situation and the consequent severe limitations on development space. Options focus on raising the capability of the existing runway to handle larger aircraft and enable new markets to be served. A runway of 3,000m is envisaged for this, but an additional option looks at a shorter alternative.

Options Identified

4.5.2 The three options and two sub-options identified in the initial work are outlined in Table 4.7. All of the runway locations appraised are shown on Figure 4.4.

Table 4.7: Initial Luton Options

Option	Runways	Configuration
3,000m runway options		
1A	1	Existing runway extended to 3000m, redeveloped terminal area
1B	1	Runway as in 1A, all processing at remote rail-based terminal
2	1	Replacement runway 200m south of existing
3	1	New runway aligned approximately SSW-NNE

4.5.3 The base case for Luton is taken as a capacity of 10 mppa. This is estimated to be achievable within available facilities (including use of existing new terminal space not yet fitted out), and with the completion of a full parallel taxiway and high-speed runway exits to reduce runway occupancy times.

Options 1A and 1B

4.5.4 Both these options entail extension of the existing runway eastwards to 3,000m on its present alignment. Extension to the west was not considered feasible due to the very steep terrain and the presence of major roads and development. A full parallel taxiway and high-speed exits are included in both cases. Additional terminal development is assumed, increasing the estimated capacity of both these options to 31 mppa.

4.5.5 The two options are differentiated by their treatment of the terminal facilities. Option 1A has a conventional arrangement of a core terminal and satellite concourses, based on the present terminal site and utilising essentially the same surface access infrastructure. All passenger processing would be done in these terminal buildings. Option 1B makes use of the Parkway rail station located on the main line running about 2 km to the west of the airport. All primary passenger and baggage processing would be carried out in a new facility built over the station. A light rail or other form of rapid transit system would connect the station terminal to satellite concourses on the present terminal site. This scheme would reduce pressure on land in the centre of the airport site, by removing processing space off site and eliminating the need for passenger-related vehicle access to the central area. Both schemes were considered entirely feasible and were taken forward to appraisal.

Option 2

4.5.6 In this option, a new 3,000m runway would be built 200m south of and parallel to the present one, which would be retained as part of a parallel taxiway and could be retained for use as a runway in emergencies. The advantage of this option, in addition to the longer runway provided, is the resulting release of land area in the centre of the airport site. The additional site depth would allow a significantly greater number of aircraft stands or a more efficient layout of the same number, with more effective access between terminal area and runway. Capacity is the same as Option 1 at 31 mppa. This option was also carried forward for appraisal.

Option 3 and E3

4.5.7 These schemes would create a new 3,000m runway on an alignment similar to that of Stansted, while also taking advantage of terrain to the north east more favourable to extension. These options have an advantage similar to, but greater than Option 2, in that they open up large areas of developable land around the present centre of the airport. In this case, the available area between the centre and the main road and rail corridors to the west is greatly expanded, giving the opportunity to overcome the site depth and gradient problems that currently constrain the airport's surface access arrangements. Capacity is the same as Option 1 at 31 mppa. These options were carried forward to appraisal. Options 3 and E3 are small alignment variants of this basic runway option.

Option E4

4.5.8 Options 1 to 3 reflect the ultimate potential of Luton airport in terms of traffic throughput and aircraft size capability, assuming a feasible runway length of 3,000m and a 31 mppa throughput. The impacts of these options, including land required, cost and the extent of the development required in the terminal area, are substantial. There are, also, obstacles to the unconstrained expansion of the airport, particularly the difficult topography, land ownership and land availability. These issues could well constrain implementation of a full parallel taxiway at the north east end of an extended runway, so restricting its hourly capacity. The present land use and topography of the terminal area also make large-scale development of new capacity problematic in layout terms and costly in construction.

4.5.9 A further option, Option E4, was therefore considered, that seeks a closer balance between the capacity achieved and the natural constraints of the airport site. This option is based on two parameters; a runway of less than 3,000m and an annual throughput in the order of 20-25 mppa. The required runway length was assessed as 2,500m, and this is achieved by eastward extension of the existing runway.

Summary of Options

4.5.10 The capacities of the Luton options are summarised in Table 4.8. Runway locations are shown on Figure 4.4.

Table 4.8: Luton Options Appraised in Stage One

Option	**Configuration**	**Mode**	**Hourly PATM capacity**	**Annual PATM '000**	**Annual mppa**
Existing		Mixed	27	44	**4.4**
Base	Maximum use of planned facilities	Mixed	27	100	**10**
1A, B	Existing runway extended to 3000m	Mixed	48	240	**31**
2	New 3000m runway south of existing	Mixed	48	240	**31**
3, E3	New 3000m runway realigned NE-SW	Mixed	48	240	**31**
E4	Runway extension to yield 20-25 mppa	Mixed	48	228	**29**

4.6 Cliffe Marshes Options

Location and Constraints

4.6.1 Options for the location of a major development at Cliffe Marshes are constrained by a number of factors:

- topography - the site slopes upwards from the Thames shoreline to high ground along the centre of the peninsula, requiring large volumes of cut and fill to level an airport platform;
- land use - a number of small to medium-sized settlements along the central high ground, at the base of the peninsula and shorelines, plus major port and power station facilities at the Isle of Grain;
- protected areas - the whole of the coastal flats around the peninsula, and marsh areas at the west and east ends, are designated as RAMSAR and/or SPA areas.

4.6.2 The latter areas effectively halve the potential site area for airport development. The shape of the remaining area, together with the prevailing winds, indicate an optimum runway orientation aligned approximately east-west.

4.6.3 The Stage One options at Cliffe Marshes are shown on Figures 4.5a to 4.5c. In Stage Two of SERAS, these options have been further refined, in terms of their layouts, their locations and runway alignments in order to reduce land take and noise impacts. In addition, further consideration has been given to the potential role of a new airport, how it might be operated, and its resulting capacity. The Stage Two options at Cliffe Marshes are described in Chapter 11. In this chapter, the Stage One options and assumptions are summarised.

Base Case (Figure 4.5a)

4.6.4 The initial assumption relating to development of a new airport site was that, to justify the investment necessary in site preparation and facilities such as new surface access links, the potential capacity of the site should be maximised. This was judged likely to be best achieved by the development of a four-runway layout, with the runways in two close parallel pairs, each operating in dependent segregated mode. As, at a new site, a 'do nothing' or minimum development scenario would be meaningless, this option was developed as the base case.

4.6.5 The runway pairs are separated by 2000m, leaving space for a high-capacity terminal area between them, and the runways in each pair are 400m apart. When operating in westerly winds, the arrival tracks (which would be to the two outer runways) pass mostly over the open waters of the estuary. Departure paths, to the west, cannot continue straight ahead as they would soon conflict with Heathrow traffic. They would therefore have to diverge to the north and south and, in doing so, can be designed to avoid the most populous parts of the towns to the west of the site.

4.6.6 In easterly winds, departures would be largely over open water but arrivals, which must follow a straight track, would pass over the towns to the west. With the base case layout, the southern of the two arrival routes would largely be over the meandering line of the Thames, but the northern track would pass directly over Grays and other populated areas.

4.6.7 The optioneering study examined a number of terminal layout sub-options for the base case. All placed aircraft stand capacity in the most efficient location, between the runway pairs, usually served from linear satellites running at right angles to them.

4.6.8 The choice of terminal layout would not affect the basic operation of the runway system: all the layouts require that aircraft cross the inboard runways to gain access to or from the outer runways. Capacity of the base case option was estimated at 140 ATM/hr and passenger capacity at 146 mppa.

Option 1A (Figure 4.5b)

4.6.9 If constructed, it offers a lower capacity with correspondingly reduced land take, costs and other impacts. The two widely spaced runways offer a capacity of 95 ATM/hr in independent mixed mode, with no runway crossings, an efficient terminal layout and making full use of the available runways. Passenger capacity was estimated at 105 mppa. Easterly operations would necessitate arrivals overflying populated areas to the west of the site.

Option 2 (Figure 4.5a)

4.6.10 This option replicates the base case but includes an additional pair of parallel runways, laid out to the west of the central airport area and oriented in a SW-NE direction. In westerly winds, the airport would operate exactly as does Option 1. In easterlies, departures would use the main runway pairs but arrivals the two additional runways, in independent simultaneous parallel mode. The orientation of these runways allows the arrival tracks largely to avoid passing over densely populated areas, by utilising the ‘gap’ between Rochester and Gravesend.

4.6.11 Capacity in the easterly mode could be somewhat higher than in westerlies, as arrivals and departures are independent of each other and no runway crossings are necessary. It would, of course, be possible to use this runway configuration in a similar fashion in westerly conditions, with arrivals on the main runways and departures on the additional west pair. This would make two of the main four runways redundant, however, and traffic bound for the north would have to be turned from the runway heading immediately after departure. This would be likely to increase noise exposure over built-up areas and would give rise to conflict between the turning traffic and the missed approach routes of the main runways.

4.6.12 Estimated hourly movement capacity of this option is based on operations in westerly mode, as the dominant situation. It therefore equates to that of the base case at 140 ATM/hr and 146 mppa.

4.6.13 Additional Options 1B and 3 were investigated with a view to further reducing impacts, particularly the exposure of the towns to the west to arrival aircraft noise. Another variant on the base case, Option 4, was examined as means of avoiding displacement of some of the settlements in the centre of the peninsula.

Option 1B (Figure 4.5b)

4.6.14 This option offers a further reduction in capacity and impacts, relative to the base case, by limiting operations on a two runway layout to segregated mode. Its significant feature in noise impact terms is the use of only one arrival stream. This gives more flexibility in the choice of arrival runway, to locate the track over the least populous areas or to alternate runway use and so provide respite periods.

4.6.15 The capacity of this option is estimated at 80 ATM/hr and 86 mppa. The advantages of reduced impacts are at the expense of less than full use of the available runway infrastructure and the land enclosed by the runways.

Option 3 (Figure 4.5c)

4.6.16 The concept of this option is similar to that of Option 2, in that additional runway capacity is added to allow arrivals in easterly conditions to follow a track over less built-up areas. In this case, however, the main runways are limited to a single wide-spaced pair and only a single angled runway is provided. The overall effect is to reduce capacity and impacts, relative to Option 2, and substantially reduce land take.

4.6.17 In westerly mode, capacity is the same as that of Option 1A, with the two main runways in mixed mode, at 95 ATM/hr. In easterly conditions, however, an imbalance is introduced as there are two departure runways available but only one arrival runway. This cannot be redressed by operating the north main runway in mixed mode, because arrivals on it and those on the angled runway would become dependent. The overall effect of this imbalance would depend on the proportion of easterly winds and the pattern of arrival/departure ratios over the day.

Option 4 (Figure 4.5a)

4.6.18 The configuration of this option is identical to the base case but the whole airport layout is displaced some distance to the north and rotated slightly anti-clockwise. The northward shift is intended to eliminate the need to displace the settlements of Lower Stoke, High Halstow and, possibly, Cooling. The small rotation is to facilitate the routing of westerly departures through the Rochester – Gravesend gap. Estimated capacity is the same as the base case, at 140 ATM/hr and 146 mppa.

4.6.19 The northward shift results in a significantly increased encroachment into the SPA zone along the Thames shoreline. Further, the location would require a large area of land reclamation from the estuary, with resultant impacts on river flow patterns, flood protection and marine navigation.

Table 4.9: Cliffe Marshes Options Appraised in Stage One

Option	Configuration	Mode	Hourly PATM capacity	Annual PATM '000	Annual mppa
Base	2 x 2 dep. Full length. Mixed mode	Mixed	140	812	146
1A	Wide independent	Mixed	95	551	105
1B	Wide independent	Seg.	80	464	86
2	2 x 2 dep. + 2 x SW-NE runways	Seg.	140	812	146
3	2 x wide + 1 x SW-NE runways	Mixed	95	551	105
4	As Base but moved North	Seg.	140	812	146

4.7 Other Options

London City

4.7.1 Development options at London City were appraised at a level of detail commensurate with the other main airport sites in Stage One of SERAS. Details can be seen in the Stage One Appraisal Findings Report, this section presenting a brief summary of the options explored.

4.7.2 London City is the most physically constrained of all airports examined during this study. Its single runway is built over water, the potential for expanding terminal buildings and apron areas is limited and the approach and take-off climb slopes are determined by substantial and important structures. Possible options for development were categorised under the three scenarios shown below. The Base Case for London City is taken at the present level of development, which is assumed to have a capacity of approximately 3.5mppa.

Table 4.10: Options at London City

Option	Runways	Configuration
Development within Current Planning Constraints		
1A	1	Existing runway, apron extension and east runway hold area
1B	1	Existing runway, additional east terminal and apron
Development to Maximise Capacity within Current Code 2 Runway Classification		
2A	1	Runway shifted north to accommodate parallel taxiway and extended terminal
2B	1	Existing runway plus parallel taxiway and extended apron, requiring terminal areas shifted south
2C	1	Existing runway, new terminal apron, parallel taxiway on north side
2D	2	Two parallel Code 2 runways, terminal location not specified
Development with Code 3 Runway Capability		
3A	1	Code 3 runway, rotated clockwise for improved obstacle clearance
3B	1	Code 3 runway, rotated anticlockwise with terminal, etc on north side
3C	1	Code 3 runway approximately 550m north of existing
3D	1	Code 3 runway on existing alignment

Options 1 A and 1B (Figure 4.6)

4.7.3 These reflect current operator proposals and are aimed at reducing runway occupancy times. Due to the absence of a parallel taxiway, these are currently high as a result of the need for aircraft to back track along the runway for either landing or take-off. Option 1A introduces a holding bay at the east end of the runway, allowing more than one aircraft to be held which can then backtrack in rapid succession. As an alternative, Option 1B includes an additional apron area at the east end, thereby reducing the proportion of aircraft that need to back track. Both layouts are estimated to provide a capacity of 5mppa.

Options 2 A, B, C and D (Figure 4. 6)

4.7.4 These options provide additional capacity whilst retaining the existing runway length. They increase runway capacity and provide terminal, apron and other facilities to match it. Option 2A achieves this by shifting the runway to the north and providing a full length parallel taxiway and, a substantial apron extension and additional terminal space. Whilst Option 2B achieves the same, but with new construction over water, Option 2C proposes a radical change by placing the taxiway, apron, terminal and other facilities on a new site on the north side of the dock. Although expensive, all these options are feasible and are estimated to have a capacity of 7mppa. Option 2D, not illustrated, provided additional capacity through the use of two parallel runways, one on each side of the dock area. However, the scale of land take, commercial and residential property demolition and dock in-filling to accommodate the runways and the midfield facilities required was considered unacceptable. This option was not therefore appraised as part of Stage One.

Options 3 A , B, C and D (Figure 4.6 for 3A only)

4.7.5 Representing options to accommodate a 2,000m runway, the principal constraints are local obstacles, notably the Canary Wharf Tower and the close Excel Building. These pose an obstacle clearance problem for B737 type aircraft on both approach and take-off. Different rotations and shifts of the runway alignment and locations were employed in each option but significant obstacles remained and land take requirements high. Only Option 3A was considered realistic, providing an estimated capacity of 10mppa. 3A comprised a rotation to avoid Canary Wharf and a 925m eastward shift, placing the runway out across the Thames.

Summary of London City Options

4.7.6 Table 4.11 summarises the options at London City that were further appraised during Stage One.

Table 4.11 Appraisal Options at London City

Option	Configuration	Mode	Hourly PATM Capacity	Annual PATMs '000	Annual mppa
Existing		Mixed	20-25	36	1.5
Base	Maximum use of existing facilities	Mixed	32	65	3.5
1A, 1B	Maximum use of existing runway	Mixed	32	73	5
2A, B, C	Existing + parallel taxiway	Mixed	43	100	7
3A	Extension to 2,000m and rotation to avoid obstacles	Mixed	43	100	10

Southampton

4.7.7 Development options at Southampton were appraised at a level of detail commensurate with the other main airport sites in Stage One of SERAS. The limited ultimate capacity led to Southampton latterly being included as part of the small site appraisal work. Four options were appraised, Options 1 to 3 develop the existing runway and Option 4 provides a new longer runway on a new alignment. Presently handling approximately 857,000 passengers per annum, it is envisaged that the capacity within the current land-use planning system is 2-2.5mppa. These options are shown in ***Figure 4.7***.

- Option 1 comprises new apron stands and a new terminal building to make maximum use of the existing runway. Estimated capacity is 7mppa.
- Option 2 widens the runway to accommodate Code D aircraft, provides new stands on the eastern boundary and a new terminal building. Estimated capacity is 11mppa.
- Option 3 rotates the runway through 2 degrees to the east to create space for a 500m runway extension. With the runway again widened, a new taxiway system is provided in addition to new stands and a terminal building. Estimated capacity is 14mppa.
- Option 4 is effectively an entirely new airport with a category 3 runway 3500m long and an associated terminal development, taxiway system and apron capable of accommodating Code F aircraft. Estimated capacity is 31mppa.

4.7.8 Forecasts have been produced for Southampton from two sources. SPASM forecasts produced in Stage Two indicated that usage of Southampton would be heavily dependent on the provision of runway capacity elsewhere in the south east. In a constrained scenario, with only the existing runways, Southampton is forecast to attract 3.5 mppa by 2015 and 5.7 mppa by 2030. In a less constrained scenario, Southampton is forecast to attract 1.6 mppa by 2015 and 2.7 mppa by 2030. A separate Stage One forecast for the small sites suggested maximum forecasts of 2.4 mppa by 2015 and 3.7 mppa by 2030, in the middle of the subsequently modelled ranges

Alconbury and Hullavington

4.7.9 Optioneering work at Alconbury and Hullavington is described in two Stage One reports:

- *Alconbury: Airport Optioneering*, Halcrow, February 2001,
- *RAF Hullavington: Capacity Development Options*, Scott Wilson, April 2001.

4.7.10 Summary Appraisal work for both was described in a further Stage One report:

- *Stage One: Alconbury and Hullavington*, Halcrow, August 2001

4.7.11 Alconbury and Hullavington are both former military airfields retaining certain operational facilities that were seen as having the potential to serve air freight and low cost passenger services in particular.

4.7.12 Both were selected for appraisal on the basis that they are accessible to the south east market, well connected to road and rail surface access infrastructure and sufficiently remote from large population centres to allow the possibility of night-time operations.

Alconbury

4.7.13 The Options appraised at Alconbury were:

- **Option 1 – General Air Freight and Express Parcel Hub**. As a regional centre for air freight operations, 24 hour movement capability would enable an annual throughput of 1 million tonnes and attract an express parcel hubbing operation. It also includes an aircraft maintenance facility to meet the on-line needs of the freight aircraft fleet, a GA and Business Aviation base similar to the scale of facilities offered at Farnborough and a business park area to accommodate a variety of commercial developments.

- **Option 2 – General Air Freight, Express Parcel Centre and Aircraft Maintenance Centre**. In addition to the air freight and express parcel facilities included under Option One, this option includes for a major third-party aircraft maintenance capability, on the assumption that in the event of significant development occurring here then Cambridge Airport would be closed. A level of facility was assumed that would be able to accommodate the entirety of the Marshall Aerospace operations from that site. The GA and Business Aviation facilities are retained and the assumption made that the latter would be of sufficient capacity to absorb the small volume of activity in that sector from Cambridge. The business park area is also retained.

- **Option 3 – Specialised Low Cost Passenger Airport with General Air Cargo, Express Parcel Centre and Aircraft Maintenance Capabilities**. In this option the GA and Business Aviation facilities provided in Option 2 are retained, whilst the area dedicated to the business park is substantially reduced. Area is made available instead for a 5mppa capacity low cost passenger terminal with associated airside and landside facilities, sited to the south of the runway, adjacent to the village of Little Stukely.

Hullavington

4.7.14 The Options appraised at Hullavington were:

- **Option A – Dedicated Low Cost Airport**. This option comprises a 2000m runway parallel to that at RAF Lyneham on a ENE-WSW alignment. The runway would be able to accommodate aircraft types typically used for low cost operations and would be situated to the south of the site as far from the village of Hullavington as is practically possible. Facilities to accommodate 10mppa would be provided together with a small GA and aircraft maintenance capability. Surface access improvements would include new airport access roads and a new rail station on the Great Western Mainline.

- **Option B – Dedicated Freight Airport.** Similar to Alconbury Option 1, this option assumes a facility capable of handling 1 million tonnes of freight per annum. The single 2400m runway would be aligned as in Option A, but would extend beyond the current airfield boundary to allow the retention of the RAF barracks. The small GA and aircraft maintenance facilties are retained and a freight terminal and transfer facility to the south of the runway would be served by road and rail loop from the Great Western Mainline.

- **Option C – Combined Low Cost and Freight Airport**. This option combines Options A and B, with capacities of 10mppa and 1 million tonnes of general air freight per annum. The barracks would be lost through siting of the passenger and cargo handling facilities, whilst the maintenance facility to the north of the runway would be screened from the village of Hullavington by an earth bund. A small GA facility would also be provided to the south.

4.8 Small Sites

4.8.1 Related SERAS work, notably the DTLR's South East Business Aviation Study, indicated that the region's smaller airports and aerodromes may also have an important part to play in handling overall passenger and freight traffic. The smaller sites currently serve the Business Aviation and General Aviation sectors, although some can accommodate scheduled and chartered passenger services on a small scale.

4.8.2 The pressure on the region's main airports to fill capacity with higher volume, higher yielding passenger services will tend to force GA and Business Aviation operators to look elsewhere for slot capacity and affordable facilities, further reinforcing the important contribution that the smaller sites are likely to play in these sectors.

4.8.3 Also, pressure of demand for finite capacity and prevailing slot allocation rules are making it increasingly difficult for new-entrant carriers to access the market or for existing carriers to open new routes. Domestic, 'thin' routes and low cost operations are being disadvantaged by the favourable climate for larger aircraft on higher-yield routes and it is here where some of the smaller sites may conceivably make a valuable contribution.

4.8.4 Some were formerly military bases and so have relatively long runways and many are located away from major population centres, allowing for potential traffic growth with a low environmental impact. All are going concerns with basic operational infrastructure in place to allow development to support commercial services.

4.8.5 Development possibilities at small airport sites were addressed in two Stage One reports:

- *Small Airports Optioneering*, Halcrow, December 2000
- *Small Airports – Demand and Impact Appraisal*, Halcrow, July 2001

4.8.6 Two supporting studies were used to inform the Demand and Impact Appraisal work. They provided forecasts of the potential for commercial air service activity at the small sites but took two different approaches. One took a quantitative approach, based on assumptions about the amount of traffic likely to be displaced from the major airports, and generated forecasts of passengers, ATMs and freight. The other concentrated on passengers only and generated forecasts from an airline standpoint where judgements were made on which routes and services carriers might be willing to operate at each site and what level of demand might be required to make those services commercially viable. It should be noted that no attempt was made to refine the optioneering further to reflect the forecasts.

4.8.7 The small site work encompassed the following airports: Biggin Hill, Cambridge, Farnborough, Lydd, Manston, Norwich, Shoreham and Southend. Southampton was included in the forecasting studies, but, for optioneering, was treated as a main airport site and has been described separately above. The primary features of the options appraised at each of the small airport sites are summarised briefly below. The appraisal of these options is summarised in Chapter 13.

Biggin Hill

4.8.8 In addition to its traditional role as an executive aviation facility, it was initially conceived that the proximity of the airport to large centres of population would give Biggin Hill the potential to fulfil a significant role in the scheduled and leisure charter passenger markets. Optioneering was therefore targeted at a capacity in the order of 10mppa and a single option developed making use of all existing developed areas plus all the land to the east of the runway under current airport ownership. In addition to a substantial Business Aviation capability and aircraft maintenance facilities, the option provides capacity of 8.6 mppa, constrained by the land area available.

4.8.9 Although arriving and departing aircraft could be routed to largely avoid residential areas, the fact that the average aircraft size would increase substantially would lead to a high environmental impact in noise terms. Substantial improvements to the local road network would be required, perhaps in addition to extension of the Croydon Tramlink, giving a direct link to mainline rail services to London via East Croydon. The principal constraint to development is likely to be airspace congestion where there would be major interaction with airspace corridors to Heathrow, Gatwick and Stansted.

4.8.10 The forecasting work subsequently identified a domestic and EC scheduled and non-scheduled demand in the range 300,000 to 500,000 passengers per annum (ppa) at 2015 and 500,000 to 800,000 ppa at 2030. With mainly regional jets this equated to approximately 7,000 forecast ATMs at 2015 and 9,400 at 2030. Freight forecasts showed an annual throughput of 2,500 tonnes at 2015 and 3,500 tonnes at 2030, all carried on passenger aircraft.

Cambridge

4.8.11 The main tenant at Cambridge is Marshall Aerospace with its primary function of providing access for aircraft to an extensive range of maintenance, repair and modification facilities. Whilst it has a limited local catchment, European commercial services would be supported by a strong local business base and good access to a wider area via the M11. Three options were explored:

- Option 1 requires a shift of the existing runway to the north east to accommodate the latest 300m RESA requirements, without which a civil operating licence could not be secured. This shift would require the diversion of the A1303 road. With a runway length of approximately 1800m, B737 operations could be supported, likely to be the dominant aircraft for European scheduled, low cost and charter services. For a handling capacity of 5 mppa, terminal and related facilities would be located on the southern side of the runway with a new highway connection to the A45. A rail link would be provided direct to the terminal area to facilitate a connection to Cambridge itself.

- Option 2 extends the runway to 2270m which would expand the range of services to include transatlantic charters, using aircraft such as the B767-300ER, and higher capacity European charter flights. As with Option 1, the target capacity is retained at 5 mppa to reflect the airport's perceived catchment limitations.

- Option 3 serves the same markets as Option 1 but attempts to limit noise exposure to areas to the south west of the airport. It shifts the runway 300m to the north west to achieve the length provided in Option 1.

4.8.12 The principal constraint to development at Cambridge would be noise impact, although Option 3 would mitigate that by increasing the over-flight altitude. The overall effect on the local road network would be positive with infrastructure being provided to give more direct access to the A45 and M11.

4.8.13 Forecasts identify potential passenger demand in the range 1.6 to 1.9 mppa at 2015 and 3.2 to 3.4 mppa at 2030. With mainly B737-type aircraft, 28,000 ATMs are forecast at 2015 and 37,500 at 2030. Freight would be carried on passenger aircraft and could reach 12,500 tonnes at 2015 and 18,500 tonnes at 2030.

Farnborough

4.8.14 The TAG Group, which owns Farnborough Aviation, the single 'fixed base operator' at the DERA-administered MoD site, has made re-configuration proposals to develop the aerodrome entirely for Business Aviation and supporting activities, including aircraft maintenance. With large parts of the site needing to be reserved for the biennial staging of the SBAC air show, optioneering focused primarily on whether the 2600m potential runway length could also support commercial traffic in addition to the Business Aviation market. Two options were assessed:

- Option 1 reflected the current Business Aviation aspirations, with an externally imposed limit of 25,000 ATMs per year and aircraft up to a MTOW of 40 tonnes.

The predominance of business related traffic would restrict the passenger numbers to a low figure of approximately 100,000.

- The runway availability in Option 2 accommodates the largest business jets, which are simply variants of commercial airliners such as the B737-based BBJ and similar Airbus types. It would therefore be feasible under this option to support commercial passenger services on European routes in the scheduled, low cost and low volume charter markets. Constrained by land availability north of the runway, the optioneering capacity was determined at 6 mppa.

4.8.15 With both options being accommodated within the existing site boundary, the principal constraint to development would be airspace interaction with Heathrow and Gatwick and a high noise impact with Option 2 on the south westerly heading.

Lydd

4.8.16 With the exception of a twice-daily scheduled Lydd-Shoreham-LeTouquet service operated by Skytrek, the predominant activity at Lydd is GA and training flights. There is little commercial activity apart from a small aircraft maintenance and modification business and a number of flying schools. The former owner, Atlantic Bridge, established a ten year development plan which built on an initial phase to 'prove' the market for small scale scheduled services through to a final phase targeting the potential growth generated by continuing pressure on the main London airports. However, in view of the general absence of physical constraints both on and around the site, optioneering aimed at exploring the potential for large scale passenger and freight operations. Three options were developed, based on increasing levels of runway capability:

- Option 1 would restrict operations to BAe 146 sized aircraft, mainly serving the shorter haul domestic and European scheduled and low volume charter services. Maintaining current levels of maintenance and support facilities, capacity would be constrained by land availability to approximately 2 mppa.

- Option 2 would widen the runway to 45m and allow the facility to extend beyond the current site boundary. Similar markets to Option 1 would be served but over longer sectors and at higher loads. To handle a throughput of 5mppa a rail link to Ashford with connections elsewhere via CTRL is included.

- Option 3 exploits surrounding land to yield maximum practical capacity. A full code 4D facility with a runway length of 2450m would be provided for a high target throughput of 25 mppa. Using aircraft up to B767 or A310 size, accessible markets would be east coast USA and the Middle East. Additionally, to take advantage of a potential 24 hour operating period, a freight capacity of 200,000 tonnes per year is assumed.

4.8.17 Options 1 and 2 have relatively little land take impact but Option 3 requires extensive land acquisition. With relatively low noise impact, except in Option 3 where properties to the east would be significantly affected, the principal impediment to development potential would be the remote location of the airport relative to target markets.

4.8.18 Forecasts identified passenger demand of approximately 130,000 at 2030 with 1,500 annual ATMs carrying 15,500 tonnes of freight, mostly to and from north west Europe on freighter aircraft.

Manston

4.8.19 To reflect the absence of significant physical constraints and the current owners' development plans to expand the former military base to take advantage of the perceived lack of capacity at the region's main airports, optioneering focused on large scale passenger and freight development potential. Two options were explored, one to handle 10mppa and the other 30mppa, but both with the added capability of accommodating 0.5 million annual tonnes of freight and major aircraft maintenance facilities. Both would target the full spectrum of air services, including long haul scheduled and charters utilising a range of aircraft up to the B747.

4.8.20 Similar in configuration to the current proposals, Option 1 aims to maximise capacity within the current site boundary, extending the runway by 450m to 3200m with a full parallel taxiway. The whole of the available land with airside frontage is developed for passenger terminal/ apron and freight facilities, whilst land to the north is used for aircraft maintenance hangar development.

4.8.21 Option 2 is developed from Option 1, with the aim of matching terminal capacity to runway capacity. With extended terminal, apron and parking areas the passenger capacity is raised to 30 mppa. Although freight and maintenance areas are kept at the same level, this option would require a significant amount of additional land, taking a number of residential and commercial properties and the whole of the RAF facilities. A rail link would be provided, which would connect to Ashford and the London/CTRL services.

4.8.22 The principal constraint to development would be an increase in noise exposure at the new levels of activity, particularly on the approach path over Ramsgate to the east. Although there are no local airspace restrictions, Manston lies beneath some of the busiest cross channel airways giving access to Europe and so movements would need to share airspace capacity with heavy traffic flows to and from the main London airports.

4.8.23 Stage One forecasts indicated that Manston could support domestic, EC and non-EC scheduled and non-scheduled services, including long haul. Passenger numbers are forecast to rise from current levels of only 7,000 passengers a year to an upper figure of 1.6 mppa in 2015 and 2.7 mppa in 2030. Comprising mainly regional jets with a few charter aircraft of B757 type, forecast ATMs reach 15,000 in 2015 and 20,400 in 2030. Forecast freight tonnages reach 118,000 tonnes in 2015 and 168,000 tonnes in 2030, mostly carried on long-haul freighter aircraft.

Norwich

4.8.24 Just a single option was explored at Norwich, corresponding closely to the development proposals advanced by the current operator, Norwich Airport Ltd. Recognising the airport's limited catchment area and proximity to Stansted, growth scenarios of between 2 and 4 mppa in 2030 have been projected in both scheduled and charter business and in the capture of the whole of the southern North Sea oil helicopter operations from the current one-third market share. For optioneering, the view was taken that the potential of the airport would always essentially be constrained by its distance from major demand concentrations and although much has been done already to capture local demand there are limitations on how far this could be perpetuated. Low cost operations based on ease of air access, fast turnaround and low airport costs are one possible source of new traffic and so a slightly higher level of passenger activity of 5 mppa was used as the basis for option development.

4.8.25 The layout retains the existing runway length of 1800m with additional terminal, apron and parking areas based around the expansion of the existing facilities. A dedicated helicopter terminal is provided and to create opportunities for revenue generation areas in the north of the site not required for operational purposes are allocated for GA, Business Aviation and further maintenance activity. Land in the north west corner of the site, fronting the A140, would be set aside for general commercial development.

4.8.26 In impact terms the proposed north side developments are contrary to local planning policy as it is currently formulated, being considered as encroachment into a strategic gap. The development option would increase activity levels and average aircraft size but, particularly if further residential building in sensitive areas is controlled, potential noise exposure is likely to remain low as a result of both approach and departure tracks being over relatively open countryside. Any substantial increase in activity would require improvements to be made to the local road network and, although there is no scope for a direct rail link, local bus connection into the city could offer some reduction in car access.

4.8.27 The separate demand appraisal work showed that from a current level of 375,000 passengers a year, activity could grow to a level in the range 0.6 to 1.1 mppa in 2015 and 1.1 to 1.8 mppa in 2030. With a mixture of regional jets and B737 type aircraft, this constitutes annual ATMs of 16,500 in 2015 and 21,500 in 2030. Stage Two SPASM forecasts, which include Norwich but not, for example, Cambridge or Southend Airports in national passenger allocations, suggest that by 2015 Norwich could accommodate 0.5 to 0.7 mppa, and, by 2030, 0.7 to 4.4 mppa, depending on the capacity provided at other airports in the south east.

4.8.28 A further point to note with Norwich is the concept that it could possibly relocate to RAF Coltishall, should the RAF base become surplus to MoD requirements. Situated some 8 km from the current site, initial examination has shown that the base could accommodate the scale of operations envisaged at Norwich but the impact on the local road network would be high and the site is further removed from centres of demand and labour.

Shoreham

4.8.29 In planning terms, the physical limitations of the site at Shoreham preclude consideration of the development on a scale significantly greater than that contemplated in current airport proposals. It is the airport operator's belief that, based on the perceived level of prosperity and economic activity in its catchment, and its relative ease of access from the M25 and areas on the southern edge of Greater London, the airport has the potential to attract increased numbers of business-oriented air services, both corporate/air taxi and scheduled. Some one quarter of the 80,000 current annual movements a year are training circuits, the remainder being a mixture of leisure and private activity, some air taxi and private business flying, with the only scheduled service being the Skytrek service to Le Touquet which originates from Lydd.

4.8.30 Optioneering focused on maximising capacity based on a realigned and extended main runway, with an alternative option being entirely within the existing boundary:

- Option 1 retains the existing 825m long runway, which, with a slightly steeper than average approach slope due the high ground to the north, limits use to aircraft of large turboprop size with STOL capabilities, such as the de-Havilland Dash-7. With traffic likely to be limited to short haul domestic and European services, Business Aviation and GA, the capacity was set at 3 to 3.5 mppa. A new terminal would be aligned parallel to the runway, road access would be by the present route and a new rail station on the adjacent South Coast line would be envisaged.

- Option 2 would re-align and extend the runway to 1800m allowing operations by B737 and similar aircraft. The markets served would be the same as in Option 1 but to more distant destinations and with the potential to attract low cost operations. Requiring the acquisition of land to the west this option would have a capacity of 5 mppa.

4.8.31 Although the area immediately around the site is generally open there is dense residential development less than 1 km away on three sides. Option 2 increases aircraft size and introduces more jets, and, with the re-alignment exposing a larger area of housing to the south west, noise impact would be medium to high.

4.8.32 Forecasts show that passenger activity may rise to 0.5 mppa and 0.7 mppa in 2015 and 2030 respectively, with 12,000 and 17,000 commercial ATMs at the same horizon years. Freight activity is likely to be minimal with only 1,500 annual tones being forecast in 2030 being carried on passenger aircraft.

Southend

4.8.33 Of the 61,000 current annual ATMs at Southend, 75% are flying club and private movements with only 2,500 being commercial fixed wing flights. CAA statistics indicate that in 2000 Southend served only 4,000 terminal passengers on scheduled and charter flights. Although the site accommodates over 50 tenant businesses, engaged in a mixture of maintenance, repair and refurbishment of aircraft up to B757 size, the potential of the airport is dependent on its runway length and the degree to which capacity at the main London airports becomes constrained.

4.8.34 Optioneering considered proposals by the current operators to develop the airport to achieve a capacity of 10 mppa. This would require an extension of the runway to 1750m to allow the airport to target low cost operators with possibly some conventional scheduled services and Business Aviation. Site spatial constraints however restrict expansion possibilites and would limit potential capacity to approximately 5 mppa. Proposals also include a rail station, offering frequent services to Liverpool Street.

4.8.35 Land acquisition for the runway extension would require the demolition of a listed church and a number of other adjacent properties, leading to a high impact in local heritage terms. With a high proportion of residential and industrial development in surrounding areas, noise exposure impact would be high as a result of an increased level of activity.

4.8.36 The maximum demand forecast at Southend was 2 mppa in 2030, comprising 24,200 annual ATMs, mainly of B737 type aircraft with GA and Business Aviation aircraft in addition. Freight throughput is forecast to be up to 8,000 tonnes in 2030, carried on passenger aircraft.

5 Stage Two: Options and Packages

5.1 Options at Each Airport

5.1.1 This section summarises the options that have been appraised at each airport in Stage Two of SERAS. It also introduces the concept of the Stage Two appraisal *Packages*, which combine individual airport options across the system to provide differing levels of system-wide capacity.

5.1.2 Explicit details of each option are provided under the relevant section for each airport in Chapters 7 to 12. In principle, options at each of the airports fall into the following categories:

- an option which provides the level of capacity currently envisaged in the land use planning system,
- an option which represents the maximum use of existing runways, and
- a number of options which represent additional runway and terminal capacity at each airport.

Heathrow

5.1.3 The Heathrow options appraised in Stage Two are:

- Base Case (and Maximum Use of the Existing Runways) – this assumes T5 and runways as currently envisaged in the land use planning system, operating in the existing segregated mode;
- Option 1 – assumes that the two existing runways will operate in mixed mode throughout the operating day;
- Option E1 – a variant of Option 1, with mixed mode operating only between 0700 and 1200 hours, the current practice of runway alternation applying thereafter;
- Option E4 – a new 2000m runway north of the A4, but no aircraft stands, operating in mixed mode, with the existing runways operating in segregated mode;
- Option E6 – the same new 2000m runway, serviced by aircraft stands north of the A4 to minimise runway crossings, all runways operating in mixed mode;

- Option E8 – a new 4000m full length runway also to the north of the A4, only one of the three runways operating in mixed mode at any one time on a rotational basis.

5.1.4 The assessed annual passenger and ATM capacities for each option can be seen in Table 5.1.

Gatwick

5.1.5 The Gatwick options appraised in Stage Two are:

- Base Case – the current land use planning system;
- Maximum Use of the Existing Runway;
- Option 1 – a new full-length runway 385m south of the existing runway, with no stagger, operating dependently;
- Option E1 – adds two new full-length runways: one 2900m to the north of the existing, staggered 2000m west, the other 1035m south of the existing, allowing independent operations on the three runways with the existing runway in mixed mode

5.1.6 The assessed annual passenger and ATM capacities for each option can be seen in Table 5.1.

Stansted

5.1.7 The Stansted options appraised in Stage Two are:

- Base Case – the current land use planning system;
- Maximum Use of the Existing Runway;
- Option 5 – one new full-length runway separated from the existing runway by 2450m and with a large stagger, operating in mixed mode;
- Option 11 – adds a further runway to Option 5: a full -length close-parallel runway to the north west of the existing runway and operating as a dependent pair;
- Option 7 – adds a fourth runway to the three runways in Option 11: a full-length close-parallel runway to the Option 5 new runway.

5.1.8 The assessed annual passenger and ATM capacities for each option can be seen in Table 5.1.

Luton

5.1.9 Luton options appraised in Stage Two:

- Base Case – the current land use planning system;
- Option 2 – new 3000m parallel runway 200m to the south of the existing runway;
- Option E3 – new 3000m runway aligned NNE:SSW and to avoid Someries Castle;

5.1.10 For both Options 2 and E3, variants to the layouts to accommodate increased freight activity were assessed. The assessed annual passenger and ATM capacities for each option can be seen in Table 5.1.

Cliffe Marshes

5.1.11 Between Stages One and Two, a detailed review of options at Cliffe Marshes was undertaken, with the primary objective of consolidating the potential role of the airport and minimising environmental impacts. The principal runway orientation at Cliffe Marshes is almost east – west. A single north east – south west runway to the west has also been appraised. This runway could only be used when the east – west runways were operated in segregated mode and would be intended for night-time freight activity. The options that were subsequently appraised at Stage Two are:

- Option A2(2) – one pair of wide-spaced runways operating in mixed mode;
- Option A2(3) – one pair of wide-spaced runways operating in mixed mode supplemented by a single NE-SW runway to the west for easterly night-time arrivals only;
- Option A2(4) – two pairs of close-parallel runways; each pair operating in dependent segregated mode;
- Option A2(5) – two pairs of close-parallel runways operating in dependent segregated mode, supplemented by a single NE-SW runway to the west for easterly night-time arrivals only.

5.1.12 The assessed annual passenger and ATM capacities for each option can be seen in Table 5.1.

5.2 Packages of Airport Options

5.2.1 In Stage One of SERAS, options were evaluated and compared at each airport. In Stage Two, the various available options at each airport have been selected and combined in different ways into a number of packages to allow consideration of phased capacity improvement across the system of airports. These packages are broadly categorised as described in the following paragraphs and are defined in Tables 5.1 to 5.6.

Base Cases (Package 1) (**Table 5.1**)

5.2.2 The base case at each airport defines the option and its capacity as currently envisaged in the land use planning system. There is one package which combines the base cases at each of the existing main airports (Heathrow, Gatwick, Stansted and Luton).

No New Runways (Packages 2, 3 and 4) (**Table 5.1**)

5.2.3 These packages consist of options that maximise the use of existing runways. At Heathrow, this includes incremental variants leading to full mixed mode operation.

5.2.4 Luton is a special case in that the maximum use scenario is represented by Option 2 or E3, which have the same capacity, and entail the replacement of the existing runway but not the development of an additional runway.

One New Runway: Appraised at 2015 and 2030 (Packages 5a, 5b, 5c, 6 and 7) (Table 5.2)

5.2.5 These packages each add one new runway at one of the existing airports, with the remaining airports in the package being the *maximum use of existing* options.

5.2.6 Package 5 adds a new runway at Heathrow, with variants *a*, *b* and *c* being the three runway options that were selected to be carried forward to Stage Two. Packages 6 and 7 add a new runway at Gatwick and Stansted respectively.

Two New Runways: Appraised at 2015 (*Packages 8(i)* ***and*** *8(ii)*) ***(**Table 5.3**)***

5.2.7 These two packages introduce new runways, at the new site at Cliffe Marshes, with the other airport options being *the maximum use of existing runways.* Variant (i) adds a wide-spaced parallel pair (Option A2(2)), and variant (ii) includes a NE-SW runway to the west of that pair to take easterly night time freight arrivals only (Option A2(3)).

Two New Runways: Appraised at 2030 (Packages 9, 10, 11, 12 and 13) (Table 5.4)

5.2.8 Packages 9 and 10 add two new runways at Gatwick and Stansted respectively, with the remaining existing airports at *maximum use of existing runways* status. Cliffe Marshes is excluded.

5.2.9 Packages 11, 12 and 13 distribute two new runways, one each at Heathrow and Gatwick, Heathrow and Stansted, and Gatwick and Stansted respectively. In each case the undeveloped airports are taken to be at *maximum use of existing runway* status.

Three New Runways: Appraised at 2030 (Packages 14 to 20) (Table 5.5)

5.2.10 Packages 14 to 19 distribute three new runways in various combinations at the existing airports, with undeveloped airports operating in *maximum use of existing runway* status. Package 20 has two of the additional three runways at Cliffe Marshes.

Four New Runways: Appraised at 2030 (Packages 21(i) and 21(ii) (Table 5.6))

5.2.11 In this scenario, all four runways are located at Cliffe Marshes, with Heathrow, Gatwick, Stansted and Luton operating at *maximum use of existing runway* status. Variant (ii) also has the single NE-SW runway, again catering only for easterly night time freight arrivals.

5.3 Other Airports

5.3.1 A number of airports have been categorised as small sites and have been included within the packages under the heading 'Others'. These have been assumed to contribute a constant level of additional system capacity, except in Packages 3 and 4, which is higher and includes Alconbury. Apart from Alconbury, other small sites include Southampton, Biggin Hill, Cambridge, Farnborough, Lydd, Manston, Norwich, Shoreham and Southend.

5.3.2 The Alconbury option appraised in Stage Two, most notably for noise impacts, is Option 3.

5.3.3 Small site options are described in Chapters 4 and 13.

Table 5.1 Base Cases and No New Runways – Pre 2015 (Appraised at 2015) – Options and Passenger Capacities (mppa)

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
1	Base Case	86 Base Case	40 Base Case	15 Base Case	10 Base Case	0	5	156	LHR 480 LGW 260 STN 185 LTN 100 Others 50* Total 1,075	Assumes developments currently in the land use planning system Assumes segregated mode at LHR Assumes T5 at LHR
2	Maximum Use of Existing Runways at LHR, LGW, and STN. Option 2 or E3 at LTN (hereafter referred to as Max Use at LTN)	86 Max Use	46.5 Max Use	35 Max Use	31 Option 2 or Option E3	0	15	213.5	LHR 480 LGW 260 STN 259 LTN 240 Others 150* Total 1,389	Assumes segregated mode at LHR Assumes T5 at LHR Also appraised at 2030
3	Partial Mixed Mode at LHR, Max Use at LGW, STN and LTN and Max Use of 'small sites'	91 Option E1	46.5	35	31	0	25	228.5	LHR 497 LGW 260 STN 259 LTN 240 Others 250* Total 1,506	
4	Full Mixed Mode at LHR, Max Use at LGW, STN and LTN and Max Use of 'small sites'	105 Option 1	46.5	35	31	0	25	242.5	LHR 551 LGW 260 STN 259 LTN 240 Others 250* Total 1,560	

**** denotes estimate only***

Table 5.2: One New Runway – Appraised at 2015 and 2030 – Options and Passenger Capacities (mppa)

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
5a	One New Runway - Option E6 at LHR, Max Use LGW, STN and LTN	128 Option E6	46.5	35	31	0	15	255.5	LHR 754 LGW 260 STN 259 LTN 240 Others 150* Total 1,663	
5b	One New Runway - Option E4 at LHR, Max Use LGW, STN and LTN	112 Option E4	46.5	35	31	0	15	239.5	LHR 655 LGW 260 STN 259 LTN 240 Others 150* Total 1,564	
5c	One New Runway - Option E8 at LHR, Max Use LGW, STN and LTN	121 Option E8	46.5	35	31	0	15	248.5	LHR 638 LGW 260 STN 259 LTN 240 Others 150* Total 1,547	
6	One New Runway - Option 1 at LGW, Max Use LHR, STN and LTN	86	62 Option 1	35	31	0	15	229	LHR 480 LGW 378 STN 259 LTN 240 Others 150* Total 1,507	
7	One New Runway - Option 5 at STN, Max Use LHR, LGW and LTN	86	46.5	82 Option 5	31	0	15	260.5	LHR 480 LGW 260 STN513 LTN 240 Others 150* Total 1,643	

Table 5.3: Two New Runways – Appraised at 2015 – Options and Passenger Capacities (mppa)

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
8(i)	Two New Runways - both at Cliffe, Max Use LHR, LGW, STN and LTN	86	46.5	35	31	77 Option A2(2)	15	290.5	LHR 480 LGW 260 STN 259 LTN 240 CLF 530 Others 150* Total 1,919	
8(ii)	Two New Runways (Plus NE/SW Runway) - both at Cliffe, Max Use LHR, LGW, STN and LTN	86	46.5	35	31	77 Option A2(3)	15	290.5	LHR 480 LGW 260 STN 259 LTN 240 CLF 530 Others 150* Total 1,919	

Table 5.4: Two New Runways – Appraised at 2030 – Options and Passenger Capacities (mppa)

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
9	Two New Runways - both at LGW. Max Use LHR, STN and LTN	86	115 Option E1	35	31	0	15	282	LHR 480 LGW 675 STN 259 LTN 240 Others 150* Total 1,804	
10	Two New Runways - both at STN. Max Use LHR, LGW and LTN	86	46.5	102 Option 11	31	0	15	280.5	LHR 480 LGW 260 STN 637 LTN 240 Others 150* Total 1,767	
11	Two New Rwys - One at LHR and One at LGW. Max Use at STN and LTN	128 Option E6	62 Option 1	35	31	0	15	271	LHR 754 LGW 378 STN 259 LTN 240 Others 150* Total 1,781	
12	Two New Rwys - One at LHR and One at STN. Max Use at LGW and LTN	128 Option E6	46.5	82 Option 5	31	0	15	295.5	LHR 754 LGW 259 STN 513 LTN 240 Others 150* Total 1,916	
13	2030: Two New Rwys - One at LGW and One at STN. Max Use at LGW and LTN	86	62 Option 1	82 Option 5	31	0	15	276	LHR 480 LGW 378 STN 513 LTN 240 Others 150* Total 1,761	

Table 5.5: Three New Runways – Appraised at 2030 – Options and Passenger Capacities (mppa)

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
14	Three New Runways - all at STN. Max Use at LHR, LGW and LTN	86	46.5	129 Option 7	31	0	15	307.5	LHR 480 LGW 260 STN 756 LTN 240 Others 150* Total 1,886	
15	Three New Runways - One at LHR, One at LGW and One at STN. Max Use at LTN	128 Option E6	62 Option 1	82 Option 5	31	0	15	318	LHR 754 LGW 378 STN 513 LTN 240 Others 150* Total 2,035	
16	Three New Runways - One at LHR and Two at STN. Max Use at LGW and LTN	128 Option E6	46.5	102 Option 11	31	0	15	315.5	LHR 754 LGW 260 STN 637 LTN 240 Others 150* Total 2,041	
17	Three New Runways - One at LGW and Two at STN. Max Use at LHR and LTN	86	62 Option 1	102 Option 11	31	0	15	296	LHR 480 LGW 378 STN 637 LTN 240 Others 150* Total 1,885	

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
18	Three New Runways - One at LHR and Two at LGW. Max Use at STN and LTN	128 Option E6	115 Option E1	35	31	0	15	324	LHR 754 LGW 675 STN 259 LTN 240 Others 150* Total 2,078	
19	2030: Three New Runways - Two at LGW and One at STN. Max Use at LHR and LTN	86	115 Option E1	82 Option 5	31	0	15	339	LHR 480 LGW 675 STN 513 LTN 240 Others 150* Total 2,058	
20	2030: Three New Runways - One at LGW and Two at Cliffe. Max Use at LHR and LTN	86	62 Option 1	35	31	77 Option A2(2)	15	306	LHR 480 LGW 378 STN 259 LTN 240 CLF 530 Others 150* Total 2,037	

Table 5.6: Four New Runways – Appraised at 2030 – Options and Passenger Capacities (mppa)

Package No.	Package Title	LHR	LGW	STN	LTN	Cliffe	'Others'	Pax Capacity mppa	PATM Capacity '000	Other Features of Note
21 (i)	2030: Four New Runways – all at Cliffe. Max Use at LHR, LGW, STN and LTN	86	46.5	35	31	113 Option A2 (4)	15	326.5	LHR 480 LGW 260 STN 259 LTN 240 CLF 781 Others 150* Total 2,170	
21 (ii)	2030: Four New Runways (Plus NE/SW Runway) – all at Cliffe. Max Use LHR, LGW, STN and LTN	86	46.5	35	31	113 Option A2 (5)	15	326.5	LHR 480 LGW 260 STN 259 LTN 240 CLF 781 Others 150* Total 2,170	

6 Stage Two: Appraisal Process

6.1 Introduction

6.1.1 This chapter introduces the appraisal processes applied in Stage Two of SERAS principally to give guidance in interpreting the findings presented in following chapters. It does this by setting out the key principles and assumptions underlying the appraisals. This is not intended to be a full, detailed methodology statement. The Stage Two Methodology report and its supporting documents are intended to provide the fuller detail.

6.1.2 In SERAS, two main appraisal years, of 2015 and 2030, have been used. As explained in Chapter 5, options involving no new runways, one new runway or two runways at Cliffe Marshes have been appraised in 2015. Larger options have been appraised in 2030. The appraisal of options is carried out relative to a base case. In this case, two bases are possible:

- The provision of facilities and capacity already allowed for in the land-use planning system represents a ‘do-minimum’ and is more appropriate as a shorter term (2015) base; and

- For the longer term (2030) this might be deemed too restrictive a base and an unrealistic basis against which to estimate the impacts of options. It has been assumed in the 2030 appraisals that a better basis for comparison will be the maximum use of existing runways. There are several reasons for this. No major addition to capacity – a new runway, for example – is likely until, we assume, 2011. By this time the pressure of growing demand will have brought forward airports’ applications for additional capacity. So, for options with more than one runway, it has been assumed that permissions will have been given for existing runways to operate at their capacity.

6.1.3 The principal differences between these two base case scenarios arise at Stansted and Luton. At Heathrow, there is no difference: T5 is assumed in both cases. At Gatwick, there are no extra facilities, but there is significantly more throughput.

6.1.4 The SERAS appraisal process is wide-ranging. In different areas of the appraisal process it has been found helpful, in order to capture the full range of impacts or to present impacts in forecast years against known current conditions, to use different bases for comparison. The bases used for the principal assessments of impacts are as follows:

- The principal cost estimates are expressed as the incremental costs of options over airport layouts which allow maximum use of the existing runways.

- The economic and financial impacts of options are appraised against a base of the maximum use of the existing runways. The economic and financial impacts of making maximum use of existing runways, relative to maintaining only those capacities envisaged in the land-use planning system are separately estimated.

- Surface access impacts of options in 2015 are assessed relative to the airport options as currently envisaged in the land-use planning system. In 2030, they are assessed relative to options which make maximum use of existing runways.

- Land take impacts are assessed relative to airport layouts currently envisaged in the land-use planning system, so that the full impacts of options are identified.

- Local air quality impacts are assessed using numbers of people exposed to 'exceedances' of the pollution concentration statistic embodied in UK Air Quality Regulations 2000.

- Aircraft noise impacts are expressed relative to future year base cases (operations currently envisaged in the land-use planning system for 2015 and maximum use of existing runways for 2030) and against current or recent observed noise levels so that forecast noise levels can better be set in context.

6.1.5 In this chapter principal elements of the SERAS appraisal process and assumptions underlying the different parts of the appraisal process are set out.

6.2 Appraisal of Options and Packages

6.2.1 Many of the impacts of airport options can be identified on an option by option basis. Some impacts can only be addressed for the South East airports as a system or at a national level. Chapters 7 to 11 identify the impacts of the options appraised at Heathrow, Gatwick, Stansted, Luton and Cliffe Marshes. The principal impacts addressed in this way are: option costs; traffic forecasts; safety risk; surface access; environmental impacts - land take, water resources, noise, local air quality; employment; land use and urbanisation; regional impacts; social impacts; and impacts in relation to integration.

6.2.2 Some of these impacts are determined by airport layouts: others are related to the passenger and freight traffic forecast to use an option. But the traffic forecasting has to recognise the interactions between airports, so can only be undertaken on a package basis. Forecasts have been made for all of the packages listed in Tables 5.1. to 5.6. The appraisal of options was based on forecast use of each option in a ‘representative case’ forecast. Typically, the representative case for each option has been taken as the forecast for an option when it is combined with the least amount of development at other airports. Normally the assumption is that the airport option is added to 'maximum use of existing runways' at all other airports.

6.2.3 A number of areas of the appraisal required the best available traffic (passenger and ATM) forecasts to be provided as inputs. In particular: airport employment forecasts are dependent on forecast airport use by passengers and air freight; surface access modelling requires airport passenger and employment forecasts; noise and air quality modelling requires ATM and surface access forecasts; employment forecasts feed into the appraisal of land use and urbanisation impacts.

6.2.4 In order to meet the study's timetable, these downstream appraisal activities had to proceed with the best available forecasts at the time, but subsequent refinements to the SPASM forecasting model meant that the earlier forecasts used in these downstream parts of the appraisal process differ to a small degree from the forecasts presented in this report. A comparative review of the different forecasts confirms that the surface access, noise, air quality and land use/urbanisation findings reported here would not be materially different if final forecasts had been used.

6.2.5 The principal impacts that are addressed on a package basis, with results described in Chapter 14, are the economic and financial impacts, wider economic impacts and global air quality impacts.

6.3 Capital Costs

6.3.1 Capital cost estimates have been presented in a standardised spreadsheet format to ensure a comprehensive coverage of items and consistency of approach between options.

6.3.2 A common set of rates was applied to all major capital cost items such as terminals, satellites, pavements, car parking, hangars, cargo and maintenance buildings. These were determined from a range of rates used by the various optioneers at Stage One and from published estimating data. This common set of rates guards against significant over or under estimating and enables inter-airport comparisons to be made with a reasonable degree of confidence.

6.3.3 Where the level of detail applied to the optioneering did not allow sensible measurable quantities to be determined, single 'sums' have been used. Typically these items have a much less significant effect on the total costs than the major measurable items.

6.3.4 Figures in the Cost Estimate Tables are rounded to the nearest £ million and all costs are those applicable at year 2000.

6.3.5 With the current level of scheme development, the estimating tolerance is considered to be in the order of plus or minus 25%.

Surface Access Scheme Costs

6.3.6 A breakdown of surface access costs is presented in a separate table. These include the construction of road and rail access routes considered to be necessary for new airport layouts or to cater for additional airport capacity. The cost of road diversions, either around or under an airport footprint is included in enabling works. These scheme costs have been included in economic and financial appraisals of options. Separately identified are estimates of the costs of providing additional capacity on the strategic road networks which is only in part required for higher volumes of airport traffic.

6.3.7 In some areas, the provision of additional airport capacity will bring forward the need for interventions (or schemes) in order to deal with potential congestion on the strategic road network. Schemes to be brought forward are of two types:

- Schemes that are triggered by airport capacity provision, and which would not otherwise be needed within the forecasting period; and
- Schemes that would be required in any event, even without new airport capacity.

6.3.8 The surface access costs included in the Stage 2 appraisals include the full estimated costs of schemes triggered by airport development. For those schemes required to serve a particular airport option, initial estimates of when they would be needed have been made, both with and without the additional airport capacity. Based on this analysis, the cost of bringing forward schemes has been estimated, as the difference between the present year value of the scheme costs, discounted from the respective years in which they would be needed. This process would, of course, reduce the surface access costs attributable to the airport option, although this reduction was found to be very small relative to the overall airport costs.

6.3.9 Conversely, those schemes that, based on the SERAS background assumptions, are required without any new runways, may need to be brought forward if additional airport capacity is provided nearby. However, since most of these schemes would be required by 2015 – and the additional airport capacity could not be provided much before that date – the additional costs of bringing forward such schemes will be small and has not been estimated at this stage.

6.3.10 It should be noted that, at Cliffe Marshes, it was assumed that the need for a (road and rail) Lower Thames Crossing would pre-date the airport. The costs of the road and rail Lower Thames Crossing were therefore excluded from the Cliffe airport infrastructure costs.

Details of Cost Estimates

6.3.11 The following are excluded from the capital cost estimates:

- Public Inquiry costs

- Marketing
- Legal costs
- Environmental mitigation measures
- Compensation to affected communities & companies adjacent to the development.
- Ground contamination
- Effects of timing of construction works, eg out of sequence working
- Hotels
- Demolition at end of useful life
- Relocation of disturbed structures
- Value Added Tax

6.3.12 Contingencies are shown as a separate line item in the estimates and have been added at a rate of 25% of airport development costs. These are intended to cover design reserve and site contingencies. Design reserve would be expected to reduce as design development advances. Site contingencies are allowances for unforeseen site factors such as deleterious ground conditions and post-tender design changes.

6.3.13 On-costs are also within this separate line item and attract the same rate of 25% of airport development costs. These are intended to cover professional design fees, planning fees, specialist consultants' fees, construction/project management fees, insurances and site preliminaries.

6.3.14 Land costs include compulsory purchase compensation and have been established from data published in the Valuation Office Property Market Report, Autumn 2000, and additional local house price data available in the public domain. Reference was made to DETR Review of Compulsory Purchase and Compensation, published in July 2001. No account has been taken of compensation payments outwith the footprint of the airport.

6.3.15 To reflect the higher cost of capital works in the Greater London area, rates at Heathrow have been inflated by 10% relative to the other airport sites. For similar reasons, rates at Alconbury have been deflated by 15% relative to the other airport sites. Rates at all other sites are consistent. It is probable that at Heathrow, Gatwick and Stansted, BAA could obtain lower construction rates through framework agreements with their core suppliers.

6.3.16 Figures are also presented that show costs per additional million passengers per annum (mppa), over and above the relevant base case at each airport. This allows easy comparison to be made between options and airports of the costs of providing additional capacity.

6.3.17 Although it is recognised that some capital cost items will attract a disruption premium for works on a live operational airfield, these have not been included at this stage. They are likely to represent only a very small percentage of the total cost and could be considered to be within the contingency allowance. Nevertheless, they do warrant further examination at a later stage to determine the relative effects between individual options.

6.3.18 It is also recognised that revenue is likely to be generated at all sites through rental or leasing of office space, maintenance facilities, hangarage, fuel supply, etc. This has not been included in financial modelling at this stage but does warrant assessment at a later stage to allow a balanced appraisal of the relative effects on financial viability between options and airports.

6.4 Demand Forecasts

SPASM

6.4.1 Air passenger demand forecasts and associated ATM forecasts are derived from a new passenger allocation model developed by DTLR for SERAS and other related studies. The model – SPASM – is an annual, national passenger allocation model, taking national air travel demand forecasts, by category, each year from 1998 to 2030, and allocating this demand to airports. 29 existing UK airports are represented in each SPASM run and there is the facility to add three new airports into each run.

6.4.2 SPASM works on an annual level. Annual demands are fed in, as are annual airport capacities. There is no facility within SPASM for addressing the allocation of demand in other periods, eg, busy summer months or busy days. The capacities fed into SPASM are annual physical capacities, of runways and terminals, assuming these are used to the full. SPASM's base year is 1998. The base capacities input to SPASM have been defined to accommodate 1998 actual demands. Therefore, on an annual basis, physical runway and terminal capacities are not exceeded and there are no capacity constraints at any airport in the base year within SPASM. It is accepted that in reality, at particular times of the day, week and year, there was an excess of demand over supply at some airports in 1998, which has not been removed subsequently.

6.4.3 The passenger demand allocated in SPASM comes from recent surveys of air passengers conducted by the CAA and DTLR forecasts of growth in demand. The base year demand is derived from different CAA surveys of departing passengers at UK airports carried out in 1998 and preceding years. In the case of surveys at airports carried out prior to 1998, surveyed results have been factored up to 1998 totals. The surveyed data identifies the number of trips made at each airport sub-divided as follows:

- By category: four types of international scheduled air service passengers - UK residents making business trips, UK residents making leisure trips, foreign residents making business trips, foreign residents making leisure trips; those interlining between international flights (I to I interliners); passengers on international and domestic low cost services; passengers on charter flights; passengers on domestic scheduled services.

- By UK origin or destination districts. The UK ends of international trips and both ends of domestic trips are identified for 455 local authority districts in England, Wales and Scotland (These reflect the 1991 census boundaries used as the basis for coding CAA survey data. Subsequent reorganisation of districts in Scotland and the creation of unitary authorites have reduced the number of administrative areas.)

- For international trips, overseas origins/destinations are grouped into 48 world zones, some of which represent individual routes – 21 destinations in Europe – and the others represent groups of routes, eg, United States West and United States East.

6.4.4 Unconstrained demand forecasts for each year between 1998 and 2030 are produced by increasing 1998 demand in line with DTLR's central forecasts in Air Traffic Forecasts for the United Kingdom, DETR, May 2000 (see Table 2.6). At a national level, forecasts are constrained to these totals. Within this constraint a lower rate of growth is applied to represent the greater maturity of the air travel market in the East and South East of England and London. Within these three regions, the growth rate assumed to 2015 is 1 percentage point per annum lower than that in the rest of the country.

6.4.5 Passengers are allocated to airports on the basis of the combined cost of surface access movements between their origin/destination districts and each airport, service frequencies and shadow costs. A multinomial logit model formulation, calibrated for each trip category, is used to allocate passengers between direct routes (origin district – departing airport – arrival airport) and indirect routes (origin district – departing airport – interlining airport – arrival airport).

6.4.6 Interlining from regional UK airports is allowed for international scheduled trips at Heathrow, Gatwick, Manchester, and at Stansted (in packages with a 'large' Stansted option) and at Cliffe Marshes when that airport is open in the UK, and at Paris, Amsterdam, Frankfurt and Brussels.

6.4.7 The surface access costs used in the logit model are a combination of time costs and money costs and a combination of costs by car and by public transport. Surface access costs used in the modelling can be changed at intervals between 2000 and 2030. In the SPASM modelling in SERAS, no specific allowance for new airport-related road schemes has been made, except in relation to new airport sites. Travel times by car to airports generally increase through time (travel times are adjusted in 2011 and 2021) as road networks are assumed to become increasingly congested. Travel times by public transport to/from each airport vary from option to option in SERAS to represent the effects of the rail schemes associated with each option in the following chapters

6.4.8 The value of additional service frequencies is represented in SPASM via a formula which gives declining value to each additional daily frequency and incorporates a factor which allows for the ability of passengers to tailor to a certain extent their arrival times at airports to aircraft departure times.

Shadow Costs

6.4.9 Shadow costs are market clearing prices which limit demand at an airport for which demand exceeds capacity to airport capacity. In practice, shadow costs might materialise as higher air fares or charges for using those airports with the greatest excess demand. They could ultimately accrue to airports, airlines or governments. With current regulatory and fiscal policies, and in the absence of a proper market in airport slots, they are likely to accrue to the airlines. Current regulatory policies limit airport charges and the return on capital at regulated airports, and current fiscal policies levy the Air Passenger Duty on a flat rate basis at all airports, irrespective of the balance of demand and capacity.

6.4.10 Shadow costs are generated in SPASM to limit allocated demand at any airport to airport capacity. Two capacity measures are applied to each airport in each year in each SPASM run: terminal capacities, expressed in millions of passenger per annum (mppa), and runway capacities, expressed in ATMs per year. Relevant values for different options at South East airports are given in Chapter 5. For each airport in each year of a model run, SPASM determines whether either capacity is reached and, if both are, that for which excess demand is greater, which becomes the binding capacity constraint. It then develops and tests appropriate shadow costs (per passenger if terminal capacity is the binding constraint, or, more commonly in SERAS, per ATM if runway capacity is the binding constraint). ATM shadow costs are converted into costs per passenger, taking account of passengers per ATM by route. In an iterative process, shadow costs per passenger are adjusted and passengers reallocated until allocated passengers and their associated ATMs at each airport are within an accepted tolerance interval around the defined capacities. The shadow costs generated at an airport in one year are carried forward as the starting values in developing the next year's shadow costs at that airport if capacity has not changed in the meantime.

6.4.11 The application of shadow costs at any airport will push passengers away from the airport where shadow costs apply, to other airports or out of the UK airport system. It follows that the lower the capacity provided, more trips will be pushed out of the UK airport system altogether. Some of the important general effects of shadow costs at SERAS airports are:

- ATM shadow costs are translated into a cost per passenger based on the number of passengers per ATM on each route. An ATM shadow cost will therefore be a larger cost per passenger on those routes with smaller aircraft, typically short haul scheduled services, both domestic and international. So, at airports with ATM shadow costs, those services with larger aircraft and higher load factors (eg, long haul scheduled) will tend to push out services with using smaller aircraft and with lower load factors.

- Any shadow cost, other things being equal, will be a larger percentage addition to the total cost of leisure passengers (who have a lower value of time) than business passengers (who have a higher value of time). Leisure passengers are therefore more likely to be pushed away from airports where shadow costs apply than business passengers.

6.4.12 Shadow costs serve a useful function in estimating the economic surpluses or benefits accruing from additional capacity. At capacity constrained airports, they are surpluses accruing to producers (perhaps airlines) at the expense of passengers. Additional capacity will cause shadow costs to fall, reducing producer surpluses but increasing consumer surpluses. The fall in shadow costs with the additional capacity is the basis for estimating the benefit to additional (generated) traffic.

Service frequencies in SPASM

6.4.13 The starting service frequencies in SPASM are actual service frequencies, by type (scheduled by route, charter, low cost), in 1998. SPASM re-forecasts frequencies each year on the basis of the allocated number of passengers by route at each airport and a series of graphs which relate passengers to service frequency, allowing for increases in average aircraft sizes on a route as the number of passengers grows.

6.4.14 SPASM is a demand-led model, so new services are generated at an airport whenever the allocated demand is sufficient to justify a commercial frequency and load factor. Services can decline through time at an airport, for example, when shadow costs push particular passengers away from an airport, or if a new airport is assumed to open up and attract passengers away from existing airports.

6.4.15 Allowance had to be made for the very high growth in low cost demand and services between 1998 and 2000, particularly at Stansted, Luton and Liverpool airports. Actual 2000 low cost service frequencies were fed into SPASM to replace 1998 frequencies. Low cost services can only be generated within SPASM at user-specified airports.

Principal SPASM Outputs

6.4.16 The output produced from each SPASM run, for each year between 1998 and 2030, falls into three main categories:

- Passenger forecasts, by UK district, by passenger type and by service category (scheduled services by route, charter, domestic and international low cost, I to I interlining) at each airport,
- Associated ATMs by route at each airport, and
- ATM or passenger shadow costs at each airport, as appropriate.

Use of SPASM Within SERAS

6.4.17 Within SERAS each core package has been run through SPASM , along with a series of sensitivity tests and non-core runs. The runway and terminal capacities assumed for each airport in each package are as set out in Chapter Five. The timing at which capacity enhancements have been assumed for each package are set out in Table 6.1 for those packages appraised in 2015 and in Table 6.2 for those packages appraised in 2030.

6.4.18 For packages beyond package 2, the package 2 assumptions hold at each of the main airports other than those where capacity enhancement is being tested. Generally, where additional runways are incorporated in a package, they have been assumed to be phased in accordance with expected commercial pressures, ie, a sequence of Heathrow first, then Gatwick, Stansted or Cliffe Marshes. The exception is package 20 which has new runways at Cliffe Marshes introduced before a runway at Gatwick. If a package has two major investments, it is assumed that the first is in 2011 and the second in 2021. If there are three major investments, the first is in 2011, the second in 2018 and the third in 2024.

Table 6.1: Timing of Capacity Enhancements in SERAS 2015 Core Packages

Package	Enhancement
1	ATM capacity at Heathrow is assumed to be 470,000 from 2001 and 480,000 from 2007. Passenger capacity is assumed to be 70 mppa from 2001 and 86 mppa from 2007 Passenger capacity at Gatwick grows from 35 mppa to 40 mppa in 2005 Passenger capacity at Stansted remains at 15 mppa, runway capacity at 185,000 ATMs Passenger capacity at Luton increases from 5 mppa to 10 mppa in 2006: runway capacity remains at 100,000 ATMs
2	Heathrow capacities are as in Package 1 Passenger capacity at Gatwick grows from 35 mppa to 40 mppa in 2005 then to 46.5 mppa by 2011. Passenger capacity at Stansted grows from 15 mppa in 2001 to 35 mppa in 2011 with associated growth in ATM capacity Passenger capacity at Luton increases from 10 mppa to 31 mppa in 2011, ATM capacity from 100,000 to 240,000 in 2011
3	Partial mixed mode operation at Heathrow phased in from 2007 (when T5 is assumed to open) to 2011
4	Full mixed mode operation at Heathrow phased in from 2007 (when T5 is assumed to open) to 2011
5A	Full mixed mode operation at Heathrow phased in from 2007 (when T5 is assumed to open) to 2011 and new runway and terminal capacity at Heathrow in 2011
5B	New runway and terminal capacity at Heathrow from 2011
5C	Full mixed mode operation at Heathrow phased in from 2007 (when T5 is assumed to open) to 2011 and new runway and terminal capacity at Heathrow in 2011
6	New runway and terminal capacity at Gatwick from 2011
7	New runway and terminal capacity at Stansted from 2011
8(i), 8(ii)	New runway and terminal capacity at Cliffe Marshes from 2011

Table 6.2: Timing of Capacity Enhancements in SERAS 2030 Core Packages

Package	Enhancement
9	New runway and terminal capacity to 486,000 ATMs and 83 mppa at Gatwick in 2011 and to 675,000 ATMs and 115 mppa in 2021
10	New runway and terminal capacity at Stansted to 513,000 ATMs and 82 mppa in 2011 and to 637,000 ATMs and 102 mppa in 2021
11	Mixed mode operation at Heathrow phased in from 2007. New runway and terminal capacity at Heathrow (754,000 ATMs and 128 mppa) from 2011, and new runway and terminal capacity at Gatwick (378,000 ATMs and 62 mppa) from 2021
12	Mixed mode operation at Heathrow phased in from 2007. New runway and terminal capacity at Heathrow (754,000 ATMs and 128 mppa) from 2011, and new runway and terminal capacity at Stansted (513,000 ATMs and 82 mppa) from 2021
13	New runway and terminal capacity at Gatwick (378,000 ATMs and 62 mppa) from 2011, and new runway and terminal capacity at Stansted (513,000 ATMs and 82 mppa) from 2021
14	New runway and terminal capacity at Stansted to 513,000 ATMs and 82 mppa in 2011, to 637,000 ATMs and 102 mppa in 2018 and to 756,000 ATMs and 129 mppa in 2024
15	Mixed mode operation at Heathrow phased in from 2007. New runway and terminal capacity at Heathrow (754,000 ATMs and 128 mppa) from 2011, new runway and terminal capacity at Gatwick (378,000 ATMs and 62 mppa) from 2018, and new runway and terminal capacity at Stansted (513,000 ATMs and 82 mppa) from 2024
16	Mixed mode operation at Heathrow phased in from 2007. New runway and terminal capacity at Heathrow (754,000 ATMs and 128 mppa) from 2011, new runway and terminal capacity at Stansted (513,000 ATMs and 82 mppa) from 2018, and again from 2024 (637,000 ATMs and 102 mppa)
17	New runway and terminal capacity at Gatwick (378,000 ATMs and 62 mppa) from 2011, new runway and terminal capacity at Stansted (513,000 ATMs and 82 mppa) from 2018 and again from 2024 (637,000 ATMs and 102 mppa)
18	Mixed mode operation at Heathrow phased in from 2007. New runway and terminal capacity at Heathrow (754,000 ATMs and 128 mppa) from 2011, new runway and terminal capacity at Gatwick (486,000 ATMs and 83 mppa) from 2018 and again from 2024 (675,000 ATMs and 115 mppa)
19	New runway and terminal capacity at Gatwick (486,000 ATMs and 83 mppa) from 2011, and again from 2018 (675,000 ATMs and 115 mppa) and new runway and terminal capacity at Stansted (513,000 ATMs and 82 mppa) from 2024
20	New runway and terminal capacity at Cliffe from 2011 (530,000 ATMs and 77 mppa) and new runway and terminal capacity at Gatwick (378,000 ATMs and 62 mppa) from 2021
21(i), 21(ii)	New runway and terminal capacity at Cliffe from 2011 (530,000 ATMs and 77 mppa) and again from 2021 (781,000 ATMs and 113 mppa)

Airport Assumptions in SERAS Runs

6.4.19 In all the SERAS runs reported here it is assumed that regional airports are essentially unconstrained, limiting the overspill from regions outside the South East into South East airports. In practice, this has been achieved by assuming full use is made of existing runway capacity at regional airports and additional runway and terminal capacity is provided at both Manchester and Birmingham Airports in 2021.

6.4.20 Heathrow currently is served almost exclusively by scheduled services. It is assumed that this will continue and charter and low cost services have been specifically excluded from Heathrow in the SPASM modelling.

6.4.21 Gatwick is assumed to continue to operate a mixture of scheduled and charter services. Luton is assumed to continue to operate a mixture of domestic and short haul and USA scheduled services, charter and low cost services. London City is assumed to operate domestic and short haul scheduled services only.

Seeding of Services at Stansted and Cliffe Marshes

6.4.22 At Stansted, different assumptions are made for single runway and multi-runway versions. It is assumed that the services operated at a single runway Stansted will continue to develop from the current mix of low cost, scheduled and charter services.

6.4.23 For multi-runway Stansted options, services have been 'seeded' within SPASM to represent a change in the role of the airport. Similarly, services have been seeded at the new Cliffe Marshes airport. Seeding effectively means that an operator or operators moves a major tranche of services to an airport as a new runway or the airport opens. In the case of scheduled services, for example, the seeding assumption is roughly based on the notion of the second largest alliance currently operating at South East airports taking its services to the seeded airport. SPASM assumes that the seeded service frequencies exist and uses them in the allocation of passengers between the seeded and other, competing airports. No reduction is made in service frequencies at the existing airports in this allocation process.

6.4.24 At Stansted, initial forecasts showed that current charter, low cost and short haul scheduled services continued to grow, so seeding was confined to long haul and USA scheduled services. Service frequencies representing 40% of Heathrow's 1998 scheduled long haul and USA services were assumed for multi-runway Stansted options in 2011.

6.4.25 At Cliffe Marshes, where no services at all exist prior to 2011, the seeded service frequencies amount to 40% of Heathrow's 1998 scheduled services, 23% of Gatwick's 1998 charter services and 11% of Stansted's 2000 low cost services.

6.4.26 In many of the cases where services have been seeded in this way, a comparative unseeded model run has been made so that the effect of seeding can be seen. In addition, a commercial viability test is applied to the seeded services, by comparing forecast frequencies at a commercially viable load factor with the input seeded frequencies. If these are comparable it can be assumed the seeded services are viable and likely to remain. If forecast frequencies are lower than seeded frequencies, load factors will fall short of those necessary for commercial viability and the seeded services may not survive.

Sensitivity Tests and Non-Core Runs

6.4.27 Sensitivity tests that have been run through SPASM, and through economic and financial appraisals, fall into three categories:

- running Stansted or Cliffe Marshes options without seeding,
- infrastructure changes in core packages such as changes to runway phasing or runway options, and
- the effects on air travel demand of applying 'environmental taxes' in support of Government policy that aviation should bear its full costs, including external costs.

6.4.28 Seeding: Core runs 7 and 14 have been run without seeding at Stansted, and core runs 8 and 21 without seeding at Cliffe Marshes.

6.4.29 Infrastructure changes: Core run 15 has been run with an extra runway and extra terminal capacity added at Stansted in 2026 (637,000 ATMs and 102 mppa), and a different runway and terminal capacity ordering prior to this of 2011 Heathrow, 2016 Gatwick and 2021 Stansted. Similarly, core run 18 has been run with the addition of a runway and extra terminal capacty at Stansted in 2026, and a new runway sequence preceding this of 2011 Heathrow, 2016 Gatwick, and 2021 Gatwick. A further sensitivity test was to run core run 18 with this sequence, but without the new capacity at Stansted in 2026.

6.4.30 Environmental Policy: Core runs 2, 15, 16 19 and 21 were run with an allowance for the external costs of aviation, which are assumed to be passed on to passengers in the form of an environmental charge, thereby reducing demand. To account for this, the demand for air travel has been reduced evenly across all markets starting from a 0.5% reduction in 2006, increasing annually to a 5% decline at the beginning of 2016. These are in line with the forecasts in *'Air Traffic Forecasts for the United Kingdom*', DTLR, May 2000.

6.5 Safety Risk

6.5.1 The safety risks associated with new runways or increased use of existing runways has been assessed by the identification of their associated Public Safety Zones (PSZs). These have been calculated in accordance with the 'Green Book' – *Third Party Risk Near Airports and Public Safety Zone Policy*, DTLR, 1997.

6.5.2 Attention is focused on 1:10,000 risk areas and 1:100,000 risk areas. Within 1:10,000 risk areas it is assumed existing residential or commercial buildings will be acquired and the costs of any such acquisitions are included in option costs. An assessment has been made of the proportion of the area between 1:10,000 and 1:100,000 risk contours already developed as a proxy for the degree of 3rd party safety risk attached to each runway option. The 1999 resident population in the area between these two contours has been estimated, on the basis of the population in postcodes, which have their centroids between the two contours.

6.5.3 A refined methodology for generating PSZ risk contours was developed during Stage Two. This was primarily to allow the actual twenty year modal splits and the irregular distribution of traffic across multiple runways to be input directly.

6.6 Surface Access

Surface Access Modelling

6.6.1 A set of surface access models has been developed and validated specifically for use in SERAS, to enable the surface access movements associated with different airport options to be forecast, and then modelled alongside non-airport traffic to allow the effects of additional airport-related trips on road and public transport networks to be assessed.

6.6.2 The SPASM passenger allocation model provides a forecast of the spatial distribution of passengers for each airport option. Employee trip distribution models produce complementary trip distributions for four categories of employees, who tend to live at different distances from airports: airport and airline management, cabin crew, caterers and cleaners and all other employees.

6.6.3 The SERAS air passenger mode choice model allocates passengers, by market segment and surface origin zone, between modes on the basis of relative surface access costs by mode. The structure of the model and the definition of the six air passenger market segments is the same as in BAA's Heathrow Surface Access Model (HSAM).

6.6.4 The SERAS employee passenger mode choice model similarly allocates employee trips to different highway and public transport modes on the basis of their relative costs. The forecast number of employees at an airport is a function of forecast passenger and freight throughputs. In the surface access modelling, for those airport options with higher employment levels, no compensating reduction in employment elsewhere (and therefore in trips associated with employment elsewhere) has been assumed, which may tend to inflate background traffic levels in high airport employment options.

6.6.5 Air freight related surface access trips are forecast on the basis of forecast air freight tonnages and existing relationships between freight tonnes and associated surface access movements. Freight-related surface access traffic is assumed to have a similar distribution by time of day to existing freight movements.

6.6.6 The forecasting of non-airport, background traffic, by road and public transport, starts with SERAS base year trip matrices developed from the major data source models, NAOMI for trips by road and PLANET for trips by public transport. Projections of future change in planning parameters and in GDP growth were used to determine growth in travel demand by mode and by district. Forecast changes in planning parameters consist of 2016 and 2031 estimates of population, households by car ownership category, employed residents and jobs at County level, consistent with TEMPRO 4 data supplied by DTLR. Background public transport trip growth in the peak hour averages 24% between the base year (1997) and 2015, with no further growth beyond then. Background road traffic growth in the peak hour averages 26% by 2015 and 40% by 2030. In the SERAS modelling, airport-related trips were removed from the background traffic forecasts and replaced by the SERAS forecasts of airport-related trips for different options.

6.6.7 Airport-related trips are removed from the forecasts of background traffic. SERAS forecasts of airport-related trips and the remaining background non-airport trips by mode, derived from the various sub-models, are combined prior to their assignment to the highway and public transport networks. The models are designed to reflect conditions in an average hour in the morning peak period (0700-1000). The models use a common 600-zone system, covering London, the East and South East regions at District (or finer) level of detail and the rest of the UK at County or Region level.

6.6.8 Forecast year networks contain currently-committed schemes as well as the existing networks. Thameslink 2000 and CTRL II are included as committed schemes, but CrossRail is not. This has been modelled and appraised in the context of particular airport options.

6.6.9 The main outputs from these models are:

- Flows, speeds, delays and traffic composition on existing and new roads to feed into noise and air quality modelling, and and rail link flows to feed into noise modelling,

- These flows also feed into the appraisal of surface access impacts. These include the use made of new links, additional crowding or congestion created on existing public transport services and road links, and the need for improvements or capacity enhancements on parts of the existing strategic networks.

Appraisal of Impacts on Surface Access Networks

6.6.10 The appraisal of conditions on the road network falls into two parts: the appraisal of the requirements for access from the airports to the strategic road network, and the identification of those parts of the strategic road network that may experience severe congestion problems as a result of the airport expansion. For the purposes of the appraisal, only those roads that are expected to carry 5% more traffic with the airport option than in the base case, and that are forecast to have volume:capacity ratios greater than 0.9 are considered as problems.

6.6.11 In many cases, these parts of the strategic road network are being addressed in on-going studies (eg Multi-Modal Studies) to address existing and potential future travel problems in their corridors. Those studies are addressing the nature of the problems, potential policy or scheme intervention responses, and the feasibility of those interventions.

6.6.12 In identifying potential problems associated with airport options, and subsequently indicating the road improvement schemes that may be needed to cater for additional airport-related traffic, SERAS has not, and could not, consider the range of possible responses (demand management, pricing or new infrastructure) that the multi-modal studies may be addressing. Nor has SERAS established the engineering or environmental feasibility of potential road improvement schemes. It is for other studies to carry out this work and to identify appropriate measures. The purpose of identifying the potential road schemes that may be required is to provide a scale to the size of the problems associated with different airport options and thereby to inform decisions in respect of future airport capacity provision and other studies formulating plans for strategic road networks.

6.6.13 The approach followed in the case of major public transport schemes differs in one respect. The rail schemes considered likely, following the assessment in Stage One, to be needed to complement an airport option have been incorporated in model runs in order that the use made of them can be assessed. The likely need for these schemes was assessed in terms of the capacity that would be needed or the network coverage needed to achieve stated aims of increasing public transport shares of airport trips. The schemes modelled with each option are identified in subsequent chapters. Again the purposes of the appraisal are: to identify required schemes; to provide a scale to the size of the problem associated with different airport options; and to inform future decisions on airport capacity provision and the development of the strategic rail network.

6.7 Environment: Land Take

6.7.1 The scale and complexity of the SERAS study, combined with the need for objectivity and transparency, requires a carefully constructed and consistent approach to developing and applying criteria for determining whether an environmental effect is significant and, if so, its level of severity. In particular it is important that the technical environmental evaluation of significance and its sub-division into levels of severity ensures parity across all topic areas.

6.7.2 Any subsequent weighting of evaluations, to take account of other considerations, e.g. perceptions, politically sensitive issues etc, should be determined by Ministers. In order to ensure such parity, a two-stage methodology for determination of significance and severity has been adopted comprising:

- Establishment of generic criteria for four levels of severity (HA*, HA, MA and LA) of significant effects which can be applied across all topic areas; and
- Establishment of specific criteria for each topic area consistent with the generic descriptions for each of the four levels of severity. These criteria relate directly to the two key factors of the scale of impact and the value and sensitivity of the resource or receptor affected (ie individual, or groups of people, designated sites etc).

6.7.3 The topic areas addressed under the generic Land Take heading are:

- Impacts on people: residential properties taken
- Land take, by land use type
- Contaminated land
- Ecology
- Heritage
- Landscape/Townscape
- Community impacts
- Construction impacts

6.7.4 The definition of levels of severity were developed from a standard seven-point scale (High, medium and low adverse, neutral, and low, medium and high beneficial) with the addition of a further High* adverse category. The four levels of adverse impact are defined as follows:

- High* adverse (HA*), an effect which in isolation should have a substantial bearing on decision making,
- High adverse (HA), an effect which in isolation could have a material influence on decision making,

- Medium adverse (MA), an effect which on its own could have some influence on decision making, particularly when combined with other similar effects,

- Low adverse (LA), an effect which on its own is likely to have a negligible influence on decision making, but when combined with other effects could have a more material influence.

6.7.5 Table 6.3 summarises for each land take topic the criteria used to define levels of adversity.

6.7.6 The classification of adverse impacts into these four categories has taken account of international and national legislation, policy and guidance; findings from other studies; and appropriate best practice. In this report, the focus is on identifying the more important HA* and HA impacts.

6.7.7 While decision makers may seek uncontested objective criteria, and criteria, by definition, have their basis in science, it should be recognised that there will inevitably be uncertainties associated with any such criteria as applied to environmental appraisal. Such uncertainties relate both to incomplete baseline data, which can result in inconclusive or ambiguous evidence (scientific uncertainties), and varying opinions as to the likely consequences of particular activities (judgmental uncertainties). These uncertainties exist in the opinions of technical specialists as well as the perceptions of others with an influence on decision making (including politicians, lobby groups and the public).

Table 6.3 Criteria for evaluating levels of adversity for Land Take

	Land Use				
	Residential	**Industrial/commercial**	**Recreational**	**Public Buildings**	**Agricultural**
Basis of criterion	Number of residential properties taken. Ability to replace locally (based on provision for housing within representative Structure Plans). Expressed in terms of level of housing provision.	Area of industrial land lost. Ability to replace locally. It is assumed that commercial land is easier to replace than residential as developers will pay more for commercial sites	Recreational area lost. Ability to replace locally. Assumed that is easier to replace than commercial, since Green Belt can be used. Also, length lost of national footpath and potential for local re-routing. Modified by qualitative considerations, including proximity to residential area served, total area of designated site and consideration of use of an area for informal recreation.	Number of buildings lost and ability to replace locally. Some (eg hospitals) can be replaced like commercial buildings. Others (schools, churches) need to be in the community they serve.	Based on agricultural area lost and quality of agricultural land (where known). Grades 1-3a are taken into account: loss of grade 3b and below is not considered significant
National Policy or Guidance	PPG 3, Urban & Rural White Papers	PPG 4.	PPG 17	None	PPG 7, Rural White Paper, DMRB, Dibden and WCML methodology
High * Adverse	> 60% of nominal annual provision ie >2,580 properties with no scope for reprovision	Substantial loss of commercial premises	Substantial loss of recreational facilities	Substantial loss of public buildings	Substantial loss of agricultural land

	Land Use				
	Residential	**Industrial/commercial**	**Recreational**	**Public Buildings**	**Agricultural**
High Adverse	>40% of nominal annual provision ie >1,720 properties with scope for reprovision	>150% of nominal annual provision ie >322 ha	>648 ha from a park/playing field/ outdoor area; or loss of 322 ha from an indoor facility; or loss of >50% from a specific site designated at county or district level	Loss of >4 public buildings through a combination of >2 places of worship, >2 schools: > 2 hospitals: > 2 other significant public buildings	Loss of >100 ha of Best and Most Versatile (BMV) land
Medium Adverse	20-40% of nominal annual provision ie 860-1720 properties	50 – 150% of nominal annual provision ie 108-322 ha	216-648 ha from a park/playing field/ outdoor area; or loss of 108-322 ha from indoor facility; or loss of 15-50% from a specific site designated at county or district level	Loss of 3 or 4 public buildings	Loss of 41-100 ha of BMV
Low Adverse	<20% of nominal annual provision ie < 860 properties	<50% of nominal housing provision ie <108 ha	<216 ha from a park/playing field/ outdoor area; or loss of <108 ha from an indoor facility; or loss of <15% from a specific site designated at county or district level	Loss of 1 or 2 public buildings	Loss of 20-40 ha of BMV

	Contamination		Construction Impacts		Ecology	
	Loss of Greenfield	**Potential for pollution**	**Effect on people in their homes**	**Effect on ecological resource**	**Land take**	**Noise and AQ disturbance factors**
Basis of criterion	Based on the proportion of land taken for development.	Based on the presence of a previous or existing contaminative use and qualitative assessment of likely pathways and sensitive receptors	Based on area of expansion, scale of major works (eg cut and fill, tunneling), number of residential receptors (ie individual , or groups of people) and proximity to works. Modified by qualitative criteria including potential off-site traffic movements, location of access routes and nature of construction requirements.	Based on area of expansion, scale of major works (eg cut and fill, tunneling), number of ecological designation (international or national) and proximity to works. Modified by qualitative criteria including potential off-site traffic movements, location of access routes and nature of construction requirements.	Based on site designation (and equivalent non-designated sites), and on area of land take. Modified by qualitative considerations including Environmental Capital consideration (if known) eg rarity and typicalness in a local, regional and national context; Ability to substitute (if known); and; Total area of designated site.	Based on proximity of new runways to noise-sensitive and visual sensitive species populations receptors. Modified by qualitative consideration: proportion/ area of site affected
National Policy or Guidance	None	DMRB, ICRCL	DMRB	DMRB	PPG 9, Habitats Regulations, DMRB, GOMMMS, CTRL and Dibden methodology	PPG 9, Habitats Regulations, DMRB, GOMMMS, CTRL and Dibden methodology
High * Adverse			None due to temporary impact only	Large scale long term works within 50m of internationally or nationally designated ecological site	Major impact on internationally designated site or equivalent which has potential to affect its integrity	International site, with species sensitive to noise and visual disturbance, within 100m of source. Plus noise impacts on receptors within 1km of end of runway or 200m to side of runway

	Contamination		Construction Impacts		Ecology	
	Loss of Greenfield	**Potential for pollution**	**Effect on people in their homes**	**Effect on ecological resource**	**Land take**	**Noise and AQ disturbance factors**
High Adverse	>90% Green Field	Great Scale for contamination	Large scale works affecting >500 residential properties within 250m of large scale works	Large scale works within 50-250m or medium scale works within 50m of internationally or nationally designated ecological site	25-50% land take on internationally designated site. >50% land take on nationally designated site	International or national site with species sensitive to noise within 1km of end of runway or 200m to side of runway
Medium Adverse	60-90% Green Field	Moderate Scale for contamination	Small scale works within 50m or medium scale within 50-250m or large scale works within 250-1,000m of >500 residential properties	Small scale works within 50m or medium scale within 50-250m or large scale works within 250-1,000m of internationally or nationally designated ecological site	Up to 25% land take on internationally designated site. 25-50% land take on nationally designated site. >50% land take on Regional or County designated sites	International or national site with species sensitive to noise within 1-3km of end of runway or 200-500m from side: or county/district designation within 100m of end of runway or 50m to the side
Low Adverse	30-60% Green Field	Minor Scale for contamination	>500 properties within 250m of small scale works or 100-500 residential properties within 250m of medium scale works or >500 properties within 250m of large scale works	Internationally or nationally designated ecological site within 250-1,000m of medium scale works or 50-250m of small scale works mitigated	Up to 25% land take on nationally designated site. 25-50% land take on Regional or County designated sites. Over 50% land take on District or local designated sites	International or national site with sensitive species within 3-5km of end of runway or country/district site within 200m of end of runway.

	Heritage		Landscape	
	Land take and buildings of historical or archaeological significance	**Sites of archaeological significance**	**Areas lost by designation**	**Deterioration in views**
Basis of criterion	Based on importance of designation, number of buildings lost, area of land lost, area lost from or in the vicinity of archaeological sites. Modified by qualitative considerations including value of conservation area (somewhere on scale of district - national); ability to mitigate effects on archaeology through advance recording; total size of archaeological site/ area.	Based on proximity and impact on historic landscape/garden within 1 km of airport site and an evaluation of undesignated sites and area of high archaeological potential.	Based on area lost and importance of designation (national/ district)	Based on proximity of designated landscape to airport site and importance of designation Modified by qualitative considerations including level of visibility (ie degree of screening available) and type of landform to be constructed/ degree of change to landscape character (eg construction of flyover instead of at-grade road).
National Policy or Guidance	PPG 15; PPG 16; National Monuments Record; Scheduled Ancient Monuments Record; Listed Buildings; Registered Park and Garden Records; DMRB; GOMMMS; Dibden and WCML methodologies	PPG 15; PPG 16; Planning (Listed Buildings and Conservation Areas Act) 1990; Ancient Monuments and Archaeological Areas Act (1979); DMRB; GOMMMS; Dibden and WCML methodologies	PPG2	PPG 7, DMRB, GOMMMS, Dibden and WCML methodologies, sectoral guidance
High * Adverse	Loss of or encroachment on an Internationally designated site.	Loss of or encroachment on an Internationally designated site.		

	Heritage		Landscape	
	Land take and buildings of historical or archaeological significance	**Sites of archaeological significance**	**Areas lost by designation**	**Deterioration in views**
High Adverse	Any loss of Grade I or II* listed building; or Loss of >5 Grade II listed buildings; or Loss of >5% of Conservation Area or Registered Park or Garden; or any loss of SAM or non-scheduled area of National Importance; or >50% of historic site, monument or area of archaeological potential	Significant loss of undesignated sites and areas of high archaeological potential	>50 ha of nationally designated site, > 100 ha of regional / county designated site, > 200 ha of district designated site.	Nationally designated site within 3 km of airport site or County site within 1 km with qualitative appraisal for scale of impact
Medium Adverse	Loss of 2-5 Grade II listed buildings; or Loss of 2-5% of Conservation Area or Registered Park or Garden; or loss of 25-50% of historic site, monument or area of archaeological potential	<10 undesignated sites of local or regional interest	10 –50 ha of nationally designated site, 50 - 100 ha of regional / county designated site, 100 - 200 ha of district designated site.	Nationally designated site within 3-5 km of airport site, or County site within 1-3 km, or District site within 1 km.
Low Adverse	Loss of 1 Grade II listed building; or Loss of <2% of Conservation Area or Registered Park or Garden; or loss of <10% of historic site, monument or area of archaeological potential	Minimal impact and low potential and/or mitigation possible	<10 ha of nationally designated site, <50ha of regional / county designated site, <100ha of district designated site.	Nationally designated site within >5 km of airport site, or County site within 3-5 km, or District site within 1-3 km

	Community Impacts		
	Community infrastructure	Community structure/ distinctiveness	Employment
Basis of criterion	Based on loss on residential housing particularly for vulnerable groups.	Based on effect of the development on community structure and urban form.	Loss of employment opportunities and loss of commercial land.
National Policy or Guidance	No published guidance. Follows current EIA practice in terms of the approach to identifying the significance of effects.	No published guidance. Follows current EIA practice in terms of the approach to identifying the significance of effects.	No published guidance. Follows current EIA practice in terms of the approach to identifying the significance of effects In the absence of established methodologies this is a qualitative assessment.
High * Adverse	Not used in this category		
High Adverse	Displacement of >20% of persons in Ward with consideration of IMD of affected groups, nature and number of community facilities lost.	>20% increase in population of Core Catchment Area: or >50% of housing capacity. Consideration also of nature of settlement patterns and ability to accommodation housing demand whilst retaining character and extent of wards subject to increased noise levels or subject to new noise disturbance.	Qualitative appraisal of loss of commercial/industrial facilities; new employment opportunities, diversity etc. Relationship of Core Catchment Area unemployment to national average; below average unemployment is assumed to indicate that additional jobs would not necessarily represent a net community benefit.
Medium Adverse	Displacement of 10-20% of persons in Ward with consideration of IMD of affected groups, nature and number of community facilities lost.	10 – 20% increase in population of Core Catchment Area: or 25 – 50% of housing capacity. Consideration also of nature of settlement patterns and ability to accommodation housing demand whilst retaining character and extent of wards subject to increased noise levels or subject to new noise disturbance.	As above

6.7.8 Specific assumptions and limitations relating to each of the relevant topic areas are included in the Stage Two Methodology Report. Generic limitations and assumptions include:

- The Stage Two appraisal includes some but not all aspects of an Environmental Capital Approach. It does consider non-designated sites (which were not considered in Stage One) but does not rigorously follow an Environmental Capital Approach in determining the value of resources and undertaking the appraisal, although where possible GOMMS criteria have been incorporated.

- The confidential nature of the project restricted consultation and thus the views of key statutory consultees (English Nature, Countryside Commission, English Heritage, etc) have not yet been sought.

- The appraisal of the environmental effects arising from induced development and surface access has been excluded from this study. It goes beyond the scope of this study to design surface access improvements or other surface access strategies which are being addressed in, for example, multi-modal studies. The location and design of induced development is also beyond the scope of this study, and is for consideration in the land-use planning system, starting with the next revision of Regional Planning Guidance.

- The future baseline in 2030 (without airport development), against which the evaluation has been made, has been estimated from local plans and other available sources as identified in the main text. This information is unlikely, however, to reflect reality in 2030. While some information regarding future changes was available, this was very limited. In most cases it did not extend to 2030 and it varied between locations.

- The appraisal has been primarily based on desk studies alone with no consultation and only limited site visits. It is therefore possible that some resources may be missed, particularly those which are not officially designated. Furthermore, there are limits to the verification of the accuracy of data (eg, the number of houses affected by each option has to be estimated from OS maps).

- The appraisal has been undertaken for development options at each airport site up to the 2030 planning horizon. Explicit appraisal of developments within current planning permissions and for the maximum use of facilities at each site has not been undertaken as these have been deemed to be confined within the existing airport boundaries.

- Mitigation. At this stage in the appraisal process, and given the need to maintain confidentiality, it has not been possible to identify all feasible opportunities for mitigating impacts, whether by modifications to layouts and designs, relocating affected resources, re-creating habitats or other means. In some cases, for example impacts on contaminated land and water resources, where it is very often possible to mitigate the impacts of major projects, qualitative judgement on the scope for mitigation has been applied here in the assessment of the potential severity of impacts. In other cases, no allowance for potential mitigation has been made, so, on that basis, the recorded impacts may overstate true impacts to the extent that they can be mitigated.

6.8 Environment: Water

6.8.1 The appraisal of the impacts of options on water resources follows the approach used for the appraisal of land take impacts. The severity of impacts on the water environment takes account of the scale of the impact and the importance and sensitivity of the resource affected. Adverse impacts are similarly classified as HA*, HA, MA and LA. National policy and guidance, in particular that emanating from the Environment Agency, and other standard appraisal approaches, have been used in determining the severity of impacts.

6.8.2 Impacts on four areas of the water environment, as set out below, are appraised. In each case the appraisal year is 2030.

- Surface Water Quality. The appraisal system takes account of the sensitivity of the receptor and the potential of the proposal to cause harm. The appraisal findings have been modified by qualitative consideration of the potential for mitigation. The appraisal takes account of the Environment Agency's GQA (General Quality Assessment) scheme River Quality Objectives, and fisheries designation. Standard appraisal approaches (DMRB, NATA) are also drawn upon.

- Groundwater. The appraisal system takes account of the sensitivity of the receptor and the potential of the proposal to cause harm. The appraisal findings have been modified by a qualitative consideration of the potential for mitigation. The appraisal takes account of the Environment Agency's Policy and Practice for the Protection of Groundwater which includes Groundwater Vulnerability mapping and source protection Zones. Again, DMRB and NATA are drawn upon.

- Flooding. The appraisal system takes account of the sensitivity of the receptor and the potential of the proposal to cause harm. The appraisal findings have been modified by a qualitative consideration of the potential for mitigation. The appraisal takes account of the Environment Agency's 1 in

100 year flood plain mapping and the Flood Estimation Handbook, along with DMRB and NATA.

- Water Resources. The appraisal is based on a qualitative assessment of available water resources, having regard to the Environment Agency publication Water Resources for the Future, March 2001.

6.8.3 The appraisal is initially carried out for the base case option, i.e. for the current land-use planning system. The assessment of future options is set against the base case, in that assessments only consider those impacts that are *additional* to those identified under the base case option.

6.9 Environment: Noise Impacts

Aircraft Noise - Daytime

6.9.1 To assess daytime aircraft noise the $L_{Aeq,16h}$ (07.00 to 23.00) noise contours are presented for the 3 month summer period normally used for aircraft noise contours in the UK. ERCD's ANCON 2 model has been used to produce contours from 54 dB $L_{Aeq,16h}$ upwards in 3 dB intervals. This enables comparison to be made of forecast 2015 or 2030 contours with different options and current or recent modelled noise contours.

6.9.2 The correspondence between aircraft noise levels on the L_{Aeq} scale and average annoyance levels, which relates back to original survey work published in the Wilson Report in 1963, is as follows:

Table 6.4: Aircraft Noise and Annoyance

Noise level $L_{Aeq,16h}$ dB	Average Annoyance Response
57	Low
63	Moderate
69	High

6.9.3 Although 57 dB is commonly taken as the indicator of the onset of significant community annoyance, the 54 dB contour is also presented as a sensitivity test.

Aircraft Noise – Night-time

6.9.4 Current policies in relation to night-time noise at major UK airports are implemented through night-time noise quotas which take account of numbers of night-time flights, permitted aircraft types and noise emissions by aircraft type. Following the October 2001 ruling by the European Commission for Human Rights on night flights, policies with regard to night flights (numbers of flights, permitted aircraft types, etc) are under review. Until this review is completed, there is no basis on which forecasts of night flights or of night-time noise can be made. As illustrative examples, 90dB(A) SEL (Sound Exposure Level) footprints for each existing and proposed runway option have been produced based on typical loudest (QC2) aircraft likely to operate at night-time. To represent night-time aircraft noise impacts an indicator that predicts sleep disturbance is the most useful. Research into aircraft noise and sleep disturbance, produced by the CAA in 1992 but now under review, showed that aircraft pass-by events below 90dB(A) SEL were unlikely to produce sleep disturbance. The SEL gives a measure of peak noise level and is not a function of the number of noise events.

Assessment of Noise Impact

6.9.5 Populations within the noise contours and SEL footprints have been estimated by ERCD using 1991 census data as updated by CACI Ltd to mid-1999. For forecast years, the population data remains unchanged except where airport options indicate that houses would be demolished in order for development to take place. In these cases the populations within the revised airport boundaries have been subtracted from the totals.

6.9.6 ERCD's ANCON Version 2 model is a semi-empirical model which calculates L_{Aeq} at a point on the ground by summing the SELs due to all passing aircraft. Calculations are repeated for a grid of receptors and from the results the noise contours are determined.

6.9.7 ANCON 2 is used to produce the annual published noise contours for the three designated London airports Heathrow, Gatwick and Stansted. Since 1995 it has been the practice to produce two sets of contours. These are based on the "actual" modal (landing/take-off direction) split over the relevant period, and the "standard" modal split, based on the 20 year average. When comparing predicted noise contours it is important to be aware of the directional split assumptions. The modal directional split assumed for the SERAS modelling has been the current "standard" at each airport. These are 77/23 Westerly/Easterly at Heathrow, 73/27 at Gatwick, 76/24 at Stansted and 76/24 at Luton. For the new site at Cliffe Marshes a split of 70/30 was adopted.

6.9.8 The input data provided for the model includes summer average ATMs for the 0700-2300 daytime period, split into aircraft types. Details of aircraft tracks and precise runway locations are also provided with the split of movements between these. The process for determining this data is outlined below.

SIDs, Allocation of ATMs to Runways, Distribution of ATMs to SIDs and Future Aircraft Fleet

6.9.9 The allocation of ATMs from SPASM output between runways at each airport allows for their distribution to runway-specific Standard Instrument Departure routes (SIDs). For all arrival movements, straight-in flight tracks were assumed. The allocation of ATMs to tracks is the primary input for the noise modelling process and a derivative input for the air quality and CO_2 modelling.

6.9.10 The allocation rationale adopted for the new short runway options at Heathrow, Options E4 and E6, was to transfer from the existing full length runways to the new all aircraft types with performance characteristics suitable for operating from the short runway (2000m). These are all aircraft within the two lowest seat bands in SPASM, with 150 seats or less. Where that number of ATMs fell short of the assessed short runway capacity, a number of larger aircraft types, operating within a range of 750km, were also transferred to make up the shortfall.

6.9.11 For the full-length runway options, the requirement to allocate between the new and existing runways on the basis of aircraft size or performance characteristics was not applicable. To maintain the notion of 'maximum achievable capacity' no attempt has been made to constrain or allocate particular movements to the new runways, the assumption being that all aircraft types could operate equally from any of the runways. Thus, for options that have three full length runways (such as Option E8 at Heathrow or Option 11 at Stansted) the allocation was split equally between the three, ie. 33.3% / 33.3% / 33.3%.

6.9.12 Once allocated to runways, the forecast ATMs, by market (or route group), were distributed across the SIDs in a way that reflected the current (2001) SID usage.

6.9.13 Where existing runways have been retained, existing SIDs have also mostly been retained. Where new runways have been introduced at existing airports, new SIDs have been designed to converge with the existing SIDs either by the first waypoint or sooner, cognisant of minimum radii and other air navigation rules. In the case of new airports, ie. Cliffe Marshes, SIDs used in noise contour generation have been designed to minimise overflying of populated areas as far as possible. ATMs classified by aircraft size bands and allocated by track were provided for each option for which noise impacts were to be modelled, and ERCD assigned aircraft types.

Future Aircraft Types

6.9.14 Aircraft types were assigned by ERCD to the forecast movements using a 'bottom-up' approach for replacement of old aircraft as they are phased out or retired. For future aircraft types, aircraft noise performance characteristics were defined using available manufacturers' data and assumptions based on likely future international regulations.

6.9.15 The bottom-up approach to the replacement of old aircraft had the following steps:

- Start with the existing fleet mix at each airport for which noise impacts were modelled,
- Phase out those that will not be permitted to operate in the forecast years of 2015 and 2030, in this case Chapter 2 aircraft,
- Divide remaining aircraft types into those no longer in production and those still in production,
- Develop a retirement profile for those types no longer in production based on the current age profile of the European fleet,
- For those aircraft types still in production, retirement has been ignored. This means, conservatively, that, for a given type, an aircraft bought in, say, 2010 will have the same noise performance as one currently in operation.
- Additional aircraft to replace retired aircraft or to cater for growth are drawn equally from all relevant types in a ‘supply pool’.

6.9.16 The Supply Pool comprises existing types no longer in production, existing types still in production and future types not yet flown. Manufacturers’ data describing noise performance has been used where available. For new types, noise performance has been derived from that of similar types whose performance is known.

Noise Characteristics

6.9.17 ICAO contracting states have agreed to ban Chapter 2 aircraft operations by 31 March 2002 and CAEP, ICAO’s Committee for Aviation Environmental Protection, is considering the adoption of more stringent noise standards, both for new designs and the phase out of the noisiest Chapter 3 aircraft.

6.9.18 The SERAS and RASCO noise modelling work undertaken for DTLR has considered three principal design standards, based on reductions below current Chapter 3 permitted noise levels of 8dB, 11dB and 14dB, with Chapter 3 levels to be bettered at each of the three noise measurement points.

6.9.19 For the core model runs, deliberately cautious assumptions have been made in both relevant areas. It has been assumed that a new design standard of Chapter 3 –8dB will be introduced in 2002, and that aircraft that do not comply with Chapter 3 –5dB will be phased out beginning in 2007.

6.9.20 For sensitivity testing, more stringent standards of Chapter 3 –14dB have been assumed in both areas. The sensitivity testing has also incorporated an accelerated retirement programme for those aircraft no longer in production in 2000 and a reconsideration of the aircraft types that might be present in future aircraft fleets. In practice, this has tended to replace long-range variants of some new aircraft types in the core model runs with shorter-range variants of the same types more likely to be in general use and more compatible with forecast air services.

6.9.21 A decision on a new standard was taken in early 2001, after this modelling work had started, when CAEP recommended that ICAO member states adopt a Chapter 3 –10dB standard for the certification of new aircraft designs submitted after 1 January 2006. No agreement was reached on the phase out of marginal Chapter 3 aircraft.

Surface Access Noise

6.9.22 The surface access noise assessment is based on the advice given on multi-modal environmental assessment in GOMMMS. This involves separately tabulating for roads and railways estimates of population exposed to changes in noise. From these, estimates of the population annoyed by noise are determined by applying annoyance response relationships. The incremental changes in population annoyed are then determined for the scenario under test and these values are summed to give the total change in estimated population annoyed for that scenario.

Road traffic noise

6.9.23 The SERAS highway surface access model is used to determine estimates of population subject to changes in noise levels. The following steps are involved:

- traffic model outputs are processed to calculate source noise (basic noise levels) for Do Minimum and Do Something scenarios;
- a simplified prediction methodology is used to determine noise contours within 300m of each road;
- populations within noise contours are estimated; and
- annoyance response relationships are applied to allow changes in population annoyed by noise to be estimated (GOMMMS Plan method).

6.9.24 Traffic noise predictions use a simplified version of the methodology given in Calculation of Road Traffic Noise (CRTN 1988). The Basic Noise Level is calculated, which is the $L_{A10,\ 18h}$ level at 10 m from the edge of the road. This is based on the 18 hour AAWT traffic flow and speed, and percentage of heavy vehicles. A look-up table is used that applies corrections for distance assuming propagation over absorbent ground in relation to each road link. The amount of data to be processed has been minimised by screening out links with noise level changes of less than 1 dB and links with basic noise levels of less than 57 dB $L_{A10,\ 18h}$.

Rail noise

6.9.25 Data from the SERAS railway surface access model is used to determine estimates of population subject to changes in noise levels. The process used is:

- to adapt public transport model rail outputs into appropriate form to calculate source noise levels;
- calculate $L_{Aeq,18h}$ noise values for Do Minimum and Do Something scenarios;
- estimate the population within 200m of each railway line; and
- apply annoyance response relationships to allow changes in population annoyed by noise to be estimated (GOMMMS Strategy method).

6.9.26 Railway noise calculations use simplified predictions based on the methodology given in Calculation of Railway Noise (CRN 1995). The equivalent to the Basic Noise Level is the $L_{Aeq,18h}$ level at 25 m from the edge of the railway. This is based on the 18 hour traffic flow by type and number of rail vehicles and the average speed for each train type. The amount of data to be processed has been minimised by screening out links with noise level changes of less than 1 dB and links with basic noise levels of less than 55 dB $L_{Aeq,\ 18h}$.

6.10 Environment: Local Air Quality Impacts

6.10.1 The air quality assessment undertaken for Stage Two of SERAS is designed to provide a comparative assessment of the performance of airport options with respect to local air quality impacts. The pollutants considered are NO_2 and PM_{10}. The focus of the assessment is the identification of potential air quality problems. These are defined as locations where population would be exposed to resultant concentrations of pollutants in excess of the concentration statistic incorporated in the Air Quality (England) Regulations 2000. The air quality statistics used as assessment criteria for defining poor air quality in SERAS Stage Two are:

- Annual mean Nitrogen Dioxide concentrations of $40\mu g/m^3$
- 90^{th} percentile of running 24-hour mean PM_{10} concentrations of $50\mu g/m^3$

6.10.2 It should be noted that at a given location, the annual-mean NO_2 objective is recognised as being more onerous than the 1-hour NO_2 objective. Similarly the 90^{th} percentile of 24-hour means objective for PM_{10} is recognised as being more onerous than the annual-mean objective at the same location.

6.10.3 Pollutant concentrations in the study area are modelled from two contributor sources: the contribution from those sources explicitly included in the dispersion modelling carried out for this assessment; and the contribution from all other sources, included via background 'source mapping'. Dispersion modelling accounts for all significant emissions sources and local meteorology to give total ground level pollution concentrations within a pre-defined study area.

6.10.4 Emission sources directly modelled include:

- 'aircraft-related' emissions, including engine exhaust emissions in the Landing and Take-Off (LTO) cycle, Auxiliary Power Unit (APU) emissions, fugitive PM_{10} emissions from aircraft brake and tyre wear on landing;
- road-vehicle emissions on a major road network around the airport, including engine exhaust emissions and cold start emissions;
- emissions from airside support vehicles.

6.10.5 Air quality results are provided for representative options at each airport, for 2015 and 2030 as appropriate. These results are expressed in terms of resultant pollution contours, identifying the areas in which pollution concentration statistics are forecast to be exceeded, and the population exposed to any exceedances of these values. This methodology takes into account the fact that air quality standards only apply in non-occupational near-ground level outdoor locations, where a person might be expected to be exposed over the relevant averaging period.

6.10.6 For SERAS, the estimated population potentially exposed to different degrees of exceedance are identified, and summarises these into a SERAS Key Indicator, to allow direct comparison between options and packages. The Air Quality Key Indicator for SERAS Stage Two is 'the number of people exposed to an exceedance of the air quality standard, weighted by the degree of exceedance'. The higher the key indicator, the worse the air quality impact is.

6.10.7 The SERAS air quality methodology has been specified and developed to provide a comparison between options using key indicators of air quality, rather than a validated and accurate estimate of air pollution concentrations. The method aims to produce estimates of air pollution concentrations as realistic as is feasible with the approach adopted, but the absolute numbers have uncertainties as a result. Where approximations and simplifications have had to be made, or where there are gaps in the knowledge base, the SERAS methodology tends towards over-prediction rather than under-prediction.

6.10.8 Following on from the main appraisal, some key assumptions have been relaxed in sensitivity tests relating to NO_2, applied (for illustration) to options at Heathrow, where impacts were found to be worst. The principal assumptions modified in the sensitivity tests are set out in Table 6.5. For the purposes of this table, assumptions are expressed simply. In practice, many caveats and exemptions apply.

Table 6.5: Aircraft-related Emissions - Assumptions

Technical Area	Core model runs	Sensitivity test 1	Sensitivity test 2
Future (new) engine performance – NOx	Just meet CAEP/4 limit for Oxides of Nitrogen	All engines not yet certificated would, by 2015, match the NOx performance of current dual-annular combustors (DAC) engines, giving lower emissions than CAEP/4 (20% at π=40, less at higher π)	Based on aggressive take-up of ultra-low NOx technology. All aircraft using Heathrow must have LTO EI NOx of no more than 45% of CAEP/4 limit.
% thrust on take-off	All aircraft at 100%	Reduced thrust (85%) applied as % of fleet by aircraft type, based on BA data for Heathrow	Reduced take-off thrust (75-100%) defined for all major jets, where relevant, using 'assumed temperature method'
Reverse thrust on landing	Larger jets, where relevant, use reverse thrust on landing	Same as core	Larger jets assumed to use reverse idle, where relevant, on landing
APU emissions	APU emissions assume that Pre-Conditioned Air (PCA) is not used. APU usage assumed to be for 90 minutes before departure for wide-bodied and 30 minutes for narrow-bodied aircraft. Assumed 15/20 minutes on arrival	All stands assumed to be fitted with PCA and all aircraft with APUs use this facility. APU usage reduced to 15/10 minutes before departure and 5 minutes on arrival	Same as test 1

6.10.9 The core assumptions are more likely to over-estimate than under-estimate local air quality impacts. The assumptions in sensitivity test 1 are considered to approximate to the best available current technology in 2015. The assumptions in sensitivity test 2 are demanding and optimistic, and are only likely to be realised as a result of a stringent government and airport operating policy, and at some expense to the airlines.

6.11 Employment

6.11.1 In order to gain a better understanding of the economic, land use and surface access impacts of increasing airport capacity, forecasts of future airport employment are required. The principal assumptions underlying the model used to forecast employment for each option, in 2015 and 2030 as appropriate, are as follows.

Key assumptions

6.11.2 Employment data was obtained from surveys at BAA airports (Heathrow, Gatwick and Stansted) and Luton airport in 1998, and, in some cases, earlier years. It has been assumed that the employment structure at Cliffe Marshes will be similar to that at Heathrow, but that, as a new airport, labour could be saved in particular areas (passenger services, sales, clerical; maintenance; apron and cargo-related; catering and cleaning). These savings would allow a reduction in employees per passenger of around 25%. These observed data provide the starting points in the forecasting of employment at each airport.

6.11.3 Three types of employment are forecast for 2015 and 2030 options:

- *direct on-site employment* – employees working at the airport;
- *direct off-site employment* – employees working directly for the airport but located within 20 minutes of the airport boundary. Direct off-site employment is assumed to be equivalent to 15 percent of direct total employment.
- *indirect employment* – jobs which supply services to the aviation industry and are supported by purchases made by the industry. The indirect employment multiplier based on past experience is assumed to be 0.3, ie, 0.3 indirect jobs for each direct job.

6.11.4 Long run labour productivity growth is assumed to be 1.5% per annum. The same rate is applied to all airport employees over the forecast period.

6.11.5 Employment forecasts are based on the forecast growth in passengers over 1998 levels. Using the employee per mppa ratio for each airport the number of employees required to serve the additional passengers are estimated.

6.11.6 Allowances have been made to the employee per mppa ratio for airports that are forecast to serve a higher proportion of low cost carriers, which typically employ fewer employees per mppa.

6.11.7 The approach followed, of relating all current airport employees to passenger movements within employee:mppa ratios, allows for current ratios of freight:passenger movements within forecast employment totals. Where forecast freight movements differ substantially from current ratios, additional forecasts of freight related employment have been made.

Skill groups

6.11.8 For regional and social impacts the employment skills mix is an important issue. Employment at airports typically breaks down as follows:

- Skill Group A (Professional) 8.5%
- Skill Group B (Managerial and Technical) 14%
- Skill Group C1 (Skilled non-manual) 18%
- Skill Group C2 (Skilled manual) 28.5%
- Skill Group D/E (Partially skilled and unskilled) 31%

6.11.9 The Cliffe skill mix is based primarily on that of Heathrow. However a new airport could take advantage of new technology and working practices which could lead to a slightly different skill mix. For Cliffe it is assumed there would be fewer passenger services, sales and clerical staff (Skill Group C1 employees), fewer apron and maintenance staff (C2/D) and fewer catering and cleaning staff (D/E) than currently employed at Heathrow. The assumed skill mix for Cliffe is as follows:

- Skill Group A (Professional) 9%
- Skill Group B (Managerial and Technical) 15%
- Skill Group C1 (Skilled non-manual) 13%
- Skill Group C2 (Skilled manual) 32%
- Skill Group D/E (Partially skilled and unskilled) 31%

6.12 Land Use & Urbanisation

6.12.1 The principal objective of the land use and urbanisation appraisal has been to identify the extent of off-site developments associated with each of the airport options. In practice these are mainly requirements for housing and employment. The estimates of employment land are based largely on the off-site employment impacts of the options and their associated land and floorspace requirements. The housing element is assessed based on the potential need for in-migration to fill airport jobs, and the requirements for additional housing (and associated services) arising from these in-migrants. The relationship of these requirements to existing and future housing provision through the RPG is also considered and the capacity of the catchment areas to accommodate any excess is considered.

Employment Land Requirements

6.12.2 Assumptions have been made on worker floorspace density and ratios of floorspace to site area, ranging from 17.9 to 40.1m^2 floorspace per worker (based on a recent study for SERPLAN on worker densities). This has been translated into land take assuming a plot ratio of 1:0.5, equivalent to 50% site coverage of single storey development. To the extent that off-airport employment includes denser development such as hotels or offices, the resulting estimates will over-estimate land take. It is also possible that existing businesses will be able to produce greater output or switch markets without needing to expand their premises.

6.12.3 It has been assumed that no additional land allocations would be necessary for induced (employee expenditure-induced) employment and would expect these to be accommodated in the main service centres nearest to any new urbanisation. Similarly no new allocations are assumed to be necessary for attracted employment where proximity to the airport would be only one of several factors influencing locational choices.

Dwelling Requirements

6.12.4 The estimation of dwelling requirements starts with the airport employment forecasts. The Department's own trip end model, TEMPRO, provides a labour market context within which additional employment requirements can be considered. TEMPRO contains forecasts of future population and households (e.g. potential labour supply) derived from ONS sources and forecasts of employment growth (labour demand) based on forecasts sourced from independent forecasters, Cambridge Econometrics. Using TEMPRO data as a base it is possible to consider the extent to which there may be surplus labour in the region to fill any additional airport jobs, based on defined core and wider catchment areas. The latter are defined in relation to each of the airports and are specified in more detail in the airport-related chapters that follow.

6.12.5 The TEMPRO forecasts of household requirements are also compared with the RPG provision to examine the extent of existing under- or over-provision of housing in the London, South East and Eastern regions (e.g. the areas covered by RPGs 3, 6 & 9). In the case of London, the Mayor's housing capacity estimates are used as these provide the most recent figures that best reflect prevailing policy and housing trends.

6.12.6 To implement the method it has been necessary to make assumptions about the extent to which TEMPRO forecasts at regional level already incorporate airport related employment growth, and the extent to which airport related housing requirements are already incorporated in the RPG provision. A more detailed discussion of these issues follows below.

The relationship of airport employment forecasts to the employment forecasts contained within the TEMPRO model.

6.12.7 TEMPRO forecasts are derived from independent forecasts commissioned by DTLR from Cambridge Econometrics (CE). They are derived from national forecasts and are unconstrained. For the purposes of the study it is assumed that all airport requirements are included in regional employment forecast totals, although it is assumed that the decision to pursue a particular option may result in differences in the sub regional distribution of employment growth. By implication it is also assumed that if future airport expansion is constrained, then the TEMPRO employment forecasts may not be realised. However, it is also assumed that, in the context of a South East economy where there are potential factors such as land or labour in scarce supply, there is also an element of "crowding out". That is to say that airports may displace some other forms of employment. It should also be noted that TEMPRO forecasts employment levels in excess of available workforce for the SERAS region over the period, suggesting very high levels of employment within the SERAS region, and, if realised, potentially fuelling additional housing pressures.

The relationship of airport housing requirements to RPG provision.

6.12.8 This refers particularly to relationships with RPG 9, which specifies housing provision for the former South East standard planning region, which is the area in which (with London) most of the airport related housing pressures will be experienced. The main exception to this is Stansted where urbanisation pressures will also be likely to occur in the former East Anglia region.

6.12.9 RPG 9 identifies requirements only up to 2006 (although in the absence of further guidance it is suggested that the targets should simply be rolled forward beyond this period) and the RPG itself suggests that a higher figure may in fact be possible as a consequence of the plan-led approach. RPG 9 housing provision is not designed to meet the needs of any specific sector or economic development. Housing pressures created by airport development can therefore be judged similarly to those created by any other expanding sector. Airports and airport related sectors have been rapidly growing in recent years and have clearly fuelled a significant proportion of past regional growth trends. The future options under consideration in SERAS are predicated on continuing overall growth in demand for movement through airports, but at a declining rate.

6.12.10 However, there is a shortfall between current RPG housing provision and the levels of household growth under a number of soundly based household forecasts (including ONS household forecasts). This means that there is insufficient housing provision within the current version of the RPG to meet all of the needs arising from all economic development. Assuming even an "equal shares" approach (and no change in provision), not all airport-related housing pressures are likely to be addressed through the RPG provision.

6.12.11 The calculation made of airport-related housing requirements seeks to identify the excess of housing requirements over RPG provision. It starts by assuming that all airport employment growth is contained in the TEMPRO employment forecasts. Housing requirements associated with airports are then defined as the product of an airport's share of forecast employment growth and the under-provision of dwellings in the RPG compared with those assumed to be required in TEMPRO. These comparisons are made for the core and wider catchment areas of each airport, recognising that, in location terms, housing pressures and provision are not necessarily well matched across the region, and airports are locationally specific. The extent to which the RPG makes sufficient provision will be dependent on competing claims in a particular location, with the balance of probabilities suggesting that areas of economic pressure will face the largest overall shortfalls.

6.12.12 The uncertainties associated with future housing provision are compounded by further uncertainties relating to the long term forecasting of employment, by sector and location, which mean that statements on the requirement for new housing can at best be regarded as a guideline figure. The balance between the future labour force and employment needs in an area may be met in different ways. Airport development may come on stream in periods when housing markets and completion rates are otherwise depressed and the pressure for new housing is reduced. New transport infrastructure projects may act to widen airport catchment areas for some types of labour, reducing the pressure for new housing perhaps at the expense of sustainability criteria that require commuting distances to be minimised. Over a 30 year period, the scope for changes in employment structure, working practices, technology and in adjustment processes in housing markets are further reasons for considering estimates of housing requirements as guidelines only.

6.13 Social Impact

6.13.1 In constructing indicators of social deprivation for use in Stage 2 of SERAS, a district has been defined as "deprived" if it falls within the top 30% (by ranking) of districts within the national Indices of Multiple Deprivation (IMD) on both the following criteria:

- a count of individuals experiencing income deprivation; and
- a count of individuals experiencing employment deprivation.

6.13.2 The districts that fall into this top 30% within the SERAS airports Core and Wider Catchment Areas (CCAs and WCAs) have then been selected for subsequent analysis.

6.13.3 As the analysis is necessarily of a judgmental nature, only the smallest and largest development options at each airport have been selected to demonstrate the possible contribution that the plans could make towards addressing issues of social exclusion.

6.13.4 Forecast on and off-site additional employment forecasts have then been compared against potential low skill labour surpluses in these “deprived districts”.

6.14 Regional Impacts

6.14.1 The appraisal of regional impacts of airport development options has been made against the relevant regional policies for the East, South East and London regions. These are summarised in Table 6.6 below.

Table 6.6: Relevant Regional Policies

Region	Planning and Transportation Policy	Economic Strategy	Other / Non-Statutory
East	GO-EAST (Nov 2000) RPG6: East Anglia	EEDA (June 2001) East of England 2010	
South East	GOSE/GO-EAST/GOL (March 2001) RPG9: South East	SEEDA (Oct 1999) Building A World Class Region	RTP (May 1999) Areas of Economic Pressure
	GOSE/GO-EAST/GOL (Feb 1995) RPG9a: Thames Gateway		
London	GLA/Mayor of London (May 2001) Towards The London Plan	LDA (July 2001) Success Through Diversity: London’s Economic Development Strategy	

6.14.2 The assessment of the impact of development options against regional policy has also been made with reference to relevant Policy Planning Guidance (PPG) documentation. The working assumption that has been made is that these broad principles are likely to prevail over the next 30 years. As such, development options will have to recognise that they are appraised against these longstanding principles. This reflects the reality of greater public awareness of the environment and the growing level of international commitment, guidance and regulation to secure sustainable development.

6.14.3 The various policy objectives contained within the documents noted above have been structured under the headings of housing, economy (employment/labour force) and transport. The objectives have then been structured as outlined below to allow scoring (by means of a qualitative scoring index) of small and large scale development options, in terms of their positive or negative contribution towards the achievement of regional policy objectives.

Table 6.7: Regional Policy Objectives

Area	Objectives
Housing	Accommodate housing growth
	Meet brownfield development targets
	Meet affordable housing targets
	Provision of housing near to employment areas
Employment/Labour Force	Meet demand for labour
	Diversify employment base
	Assist people entering or re-entering the job market
	Develop requisite training and skills profile
	Provide employment sites in sustainable locations
	Develop business clusters
	Provide a range of business accommodation
Transport	Allow multi-modal access to major hubs, eg, ports
	Reduce the need to travel
	Reduce pressures of longer distance commuting
	Improve rail network

6.15 Integration Impacts

6.15.1 The appraisal of impacts in relation to Integration is taken in the context of SERAS to relate to the way in which airport development options fit with other Government policies, and particularly whether they complement or are in conflict with other policies. The Appraisal

Framework for Airports in the South East identified relevant policy areas in which the impacts of airport development options should be appraised. In some Government policy areas, however, it is apparent that policies are under review and that next versions of policies are awaiting the formulation of future airports policy. Regional transport policies, for example, will be developed on the basis of on-going strategic, multi-modal studies and future airports policy, and the next revision of Regional Planning Guidance will incorporate future airports policy into spatial development policies.

6.15.2 The five policy areas in which the impact of airport development options have been appraised are:

- Airport Strategy: a comment on airport development options in relation to levels of airport use and development incorporated in current plans,
- Land Development Strategy: a comment on airport development options in terms of Green Belt taken, greenfield land taken and brownfield land re-used,
- Transport Strategy: a comment on the surface transport requirements of airport development options in relation to strategic plans,
- Social Strategy: a comment on airport development strategies in relation to social exclusion policies (see Section 6.14 above),
- Spatial Strategy: a comment on airport development strategies in relation to spatial development policy (see Section 6.15 above).

6.16 Financial

Purpose of Financial Appraisal

6.16.1 The principal purpose of the financial appraisal is to estimate the rate of return generated by the additional investment and capacity provided in each package relative to the base case. Returns are based on a comparison of airport capital and operating costs with airport revenues and revenues from other sources. Calculated rates of return are compared with a high target rate of return of 12.5% (pre-tax, nominal) to establish the financial viability of the investment options within a package. Rates of return are calculated first on the basis of the revenues generated by the investment option. Supplementary sources of revenue are considered in sensitivity tests. All estimated figures are in nominal terms with inflation assumed to grow at 2.5% per annum over a 60 year period (2000-60). All costs and revenues are discounted back to 2000. Principal outputs are project Net Present Values (NPV), assuming a 12.5% discount rate, and Internal Rates of Return (IRR).

Cost and Revenue Calculations

6.16.2 The costs and revenues of each option are calculated as incremental numbers above the base case. That is, the appraisals show the financial performance of the options in each package on the assumption that they are additional to package 2.

6.16.3 Capital costs relating to the construction of each package have been separately estimated. Runway-related costs are assumed to be incurred in the years prior to assumed runway opening, eg, 2011, 2021, etc as appropriate. Terminal costs are fed in by the model in tranches of 10 mppa capacity as the available terminal capacity is filled up. Initial capital costs are supplemented by refurbishment costs. Runways and terminals are assumed to be refurbished every eight and twelve years respectively, at a cost of 10% of the original capital cost.

6.16.4 Airport operating costs are based on current operating costs per passenger at each airport as reported in the University of Bath's *Airport Industry Statistics*, 2001. Operating costs at Cliffe Marshes have been assumed to be 10% lower than Heathrow's, as some efficiency improvements can be expected with the operation of a new airport.

6.16.5 Airport revenues per passenger, from both aeronautical and non-aeronautical sources, for each airport have also been derived from the University of Bath's *Airport Industry Statistics.* Other than changing in line with inflation, the core assumption is that they do not change through time, ie, this is equivalent to a regulatory regime of $x = 0$ in an (Retail Price Index) RPI – x formula. This assumption effectively implies the retention of the 'single till' principle in setting aeronautical charges.

6.16.6 The effects on IRRs of supplementary revenues levied on air passengers in two different ways are examined in sensitivity tests. These are: a levy on departing passengers, either at the airport where the particular investment is made or applied more widely across the South East airport system; or a change from 0 in the value of x in the RPI $\pm$ x formula, again either at the airport where the investment is made or more widely across South East airports.

6.16.7 The principal results presented for each package in Chapter 14 are:

- The NPV and IRR of individual investment options or combined options at one airport within each package run with standard assumptions,
- The effects on IRRs of variations in revenues per passenger, operating costs per passenger and total capital costs,
- The effects on IRRs of different levies applied on departing passengers, either at the airport where the investment is made or more widely, and

- The effects on IRRs of a change in *x* in an RPI – *x* formula, again either at the airport where the investment is made or more widely.

6.17 Economic Appraisal

6.17.1 The appraisal of the direct economic impacts of the SERAS packages is carried out in a spreadsheet model called SCAB. Within SCAB the net benefits to users (generated and existing) and producers are calculated and compared with the capital costs of packages to calculate a net present value (NPV) of the economic impacts. These net present values can then be compared for different packages. SCAB takes outputs from SPASM (forecasts of passengers, ATMs and shadow costs), and uses these to calculate the benefits to generated users and to existing users for each package. Producer surpluses and capital costs are derived from the SERAS financial model. The additional revenue to the Government from the Air Passenger Duty charged to additional passengers is calculated and added to the benefits. There are also freight user benefits, which are also added into the net benefits. NPVs are calculated using the Government's current test discount rate of 6% per annum in real terms.

6.17.2 SPASM gives forecasts for each year to 2030, but the economic benefits need to be measured for at least 30 years after the last investment in a package, so inputs of costs and benefits are extended to 2060. In order to be consistent, as the packages have capital investment in different years, the costs and benefits reported here are measured between 2000 and 2060 for all packages. The years over which costs and benefits are measured is a user input to the model. It is assumed that no further capacity is added after 2030.

6.17.3 The base case against which the benefits are measured is package 2 (maximum use of existing runways). The costs and benefits of package 2 compared to package 1 (current land use planning system) are measured separately.

Benefits to Generated Users

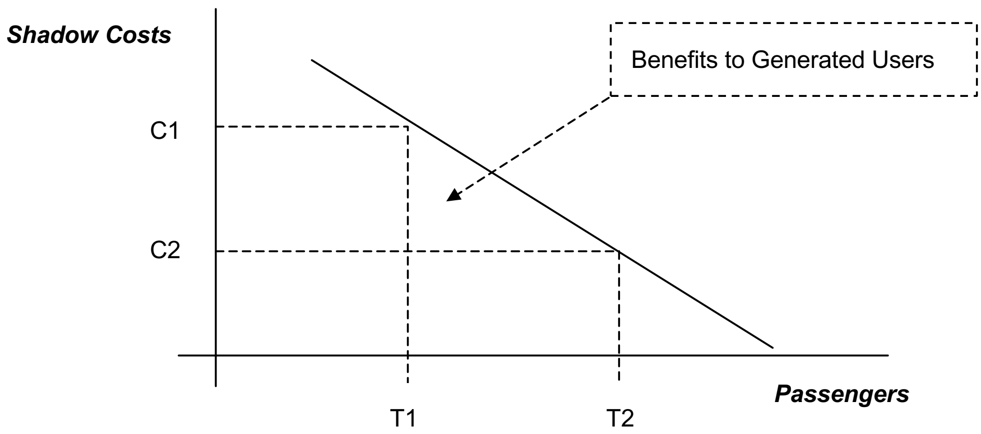
6.17.4 Benefits to generated users are calculated for each type of user, except International to International interliners, whose origins and destinations are both outside the UK, and who give benefit to the UK economy only through airport and airline surpluses. The calculation of benefits to generated passengers at all airports means that the benefits generated at airports where capacity is increased are dissipated to the extent that there is a loss of passengers at other airports. Benefits to generated users are calculated at all airports for each year using the following formula:

$$0.5*(T_2-T_1)(C_1-C_2)$$

Where:

T_1 = number of passengers in base case
T_2 = number of passengers in package
C_1 = base shadow costs
C_2 = package shadow costs

6.17.5 This can be shown using the graph below:



6.17.6 In order to calculate generated benefits at a new airport, for which there is no base case shadow cost output by SPASM, it is necessary to simulate base case shadow costs. This has been done by modelling within SPASM reduced capacity versions of new airports in order to derive a profile of shadow costs against passenger throughput.

Benefits to Existing Users

6.17.7 Benefits to existing users represent the effects of changes in service frequencies in different packages. It is difficult however to " forecast " all the passenger benefits from increasing frequency .

6.17.8 In our modelling, only scheduled passengers, and only a proportion of them, are assumed to benefit from higher service frequency. A higher proportion of business passengers than leisure passengers will tend to have fully flexible tickets; the concern of the business passenger will be to arrive at the destination at the preferred time, which may well depend on events during the working day. A business meeting late in the business day is less of a burden if the last plane out that day can be accessed. Other passengers are less likely to pay a high price for flexibility. Thus a higher weight has been given to business passengers than to leisure passengers in assesssing benefits from increased frequency on a given air route.

6.17.9 Benefits to existing users are measured at all UK airports.

Producer Benefits

6.17.10 Benefits to producers are calculated using the formula below:

Producer Benefits = Change in passengers x (revenue per passenger – operating costs per passenger)

6.17.11 The revenue and operating costs are in real prices, and the producer benefits are then discounted at a real rate of 6% per annum.

6.17.12 The benefits to producers are measured at all airports. The financial model has outputs for the five main airports in the appraisal (Heathrow, Gatwick, Luton, Stansted, and Cliffe Marshes). The other airports are measured using average revenues and operating costs for all of these airports.

6.17.13 Benefits to producers take account of all passenger types. They are measured for airports only, not airlines.

Government Revenue

6.17.14 Additional Government revenue is generated by the Air Passenger Duty charged to the additional passengers for each package. This is charged at a standard rate of £10 for destinations in the EEA and £40 for other destinations, and a reduced rate of £5 for destinations in the EEA and £20 for other destinations, with the reduced rate applying to passengers who are carried in the lowest class of travel on any flight.

NPVs

6.17.15 The costs (also in real values, discounted at 6% per annum) and benefits are brought together in a summary sheet containing an NPV calculator. This shows benefits to users, split by foreign and UK passengers, by new (generated) and existing users, benefits for freight users and benefits to producers and the government.

Environmental Charges

6.17.16 Sensitivity tests have been undertaken to reflect Government policy that aviation should bear its full costs including external costs. Three principal sources of external cost associated with the SERAS packages have been taken into account: increased noise; local air quality effects, particularly nitrogen dioxide; and increased global warming impacts, particularly CO_2 emissions. These costs were estimated for some key packages to assess their potential impact.

6.17.17 Noise: The effects of noise were quantified by assessing the impact of increased air traffic noise on house prices in the region of the option airports for various packages, and for the base case at Heathrow, Gatwick, Stansted and Luton. The tentative finding of past research, that a 1dB increase in noise level results in an approximate 0.5% reduction in house prices, was used to assess the noise value of different options. Aircraft noise impacts were modelled for the core model runs [-8dB] for both maximum use of existing runways and for selected runway options, so as to give the change in the number of houses in each decibel band, in excess of 57dB. Thus the total change in the numbers of houses subject to different levels of noise, and therefore the reduction in house prices for each airport in the packages tested, was estimated using average house prices for each region. This value was converted into a cost per passenger, spread between 2005 and 2030. The value varied by option and, particularly, by airport. Values at Heathrow ranged between 36 and 40 pence per passenger: at all other airports, values never exceeded 5 pence per passenger. The principal inputs to the derivation of these values are set out in Table 6.8 below.

Table 6.8: Principal Inputs to Valuation of Noise Impacts

Airport Option	Number of houses affected, '000	Discounted value of house price change, £m	Average price change per house	Equivalent charge per passenger, £
Heathrow (at £168,000 per house)				
Max Use of Existing Runways	159.6	£293.17	£1,840	£0.36
Option E4	216.3	£400.25	£1,850	£0.40
Option E6	231.7	£426.94	£1,840	£0.39
Gatwick (at £154,000 per house)				
Max Use of Existing Runway	3.8	£5.24	£1,380	£0.01
Option 1	6.8	£9.86	£1,450	£0.02
Option E1	17.6	£31.04	£1,760	£0.05
Stansted (at £137,000 per house)				
Max Use of Existing Runway	3.5	£5.41	£1,520	£0.02
Option 5	10.0	£16.12	£1,610	£0.03
Option 11	13.9	£24.86	£1,790	£0.04
Luton (at £92,000 per house)				
Current land use plans	2.7	£2.45	£900	£0.03
Option 2	6.1	£4.91	£800	£0.03
Option E3	4.6	£2.38	£520	£0.01
Cliffe Marshes (at £123,000 per house)				
Option A2	10.3	£16.08	£1,550	£0.03

6.17.18 Local Air Quality: The Committee on the Medical Effects of Air Pollutants (COMEAP) gives guidance on which health effects are considered sufficiently robust for quantification. Evidence of the effects of NO_2 on acute mortality is not considered sufficiently robust and COMEAP therefore currently do not advise quantification. There is some evidence, however, that hospital admissions for respiratory diseases are related to concentrations of NO_2 and COMEAP suggest quantification as a sensitivity analysis. The available information suggests that respiratory hospital admissions might increase by 0.5% for each 10ug/m^3 of NO_2. This implies an increased admission rate of approximately 5 per 100,000 people at an NHS cost of £1500 – 2700 per respiratory hospital admission. These values give a total cost of between £7,500 and £13,500 for every 100,000 people subject to an increase of 10ug/m^3 of NO_2. It is only at Heathrow that any significant number of people are subject to changes in NO_2 of this magnitude in excess of standards with any of the estimation assumptions made, and there the highest estimate is of 30-40,000 affected, indicating that the money value of NO_2 effects will be sufficiently small for them not to be expressly represented in any environmental levy.

6.17.19 Global Air Quality: CO_2 has been taken as the principal indicator of SERAS options on global air quality. Estimates were made of the CO_2 emissions in 2030 for three selected packages, representing different levels of capacity provision. These estimates, together with an allowance for other contributors to radiative forcing due to aircraft air polluting emissions, and valuing the damage cost of a tonne of carbon at around £70 (and therefore around £20 per tonne of CO_2), suggested equivalent charges would add around 3-4% to air fares.

6.17.20 On the basis of these estimates, with global air quality impacts being both the dominant item and not airport-specific, it seemed appropriate to test the effects of environmental charges as set out in Valuing the External Costs of Aviation, DTLR, December 2000. It was therefore assumed that the introduction of these charges, determined principally by global air quality impacts, would cause the demand for air travel to be reduced by 0.5% in 2006, increasing annually to a 5% decline at the beginning of 2016.

Wider Economic Benefits

6.17.21 In addition to the direct benefits, increased airport capacity is expected to have wider, indirect economic impacts for the economy as a whole, or for those parts of the economy most closely linked to aviation and air transport. The potential for wider economic impacts from increased airport capacity has been assessed in this study through: the potential increase in productivity across the economy as a whole due to an increase in business-related travel; the increase in foreign direct investment that might follow from increased numbers of business trips by foreign residents; and impacts on the tourism industry.

6.17.22 The potential for productivity growth across the economy as a whole has been assessed from the change in business trips by air to/from the UK with different packages.

6.17.23 The benefits from increased foreign direct investment (FDI) due to increased business travel into the UK are found from the percentage of unconstrained demand for business travel by air to/from the UK by foreign passengers lost with each package. The amount of FDI which could be attributable to each of these passengers, and thus the foregone foreign direct investment, are referred to.

6.17.24 The impacts on the tourism industry of each package are estimated from the potential change in expenditure in the UK tourism industry associated with each package. The estimates take account of numbers of foreign visitors to the UK and their expenditure and the number of UK visitor trips overseas and the amount UK tourists spend abroad. Calculation of the relative magnitudes of expenditure foregone, by foreign visitors to the UK and UK visitors overseas, is used to calculate the net benefit (or cost) to the UK tourism industry for each package.

6.18 Air Freight

Air Freight Forecasts

6.18.1 Freighter movements made up 3% of total air traffic movements at London airports in 2000. Freight forecasts have therefore been based on a simplified approach, with base year freight movements increased by national growth forecasts, any excess demand being reallocated across airports on the basis of generalised cost.

Unconstrained Freight Forecasts

6.18.2 For forecasting purposes air freight has been categorised as either:

- express – door to door transport of time-sensitive products, with an average shipment weight between five and ten kilograms, predominately moved by the four integrators, TNT, Fedex, UPS and DHL; or
- standard – less time-sensitive goods usually handled through forwarders or agents

6.18.3 There are two modes of air freight transport; bellyhold, where freight is carried in the bellyhold of an aircraft, and dedicated freighter, where freight is carried by scheduled or charter air freight services. Base year, 1998, express and standard freight volumes by bellyhold and dedicated freighter have been estimated for each airport based on operators' flight schedules and information contained in the UK Air Freight Study[1].

6.18.4 Express air freight has grown by an average of 20% per annum over recent years and now accounts for over 20% of the UK air freight market. Growth rates for standard air freight have averaged 6% over the last decade. These growth rates will be unsustainable over the long term and growth is forecast to decline to 3% per year, the growth in the road freight industry. Total UK air freight has been held to the totals forecast in the UK Air Freight Study, leading to a six-fold increase in air freight by 2030. The share of express freight is expected to increase to 52% in 2030, slightly below the current share in the US. Air freight forecasts are summarised in Table 6.9

[1] UK Air Freight Study, Part 1, November 1999, Part 2, August 2000, MDS Transmodal

Table 6.9: Express and Standard Air Freight Forecasts (thousand tonnes)

	1998	2000	2005	2010	2015	2020	2025	2030
Express	417	600	1,292	2,284	3,482	4,750	5,970	7,061
Standard	1,660	1,865	2,449	3,124	3,882	4,712	5,604	6,541
Total	2,077	2,465	3,742	5,408	7,363	9,462	11,573	13,602
Annual growth		9.0%	8.7%	7.6%	6.4%	5.1%	4.1%	3.3%
Express share	20%	24%	35%	42%	47%	50%	52%	52%

Bellyhold Freight Forecasts

6.18.5 Bellyhold freight is predominately carried on long haul passenger services. Bellyhold freight forecasts have been based on the growth in passenger movements, aircraft size and the proportion of long haul flights. Any bellyhold freight demand that cannot be satisfied has been separated into short haul traffic that will divert to road transport, long haul traffic that will divert to continental airports and freight that will divert to dedicated freighters.

Dedicated Freighter Forecasts

6.18.6 The total demand for dedicated freighter transport will be the sum of unconstrained freighter demand and any diverted bellyhold demand. It may not be possible to satisfy all the demand for freighter transport at an airport and final freighter throughput has been based on airport capacity, existing freight presence, generalised costs as well as freighter demand. To allow for diversion to overseas airports Charles de Gaulle was included in the analysis.

6.18.7 Freight transport is often seen as an infilling traffic by the larger passenger airports as it brings less revenue than corresponding passenger services. The capacity for freight movements has been based on the available runway capacity after the allocation of passenger movements. As most freight movements occur at night an additional night-time capacity allowance has been made for freighter movements.

New Site Freight Forecasts

6.18.8 A new site will impact on existing as well as reallocated air freight demand. Whilst the above approach can adequately deal with reallocated demand it cannot forecast the impact of a new site on existing airport flows. For freighter demand, a separate new site model has been developed. This model identifies how demand would be redistributed across airports from the introduction of a new site on the basis of a synthesised air freight demand matrix and generalised costs. The impact on bellyhold traffic has been identified through a comparison of unconstrained passenger demand forecasts with and without the new site.

Economic and Financial Appraisal

6.18.9 Airport accounts typically display all costs and revenues in passenger terms, effectively ignoring the (marginal) contribution of freight transport. The financial model uses revenues and costs in these terms and so implicitly includes freight revenues and costs. The financial model will therefore give accurate estimates of costs and revenues if the existing proportions of passenger and freight traffic continue into the future. For South East airports, this is generally the case. At existing South East airports, even if this constant proportion does not hold, any changes in costs and revenues will be small, as freight accounts for less than 5% of total revenues. The impact of freight traffic has therefore not been separately identified for the existing SERAS airports.

6.18.10 At Cliffe Marshes, per passenger costs and revenues have been based on those at Heathrow, so only allow for a small element of freighter aircraft and freight revenues. As a significant amount of freight traffic is expected at Cliffe, freight costs and revenues have been separately identified.

6.18.11 A simplified approach has been taken to the appraisal of the economic impacts on air freight. Only the impact on generated traffic has been included. This has followed the same principles as the estimation of benefits to generated passenger traffic, with the benefits measured in terms of user surpluses. Air freight is assumed to benefit from a reduction in ATM shadow costs when additional runway capacity is introduced.

6.19 CO_2

6.19.1 The published *Appraisal Framework for Airports in the South East and Eastern Regions of England* requires an assessment to be made of the impact of aviation strategy on climate change, using CO_2 as a proxy. According to the DTLR Report *Treatment of Uncertainty for National Estimates of Greenhouse Gas Emissions,* over the report's study period of 1990 to 2010, the uncertainties in national CO_2 estimates are three times larger than the expected change in CO_2 emissions. Transport accounted for 20.5% of total energy CO_2 emissions in 1990, with civil aviation accounting for just 2% of the transport-related emissions.

6.19.2 Given the uncertainties, to assess the impact of overall aviation strategies broad estimates of the CO_2 implications for three SERAS packages have been made. The packages were deliberately chosen to represent a range of the capacity scenarios being appraised in SERAS. Package 2 is a base case with maximum use of the existing runways, but no new runways. Package 5C adds a new runway at Heathrow and is a middle range capacity scenario. Package 18 is a large capacity scenario adding a new runway at Heathrow and two new runways at Gatwick. Possible new airport sites do not figure in these packages tested.

6.19.3 Details of the approach are outlined in the SERAS Methodology Report. The SERAS CO_2 approach has a "without prejudice" disclaimer that the approach shall not be taken to imply any UK Government preference among the various SBSTA allocation alternatives.

6.19.4 Estimation of CO_2 impacts for each scenario took account of CO_2 emissions from the following sources: total mission aircraft emissions; surface access related emissions; and extra emissions from displaced movements under capacity constrained scenarios.

6.19.5 Aircraft emissions estimates are from landing and take-off (LTO) cycles and from cruise: generally LTO accounts for 20% of aviation-related CO_2 and cruise for 80%. Emissions from domestic and international flights from SERAS airports were estimated on the basis of forecast ATMs in 2015, 'great circle' city-pair distances, and representative 2015 aircraft/engine types (as assumed in the local air quality and noise modelling). Emissions estimates include all domestic aviation from and to SERAS airports. Only 50% of total emissions from international flights from SERAS airports have been counted as being attributable to UK policy.

6.19.6 Surface access related emissions are included from all surface access trips in the SERAS study area to and from SERAS airports. Estimates are based on forecast vehicle kilometres in SERAS surface access models, and future vehicle fleet and emission assumptions taken from the UK Emissions Factor Database and the DMRB as appropriate.

6.19.7 In capacity-constrained South East scenarios, more passengers would travel (flying or by road/rail) from SERAS airports to UK regional airports and European airports for onward connections (rather than flying direct from the SERAS airports). This could mean increased aircraft CO_2 at regional and European airports, and people travelling longer distances by car and train to reach other airports. These displaced movements are included in CO_2 estimates: those going to other airports by road/rail are estimated using passenger movements from SPASM; those going by air are included in the total domestic CO_2 determined earlier. Aircraft emissions from non-SERAS airports to international destinations are excluded due to lack of data.

6.19.8 Some elements of the CO_2 estimates are based on the situation in 2015 (ATM and basic surface access data for example). However, these components are assumed to be at capacity by 2015, and so are assumed constant to 2030.

6.19.9 The approach provides results as total CO_2 emissions (tonnes) for each SERAS package, and relative changes over the base case.

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7 Appraisal of Options at Main Sites: Heathrow

7.1 Options Appraised in Stage Two

7.1.1 The options appraised at Heathrow consist of mixed mode operation on the existing two runways and alternative versions of a new runway to the north of the airport. They differ from the Stage One options principally in that it has been assumed in Stage Two that Terminal Five will proceed and will be in place by 2007. T5 is therefore assumed in the version of Heathrow which is defined as both 'currently envisaged in the land-use planning system' and 'makes maximum use of the existing runways'.

7.1.2 All options assume the reconfiguration of the Central Terminal Area (CTA) – Terminals 1, 2 and 3 – and the space between the existing runways at Heathrow, which is likely to be required over the period to 2030. These costs are included in the base case: the appraisal of the options allows for the additional cost relative to the base of providing extra terminal or runway capacity or associated facilities.

7.1.3 Two mixed mode options have been appraised. Option 1 has the two existing runways operating in mixed mode throughout the operating day. The current practice of runway alternation to give periods of relief from being overflown, for half a day each day, would not be maintained. In addition, the Cranford Agreement, which limits the use of the northern runway for take-offs in easterly operations, would cease. It has been assumed that mixed mode operation would be phased in between 2007 and 2011, the 2007 start date reflecting the provision of additional terminal capacity with the opening of Terminal 5.

7.1.4 Option E1 assumes that mixed mode operation would apply only in the mornings between 0700 and 1200 hours. From 1200 onwards, the practice of runway alternation would apply giving relief from being overflown after noon on half of the days. Options 1 and E1 share essentially the same airport layout, to accommodate movements in the morning peak period.

7.1.5 Three alternative new runway options have been appraised. They are all north of the existing airport, north of the A4 but south of the M4. In each case it is assumed that a new runway could be in place by 2011. They are combined with different ways of operating the existing runways and would add ATM capacity of between 158,000 and 274,000 to the 480,000 assumed with the two existing runways in segregated mode.

7.1.6 Option E4 has a new 2000m runway but no aircraft stands north of the current north runway (09L-27R). The new runway would operate in mixed mode and the existing runways in segregated mode.

7.1.7 Option E6 has the same new 2000m runway and aircraft stands north of the A4 to minimise runway crossings, thereby adding to capacity. It is assumed in this option that all runways, new and existing, would operate in mixed mode, further adding to capacity.

7.1.8 Option E8 has a new 4000m runway. Option E8 provides flexibility in distributing aircraft noise exposure, and allows for periods of relief, by rotating the use of one of the three full length runways in mixed mode.

7.1.9 The Heathrow options appraised are summarised in Table 7.1. The existing airport site is shown in Figure 7.2, potential development of T5 and the CTA in Figure 7.3 and Options E1, 1, E4, E6 and E8 in Figures 7.4 to 7.8.

Table 7.1: Options Appraised at Heathrow

Option	Description	Terminal capacity, mppa	Runway capacity, ATM	Year of Introduction
	Current Land Use Planning System Maximum Use of Existing Runways	86	480, 000	
E1	Partial (0700-1200 hours) mixed mode operation on existing runways	91	497,000	2007-2011
1	Full mixed mode operation on existing runways	105	551,000	2007-2011
E4	New 2000m runway, no stands north of A4. New runway in mixed, existing runways in segregated mode	112	655,000	2011
E6	New 2000m runway, stands north of A4, all three runways in mixed mode	128	754,000	2011
E8	New 4000m runway. One of three runways in rotating mixed node	121	638,000	2011

7.2 Capital Costs

Introduction

7.2.1 Table 7.2 below shows the estimated incremental capital costs for each option above the 86 mppa capacity Base Case. Table 7.3 gives the breakdown of surface access (road and rail) costs.

Table 7.2: Estimated Incremental Capital Costs for Heathrow Options above Base Case (£ million)

Item	Option E1	Option 1	Option E4	Option E6	Option E8
Capacity	91 mppa	105 mppa	112 mppa	128 mppa	121 mppa
Terminals & Satellites					
Terminal Buildings	212	212	339	549	458
Satellite Buildings	0	0	55	134	79
Baggage Handling	86	86	87	95	94
Total	**298**	**298**	**481**	**777**	**630**
Aircraft Pavements					
Runways	0	0	25	25	52
Taxiways	5	5	48	54	59
Aprons / Stands	129	129	169	255	148
Total	**134**	**134**	**242**	**335**	**259**
Enabling Works & Infrastructure					
Demolition, Earthworks, etc	29	29	170	188	333
Car Parking	5	17	23	37	31
Utility Services	10	10	21	31	31
Airside Roads and public road diversions	0	0	45	61	63
Tracked Transit	113	113	161	393	357
Drainage	11	11	28	35	33
Landscaping	3	3	10	12	22
Total	**171**	**183**	**458**	**759**	**870**

Item	Option E1	Option 1	Option E4	Option E6	Option E8
Navigation Aids (ATC, ILS & AGL)	**0.3**	**0.3**	**7**	**7**	**8**
Cargo & Maintenance Cargo buildings & aprons Hangar/ Maintenance buildings & aprons **Total**	 9 0 **9**	 9 0 **9**	 10 12 **22**	 19 12 **31**	 19 12 **31**
Support Facilities, etc Support facilities Offices Other facilities / services **Total**	 87 140 0 **227**	 87 140 0 **227**	 156 253 0 **409**	 156 253 0 **409**	 156 253 0 **409**
On-costs	210	213	405	579	552
Contingencies	262	266	506	724	689
Land Costs	16	16	201	274	402
Sub-total: Airport Development Costs	**1328**	**1348**	**2731**	**3895**	**3849**
Airport Development Costs per mppa provided above 86 mppa Base Case	266	71	105	93	110
Costs of Associated Surface Access (see Table 7.3)	**288**	**288**	**1253**	**1253**	**1253**
Total Capital Costs	**1616**	**1636**	**3984**	**5148**	**5102**
Total Capital Costs per mppa provided above 86 mppa Base Case	323	86	153	123	146

Table 7.3: Estimated 'Airport Specific' Surface Access Costs (£ million)

Item	Option E1	Option 1	Option E4	Option E6	Option E8
Road Schemes					
Tunnelled link to M3	n/a	n/a	340		
A4 & M4 Spur diverted in tunnels – inc. in Airport Development Cost					
Sub Total	**0**	**0**	**340**	As E4	As E4
Rail Schemes					
T5 to Staines (Airtrack)	238	238	238		
Upgrade Acton Wells - Cricklewood	n/a	n/a	88		
Improvement near Willesden	n/a	n/a	38		
Multitrack Airport Junction to Acton (proportion attributable to Airport)	n/a	n/a	375		
Hayes Station alterations and Double-track Stockley Viaduct	50	50	n/a		
Heathrow West Stn & connections	n/a	n/a	125		
Airtrack – Colnbrook Branch	n/a	n/a	50		
Sub Total	**288**	**288**	**913**	As E4	As E4
Total	**288**	**288**	**1253**	**1253**	**1253**

7.2.2 As described in Chapter 6, Heathrow rates have been inflated by 10% relative to the other airport sites in order to reflect the higher cost of capital works in the locality.

7.2.3 The reconstruction or re-modelling of the Central Terminal Area (CTA - comprising Terminals 1, 2 & 3) is inherent in the facilities planning for every Option, including the Base Case, and has been estimated to cost in the order of £1.6 billion, excluding on-costs but including an allowance for working within an operational airfield. This view has been taken in recognition of the age and condition of the existing facilities and the notion that reconstruction would be required irrespective of other airport development in order to retain an acceptable level of service standard. The costs of these works are not recorded in the above table. This also applies to costs associated with T5, also included in every option including the Base Case, which has a capital cost in the order of £2.1 billion using the same rates as for other Heathrow options, excluding on-costs.

Airport Option Costs

7.2.4 The incremental airport development costs for both Options 1 and E1 are similar. The higher passenger capacity for Option 1 results from the full mixed mode operations against partial mixed mode operations, between 0700 and 1200 hours only, for Option E1. Facility planning and space provision, however, is based on requirements to accommodate the busy, or peak hour, throughput, which will be the same in both cases. Consequently, the costs per additional mppa are significantly higher by comparison for Option E1.

7.2.5 The three new runway options have costs per additional mppa of £105, £93 and £110 million respectively. E4 is a new 2000m runway operating in mixed mode with the existing runways remaining in segregated mode, giving an assessed annual passenger capacity of 112 mppa. E6 is also the new 2000m runway but with the new and the existing runways all operating in mixed mode, giving a capacity of 128 mppa. The lower cost per additional mppa reflects this higher throughput. E8 is a new full length 4000m runway but with just one of the three runways operating in mixed mode at any time. Together with the physical costs associated with the additional runway length in E8, this accounts for the higher cost per mppa in this option. The capital cost of E6 is significantly higher than E4, primarily due to the provision of additional satellite and terminal space and the extension of the tracked transit system to the remote northern satellite. However, this increase is more than offset in terms of cost per mppa.

7.2.6 Road costs related to airport construction in Options E4, E6 and E8, included under ‘enabling works and infrastructure’, are high, in the range from £40M to £60M million. This is due to diverting the A4 and M4 spur beneath the site in tunnels which range from about 550m to 1050m long.

7.2.7 The cost of the tracked transit system differs considerably across the options. In Options 1 and E1 it links the rebuilt CTA to the T4/T6 area whilst in Option E4 it has an additional link to the satellite east of the CTA. In Options E6 and E8 it is the most expensive because a connection is required to the new satellite to the north of the A4.

7.2.8 The relative costs of providing car parking at Heathrow are lower than at other SERAS airports due to a high proportion of surface access being by public transport.

7.2.9 Office space provision is the highest of all airports and has a ratio of between 5400 and 8800 m^2 per mppa. It is probable that much of this floorspace could generate revenue through rent or leasing.

7.2.10 Although not included in the estimates, a cost premium may be expected for working in operational areas. This may occur for example in all options with the construction of T6 aprons and the interface of T4 with T6 and in E4, E6 and E8 with taxiways tying in to the existing northern runway.

7.2.11 Land costs contribute up to 10% of the Airport Development Costs of E4, E6 and E8, primarily due to a high proportion of the acquired land being residential and commercial.

Surface Access Costs

7.2.12 The rail access costs for all options include Airtrack, running from the mainline near Staines via T5 with rail improvements to take the trains on to the north of the airport. In Options E1 and 1, trains are turned back at Hayes, whilst in E4, E6 and E8 they are taken on to St Pancras. Among the costs for the St Pancras route is an assumed 50% contribution (£375M) to the cost of multitracking between Airport Junction and Acton Wells. The costs of Options E4, E6 and E8 include the provision of a new ‘Heathrow West’ Intercity station, with connections to the north and south.

7.2.13 The only road access costs at Heathrow are for the provision of a dual 2-lane highway in tunnel from T4/T6, southwards to connect with the A316/M3. This is required for Options E4, E6 and E8. The scheme is not defined and costs have been estimated on the assumption of half being bored and half in cut and cover. Other major access road improvements are considered to be required and constructed for the Base Case. Diversions of the A4 and M4 spur in tunnels (Options E4, E6 and E8) are included in the airport development costs since they are necessary consequences of construction.

7.2.14 Required improvements to the strategic road network, ie those not specifically required to accommodate airport related traffic, are on the A4 west of the airport. The cost of widening the A4 from A3044 junction to M4 junction 5, from single 2 lane to dual 2 lane (required for 2030) is estimated to be about £12 million.

7.3 Demand Forecasts - Heathrow

7.3.1 Forecast passenger movements, ATMs and passengers per passenger ATM for each Heathrow option are summarised, at 5 year intervals between 2000 and 2030 in the following tables, while freight forecasts are considered in Chapter 15:

- Table 7.4: Current Land Use Planning System / Maximum Use of Existing Runways
- Table 7.5: Option E1
- Table 7.6: Option 1

- Table 7.7: Option E4
- Table 7.8: Option E6
- Table 7.9: Option E8

7.3.2 The principal features of the demand forecasts for each option are summarised below. In the forecasting it has been assumed that neither charter services nor low cost services would operate at Heathrow in any of the cases appraised.

Current Land Use Planning System/Maximum Use of Existing Runways

7.3.3 This option is heavily capacity-constrained throughout the period, with runway capacity the dominant constraint. The assumed terminal capacity, of 86 mppa with T5, is not reached until 2019, when the forecast number of passengers per PATM has risen to around 175 from 139 in 2000. Within the capacity constraint, there is an increase in the number of long haul and USA ATMs and a fall in domestic and short haul. The number of I to I interliners grows from 18 mppa to 22 mppa by 2015 and 24 mppa by 2030. Heathrow becomes more of a business airport. Of passengers to or from the UK, the number of business passengers increases from 16 mppa in 2000 to 24 mppa in 2015 and 34 mppa in 2030. The number of leisure passengers increases only from 26 mppa in 2000 to a maximum in any year of 27 mppa, and falls to 24 mppa by 2030. Heathrow also becomes a more ‘local’ airport in this and all cases. In 2000, 81% of trips to/from the UK via Heathrow were to/from London and the South East. By 2015 this proportion rises to 85% and to 89% by 2030.

Mixed Mode on Existing Runways: Options E1 and 1

7.3.4 The partial mixed mode option (Option E1) provides only a small increase in ATM capacity over the use of the runways in segregated mode (17,000 ATMs or 3.5% of segregated mode capacity). It typically adds around 3 mppa to annual passenger movement through Heathrow, of whom most are short haul passengers up to 2020, then more long haul and USA passengers. With the full mixed mode option (Option 1), the additional runway capacity (15%) allows an increase in the number of short haul ATMs through time and some additional long haul and USA ATMs. The available runway capacity is always fully utilised and the existing terminal capacity of 86 mppa is filled in 2011. The number of I to I interliners grows to a maximum of 29 mppa by 2025. The number of business passengers grows to 27 mppa by 2015 and 39 mppa by 2030, with a maximum number of leisure passengers in 2020 of 33 mppa, declining to 29 mppa by 2030.

Option E4

7.3.5 The new runway capacity introduced in 2011 (175,000 ATMs) is always fully utilised, principally by additional short haul services but also some increases in long haul, USA and domestic services. The number of I to I interliners at Heathrow increases to a maximum of 33 mppa by 2015 but falls to 31 mppa by 2030. The number of leisure passengers increases to a maximum of 43 mppa in 2015, but falls to 30 mppa by 2030. The number of business passengers increases from 16 mppa in 2000 to 33 mppa by 2015 and 46 mppa in 2030.

Option E6

7.3.6 This option provides the largest increase in both runway and terminal capacity over the base case in 2011. Runway capacity is 754,000 ATMs as opposed to 480,000 ATMs and terminal capacity 128 mppa as opposed to 86 mppa. The terminal constraint prevents runway capacity from being fully used. By 2016, the average number of passengers per ATM is 180 and by 2030 is 188. Again the additional capacity is principally taken by short haul services. The number of I to I interliners increases to a maximum of 38 mppa. The number of leisure trips to/from the UK increases to a maximum of 51 mppa in 2015 but falls to 38 mppa by 2030, and the number of business trips to/from the UK increases to 35 mppa by 2015 and 50 mppa by 2030.

Option E8

7.3.7 As with Option E4, the additional runway capacity provided in 2011 is filled from its introduction, with increases in all route categories. The number of I to I interliners increases to a maximum of 34 mppa in 2030, the number of leisure trips to/from the UK increases to a maximum of 41 mppa in 2015 but falls to 37 mppa by 2030. The number of business trips to/from the UK reaches 32 mppa by 2015 and 47 mppa by 2030.

Table 7.4: Heathrow Option - Current Land Use Planning System / Maximum Use of Existing Runways

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	4	4	4	5	6	7	7
	Short haul	30	31	31	29	30	29	28
	USA	14	16	17	18	21	22	23
	Long haul	16	19	22	24	29	31	31
	Total	64	70	74	76	86	89	89
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		64	**71**	**75**	**77**	**86**	**89**	**89**
ATMs, '000								
Scheduled	Domestic	68	60	58	56	56	56	54
	Short haul	278	279	276	259	256	244	234
	USA	48	55	60	61	70	74	76
	Long haul	65	78	86	88	99	105	106
	Total	459	472	480	464	481	479	470
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		461	**474**	**482**	**466**	**483**	**481**	**473**
Passengers/PATM								
Scheduled		139	149	155	165	178	185	189
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Average		139	149	155	165	178	185	189

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

Table 7.5: Heathrow Option E1 - Partial Mixed Mode Operation on Existing Runways

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	4	4	5	5	6	6	6
	Short haul	30	31	32	31	32	31	30
	USA	14	16	17	19	21	23	24
	Long haul	16	19	23	25	29	31	33
	Total	64	70	77	80	88	91	93
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		64	**71**	**77**	**81**	**88**	**92**	**94**
ATMs, '000								
Scheduled	Domestic	68	60	59	56	56	56	55
	Short haul	278	279	287	278	266	257	248
	USA	48	55	61	64	71	76	79
	Long haul	65	78	87	91	99	106	111
	Total	459	472	493	489	492	496	493
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		461	**474**	**495**	**491**	**494**	**498**	**495**
Passengers/PATM								
Scheduled		139	149	155	165	178	185	190
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Average		139	149	155	165	178	185	190

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

Table 7.6: Heathrow Option 1: Full Mixed Mode Operation on Existing Runways

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	4	4	5	5	6	6	7
	Short haul	30	31	38	38	39	37	37
	USA	14	16	18	21	23	25	26
	Long haul	16	19	24	27	31	33	35
	Total	64	70	85	91	99	101	104
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		64	**71**	**85**	**91**	**99**	**101**	**104**
ATMs, '000								
Scheduled	Domestic	68	60	61	59	57	57	56
	Short haul	278	279	322	325	322	305	293
	USA	48	55	64	68	75	81	83
	Long haul	65	78	88	95	104	110	116
	Total	459	472	536	546	558	552	548
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		461	**474**	**538**	**548**	**560**	**554**	**550**
Passengers/PATM								
Scheduled		139	149	157	166	177	183	189
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Average		139	149	157	166	177	183	189

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

Table 7.7: Heathrow Option E4 - New 2000m Runway, Existing Runways in Segregated Mode

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	4	4	4	5	6	6	7
	Short haul	30	31	31	54	52	47	57
	USA	14	16	17	24	25	26	20
	Long haul	16	19	22	30	33	35	31
	Total	64	70	74	113	116	114	115
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		64	**71**	**75**	**114**	**116**	**115**	**115**
ATMs, '000								
Scheduled	Domestic	68	60	58	66	59	57	58
	Short haul	278	279	276	412	387	349	396
	USA	48	55	60	76	80	83	65
	Long haul	65	78	86	100	110	117	106
	Total	459	472	480	654	636	606	625
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		461	**474**	**482**	**656**	**638**	**608**	**627**
Passengers/PATM								
Scheduled		139	149	155	174	182	189	184
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Average		139	149	155	174	182	189	184

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

Table 7.8: Heathrow Option E6 - New 2000m Runway, Existing Runways in Mixed Mode

		2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Passengers, mppa								
Scheduled	Domestic	4	4	5	6	7	7	7
	Short haul	30	31	38	66	66	66	66
	USA	14	16	18	27	25	23	22
	Long haul	16	19	24	32	33	33	34
	Total	64	70	85	131	131	130	129
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		64	**71**	**85**	**131**	**131**	**130**	**130**
ATMs, '000								
Scheduled	Domestic	68	60	61	77	63	60	59
	Short haul	278	279	322	470	458	449	440
	USA	48	55	64	84	79	75	72
	Long haul	65	78	88	106	110	112	115
	Total	459	472	536	736	710	697	686
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		461	**474**	**538**	**738**	**712**	**699**	**688**
Passengers/PATM								
Scheduled		139	149	157	178	184	186	188
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Average		139	149	157	178	184	186	188

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

Table 7.9: Heathrow Option E8 - New 4000m Runway, One of Three Runways in Mixed Mode

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	4	4	5	5	6	6	6
	Short haul	30	31	38	52	53	52	52
	USA	14	16	18	23	25	27	28
	Long haul	16	19	24	30	33	35	38
	Total	64	70	85	110	117	120	124
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		64	**68**	**85**	**110**	**118**	**121**	**125**
ATMs, '000								
Scheduled	Domestic	68	60	61	63	59	58	57
	Short haul	278	279	322	398	395	384	375
	USA	48	55	64	75	82	86	89
	Long haul	65	78	88	99	109	117	125
	Total	459	472	535	635	644	644	646
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Total		461	**474**	**538**	**637**	**646**	**646**	**648**
Passengers/PATM								
Scheduled		139	149	157	173	182	187	193
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0	0	0	0
Average		139	149	157	173	182	187	193

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

7.4 Safety Risk

7.4.1 The Stage Two assessment of safety risk appraises the third party risk associated with both existing and new runway options. The full extent of the 1;10,000 and 1:100,000 designated risk areas are shown on the following Figures. The runway end origins of the 1:1,000,000 contours are also shown but extend beyond the limits of the drawings.

- Figure 7.9 – Maximum Use of Existing Runways
- Figure 7.10 – Option E1, Partial Mixed Mode
- Figure 7.11 – Option1, Full Mixed Mode
- Figure 7.12 – Option E4, New 2000m runway in mixed mode with existing in segregated
- Figure 7.13 – Option E6, New 2000m runway in mixed mode with existing also in mixed
- Figure 7.14 – Option E8, New full-length runway in rotating mixed mode

1:10,000 Risk Contours

7.4.2 The impact of the 1:10,000 risk contours are shown in Table 7.10 below;

Table 7.10: 1:10,000 Risk Contours

Impact	Max Use	1	E1	E4	E6	E8
Increase in Area (ha) above Max Use (West and East)	W 12.5 E 11.8	W +2.3 E +2.2	W +0.4 E +0.4	W +5.1 E +4.9	W +7.7 E +7.4	W +4.6 E +4.5
Properties within contour (outside airport boundary) above Max Use	None	2	2	2	2	2
% developed area affected (outside airport boundary) above Max Use	0	0	0	0	0	0

7.4.3 The 1:10,000 contours in each of the options fall almost entirely within the airport boundary and consequently have no impact on surrounding population, commercial areas or other prominent features.

1:100,000 Risk Contour

7.4.4 The impacts of the 1:100,000 risk contours are shown in Table 7.11 below:

Table 7.11: 1:100,000 Risk Contours

Impact (beyond 1:10,000 contour)	Max Use	1	E1	E4	E6	E8
Increase in Area (ha) above Max Use (West and East)	W 132.8 E 126.1	W +23.3 E +22.1	W +4.6 E +4.3	W +51.2 E +48.6	W +77.8 E +73.9	W +46.7 E +44.3
Increase in Population affected above Max Use	2,013	+839	+150	-115	+431	-292
% developed area affected (outside airport boundary) above Max Use	W 15 E 50	W 0 E 0	W 0 E 0	W 0 E 0 New W < 10 New E < 20	W 0 E 0 New E<20	W 0 E 0 New W<10 New E,20
Other prominent features affected above Max Use	None	None	None	Part of M25/M4 interchange, Tithe Barn, M4 to the East	As E4 plus Junction 3	As E6 plus several Listed Buildings, 2 churches and a golf course

7.4.5 There are no housing development allocations made in the Local Plan in these areas. There is greater urbanisation to the east of the airport than to the west resulting in greater relative impacts to the east. Options E4, E6 and E8, with a new runway to the north and higher capacities, have larger PSZs, which extend over the M25/M4 interchange. They lie, however, over areas with lower density development (<20%) and therefore have a correspondingly reduced level of risk compared to that for the existing runways. The presence of major road corridors and interchanges within the risk contour pose a higher level of risk.

1:1,000,000 Risk Contour

7.4.6 The impacts of the 1:1,000,000 risk contours are shown in Table 7.12

Table 7.12: 1,000,000 Risk Contours

Impact (beyond 1:100,000 contour)	Max Use	1	E1	E4	E6	E8
Increase in area (ha) above Max Use (West and East)	W 1253.1 E 1189.8	W +233.4 E +221.6	W +45.6 E +43.3	W +512.4 E +486.4	W +778.2 E +738.9	W +467.2 E +443.6
% developed area affected above Max Use	W <10 E 65–70	W +<5 E +<5	W 0 E 0	W0 E0 New W + <5 New E +15 to 20	W0 E0 New W + <5 New E + 15 to 20	W0 E0 New W + <5 New E + 15 to 20

7.4.7 Prominent features affected at Max Use:

- West – M25 and J14 of M25, railway line
- East – School, 3 churches, cemetery, civic centre, recreation centre, A4, A30, Royal Botanic Gardens

7.4.8 Prominent features affected above Max Use:

- Option 1: West – 1 Church; East – None
- Option E1: West – None; East – None
- Option E4: West – M25 J15, M4; East – 2 schools, M4
- Option E6: West – M25 J15, M4; East – 2 schools, M4
- Option E8: West – M25 J15, M4; East – A4, 2 churches

7.5 Surface Access

Infrastructure and service assumptions - roads

7.5.1 For the purposes of surface access demand forecasting, the changes to the existing road access arrangements were based on the findings of Stage One appraisals. This helped define a number of schemes associated with each option, as summarised in Table 7.13 and shown in Figure 7.19. All of the options (including the maximum use of existing runways) include the new links proposed between the M25 and Terminal 5. No further changes to the road access arrangements are assumed for the options with partial mixed mode (Option E1) or full mixed mode (Option 1) operation.

7.5.2 It should be noted that options including a new runway would each require that some of the existing A4 and M4 Spur be put into tunnel – the extent of tunnelling differing between options. Similarly, it has been assumed that some of the local roads in Harmondsworth and Harlington, severed by the new runway and apron facilities in these options, would be closed. It is assumed that each of the higher capacity options, with an additional runway, would require an additional road access from the M3/A316 to the southern terminals. A notional alignment for this (tunnelled) link is shown on Figure 7.19. All new and improved roads are assumed to be built as dual 2-lane carriageways with grade-separated junctions.

Table 7.13: Changes to road access – Heathrow Options

Scheme	**Current Land Use Planning System** **Maximum Use of Existing Runways** **(Package 1 & 2)**	**Option E1** **(Partial mixed mode)** **(Package 3)**	**Option 1** **(Full mixed mode)** **(Package 4)**	**Options E6/E4/E8** **(Package 5a/b/c)**
1. Closure of local roads in Harmondsworth and Harlington				✓
2. M4 Spur in tunnel beneath extended airport				✓
3. A4 in tunnel beneath extended airport				✓
4. Widening of south-western section of Perimeter Road		✓	✓	✓
5. Widening of eastern section of Southern Perimeter Road		✓	✓	✓
6. New link between M3/A316 and southern terminals				✓

Infrastructure and service assumptions – rail

7.5.3 Additions to Base Case / Max Use rail infrastructure and services were based on Stage One findings and shaped by discussions, with DTLR and SRA in particular, on the potential to integrate airport-focused schemes with parallel improvements in infrastructure and services planned to accommodate future increases in non-airport demand. It is assumed that in the Base Case T5 will be accompanied at least by extension of the Heathrow Express and Piccadilly Line to serve T5 and by the upgrading of the Piccadilly Line, to give higher frequencies and increased capacity. Schemes /services that were associated with each Option are summarised in Table 7.14 and shown in Figures 7.23 to 7.26.

7.5.4 The "Airtrack" link between T5 and Staines is assumed for Options E1, 1 and E4/6/8 and services to Heathrow via the proposed CrossRail project (linking suburban lines in East and West London) are assumed for Options 1 and E4/6/8. The services proposed for the Airtrack link are paired with new services proposed to the north east of the airport running on existing lines, but which will need further infrastructure works: between Acton and Cricklewood for access to St Pancras and Watford (West Coast Main Line); and additional tracks on the Great Western between Hayes and Acton (or a major overhaul of Thames Trains suburban services) if more than 4 additional trains per hour are to be run. The latter is also needed for CrossRail.

7.5.5 It should, however, be noted that the main function of these airport services would be to improve the public transport accessibility of the airport (and thus increase public transport's mode share and reduce highway demand) rather than to address any specific public transport crowding issues. The infrastructure improvements and services could be equally applicable in the Base Case, and their step-wise association with Options E1 and 1 is intended to facilitate the measurement of the marginal impacts of each scheme on airport options with broadly similar surface access demand.

7.5.6 A surface station to the west of T5, with links to the Great Western Main Line and via Airtrack to Staines is added for Options E4/6/8, allowing direct InterCity (diesel) access to the airport with a tracked-transit link via T5. With a further link between T5 and this station's northern access line, local (Cross-Rail) Services can run to Slough and Reading.

Table 7.14: Changes to rail access – Heathrow Options

Infrastructure	Services	Current Land Use Planning System/ Maximum Use of Existing Runways	Option E1 (Partial mixed mode)	Option 1 (Full mixed mode)	Options E6/E4/E8
Extension of rail and underground networks to T5	Heathrow Express and Piccadilly Line services at T5 T5-T123-Hayes-Ealing rail service	✓	✓	✓	✓
Piccadilly Line Upgrade	Increased frequency and capacity on Piccadilly line	✓	✓	✓	✓
"Airtrack" link T5-Staines	Guildford-Woking-Staines-Heathrow- Reading-Bracknell-Staines-Heathrow- Waterloo-Richmond-Staines-Heathrow- *Paired with*		✓	✓	✓
Upgrade Acton-Cricklewood Additional tracks Hayes-Acton	Heathrow-Ealing-W.Hampstead-St.Pancras Heathrow - Ealing-Watford-St Albans		✓	✓	✓
CrossRail	Heathrow-Ealing-Paddington-City-Stratford-Romford-Shenfield			✓	✓
"Heathrow West" station, connections to Iver/West Drayton and Staines	InterCity services from South West, South Wales, Birmingham, Manchester, Newcastle, Leeds, Brighton (via Gatwick)				✓

Infrastructure	Services	Current Land Use Planning System/ Maximum Use of Existing Runways	Option E1 (Partial mixed mode)	Option 1 (Full mixed mode)	Options E6/E4/E8
"Western Connection", T5 to Iver	CrossRail services Reading/Slough-Heathrow-Ealing--Paddington-City-Stratford-Romford-Shenfield				✓

Catchment Areas and Accessibility

7.5.7 Catchment area and accessibility analyses have been carried out to provide indicators of the accessibility of options to the air passenger markets they serve, and the workforce they might attract. These analyses are based on:

- Travel times derived from the SERAS models' representation of the forecast year road and public transport networks associated with each option. (Note that this system uses a finer zoning system in the main study area than was used in Stage One.)

- Air passengers – the number and geographical distribution of total air passengers used in the catchment area analyses is based on the SERAS forecast from the 2015 air passenger allocation model, assuming maximum use of existing runways. For the purposes of the catchment area analysis, a fixed air passenger demand matrix was assumed; and

- Workforce – for the purposes of the workforce catchment analyses, estimates of the total potential workforce were based on TEMPRO planning projections of total resident labour force. A fixed forecast of resident labour force for the year 2016, modified to take account of dwelling allocations in Regional Planning Guidance, was used.

7.5.8 The results of the catchment area analyses are summarised in the Appraisal Summary Tables under the heading "Accessibility" and shown in Figures 7.15 to 7.18. Public transport catchments increase substantially between the Maximum Use options and Options E6, E4 and E8 (air passengers within one hour's overall journey time increasing from 19 to 31 million pa, and resident workforce increasing from 0.5 to 0.8 million), reflecting the improvements in rail services associated with the larger capacity options. Heathrow's good accessibility by road is reflected in its greater catchments (80 million annual air passengers, and around 2 million potential workers within one hour's travel time). Catchments by road are similar between options.

7.5.9 The accessibility of options to the air passenger market in Central London (and beyond) is of particular interest and is summarised in Table 7.15. It should be noted that the public transport travel times quoted in this table exclude walking access and egress, and waiting times – they therefore indicate minimum travel times. It should also be noted that these figures relate to the Central Terminal Area – travel times to other terminals will vary.

7.5.10 With the services assumed for the Base Case, Heathrow has moderate public transport accessibility from Central London – with only Paddington within 15 minutes travel time. Table

7.15 also illustrates the effect of the new rail services added in Options E1 and 1, with direct services to Liverpool Street and Waterloo.

Table 7.15: Accessibility from Central London – Heathrow options.

	Current Land Use Planning System Maximum Use of Existing Runways	Option E1	Option 1	Option E4/E6/E8
By Car				
Liverpool Street	87	As Max. Use	As Max. Use	88
St Pancras/Kings Cross/Euston	78	As Max. Use	As Max. Use	79
Marylebone/Paddington	65	As Max. Use	As Max. Use	66
Waterloo	82	As Max. Use	As Max. Use	83
By Public Transport				
Liverpool Street	Interchange needed	As Max. Use	4 tph in 28 minutes	As Option 1
St Pancras/Kings Cross	18tph in 52 minutes Piccadilly Line	4 tph in 37 minutes	As Option E1	As Option E1
Marylebone/Paddington	4 tph in 15 minutes	As Max. Use	4 tph in 15 minutes 4 tph in 18 minutes	As Option 1
Waterloo	Interchange needed	2 tph in 41 minutes	2 tph in 41 minutes	4 tph in 42 minutes

Surface Access Travel Demands

7.5.11 The main indicators of surface access demand in 2015 for each option at Heathrow are summarised in Tables 7.16 and 7.17. Corresponding results for the forecast year 2030 are presented in Table 7.18 and 7.19. Note that for the purposes of the surface access appraisal, the full modelling procedure was only applied to one (Option E8) of the three large capacity options: E4 (112mppa), E6 (128mppa) and E8 (121mppa). Surface access requirements for the other two options would be similar to those for Option E8 and have been assessed by interpolation and extrapolation.

7.5.12 Air passenger capacity and demand estimates have been described above and are repeated in Tables 7.16 and 7.18 for convenience. Note that both the amount of spare capacity (in 2015) and the number of interlining passengers vary between options – reflecting the interaction between Heathrow and other airports in the packages from which these estimates were derived. This results in the forecast number of passengers requiring surface access in 2015 being less with Option E1 than in the Base Case, despite its higher capacity. By 2030 Option E8 would be operating at capacity.

Employee Travel Demands

7.5.13 The forecast number of on-site employees in 2015 and 2030 is reported in Tables 7.16 and 7.18 and is assumed to be a function of overall passenger demand and assumed improvements in productivity, giving a reduction in employees between 2015 and 2030, despite the increased passenger throughput. (Further details of the employment forecasts can be found in section 7.10.)

7.5.14 In 2015, the number of peak hour employee-related car trips is estimated to increase by 20% between the Base Case and Option 1 and by over 40% in Option E8, reflecting the increases in total employment and a small shift towards public transport in Option E8. Employee trips by public transport are forecast to increase by over 30% in Option 1 and by almost 60% in Option E8. However, Table 7.18 shows that by 2030, the number of car trips is expected to reduce, as a result of the assumed employment productivity gains (2-way car trips in Option E8 falling from 5,900 in 2015 to around 4,900 by 2030).

Air Passenger Travel Demands

7.5.15 Tables 7.17 and 7.19 summarise the air passenger mode split results for each option in 2015 and 2030 respectively. In 2015, Table 7.17 indicates a higher proportion of trips being made by public transport in Option E8 (40.9%), than the 37.4% in the Base Case. The mode share forecasts for 2030 are similar, but further growth of between 15 and 20% in the absolute number of public transport trips is forecast. The mode share results are influenced by the mixture of passengers by type and their geographical distribution, but it appears that air passengers are more inclined to switch mode in response to the introduction of improved rail services than are employees.

7.5.16 Finally, it is worth noting the changes in overall peak hour road traffic demand generated by these options, (see Tables 7.17 and 7.19). Table 7.17 shows increases over the Base Case of around 15% for Option 1 and almost 30% for Option E8. By 2030, the overall road traffic demand generated by Heathrow is estimated to increase in the Base Case by around 7.5% (from 12,050 to 12,950 vehicles per hour 2-way). Road traffic in Option E8 in 2030 shows a further increase of just over 10% relative to the Base Case (Package 2), but note that, due to the decrease in employee-related trips, this 2030 flow of 14,400 is lower than the 15,600 estimated for Option E8 in 2015.

Table 7.16: Main indicators and employee mode shares – Heathrow 2015.

Main Indicators	Current Land Use Planning System	Maximum Use of Existing Runways	Option E1 – Partial Mixed Mode	Option 1 – Full Mixed Mode	Option E8
Total capacity (mppa)	86	86	91	105	121
Total passengers requiring surface access (mppa)	55.6	50.5	53.6	61.2	73.1
Total employees on-site	66800	65200	71500	80000	95300
Employees' Highway trips (AM peak hour): vehicles					
Origin	642	627	696	766	909
Destination	3515	3433	3816	4207	4990
Total	**4157**	**4060**	**4512**	**4973**	**5899**
Employees' Public Transport trips (AM peak hour): persons					
Origin	162	158	178	214	258
Destination	835	815	917	1095	1326
Total	**997**	**973**	**1095**	**1309**	**1584**
% Public Transport trips					
Origin	19%	19%	19%	21%	21%
Destination	18%	18%	18%	20%	20%
Total	**18%**	**18%**	**19%**	**20%**	**20%**

Table 7.17: Air passenger mode choice and overall surface access demand – Heathrow 2015.

Mode	**Base Year**		**Current Land Use Planning System Maximum Use of Existing Runways**		**Option E1 – Partial Mixed Mode**		**Option 1 – Full Mixed Mode**		**Option E8**	
	No. (mppa)	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Underground	6.56	17.0%	6.79	12.2%	4.75	8.9%	6.25	10.2%	7.45	10.2%
Bus	5.98	15.5%	7.90	14.2%	7.35	13.7%	8.56	14.0%	10.20	14.0%
Taxi	9.70	25.2%	13.90	25.0%	12.49	23.3%	14.43	23.6%	16.82	23.0%
Park and fly	6.16	16.0%	9.08	16.3%	8.65	16.1%	9.84	16.2%	11.77	16.1%
Kiss and fly	9.60	24.9%	11.81	21.2%	10.88	20.3%	12.41	20.3%	14.62	20.0%
Premium rail	0.50	1.3%	5.06	9.1%	4.19	7.8%	5.03	7.8%	5.81	8.0%
National rail	0.50	1.3%	1.07	1.9%	5.28	9.97%	4.72	7.7%	6.40	8.8%
Total	**38.50**	**100.0%**	**55.62**	**100.0%**	**53.60**	**100.0%**	**61.24**	**100.0%**	**73.07**	**100.0%**
Public	13.04	33.9%	20.83	37.4%	21.57	40.2%	24.56	40.1%	29.86	40.9%
Private	25.46	66.1%	34.79	62.6%	32.03	59.8%	36.68	59.9%	43.21	59.1%
Total peak hour demand including employees, air passengers, freight and service traffic.										
Road (vehicles 2-way)	11,300		12,050		13,700		13,700		15,600	

Table 7.18: Main indicators and employee mode shares – Heathrow 2030.

Main Indicators	Maximum Use of Existing Runways	Option E8
Total capacity (mppa)	86	121
Total passengers requiring surface access (mppa)	68.6	88.1
Total employees on-site	60700	80900
Highway trips (average AM peak hour): vehicles		
Origin	597	749
Destination	3279	4123
Total	**3876**	**4872**
Public Transport trips (average AM peak hour): persons		
Origin	144	218
Destination	735	1109
Total	**879**	**1327**
% Public Transport trips		
Origin	19%	22%
Destination	17%	20%
Total	**18%**	**20%**

Table 7.19: Air passenger mode choice and overall surface access demands – Heathrow 2030.

Mode	Base Year		Maximum Use of Existing Runways		Option E8	
	No. (mppa)	%	No. (mppa)	%	No. (mppa)	%
Underground	6.56	17.0%	7.22	11.0%	7.72	9.1%
Bus	5.98	15.5%	8.91	13.6%	10.67	12.6%
Taxi	9.70	25.2%	18.12	27.6%	22.63	26.6%
Park and Fly	6.16	16.0%	10.31	15.7%	12.82	15.1%
Kiss and Fly	9.60	24.9%	12.71	19.4%	15.50	18.2%
Premium rail	0.00	0.0%	6.98	10.6%	8.49	10.0%
National rail	0.50	1.3%	1.34	2.0%	7.16	8.4%
Total	38.50	100.0%	65.58	100.0%	84.99	100.0%
Public	13.04	33.9%	24.44	37.3%	34.04	40.1%
Private	25.46	66.1%	41.14	62.7%	50.95	59.9%
Total peak hour demand including employees, air passengers, freight and service traffic						
Roads (vehicles 2-way)	11,300		12,950		14,400	

Highway appraisal results - Heathrow

7.5.17 The highway appraisal has identified a number of sections of the Motorway and Strategic Road Network that are expected to be under stress - close to or beyond their capacities - in the SERAS forecast years. These 'Background Highway Requirements' are shown in Figure 7.20. These problem links have been categorised into those where the potential solution required to solve the problem in the Base Case would be adequate also to accommodate the airport option under consideration, and those where an airport option would require a further intervention, categorised here as an increase in capacity. By 2030, in the vicinity of Heathrow, the following sections of the network have been found to be under stress. They include large sections of the M25 and M4 and indicate the scale of problems on the strategic road network that relevant multi-modal studies need to address:

- M3, J2 to J3
- M4, J2 to J7
- M25, J9 to J19

- A312 to east of Heathrow; and
- A316

7.5.18 The additional potential scheme improvements required by the airport options are summarised in Table 7.20 and illustrated in Figure 7.21 (for Options 1 and E1) and Figure 7.22 (for Options E4/E6/E8).

Table 7.20: Highway capacity problems and potential schemes - Heathrow

Description	Initial Standard	Potential standard required by:					
		2015				2030	
		Current Land Use Planning System Max Use of Existing Runways	Option E1	Option 1	Option E6/E4/E8	Max Use of Existing Runways	Option E6/E4/E8
Airport Access							
M4 spur	D3(M)	D3(M)	D3(M)	D3(M)	D3(M) tunnel	D3(M)	D3(M) tunnel
A4 tunnel	D2/S4	D2/S4	D2/S4	D2/S4	D2 tunnel	D2/S4	D2 tunnel
Link to M3	n/a	n/a	n/a	n/a	D2	n/a	D2
Eastern section of Southern Perimeter Road	S2	D2	D2	D2	D2	D2	D2
Eastern Perimeter Road	S2	D2	D2	D2	D2	D2	D2
South West Perimeter Road	S2	D2	D2	D2	D2	D2	D2
Strategic Network							
A4: A3044 to M4 J5	S2	S2	S2	S2	D2	S2	D2

Rail Network Performance - Heathrow

7.5.19 The Piccadilly Line is most crowded in the Base Case, particularly in 2030, when line loading is forecast to exceed capacity between Hammersmith and Knightsbridge in the morning peak, with 5% of demand airport-related. In all the options, the provision of alternative services between the airport and central London leads to the line being less crowded, particularly in Options in which CrossRail is assumed. CrossRail also diverts non-airport trips away from the line.

7.5.20 Similarly, higher airport throughput has limited impact on the demand for Heathrow Express. As shown in Table 7.17, its (Premium rail) mode share declines with increasing airport throughput, owing to diversion of demand to alternative routes. Table 7.19 shows a similar trend, but demand for this service is signficantly higher in 2030, rising values of time reducing the disincentive of the premium fare.

7.5.21 The main mode split values in Table 7.17 show the relative impacts of Airtrack and CrossRail services at the airport. The Airtrack scheme modelled with partial mixed mode (Option E1) provides services from the south west (Waterloo, Guildford, Reading) through Heathrow and along an upgraded Great Western Main Line to St Pancras and Watford. It increases the public transport mode share by some 3% and is forecast to carry 600 and 1,900 passengers into the airport from the south west and north east respectively in the morning peak three hours.

7.5.22 As originally conceived, Airtrack services terminated at Heathrow, rather than running through the airport, but studies in the late 1990s demonstrated the operational value of connecting Airtrack services from the south west with services to St Pancras and the north. Following the Ladbroke Grove accident, however, it is considered that even a small number of additional services between the airport and London will require extra tracks on GWML, which will add substantially to costs and delay the time at which services could be introduced.

7.5.23 Variants which would cost less and could be implemented more quickly, but which all have some comparative disbenefit, include: turning trains back at Heathrow (expensive additional tunnelling work under Heathrow); displacing commuter trains on GWML (at a cost to commuters); extending Heathrow Express services from T5 to Reading and Guildford (lowering the image of this premium service and introducing a risk of poorer timekeeping); running through Heathrow but turning trains back at Hayes. The last option would cost, in total, around £50 million, a saving of around £450 million on the modelled option, but would lose services to the north east and would be likely to change public transport mode shares only from 37.4% in the base to 37.9%.

7.5.24 For the longer-term, two principal ways of increasing rail connections between the airport and Central London have been tested: additional services to St Pancras and CrossRail. Either would require additional track capacity on GWML and they thus have similar costs west of Acton. The modelling of CrossRail suggests that this is preferable in terms of accessibility and passenger loadings - 700 peak period trips on the St Pancras service in the Option E1 test decline to 200 in the Option 1 test when CrossRail is introduced.

7.5.25 However, as shown in Table 7.17, adding CrossRail to a Heathrow surface access network that already contains Airtrack does not appear to add to the airport's accessibility, with public transport's mode share being marginally lower in Option 1 than in Option E1. While this decline is due to the different passenger mix and distribution of trip ends in Option 1 compared to E1, airport demand is minimal east of Liverpool Street, so most airport demand on CrossRail is abstracted from the Piccadilly Line, St Pancras service and Heathrow Express. Further potential disadvantages are that it would prevent the development of St Pancras as a 'superhub', and would increase the numbers of air passengers (and their luggage) on crowded CrossRail and Thameslink 2000 services, perhaps compromising the station dwell times which will be particularly important to the smooth operation of Thameslink 2000.

7.5.26 The importance of frequency to airport access services is shown by Option E8, where the halving of waiting time at Waterloo and Clapham Junction compared to Option 1 trebles airport demand on these services. As noted, in the 2030 tests Heathrow Express demand increases at the expense of cheaper, slower routes between London and the Airport.

7.6 Environment: Land Take

Context

7.6.1 The environmental issues considered in Stage Two of SERAS builds on work undertaken in Stage One on land use, ecology, heritage, landscape and townscape, water, noise and air quality. Stage Two in addition appraises impacts on contamination and community issues. For each of these environmental topics a baseline is defined and then the results of the appraisal of each option is presented. Details of existing land uses and environmental features within the study area are provided in Figures 7.27 to 7.31. Summaries of the key impacts of each option are presented in the Appraisal Summary Table. Fuller details of the environmental appraisal baseline data and appraisal of options can be found in the supporting report.

Existing Conditions

Land Use – residential, commercial/industrial, public buildings, recreation, agriculture, planning constraints

7.6.2 The airport is surrounded by various urban areas within Greater London including Hounslow, Feltham, Ashford, Staines, Egham, Slough, Windsor, Hillingdon and Ealing. There are several commercial/industrial areas in the immediate vicinity of the airport, plus two sites allocated for future commercial/industrial development in the London Borough of Hounslow Local Plan.

7.6.3 There are areas of agricultural land of Grade I plus further areas where the quality is not known. There are also numerous sand and gravel workings and much of the area to the north and west is considered to have potential for sand and gravel reserves.

7.6.4 Much of the undeveloped area surrounding Heathrow is classified as Green Belt.

Contamination (Figure 7.27)

7.6.5 Twenty-eight potential sources of contamination have been identified in the study area. Of these, 22 are considered to have potential for greater than minor scale contamination. There are 8 areas with the potential for a 'great' scale of contamination. All of these are either landfill sites that have been licensed to accept 'difficult' or 'putrescible' waste or are landfills or potential landfill of unknown content. There are 8 other sites with the potential for a 'moderate' scale of contamination.

Ecology (Figure 7.28)

7.6.6 There is one internationally-designated site (of very high ecological value) within the area of search. The South West London Waterbodies are designated as a Special Protection Area (SPA) and Ramsar site. All areas within the SPA are also designated as Sites of Special Scientific Interest (SSSI). The South West London Waterbodies SPA comprises a series of embanked water supply reservoirs and former gravel pits that support a range of man-made and semi-natural open water habitats. The large expanse of open water and the bare muds on the reservoir margins provide habitat for wildfowl and waders and the site has been designated because it regularly supports more than 1% of the biogeographic populations of wintering gadwall and shoveler. The South West London Waterbodies are considered to have a low potential for substitution as, although the water bodies are man-made, they cover a considerable area (828 ha) of south west London and this space would be hard to find elsewhere in London for habitat recreation.

7.6.7 There are four nationally-designated Sites of Special Scientific Interest (SSSIs) (of high ecological value) within the area of search, including the following:

- Staines Moor SSSI consists of the largest area of alluvial meadows in Surrey (including several oxbow lakes) and a semi-natural stretch of the River Colne. This site is considered to have no potential for substitution due to the complex mosaic of habitats and hydrological conditions.
- Thorpe Hay Meadow SSSI is thought to be the last remaining example of a Thames Valley hay meadow in Surrey, and contains a range of characteristic lime-loving plants including meadow cranesbill, cowslip, and hoary plantain. This site is considered to have no potential for substitution due to the rarity and age of the habitat.
- Langham Pond SSSI consists of a pond surrounded by alluvial meadows, hedges and broad-leaved woodland.
- Hythe End Gravel Pits SSSI comprises a mosaic of open water, islands, grassland, scrub and woodland.

7.6.8 There are two sites of Metropolitan Importance for Nature Conservation within the area of search (medium ecological value). These are the River Crane and adjacent habitats and the River Colne Valley. In both areas the rivers act to connect other areas of semi-natural and have no potential for substitution.

7.6.9 There are two further designated areas of county importance (medium ecological value) within the area of search and some wildlife heritage sites (also of medium ecological value) outside the area of search. There are also three sites designated as Sites of Borough Importance for Nature Conservation (Grade I) (of low to medium ecological value). There are five further sites within the area of search which are undesignated but which are considered to be of low ecological value.

Heritage (Figures 7.29 and 7.30)

7.6.10 The Base Case contains 38 undesignated archaeological sites or groups of sites (considered for this appraisal to be of county/district value). The maximum area of expansion contains an additional such 32 sites with a further 55 sites lying in the surrounding 500m corridor. The area contains one Scheduled Ancient Monument, a 14th century Tithe Barn at Harmondsworth to the north. A further three SAMs lie within the 500m corridor.

7.6.11 The area contains two designated areas of high archaeological potential. These comprise the historic cores of Harmondsworth and Harlington.

7.6.12 *Archaeology* - The current airport site and its area of expansion lies within an area of high archaeological activity and potential as demonstrated by excavations within the current airport boundary and in the surrounding area. There is archaeological evidence in the area of historic activities dating from prehistoric times. The pattern of landscape and settlement probably changed little from the medieval to the post-medieval period. Much of this settlement pattern has now been swallowed up by the construction of the airport and the westward growth of suburban London.

7.6.13 *Listed Buildings* - The study area, contains 102 Listed Buildings. This includes: one Grade I Listed Building, the Manor Farm Barn at Harmondsworth which is also a Scheduled Ancient Monument); two Grade II* Listed Buildings; and 95 Grade II Listed Buildings; three Grade B Listed churches and 1 Grade C Listed church. The exact level of significance of the Grade A and Grade B buildings is uncertain: in the early days of the Listing programme, churches were exempt from Listed Building controls and were classified as A, B or C.

7.6.14 *Conservation Areas* - The area of proposed landtake contains two Conservation Areas at Harmondsworth and Cranford. The 500m corridor contains 4 further Conservation Areas.

Landscape and Visual (Figure 7.31)

7.6.15 *Landscape/Townscape* - The landscape in the vicinity of Heathrow falls within the Thames Valley which comprises a broad floodplain of fragmented, poor agricultural land dominated by the urban influences of the towns of Reading, Bracknell, Windsor and Slough and metropolitan London. The landscape within 5km of the site at Heathrow has been divided into three areas of distinct landscape and townscape character.

7.6.16 Runnymede Hills rise above the otherwise flat and low-lying landscape and provide panoramic views across the floodplain. The landscape is well wooded and relates to the adjoining wooded hills at Virginia Water and Windsor Great Park. The character of the landscape in the vicinity of Runnymede and Coopers Hill is especially distinct due to its historic associations with the signing of the Magna Carta. Land at Runnymede through to Virginia Water is designated at district level as an Area of Landscape Importance. The overall value of the landscape is assessed as high.

7.6.17 Colne Valley runs in a north to south direction to join the River Thames in the vicinity of Staines. The valley has a more vegetated character than the open landscapes to the west and east. This shallow valley effectively forms the western boundary of the metropolitan area of London and its character merges with that of the Thames Valley to form an extensive area for which the presence of water is the defining characteristic. Pylons and transport infrastructure have resulted in a visually and physically fragmented landscape. The overall value of this area of contrasts is assessed as low.

7.6.18 West London Suburbs are characterised by late twentieth century low-rise urban expansion over flat and low-lying topography. The character of these suburbs is heavily influenced by the presence of the existing airport and the associated commercial activities and transport infrastructure that dominate the area. The overall value of the landscape is assessed as low.

Visual

7.6.19 The extent of the indicative zone of potential visual impact (ZVI) of the maximum extent of Airport Options boundaries is limited by the flat topography and the presence of built-up areas. The ZVI therefore generally remains close to the periphery of the airport. Key visual receptors within 5km of the site would include residents in the West London Suburbs to the north, east and south. Visibility is likely to be restricted to glimpses and will very much depend on the precise location and scale of proposed buildings. The ZVI includes a number of major roads – many close to the perimeter of the existing airport or proposed landtake. In all cases, however, the sensitivity of these very busy routes is reduced by the urban context and views of existing facilities.

Community

7.6.20 *Community Infrastructure* - The settlement pattern predominantly comprises a series of linked urban and suburban areas. Most of these developed in the 20th century, partly in response to the expansion of the airport, and comprise a relatively unstructured pattern of residential neighbourhoods around local service centres.

7.6.21 *Community Structure/Distinctiveness* - The population of the airport's Core Catchment Area, as defined in the Land Use and Urbanisation Study Stage One Report is approximately 845,000. The linked urban and suburban areas are separated mainly by transport corridors, open spaces and gravel workings. A small number of settlements retain some village characteristics.

7.6.22 *Employment* - Unemployment levels within the Core Catchment Area, at 3%, are below the national average. The economy of the area is generally buoyant, reflecting its proximity to the airport, to Central London and to the motorway network. However, it has experienced structural change in recent years, with decline in manufacturing sectors such as defence, resulting in over-dependence on the service sector.

High Adverse Impacts: Option 1

7.6.23 Archaeology - One known archaeological site, representing the location of an undated site discovered during excavations and augur survey in 1994, would be disturbed. It would also affect an area of likely archaeological potential. The loss of such sites without record would constitute a HA effect although it is likely that this impact could be substantially mitigated through the implementation of an agreed programme of archaeological investigation, evaluation and excavation prior to the construction programme.

High Adverse Impacts: Option E1

7.6.24 This option would have the same effects as Option 1 i.e. HA on the potential archaeological resource, although this could be substantially mitigated.

High Adverse Impacts: Option E4

7.6.25 The loss of 59ha of agricultural land (of unknown agricultural land quality) and 169ha of land of Grade 1 agricultural land quality would result in HA effects. In addition, some of the land to the north and west of the Base Case boundary (60ha) comprises unworked sand and gravel deposit and this resource could be sterilized.

7.6.26 A HA effect is associated with landtake from the Green Belt within the new airport boundary (228ha).

7.6.27 One Scheduled Ancient Monument, the 14th century Tithe Barn at Manor Farm, would be lost. In addition this option would result in substantial disturbance within an area of High Archaeological Importance centred around the medieval centre of Harmondsworth and would affect 22 undesignated sites. As with Option 1, this part of the area taken is of likely archaeological potential . Although it is possible that this could be substantially mitigated, the resultant severity is likely to remain HA as a consequence of the loss of the SAM.

7.6.28 A number of Listed Buildings would be lost under this option. These include Manor Farm Barn, a Grade I Listed building (also recorded as a Scheduled Ancient Monument), the Grade B church of St. Mary's, 9 Grade II Listed Buildings. The loss of the Grade I and Grade II buildings would constitute a HA adverse effect.

7.6.29 The loss of about 25% of the Harmondsworth Conservation Area would constitute a HA effect.

High Adverse Impacts: Option E6

7.6.30 The loss of agricultural land of Grade I would increase to 198 ha. In addition, slightly more land (73ha) of unworked sand and gravel deposit would be sterilized. Effects are likely to remain HA.

7.6.31 The loss of land designated as Green Belt would increase to 269 ha and effects are likely to remain HA.

7.6.32 The impacts on archaeology, Listed Buildings and Conservation Areas, are as Option E4 with an additional area of landtake which will affect a further area of archaeological potential.

7.6.33 The construction works for this option would impinge on more residential communities. In particular, more residential properties in Sipson and Harmondsworth are likely to be affected raising the likely impact to HA. Cumulative effects due to construction would be HA.

High Adverse Impacts: Option E8

7.6.34 There would be a loss of 302ha of land of Grade 1 agricultural land quality. In addition, some of the land (79ha) comprises unworked sand and gravel deposit and sterilization of this resource combined with the loss of Grade I agricultural land would result in HA effects.

7.6.35 There would be an HA impact on people with some 893 households displaced

7.6.36 A HA effect is associated with landtake from the Green Belt due to land within the new airport boundary (338 ha).

7.6.37 Impacts on the archaeological resource would be as Option E6 with the addition of impacts on:

- an additional area of archaeological sensitivity, located around the village centre of Harlington;
- an additional 10 undesignated archaeological sites.

7.6.38 There would also be a loss of: 1 Grade I Listed Building; two grade B churches, 52 Grade II Listed Buildings, which constitutes a HA adverse effect. A HA effect would also result from the additional loss of around 25% of Cranford Park Conservation Area and 25% of the Harmondsworth Conservation Area.

7.6.39 The scale of construction works is high and over 500 residential receptors would be affected, resulting in HA effects. The distance of the area of the main construction activity in the north from nationally or internationally designated sites means they are unlikely to be significantly affected. The cumulative effects of construction are considered to be HA.

7.7 Environment: Water

Existing Conditions

7.7.1 Heathrow Airport is situated within both the River Crane and River Colne surface water catchments. The study area is bounded to the north by the Grand Union Canal, to the east by the River Crane, and to the west by the River Colne and River Wraysbury (Figure 7.32). The canalised Duke of Northumberland's River and Longford River pass in culverts beneath the western end of the existing runways and then flow eastward along the southern perimeter of the Airport. There are two large reservoirs to the south west of the study area, and numerous former gravel pits that now form lakes. The runoff from the Airport flows into four balancing reservoirs, which provide temporary storage before gradually discharging into the Stanwell Ditch, River Wraysbury, Portlane Brook and the River Crane.

7.7.2 The water quality is monitored in six watercourses within the study area. The Airport does not appear to impact on the quality of the water in these rivers. There are 2 licensed surface water abstractions within the study area.

7.7.3 The Airport is outside of the 1 in 100 year flood risk area identified by the Environment Agency. However, there is a significant expanse of floodplain along the western side of the study area corresponding to the Colne catchment, which is sensitive to flooding.

7.7.4 The study area is located on the River Gravels of the middle Thames valley. The permeable gravels are regarded as a major aquifer, and are highly productive and able to support large abstractions for public supply and other purposes. There are 23 licensed groundwater abstractions within the study area, and a groundwater supported SSSI within the south west part of the study area.

7.7.5 From a regional perspective, the available water resources are virtually fully committed. However this varies between water companies and resource zones across the region. Currently there are additional, albeit limited, groundwater resources available in the middle Thames and in the confined chalk aquifer under London.

Impact of Options

7.7.6 The options have been assessed against a base case, which is the current land use planning system, and therefore only consider impacts that are *additional* to those assessed under the base case. The assessments consider the sensitivity of the water environment and the potential to cause harm, allowing for the scope for mitigation. Table 7.21 summarises the assessment for each of the water objectives, for each of the options.

7.7.7 All of the options at Heathrow present a potential impact on groundwater and surface water, and three options a potential impact on water resources, as 'High Adverse'. The impacts on the other water objectives are either 'Medium' or 'Low Adverse', as many of them may be mitigated.

7.7.8 Water quality impacts may be mitigated using water treatment techniques such as reed beds and balancing ponds. Flooding impacts may be mitigated using balancing ponds, to attenuate runoff and take out the peak flow. The effectiveness of these measures is dependent upon adequate sizing of ponds, and the use of appropriate treatment techniques.

7.7.9 All of the options require engineering works to at least one river. This would involve either culverting or diverting the river, hence the allocation of a High Adverse score. The Environment Agency is generally opposed to culverting, and such works are seen as a significant impact.

7.7.10 There are numerous areas of contamination around Heathrow Airport that are at risk of being mobilised within all of the development options. Although this could be controlled through appropriate management, there is a high risk to the aquifer, which forms an important resource.

7.7.11 Large increases in passenger numbers significantly increase the airport's demand for water, and that of the surrounding residential areas that provide the human resource base for the airport. Without any further water resource development or effort to manage demand, the area would have a deficit. However, assuming that water companies maximise existing strategic links and their use of existing and planned licensed resources between resource zones, the resource zones that supply Heathrow Airport would just be sufficient to meet the demand imposed by Options E1 and 1, but would have a slight deficit under Options E4, E6 and E8. This assumes that companies will achieve their leakage reduction targets, and also allows for environmental needs, such as the South West London Gravel Pits and Reservoirs, which are internationally significant.

7.7.12 Assuming appropriate supply and demand management techniques are put into place, and the Airport and other water users within the region are water-efficient, by carrying out good housekeeping and management with respect to water, and using water saving technology, it should be possible to meet the demand imposed by Options E1 and 1. However, even with these measures it may be difficult to meet the demand imposed by Options E4, E6 and E8.

Table 7.21: Heathrow Water Appraisal Summary Table

Option	Base Case & Maximum Use of Existing Runway	Option E1	Option 1	Option E6	Option E4	Option E8
Surface Water	4 rivers receive treated Airport drainage. 2 rivers would need to be either culverted or diverted. 2 licensed abstractions within the study area. Potential water quality impacts could be mitigated. **Medium Adverse**	1 river would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	1 river would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	3 river reaches would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	3 river reaches would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	2 rivers would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**
Groundwater	Major aquifer. 23 licensed abstractions (including a Zone 3 SPZ for a PWS) within the study area. Potential impact from mobilisation of contaminants could be prevented through appropriate management. **High Adverse**	Major aquifer. Potential impact from mobilisation of contaminants could be prevented through appropriate management. **High Adverse**	Major aquifer. Potential impact from mobilisation of contaminants could be prevented through appropriate management. **High Adverse**	Major aquifer. Potential impact from mobilisation of contaminants could be prevented through appropriate management. **High Adverse**	Major aquifer. Potential impact from mobilisation of contaminants could be prevented through appropriate management. **High Adverse**	Major aquifer. Potential impact from mobilisation of contaminants could be prevented through appropriate management. **High Adverse**
Flooding	To the west of the Airport the catchment is dominated by floodplain, and is at risk of flooding. **Medium Adverse**	No additional impacts as compared to the base case. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**
Water Resources	Increase in demand would have been planned for, and may be met through supply and demand management, and water saving technology. **Low Adverse**	Significant increase in demand may be met through supply and demand management, and water saving technology. **Medium Adverse**	Significant increase in demand may be met through supply and demand management, and water saving technology. **Medium Adverse**	It may be difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High Adverse**	It may be difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High Adverse**	It may be difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High Adverse**

7.8 Environment: Noise Impacts

Aircraft Noise: Daytime

7.8.1 The Heathrow noise contours for 2000, and each of the Options in 2015 or 2030 as appropriate are shown on Figures 7.33 to 7.64. Note that the 2000 contours include Concorde movements at 1999 levels. Tables 7.22 to 7.25 give the areas and estimated populations under the daytime $L_{Aeq,16h}$ noise contours for each of these scenarios with changes against 2000 contours and the Base Case respectively.

7.8.2 Heathrow exposes by far the largest number of people to aircraft noise of all the airports in the study area, with a population of 306,700 within the 2000 57 dB contour (266,700 without Concorde). The 'with Concorde' figure has fallen slightly from 319,300 in 1994, despite the steady growth in air traffic over this period. This change should be taken as approximate as the 1994 and 2000 population estimates are based on different census years. The contours have changed shape, extending over new areas such as over Slough to the north west of Heathrow and have decreased in area since 1994. The 57 dB contour has reduced in area by 15%. The reduced contour area is due to the introduction of quieter aircraft types which has been accelerated since 1995 when the compulsory phasing out of the older and noisier Chapter 2 aircraft began. The phase-out in Europe is to be completed by 1 April 2002. Other factors – redefinition of routings, more effective monitoring and fines - have also contributed. The Heathrow contours are generally wider, i.e. spread to the north and south, at the western end. This reflects the predominant arrival/departure directional split that is around 75% in favour of westerly operations. Therefore the lobes in the contours (reflecting departure noise) to the west, north west and south west are greater in size than those to the north east and south east, and, in areas where arrivals noise predominates, the contours extend further to the east then to the west.

Options in 2015

7.8.3 With the Maximum Use Option which is the Base Case for 2015, the population under the 57 dB contour is forecast to be 320,500, an increase of 13,800 over 2000. However the 57 dB contour area will decrease by 4 sq km from 149 to 144.6 sq km. This small reduction reflects planned development with T5 in place, Concorde not being in operation and other expected fleet changes.

7.8.4 Option E1 involves operating the existing runways in partial mixed mode and Option 1 in full mixed mode. Comparing Option E1 and Option 1 with the Base in 2015, it can be seen that the population under the 57 dB noise contour increases by 6% with Option E1, and by 25% with Option 1.

Table 7.22 : Heathrow Daytime Aircraft Noise Contours – 2015 vs 2000 Existing Situation

LAeq (dB)	Area (sq km)														
	1994	Excluding Concorde 1999	Including Concorde 2000	Max Use Total 2015	Max Use Change Cw 2000	Option E1 Total 2015	Option E1 Change cw 2000	Option 1 Total 2015	Option 1 Change cw 2000	Option E6 Total 2015	Option E6 Change cw 2000	Option E4 Total 2015	Option E4 Change cw 2000	Option E8 Total 2015	Option E8 Change cw 2000
>54	n/a	214.8	260.5	266.9	6.4	281.7	21.2	306	45.5	420.5	160	379.4	118.9	374.3	113.8
>57	175.5	124.2	149	144.6	-4.4	151.9	2.9	165.3	16.3	236.8	87.8	211.9	62.9	208.8	59.8
>60	97.4	74.4	84.1	83.6	-0.5	87.7	3.6	94.9	10.8	136.8	52.7	125.3	41.2	123.5	39.4
>63	60.3	45.9	51.6	49.3	-2.3	51.4	-0.2	55.2	3.6	82.8	31.2	75.7	24.1	77.1	25.5
>66	40.3	29.1	33.2	30.8	-2.4	32	-1.2	34.6	1.4	49.7	16.5	45.2	12	50.3	17.1
>69	27.5	17.1	20.8	18.7	-2.1	19.5	-1.3	21	0.2	28.9	8.1	26.3	5.5	27.7	6.9
>72	17.9	8.8	11.4	9.4	-2	9.9	-1.5	10.8	-0.6	15.8	4.4	13.8	2.4	13.6	2.2
LAeq (dB)	Population (000s)														
	1994	Excluding Concorde 1999	Including Concorde 2000	Max Use Total 2015	Max Use Change cw 2000	Option E1 Total 2015	Option E1 Change cw 2000	Option 1 Total 2015	Option 1 Change cw 2000	Option E6 Total 2015	Option E6 Change cw 2000	Option E4 Total 2015	Option E4 Change cw 2000	Option E8 Total 2015	Option E8 Change cw 2000
>54	n/a	522	603.3	707.9	104.6	748.7	145.4	835.2	231.9	1187.9	584.6	1076.8	473.5	1144.8	541.5
>57	319.3	266.7	306.7	320.5	13.8	339.9	33.2	384.9	78.2	588.6	281.9	512.4	205.7	531.6	224.9
>60	182.6	124.2	158.8	150.7	-8.1	162.3	3.5	172.3	13.5	274.2	115.4	241	82.2	240.9	82.1
>63	99.3	66	82	73.9	-8.1	78	-4	85.2	3.2	128.1	46.1	111.7	29.7	115.3	33.3
>66	50.8	26.9	32.9	30.5	-2.4	33	0.1	37.6	4.7	58.7	25.8	48.2	15.3	51.3	18.4
>69	18.6	9.8	13	10.9	-2.1	12	-1	13.7	0.7	18.6	5.6	15.2	2.2	15	2
>72	6.7	2.7	3.6	2.8	-0.8	3.2	-0.4	3.3	-0.3	4.6	1	3.8	0.2	3.1	-0.5

Table 7.23: Heathrow Daytime Aircraft Noise Contours – 2015 vs 2015 Base Case

LAeq (dB)	Area (sq km)										
	Max Use	Opt E1		Option 1		Option E6		Option E4		Option E8	
	2015 Base	Total 2015	Change cw Base	Total 2015	Change Cw Base	Total 2015	Change cw Base	Total 2015	Change cw Base	Total 2015	Change cw Base
>54	266.9	281.7	14.8	306.0	39.1	420.5	153.6	379.4	112.5	374.3	107.4
>57	144.6	151.9	7.3	165.3	20.7	236.8	92.2	211.9	67.3	208.8	64.2
>60	83.6	87.7	4.1	94.9	11.3	136.8	53.2	125.3	41.7	123.5	39.9
>63	49.3	51.4	2.1	55.2	5.9	82.8	33.5	75.7	26.4	77.1	27.8
>66	30.8	32.0	1.2	34.6	3.8	49.7	18.9	45.2	14.4	50.3	19.5
>69	18.7	19.5	0.8	21.0	2.3	28.9	10.2	26.3	7.6	27.7	9.0
>72	9.4	9.9	0.5	10.8	1.4	15.8	6.4	13.8	4.4	13.6	4.2
LAeq (dB)	Population (000s)										
	Max Use	Option E1		Option 1		Option E6		Option E4		Option E8	
	2015 Base	Total 2015	Change cw Base	Total 2015	Change Cw Base	Total 2015	Change cw Base	Total 2015	Change cw Base	Total 2015	Change cw Base
>54	707.9	748.7	40.8	835.2	127.3	1187.9	480.0	1076.8	368.9	1144.8	436.9
>57	320.5	339.9	19.4	384.9	64.4	588.6	268.1	512.4	191.9	531.6	211.1
>60	150.7	162.3	11.6	172.3	21.6	274.2	123.5	241.0	90.3	240.9	90.2
>63	73.9	78.0	4.1	85.2	11.3	128.1	54.2	111.7	37.8	115.3	41.4
>66	30.5	33.0	2.5	37.6	7.1	58.7	28.2	48.2	17.7	51.3	20.8
>69	10.9	12.0	1.1	13.7	2.8	18.6	7.7	15.2	4.3	15.0	4.1
>72	2.8	3.2	0.4	3.3	0.5	4.6	1.8	3.8	1.0	3.1	0.3

Table 7.24 : Heathrow Daytime Aircraft Noise Contours – 2030 vs 2000 Existing Situation

LAeq (dB)	Area (sq km)									
	Including Concorde 2000	Max Use		Option E6		Option E4		Option E8		
		Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000	
>54	260.5	307.4	46.9	395.9	135.4	360.8	100.3	402.1	141.6	
>57	149.0	165.5	16.5	222.3	73.3	202.1	53.1	227.3	78.3	
>60	84.1	93.7	9.6	130.0	45.9	118.4	34.3	130.1	46.0	
>63	51.6	54.5	2.9	78.2	26.6	71.7	20.1	80.7	29.1	
>66	33.2	33.7	0.5	46.7	13.5	42.6	9.4	52.8	19.6	
>69	20.8	20.6	-0.2	27.5	6.7	24.7	3.9	29.5	8.7	
>72	11.4	10.8	-0.6	14.7	3.3	12.9	1.5	14.6	3.2	
LAeq (dB)	Population (000s)									
	Including Concorde 2000	Max Use		Option E6		Option E4		Option E8		
		Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000	
>54	603.3	798.6	195.3	1121.7	518.4	1005.7	402.4	1199.4	596.1	
>57	306.7	378.7	72.0	545.3	238.6	477.1	170.4	583.0	276.3	
>60	158.8	175.0	16.2	254.9	96.1	225.3	66.5	259.1	100.3	
>63	82.0	82.8	0.8	117.8	35.8	103.3	21.3	122.0	40.0	
>66	32.9	36.9	4.0	52.6	19.7	43.1	10.2	56.0	23.1	
>69	13.0	12.7	-0.3	17.0	4.0	13.8	0.8	16.4	3.4	
>72	3.6	3.3	-0.3	4.3	0.7	3.6	0	3.4	-0.2	

Table 7.25: Heathrow Daytime Aircraft Noise Contours – 2030 vs 2030 Base Case

Laeq (dB)	Area (sq km)						
	Max Use	Option E6		Option E4		Option E8	
	Total 2030	Total 2030	Change Cw Base	Total 2030	Change Cw Base	Total 2030	Change cw Base
>54	307.4	395.9	88.5	360.8	53.4	402.1	94.7
>57	165.5	222.3	56.8	202.1	36.6	227.3	61.8
>60	93.7	130.0	36.3	118.4	24.7	130.1	36.4
>63	54.5	78.2	23.7	71.7	17.2	80.7	26.2
>66	33.7	46.7	13.0	42.6	8.9	52.8	19.1
>69	20.6	27.5	6.9	24.7	4.1	29.5	8.9
>72	10.8	14.7	3.9	12.9	2.1	14.6	3.8
Laeq (dB)	**Population (000s)**						
	Max Use	**Option E6**		**Option E4**		**Option E8**	
	Total 2030	**Total 2030**	**Change Cw Base**	**Total 2030**	**Change Cw Base**	**Total 2030**	**Change cw Base**
>54	798.6	1121.7	323.1	1005.7	207.1	1199.4	400.8
>57	378.7	545.3	166.6	477.1	98.4	583	204.3
>60	175.0	254.9	79.9	225.3	50.3	259.1	84.1
>63	82.8	117.8	35.0	103.3	20.5	122.0	39.2
>66	36.9	52.6	15.7	43.1	6.2	56.0	19.1
>69	12.7	17.0	4.3	13.8	1.1	16.4	3.7
>72	3.3	4.3	1	3.6	0.3	3.4	0.1

7.8.5 With the new runway proposals, the area covered by the 54 dB contour parallel to the runways extends by some 1 to 1.5 km to the north. Option E4 and Option E8 lead to increases in the populations within the 57 dB contour of around 200,000 compared with the Base, and increases of just over 4,000 in the population exposed to 69 dB and above. Option E6, which has three runways operating in mixed mode, shows the greatest adverse impact. The population within the 57 dB contour increases by 268,000 compared with the Base, and by nearly 8,000 within the 69 dB contour. Option E6 would also result in an additional 1,800 people being brought within the 72 dB contour, a 64% increase over the Base. This compares with a figure of 1,000 (36% increase) for Option E4, which has the next highest impact on the higher noise level contour. In summary, increases in 57 dB contours could affect another 64,000 people if the existing layout is retained, but operation is changed to full mixed mode. An additional runway increases the 57 dB contour area by around 65 sq km, affecting a further population of around 200,000.

7.8.6 The recent T5 decision imposes a condition restricting the area enclosed by the 57 dB contour to 145 sq km as from 2016. In 2015, the Maximum Use option just falls within this limit: all other options exceed it.

Options in 2030

7.8.7 With the Maximum Use Option, the Base Case for 2030, the population under the 57 dB contour will be 378,700, an increase of 72,000 over 2000. The 57 dB contour area would also increase by 17 sq km. The growth in the contours would be to the north west over Slough, to the south west over Egham, and to the north east over Ealing.

7.8.8 Option E6 produces a smaller impact in 2030 than in 2015. The population under the 57 dB contour would be 545,300, 7% less than in 2015. However, this would still bring an extra 166,600 people under the 57 dB contour compared with the 2030 Base Case, and 238,600 more than under the Existing contour.

7.8.9 Option E4 also demonstrates a reduced impact in 2030 compared with 2015. The population falling within the 57 dB contour would be 477,100, which is a reduction of 111,500. Option E8 would have a greater impact in 2030 than in 2015 with around a further 50,000 people within the 57 dB contour, giving a total of 583,000. This option in particular results in an extension of the predicted 57 dB contour to the east over central and southeast London.

7.8.10 All of the forecasts for 2030 show a wider area affected than the 145 sq km set as a limit in the T5 Decision. The maximum use option exceeds the limit by 21 sq km, the additional runway options by 60 to 80 sq km.

7.8.11 To summarise, even in 2030 the increases in the 57 dB contour would be small if the existing runway layout is retained and operated as at present. Adding a short runway to the north would add around 50 sq km to the 57 dB contour area, increasing to over 70sq km if all runways are operated in mixed mode. The increase approaches 80 sq km for a full-length additional runway, due to the impact of the larger aircraft classes landing and departing over areas not currently affected in such a way.

Sensitivity Tests

Options E4 and E6: Sensitivity Test with Different Class 3 Aircraft Types on New Short Runway

7.8.12 Chapter 6 outlines the rationale adopted for transferring aircraft from the existing full length runways to the new shorter runways in Options E4 and E6. It was the intention that the Class 3 aircraft to be transferred were all of the B757 type, operating within a range of 750km. However, the contours generated for those options assume a mix of aircraft including some larger than the B757 having in some cases more onerous noise characteristics. To test how significantly different the contours for these two options might be with the correct Class 3 assumptions, the worst affected case in movement number terms, Option E4, was re-run at 2030 assigning all Class 3 movements as B757 movements. Results showed that for the 57dBA $L_{Aeq,16h}$ contour level there would be a reduction in contour area of less than 3% and an associated reduction of less than 4 % for population affected within. These were considered to be within the tolerance limits accepted for the modelling technique applied and thus contours for Options E4 and E6 were left unchanged.

Option E4: Sensitivity Test with Accelerated Retirement, Aircraft Type Reassignment and Increased Noise Stringency

7.8.13 The combined effects of variations in assumptions in these three areas for Option E4 in 2015 are summarised in Table 7.26. The three variations were separately modelled. The accelerated retirement assumption had negligible effect, in part because few older aircraft types no longer in production in 2000 use Heathrow. The assumption of more short haul rather than long haul variants of aircraft types gave a 16% reduction in the 57 dB contour area and the more stringent noise rule (Chapter 3 –14 dB) gave a further 11% reduction. The more stringent noise rule of Chapter 3 –14 dB may, by 2015, be more compatible than the core assumption of Chapter 3 –8 dB with the CAEP recommendation that a Chapter 3 – 10 dB standard for new aircraft designs be implemented in 2006. The combined effect is to reduce the 57 dB contour area from 211.9 sq km with the core assumptions to 155.7 sq km, a 27% reduction in area. The resulting area exceeds the limit set in the T5 decision by 10.7 sq km or 7%.

Table 7.26: Option E4 2015 Noise Sensitivity Test Results

	Core Assumptions		Sensitivity Test	
LAeq (dB)	**Area sq km**	**Population '000**	**Area sq km**	**Population '000**
>54	379.4	1076.8	276.2	747.7
>57	211.9	512.4	155.7	333.3
>60	125.3	241.0	95.8	162.4
>63	75.7	111.7	57.6	75.7
>66	45.2	48.2	33.4	27.3
>69	26.3	15.2	19.2	8.6
>72	13.8	3.8	9.5	2.3

Aircraft Noise: night time

7.8.14 Tables 7.27 and 7.28 show the population numbers and associated house counts within the departure and arrival 90 dBA SEL footprints for easterly and westerly operations respectively. The footprints are shown in a supporting document and represent an 'average worst' QC2 aircraft, applied to each departure track (SID) and each runway's approach path for arrivals.

7.8.15 SID references are: BPK – Brookmans Park; BUZ – Buzad; CPT – Compton; DVR – Dover; MID – Midhurst; SAM – Southampton

Table 7.27 – Night Noise Population and House Counts – Easterly Operations

	Existing				Options E4 and E6		Option E8	
Runway	**09L**		**09R**		**09L (2000m rwy)**		**09R (4000m rwy)**	
	Popl'n (000's)	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**
Departures								
BPK	15.8	6.1	17.2	6.3	34.0	12.0	20.1	7.8
BUZ	15.8	6.1	17.2	6.3	34.2	12.1	20.0	7.7
CPT	17.2	6.7	9.0	3.5	24.0	9.2	20.9	8.2
DVR	21.6	8.4	8.1	3.4	24.6	9.5	19.8	7.8
MID	10.1	4.1	9.9	4.0	25.9	9.9	19.9	7.8
SAM	9.7	4.0	8.8	3.5	24.9	9.5	20.1	7.9
Average	*15.0*	*5.9*	*11.7*	*6.5*	*27.9*	*10.4*	*20.1*	*7.9*
Arrivals	10.8	5.0	4.2	1.8	8.3	3.2	7.7	2.9

Table 7.28 – Night Noise Population and House Counts – Westerly Operations

	Existing				Options E4 and E6		Option E8	
Runway	**27R**		**27L**		**27R (2000m rwy)**		**27R (4000m rwy)**	
	Popl'n (000's)	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**
Departures								
BPK	3.2	1.5	2.3	1.0	17.1	7.0	6.9	2.9
CPT	3.6	1.6	2.2	0.9	7.6	3.2	5.9	2.4
DVR	3.6	1.6	2.3	1.0	7.4	3.2	4.9	2.0
MID	3.5	1.6	2.4	1.0	7.7	3.3	5.8	2.3
SAM	3.6	1.6	2.2	0.9	7.8	3.3	5.9	2.4
WOB	3.2	1.5	2.3	1.0	16.7	6.8	7.1	3.0
Average	*3.5*	*1.6*	*2.3*	*1.0*	*10.7*	*4.5*	*6.1*	*2.5*
Arrivals	38.3	15.1	37.0	15.4	20.2	8.1	23.3	10.2

7.8.16 With the two existing runways, counts show that under the Max Use, Option E1 and Option 1 scenarios, Rwy 09R would have less impact on population for easterly departures than does Rwy 09L. Easterly departures have more impact in both population and house count terms for Options E4 and E6 than for E8. On easterly arrivals, significantly more people are affected with operations on 09L than 09R whilst for Options E4, E6 and E8 a similar number of people are affected. On Westerly departures Rwy 27R under Options E4 and E6 have a high impact on population compared to other options. Westerly arrivals impact the highest numbers of population and houses, particularly when arriving on the existing 27R and 27L.

7.8.17 On easterly operations, the use of the existing runways would subject fewer people to night-time noise. On westerly operations, numbers of people affected could be reduced by using one of the new runways for arrivals, if runway length permits.

Surface Access Noise: Highways

7.8.18 Table 7.29 gives the overall results (total Estimated Population Annoyed - EPA) from the GOMMMS plan level assessment for road traffic noise. The Surface Access Noise section of the Appraisal Summary Table also includes the EPA values split by noise contour bands.

Table 7.29 – Heathrow Surface Access Noise Assesssment: Highways

	Total change in Estimated Population Annoyed (EPA) by road traffic noise ('000)				
Year	**Option E1**	**Option 1**	**Option E6**	**Option E4**	**Option E8**
2015	0	0	+2.2	+2.2	+2.2
2030	N/a	n/a	+2.8	+2.8	+2.8

7.8.19 The noise impacts of changes in road traffic for Options E1 and 1 in 2015 are compared with the 2015 Base Case. These Options produce no change in the EPA by road traffic noise. The traffic noise effects of Options E6, E4 and E8 are all the same. The impacts are concentrated around Heathrow, including M25 Junctions 14 to 15, and parts of the A30. The total change in EPA is assessed as an increase of 2,200 people for these Options. For 2030, the Base Case is the road network for Package 2. Compared with this, the traffic noise effects for Options E6, E4 and E8 are limited to the Heathrow area, affecting a similar set of roads in this vicinity to that in 2015. The assessment results in an increase in EPA of 2,800 people.

Surface Access Noise: Railways

7.8.20 Table 7.30 gives the results (total EPA) from the GOMMMS strategy level assessment for railway noise.

Table 7.30 – Heathrow Surface Access Noise Assesssment: Railways

	Total change in Estimated Population Annoyed (EPA) by railway noise ('000)				
Year	**Option E1**	**Option 1**	**Option E6**	**Option E4**	**Option E8**
2015/2030	+4.7	+4.7	+6.4	+6.4	+6.4

7.8.21 The railway noise impacts for the options at Heathrow are compared against the Base Case which is the Maximum Use of Existing Runways Scenario. The impacts apply for 2015 and also for 2030 where this is appropriate. The increases in rail services and associated noise impacts for Options E1 and 1 are virtually the same. The greatest noise impact will occur on a line between Acton Wells and Cricklewood where a 6 train per hour passenger service (SISTERHEX) is proposed for a line currently only used for freight. The remaining noise impacts will arise on the line between Reading and Staines, Staines and Terminal 5 and Virginia Water and Byfleet. The total change in Estimated Population Annoyed (EPA) by railway noise for both Option E1 and Option 1 is an increase of 4,700 people.

7.8.22 For Options E6, E4 and E8 there are similar or increased noise impacts on the lines affected by Options E1 and 1. In addition, there will be increased noise impacts for people affected by the main line to the West between West Ealing through Hayes and Slough to Reading. The total increase in EPA would be 6,400 people for these Options.

7.8.23 This assessment should be considered as a worst case appraisal. It is based on initially assumed rail services, which, given their passenger forecasts, may not all be implemented. However, changes in service levels would not be expected to alter the relative positions between the different options in terms of railway noise impacts.

7.9 Environment: Local Air Quality Impacts

Introduction

7.9.1 Air quality results are provided for representative options at each airport, for 2015 and 2030 as appropriate. The air quality statistics used as assessment criteria for defining poor air quality in SERAS Stage Two are: annual mean Nitrogen Dioxide concentrations of 40µg/m^3; and the 90th percentile of running 24-hour mean PM_{10} concentrations of 50µg/m^3. In practice, annual mean PM10 compared to a statistic of 40µg/m^3 is also reported, as the 90th percentile values are a simple factor of these. The Air Quality Key Indicator for Stage Two of SERAS is 'the number of people exposed to an exceedance of the air quality standard, weighted by the degree of exceedance'. The higher the key indicator, the worse the air quality impact is.

2015 Results

7.9.2 Figures 7.68 to 7.71, 7.73 and 7.75 illustrate the air pollution contours for Heathrow options in 2015. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM_{10} and 90th percentile of 24hour mean PM_{10} where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 7.31 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 7.32 provides similar results for PM_{10}.

7.9.3 Heathrow options in 2015 result in large key indicator values for annual mean Nitrogen Dioxide. The base case scores best, but results in over 14,000 people exposed to exceedances. Option E6 scores the worst, with around 42,000 people exposed. Expressed as a simple average of annual mean concentration, airport related Oxides of Nitrogen across the options in 2015 account for between 57% and 64% of total Oxides of Nitrogen in the Heathrow study area. ‘Airport related’ includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the ends of the runway, associated with acceleration during take-off roll. The figures also show the major roads of the M25 and M4 with areas of exceedance.

7.9.4 Results clearly show that Heathrow options in 2015 have little impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24hour mean PM_{10} in any option. Expressed as a simple average, airport related PM_{10} in 2015 accounts for less than 9% of total PM_{10} in the Heathrow study area. Some locations do exceed air quality statistics, but these are solely over the runways. As no option results in population exposed to exceedances of the air quality statistics, figures are only provided for the package option with the largest most extensive PM_{10} contours, for illustration.

Table 7.31: Nitrogen Dioxide Key Indicators - Heathrow 2015

Package	Option	Population exposed to exceedance of annual mean NO_2 of 40 μg/m^3							*Total population exposed*	Key Indicator
		40-50 μg/m^3	50-60 μg/m^3	60-70 μg/m^3	70-80 μg/m^3	80-90 μg/m^3	90-100 μg/m^3	>100 μg/m^3		
1	Base Case	8828	4195	1095	151	78	0	0	*14347*	**21497**
3	Option E1 - Partial Mixed Mode	9563	4319	1375	197	177	0	0	*15631*	**23999**
4	Option 1 - Full Mixed Mode	11986	5013	1808	590	135	78	0	*19610*	**30939**
5a	Option E6 – New 2000m rwy north of A4	27744	6573	4551	1499	972	197	177	*41713*	**67820**
5b	Option E4 – New 2000m rwy north of A4 but no new stands	23916	6422	2648	1599	231	213	0	*35029*	**53533**
5c	Option E8 – New 4000m rwy north of A4	18315	7911	5308	1596	936	245	135	*34446*	**63540**

Table 7.32: PM_{10} Key Indicators - Heathrow 2015

Package	Option	Annual mean PM_{10} of 40 μg/m^3		90th Percentile of 24hour mean PM_{10} of 50 μg/m^3	
		Total population exposed	Key Indicator	Total population exposed	Key Indicator
1	Base Case	0	**0**	0	**0**
3	OptionE1 - Partial Mixed Mode	0	**0**	0	**0**
4	Option 1 - Full Mixed Mode	0	**0**	0	**0**
5a	Option E6 – New 2000m rwy north of A4	0	**0**	0	**0**
5b	Option E4 – New 2000m rwy north of A4 but no new stands	0	**0**	0	**0**
5c	Option E8 – New 4000m rwy north of A4	0	**0**	0	**0**

2030 results

7.9.5 Figures 7.72, 7.74, and 7.76 to 7.78 illustrate the air pollution contours for Heathrow options in 2030. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM_{10} and 90^{th} percentile of 24hour mean PM_{10} where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 7.33 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 7.34 provides similar results for PM_{10}.

7.9.6 Heathrow options in 2030 result in large key indicator values for annual mean Nitrogen Dioxide. Of the 2030 options, option E4 scores best, but results in over 33,000 people exposed to exceedances. Option E8 scores the worst, with over 43,000 people exposed. The 2030 situation is better than 2015 for options E4 and E6, but worse for option E8. The 2015 base case still scores best, (but with over 14,000 people exposed to exceedances). Expressed as a simple average, airport related Oxides of Nitrogen across the options in 2030 account for between 60% to 63% of total Oxides of Nitrogen in the Heathrow study area. ‘Airport related’ includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the holding points. The figures also show the major roads of the M25 and M4 with areas of exceedance.

7.9.7 Table 7.33 results clearly show that Heathrow options in 2030 (as in 2015) have little impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24 hour mean PM_{10} in any option. Expressed as a simple average, airport related PM_{10} in 2030 accounts for less than 9% of total PM_{10} in the Heathrow study area. Some locations do exceed air quality statistics, but these are solely over the runways. As no option results in population exposed to exceedances of the air quality statistics, figures are only provided for the package option with the largest most extensive PM_{10} contours, for illustration (option E6).

Table 7.33: Nitrogen Dioxide Key Indicators - Heathrow 2030

Package	Option	Population exposed to exceedance of annual mean NO2 of 40 µg/m³							*Total population exposed*	Key Indicator
		40-50 µg/m³	50-60 µg/m³	60-70 µg/m³	70-80 µg/m³	80-90 µg/m³	90-100 µg/m³	>100 µg/m³		
5a	OptionE6 – New 2000m rwy north of A4	27440	6213	4124	1604	602	115	98	*40196*	**63040**
5b	OptionE4 – New 2000m rwy north of A4 but no new stands	22288	6430	2916	1369	238	136	0	*33377*	**51378**
5c	OptionE8 – New 4000m rwy north of A4	24509	7887	5667	3624	935	546	295	*43463*	**81796**

Table 7.34: PM_{10} Key Indicators - Heathrow 2030

Package	Option	Annual mean PM10 of 40 µg/m³		90th Percentile of 24hour mean PM10 of 50 µg/m³	
		Total population exposed	Key Indicator	Total population exposed	Key Indicator
5a	Option E6 – New 2000m rwy north of A4	0	**0**	0	**0**
5b	Option E4 – New 2000m rwy north of A4 but no new stands	0	**0**	0	**0**
5c	Option E8 – New 4000m rwy north of A4	0	**0**	0	**0**

Sensitivity Tests

7.9.8 Two NO_2 sensitivity tests have been carried out for 2015 at Heathrow, applying the revised assumptions set out in Table 6.5. Sensitivity test 1 was applied to Option E6: sensitivity test 2 to Option E4. The effects in terms of the numbers of people exposed to exceedances of NO_2 are summarised in Table 7.35.

Table 7.35: Effects of Air Quality Sensitivity Tests

	Total population exposed to exceedance of annual mean NO_2 of 40 $\mu g/m^3$		
	Core assumptions	**Sensitivity test 1**	**Sensitivity test 2**
Option E6	41,713	25,929	
Option E4	35,029		5,235

7.9.9 The sensitivity tests have an increasing effect in reducing aircraft emissions leaving fewer people exposed to exceedances of NO_2. With the more demanding assumptions in sensitivity test 2, the population still left exposed to exceedances of annual mean NO_2 with a new runway Option E4 is just over 5,000, predominantly in areas around the A4 and in Harlington to the north of the airport, and around the M4 in West Drayton, to the north of the new runway, and Hayes.

7.10 Employment

Employment Forecasts

7.10.1 The employment forecasts for each option based on current employees at Heathrow and projected forwards to 2015 and 2030 are shown in Tables 7.36 and 7.37. The combination of passenger forecasts, productivity growth of 1.5% per annum and assumed on/off site employment produces a range of results. Total direct on/off site employment at Heathrow ranges between 75,000 for maximum use of existing runways and 128,000 with an additional runway in 2015. 2030 estimates for additional runway options indicate that continuing productivity gains will mean that total direct on/off site employment at the maximum reaches 102,000.

7.10.2 It is estimated that Heathrow options would generate a maximum additional 49,000 direct on/off site jobs by 2015 over current levels, with this figure reducing to 23,000 by 2030. At the maximum, the additional indirect employment generated by the runway options in 2015 is 15,000 new jobs and 7,000 by 2030.

Table 7.36: Current and forecast employment at Heathrow by option 2015

Current & Forecast Employment by Option	Current 1998	Max Use 2015	E1 2015	1 2015	E6 2015	E4 2015	E8 2015
Direct on-site	68,500	65,200	68,900	77,400	110,300	96,600	92,800
Direct off-site	10,300	10,100	10,800	12,300	18,000	15,700	15,000
Indirect	23,600	22,600	23,900	26,900	38,500	33,700	32,300
Total Employment	102,400	97,900	103,600	116,600	166,800	146,000	140,100
Passengers (mppa)	62	77	81	91	131	114	110
Direct employees/mppa	1,270	985	984	983	982	982	983
Total employees/mppa	1,651	1,280	1,279	1,278	1,277	1,277	1,277

Table 7.37: Current and forecast employment at Heathrow by option 2030

Current & Forecast Employment by Option	Current 1998	Max Use 2030	E6 2030	E4 2030	E8 2030
Direct on-site	68,500	60,700	87,700	77,500	84,300
Direct off-site	10,300	9,600	14,300	12,500	13,700
Indirect	23,600	21,100	30,600	27,000	29,400
Total Employment	102,400	91,400	132,600	117,000	127,400
Passengers (mppa)	62	89	130	115	125
Direct employees/mppa	1,270	787	786	786	786
Total employee/mppa	1,651	1,023	1,021	1,022	1,021

7.11 Land Use/Urbanisation

Summary

7.11.1 The core catchment area for Heathrow is generally densely developed; with most open space allocated as part of the Green Belt. The capacity review has indicated that in these conditions it is difficult to isolate likely future housing sites without a detailed knowledge of the particular areas. This is because, unless Green Belt sites are lost to housing development, the boroughs are reliant on intensification, and windfall and brownfield sites as sources of future housing land.

7.11.2 The scope for a further major expansion of Heathrow is limited by very low unemployment levels and strong competition from high tech manufacturing and service firms in the Western Policy Area and the M4 corridor. There is already emerging a shortage of homes for key workers.

7.11.3 Currently the airport accounts for 14.5% of the jobs in its Core Catchment Area (Hillingdon, Hounslow, Ealing and Spelthorne). This could increase to 23% in 2015 with the largest airport development option, but would decline to 17.5% in 2030 with continued growth in labour productivity.

7.11.4 There is a large forecast housing shortfall in Heathrow's core and wider catchment areas, ie, the difference between TEMPRO housing projections and the housing provision in RPG. The shortfall is 106,000 in 2015 and 124,000 in 2030, out of around 1.3 million houses in the combined area. The largest airport option accounts for 28% of total employment growth to 2015, but only 8% to 2030. On this basis, the largest airport development option could be said to demand some 29,400 houses above RPG provision by 2015 and 9,600 by 2030, adding to current pressures in the Western Policy Area. In terms of housing capacity, it is unlikely that any of the larger Heathrow options could be accommodated without major Green Belt releases and a major reconfiguration of the existing settlement structure.

7.11.5 The development implications of off airport employment vary significantly between options, with requirements for up to 131 hectares in 2015 of off-site employment land within reasonable proximity to the airport. The UDPs of all four districts in the core catchment area offer employment land, particularly large brownfield sites in Ealing, but it is unlikely that sufficient vacant or redevelopable land exists in the core catchment area to accommodate the larger airport requirements. Additional land releases would probably be required to fully meet maximum airport requirements.

Employment Land Requirements

London Borough of Hillingdon

7.11.6 Hillingdon has a thriving local economy with pockets of deprivation. The number of jobs in the borough is rising steadily and the unemployment rate is below average for Greater London and Outer London. There is a corridor of vacant and condemned sites in the Hayes/West Drayton corridor, which have become available due largely to the collapse of the defence industry. Over 5,000 jobs have been lost in recent years.

7.11.7 It is policy in Hillingdon to actively encourage the establishment of airport related industries in the borough, including those attracted to the area in part because of Heathrow. It wants to encourage stronger links between existing companies and workers and airport related activity. At the same time however, it does not want to become over dependent on Heathrow.

7.11.8 Examination of the adopted Hillingdon UDP (1998) indicates that there is some scope for additional direct off airport and indirect employment to locate on existing allocated sites within the district; these include the sites in the Hayes/West Drayton corridor specifically. If additional land is needed, similar issues concerning additional land releases will apply, as discussed under Overall Capacity in the section on housing below.

London Borough of Hounslow

7.11.9 Hounslow is a major employment centre providing 100,000 jobs. Heathrow airport plays an integral role in the local economy both as the most important local source of employment and through the associated activities, office and warehouse based located within Hounslow.

7.11.10 UDP employment policies seek to maintain and enhance the importance of Hounslow as an employment centre. The adopted plan (1996) notes that there are several B8 (warehouse) uses close to the airport, and that these are encouraged in these locations as they have the advantage of integrating land use and transport, reducing the length and time of journeys and linking warehousing to the airport and the national road network. The main employment area in the borough is the Great West Road Employment area, containing 384,000 sq m of floorspace, 60% of which is offices.

7.11.11 There is also a requirement to regenerate parts of the borough, particularly town centres e.g. Brentford, Feltham, Hounslow and Chiswick. As a part of this the Council is looking to concentrate office development, at high densities, in these centres.

7.11.12 Examination of the UDP identifies a range of employment sites in the borough, and implies, in the regeneration areas particularly, that there are some vacant sites. If there were insufficient vacant or redevelopment sites, similar issues concerning land releases will apply.

London Borough of Ealing

7.11.13 Ealing has a wide range of employment sites within it, including the extensive industrial estates of Park Royal and Perivale. Historically the borough economy had a strong manufacturing base, this continues to be eroded and has resulted in the availability of 80 acres of large brownfield sites in traditional industrial areas, including the Atlas Road site and Southern Gateway site in Park Royal.

7.11.14 The borough's planning policies seek to encourage the regeneration of vacant employment sites, and identifies 'renewal areas' and 'opportunity sites'. Although the adopted UDP (1995) notes the loss of employment land to other uses, namely retail and housing, it seeks to retain employment use on these established sites. It therefore identifies a series of 'major employment locations' within which employment uses are to be retained.

7.11.15 The UDP seeks to discourage large scale warehouse and distribution employers within areas, particularly Park Royal, in order to reduce lorry flows and increase employee numbers (by raising employment densities). This area therefore would suit only particular types of indirect airport employment, namely those that are based in offices, and not in larger warehouse developments. At the same time, Park Royal has an established history of catering firms, and therefore provides an obvious location for airport related caterers to locate.

7.11.16 Given the relatively wide range of existing employment sites in the borough, it is assumed that there is sufficient flexibility to accommodate a reasonable level of additional off airport employment. If additional land were required, similar issues concerning land releases will apply.

Spelthorne District Council

7.11.17 There is currently 709,000 sq m of existing employment space (industrial, warehouse and office floorspace) in the district, representing 10% of total floorspace in Surrey. The local plan (as proposed to be adopted) notes that the airport generates high demand for employment land, including pressure for Green Belt sites. Currently, the airport employs 10% of the economically active population.

7.11.18 The local plan notes that the scope for major additional employment floorspace is constrained by the Green Belt, there being very few 'greenfield sites'. Currently there is no case for its release, and there is a natural turnover of sites and some vacant space. In 1998 there was just under 50,000 sq m (5 ha) of vacant employment land; there is potential for around 4,000 new jobs at current densities on allocated employment sites. Therefore there is potential to accommodate at least some additional indirect airport employment on existing sites in the future.

7.11.19 The local plan expects all airport related development to be located within the airport; this is clearly defined as passenger terminals, cargo facilities, maintenance facilities, oil storage, airline offices, car parking, car hire depots, catering facilities, and other developments that primarily serve the airport. The local plan therefore makes no provision for additional indirect employment.

7.11.20 Examination of the plan indicates that there is some scope for indirect airport employment to locate on existing allocated sites within the district. If additional land is required, issues concerning additional land releases will apply.

Housing Capacity

7.11.21 The largest development option would require an additional 64,400 employees in 2015 (covering direct on-site and off-site and indirect employment) over current (1998) levels declining to 30,200 by 2030. The RPG housing provision in the core and wider catchment areas is for an additional 204,000 houses to 2030.

7.11.22 Mixed mode operation on the existing runways would account for 6% of forecast employment growth to 2015 in the core and wider catchment areas, but additional runways would account for between 16% and 28% of forecast employment growth. In terms of overall impact on housing allocations, it is deemed that the options which make alternative uses of the existing runways would present low pressures within the area – whilst additional housing is required, the levels forecast are not deemed to present major problems when considered against allocation forecasts. But any of the options which involve new runways will create major pressures on the housing market in the surrounding areas. A summary assessment of the scope for future additional provision is provided below.

7.11.23 The four boroughs/districts comprising Heathrow core catchment area are generally built up with remaining land being Green Belt. In these areas therefore, the intensification of existing sites, and the adequate utilisation of windfall sites and brownfield land provide the most likely source of future housing sites to accommodate airport employees.

7.11.24 The settlement structure and policy context is as follows. The built up area of Hillingdon is densely developed and accounts for about half of the borough area, the remainder is open space, predominantly Green Belt. The main settlements are Hayes, West Drayton, Uxbridge and Harefield.

7.11.25 In 1991 there were 204,400 people living in LB Hounslow in 88,300 dwellings. The five main centres in the borough, Hounslow, Chiswick, Feltham, Hounslow West and Brentford, have coalesced to form a continuous built up area.

7.11.26 UDP policies seek to protect the local environment and retain housing land. Following major housing development in the 1980s, most housing is now concentrated in the eastern and central parts of the borough (Chiswick), leading to concerns about ‘town cramming’ in these areas. Most recently, demand for housing has largely been met by conversions to smaller units. The UDP indicates that this is not a long term solution, as a high proportion of the existing housing stock is not suitable for conversion. Policies are in place to prevent the loss of residential space and to increase the density of properties where appropriate. It is accepted that due to development land constraints housing demand in the borough will continue to outstrip supply.

7.11.27 Ealing has a population of 293,000 (1992) and comprises five distinct settlement areas, including Acton town centre, the Ealing area, Hanwell, Park Royal, and the Greenford, Northolt and Perivale Area. It is generally urbanised in character, with pockets of Green Belt to its western margins and widespread coalescence between different neighbourhoods. The UDP refers to pressure for housing and other development to the west of the district, i.e. those areas closest to Heathrow.

7.11.28 Via its development sites at Park Royal, Hanwell and Perivale, the borough provides a range of employment and residential development sites. The borough contains several regeneration areas (Hanwell, Southall, Park Royal) all of which would benefit economically from the location of additional employment and residential developments in their proximity.

7.11.29 Sixty per cent of Spelthorne's area is protected by Green Belt; the remainder is built up area. There is limited scope for large scale urban expansion or a new settlement, without the erosion of the Green Belt and/or infilling of major water supply reservoirs.

7.11.30 There are five main settlements in the district: Staines, Ashford, Sunbury, Shepperton, and Stanwell. These are, in the main, joined together as part of a continuous urban fabric. Between the 1930s and 1950s there was large scale residential expansion in the area. This extended the built up area to its current boundaries, with the Green Belt designation preventing the development of further greenfield sites.

7.11.31 For the last forty years, additional housing development has been restricted to the intensification and recycling of land within the built up area. For the same period it has not been possible to meet demand for housing within the district.

7.12 Integration Impacts

Regional / sub-regional policy

7.12.1 Heathrow Airport impacts on the sub-regions of the Thames Valley (including the Western Policy Area) and the Blackwater Valley. The impacts of an expanded airport are discussed below under the headings of employment/labour force, housing and transport infrastructure.

Employment / Labour Force

7.12.2 In a low growth scenario at Heathrow, the impacts on employment and the labour force generally are likely to be positive. Although the labour pool has little capacity, this is largely due to commuting to London that can be reversed by the development of strong business clusters around the airports. With the strength of the M4 corridor and the record of companies being retained in the region, these clusters are likely to increase in variety and strength the larger the growth at the two airports. This must be tempered however by the policy aim of sustainable growth. It is unlikely that continued expansion at the present rate can be continued in a sustainable manner. Large scale growth at Heathrow could therefore have the effect of compromising the underlying strategy contained in regional guidance.

7.12.3 The nature of clustering around Heathrow Airport points to a continuation of similar high-technology, R&D sectors expanding further along key corridors such as the M4 corridor and continuing to utilise the knowledge base of the Oxford-Cambridge arc. This will consolidate the employment profile of the region, thus doing little to assist people entering or re-entering the job market. What it will do however, particularly through the learning centres of Oxford and

Cambridge, is serve to provide the requisite training and skills profile to continue the high-technology clustering in the sub-region.

Housing

7.12.4 In an area that experiences such high pressure on housing land and prices, the ability to accommodate housing growth created by expansion at Heathrow is questionable. Particularly in respect of the types of businesses that will continue to cluster in the vicinity of Heathrow, and the corresponding types of worker that will be attracted, the cycle of current residential patterns would ideally be repeated. In other words, there would be further pressure on large, spacious, greenfield developments to house a high skill workforce. With the restrictions on Green Belt release for development, this is not a realistic option.

7.12.5 Development is therefore to be focused on brownfield development closer to town centres. In the centres of the Thames and Blackwater Valleys, this inevitably lends itself to higher density affordable housing. This would infer that affordable housing targets will have a better chance of being met, but the sheer level of job creation in the area caused by airport expansion will reduce the overall levels. Nevertheless, brownfield development levels will almost certainly rise, provided developers wish to develop in these centres. The increase in jobs created by the airport will improve the likelihood of this occurring.

7.12.6 The policy of providing housing close to employment areas is likely to be contributed in a slightly negative way by expansion at Heathrow. Although increased town centre living, particularly by lower skilled workers in affordable housing will increase. However, the majority of off-site jobs created will continue to be in high technology clusters along the M4 corridor and across the Oxford-Cambridge Arc. Without strict implementation of company transport plans (which do have a greater patronage where businesses cluster) and demand management, this will lead to increased car-based travel.

Transportation / Infrastructure Improvements

7.12.7 Overall, the impact of development at Heathrow on transportation infrastructure is positive. This assumes however, that an acceptable package of transport proposals given in the regional guidance are implemented. As such, any increase in the capacity of Heathrow will have the effect of kick-starting rail development and improvement, although this will mostly be links into London or directly into the airport.

7.12.8 Increased high-technology business clusters are likely to have the effect of localising a small percentage of the local high-skill workforce that commutes to London, thus reducing the need to travel and for much long distance commuting to occur. However, inevitably the associated rail improvements will have the counterbalancing effect of increasing commuting into London for other workers. Also, it will increase the possibility of long distance commuting the other way, i.e. from Greater London into the new business clusters that will be created.

7.12.9 In a high growth scenario, the impact is likely to be negative. It is unlikely that the improvements identified in regional policy will be sufficient to support the increased levels of road and public transport usage. With the existing pattern of development along corridors and arcs continuing, only a radical combination of large scale infrastructure developments and strict demand management measures are likely to be sufficient to cope.

Social Impacts

Low Growth Scenario

7.12.10 Under the lower growth scenarios (up to 2015), around an additional 14,000 jobs are forecast to be generated in total – by Option 1. Of these, over 4,000 are forecast to be low skill in nature, with potentially 2,500 being located on-site and 1,500 off-site.

7.12.11 In terms of filling both the on-site and off-site jobs, in 1998 there was a shortage of only 1,000 available jobs in the deprived districts. However, the forecasts for labour market capacity up to 2016 indicate that the number of available jobs may only rise slightly whereas the low skill workforce could rise considerably, possibly sufficient to result in over 6,000 surplus workers.

7.12.12 As such, several thousand of the additional jobs generated could be accommodated in each of the three deprived districts in the CCA. The largest proportions would be in Ealing and Hillingdon because it has the highest available resident labour force for low skill workers.

7.12.13 There is likely to be high levels of movement between the three deprived boroughs, both to access on-site and off-site jobs. In order to reach the maximum numbers possible in each borough, it would require improved bus services to serve them, either in the form of the existing public network or private works buses provided by employers.

High Growth Scenario

7.12.14 Under a high growth scenario (also up to 2015), up to 64,400 jobs could be generated – by Option E6. Of these, over 21,000 could be low skill in nature, with potentially 13,300 being located on-site and over 7,700 off-site.

7.12.15 With the high growth scenario peaking around 2016, the labour market situation will be similar to the low growth scenario, i.e. a maximum surplus of 6,000 workers. As such, this worker surplus can fill a fair percentage of airport-generated employment but clearly several thousand jobs will need to be filled by workers from elsewhere.

7.12.16 Again, in order to fill even this percentage of the total jobs created in the three deprived districts, it will require improvements to existing bus services and possibly the provision of works buses.

8 Appraisal of Options at Main Sites: Gatwick

8.1 Options Appraised in Stage Two

8.1.1 Two options carried forward from Stage One have been appraised at Gatwick: one with one new runway and one with two. As currently envisaged in the land-use planning system, Gatwick operates as a single runway, two terminal airport with a capacity of 40 mppa. It was assumed that, under pressure of long term demand growth, maximum use of the existing runway could see capacity increase to 46.5 mppa (see Figure 8.1 for airport location).

8.1.2 Option 1 adds a new full length runway 385m to the south of the existing runway, with no stagger. Dependent operations would apply to this close parallel runway pair, probably with landings on the southern runway.

8.1.3 Option E1 adds two new full length runways to the existing runway. A new runway is added some 2900m to the north, staggered 2000m to the west, and a new runway is added 1035m to the south, permitting independent operations on the three runways. The new northern runway would be operated only to and from the west, to avoid overflying Horley, with the new southern runway operating to and from the east. The existing runway would continue to operate in mixed mode.

8.1.4 The Gatwick options appraised are summarised in Table 8.1. Figure 8.2 shows the existing airport layout and Figure 8.3 shows a revised layout to make maximum use of the existing runway. Option 1 is shown in Figure 8.4 and Option E1 in Figure 8.5.

Table 8.1: Options Appraised at Gatwick

Option	Description	Terminal capacity, mppa	Runway capacity, ATM	Year of Introduction
	Current Land Use Planning System	40	260,000	
	Maximum Use of Existing Runway	46.5	260,000	
1	New runway 365m to south of existing runway, making close parallel dependent pair	62	378,000	2011
E1	Two new runways operated in segregated mode. One 2900m to north and one 1035m to south of existing runway	115	675,000	2011 and 2021

8.2 Capital Costs

Introduction

8.2.1 Table 8.2 below shows the estimated incremental capital costs for each option above the 46.5mppa maximum use capacity of the existing runway. Table 8.3 gives the breakdown of surface access (road and rail) costs.

Table 8.2: Estimated Incremental Capital Costs for Gatwick Options above Max Use Case (£ million)

Item	Option 1	Option E1
Capacity	62 mppa	115 mppa
Terminals & Satellites		
Terminal Buildings	290	891
Satellite Buildings	80	283
Baggage Handling & conveyors	66	154
Total	**436**	**1328**
Aircraft Pavements		
Runways	32	64
Taxiways	68	234
Aprons / Stands	35	163
Total	**135**	**461**
Enabling Works & Infrastructure		
Demolition, Earthworks, etc	27	60
Car Parking	123	401
Utility Services	20	84
Airside Roads and public Road diversions	14	114
Tracked Transit	99	510
Drainage	10	23
Landscaping	10	21
Total	**303**	**1213**
Navigation Aids (ATC, ILS & AGL)	**7**	**23**
Cargo & Maintenance		
Cargo buildings & aprons	28	60
Hangar/ Maintenance Buildings & aprons	74	98
Total	**102**	**157**

Item	Option 1	Option E1
Support Facilities, etc		
Support facilities	22	47
Offices	15	44
Other facilities / services (inc. fuel, fire, security, underground link)	18	42
Total	**55**	**133**
On-costs	259	829
Contingencies	324	1036
Land Costs	184	448
Sub-total: Airport Development Costs	**1805**	**5628**
Airport Development Costs per mppa provided above 46.5 mppa Base Case	116	82
Costs of Associated Surface Access	**47**	**355**
Total Capital Costs	**1852**	**5983**
Total Capital Costs per mppa provided above 46.5 mppa Base Case	119	87

Table 8.3: Estimated 'Airport Specific' Surface Access Costs (£ million)

Item	Option 1	Option E1
Road Schemes		
M23 J9 to J9a widening D2(M)-D3(M)	13	n/a
M23 J9 to J9a widening D2(M)-D5(M)	n/a	27
Widen spur west of J9a D2-D3	34	n/a
Widen spur west of J9a D2-D4(M)	n/a	54
Access to new North Terminal	n/a	24
A23 diversion – included in Airport Development Cost		
Sub Total	**47**	**105**
Rail Schemes		
Croydon underpass	n/a	250
Sub Total	**0**	**250**
Total	47	355

Airport Option Costs

8.2.2 Current planning strategy at Gatwick is focused on accommodating 40mppa within the existing site. However, through greater use of larger aircraft and off-peak slots, it is considered that an additional 6.5mppa could be accommodated within the same facility provision. No cost has therefore been allocated to this increase in capacity.

8.2.3 Enabling works costs for the options are low, mainly due to the nature of the site requiring comparatively small volumes of earthworks.

8.2.4 The tracked transit system contributes 14% of the cost of Option E1 (8% to Option 1). In total, it is longer than for any other equivalent SERAS option and costs per mppa for the system are higher than at any other site except for some Heathrow options.

8.2.5 Car parking costs at Gatwick are about £7 million per mppa, slightly higher than at Stansted, but much higher than at other sites. This appears to be due to a high number of spaces provided and because the majority is in multi-storey or decked construction.

8.2.6 Although not included in the estimates, a cost premium may be expected for working in operational areas. This may occur with the construction of taxiways immediately south of the existing runway.

8.2.7 Land costs contribute 10% and 8% of the Airport Development Costs of Options 1 and E1 respectively. These are amongst the highest land take costs of all sites. This is primarily due to the high proportion the acquired land being commercial and the high value of such land in the area.

Surface Access Costs

8.2.8 The rail access costs do not include for Gatwick Station and Brighton mainline upgrades which it is assumed would be fully funded by the local train operating company and track owner. Option E1 includes a rail underpass at Croydon.

8.2.9 Road costs are for road widening and for a new road, all providing access from Junction 9 of the M23. Diversion of the A23 to the south of the airport (at grade in Option 1 and tunnelled in E1) is included in the Airport Development Cost since it is a necessary consequence of construction.

8.2.10 Required improvements to the strategic road network in Option E1, ie those not specifically required to accommodate airport related traffic, are on the M23 from junctions 8 to 10 (dual 3 up to dual 4) and unspecified improvements to the A264 (east of the M23). The combined cost for these works would be about £57 million.

8.3 Demand Forecasts

8.3.1 Forecast passenger movements, ATMs and passengers per passenger ATM for each Gatwick option are summarised at 5 year intervals between 2000 and 2030 in the following tables:

- Table 8.4: Current Land Use Planning System
- Table 8.5: Maximum Use of the Existing Runway
- Table 8.6: Option 1
- Table 8.7: Option E1

8.3.2 The principal features of the demand forecasts for each option are summarised below. In the forecasting it has been assumed that both charter services and low cost services could operate at Gatwick.

Current Land Use Planning System

8.3.3 Gatwick Airport is currently operating very close to its runway capacity, so while the planning system allows for 40 mppa, the lack of additional runway capacity means that additional passenger throughput can only be achieved by an increase in passengers per ATM. Total passengers at Gatwick are actually higher in this package than with maximum use of the runway. This is because charter demand, which diverts to Luton in the maximum use option, remains at Gatwick due to the heavy constraint that Luton is under in the current land use planning system. This results in a P/PATM of 174 instead of 160 in the maximum use case and therefore larger passenger numbers.

Maximum Use of the Existing Runway

8.3.4 This option has the same runway capacity as envisaged in the land use planning system, and it is this runway constraint that dominates in the period to 2030. Passenger throughput is limited to less than 40 mppa until after 2020. Despite the ATM constraint, the number of passengers is forecast to continue to grow beyond then as the number of passengers per ATM continues to increase. The greatest absolute growth is in passenger numbers on scheduled USA and short haul services, less so on domestic and long haul services. Charter passengers decline from the current 12 mppa to 8 mppa in 2015 and 5 mppa in 2030. The number of I to I interliners grows from 3 mppa to 4 mppa then stays at around that level. Leisure trips are forecast to dominate trips to/from the UK, increasing from some 24 mppa in 2000 to 24 mppa in 2015 and 26 mppa in 2030. The number of business trips is forecast to increase from 4 mppa in 2000 to 6 mppa in 2015 and 10 mppa in 2030. Gatwick too becomes more local. Trips to/from London and the South East are 83% of Gatwick's trips to/from the UK in 2000 but 89% by 2015 and 92% by 2030.

Option 1

8.3.5 The additional runway capacity introduced in 2011 is fully utilised from then, by a large increase in short haul ATMs and smaller increases in ATMs on USA and long haul routes. The additional runway capacity in this option encourages a small increase in charter traffic, but, from the time the additional capacity is introduced, scheduled services are forecast to account for over 75% of Gatwick's passengers. The number of I to I interliners increases to a maximum of 9 mppa with the second runway. Leisure trips to/from the UK increase to 33 mppa in 2015 and 35 mppa in 2030 and business trips to 9 mppa in 2015 and 15 mppa by 2030.

Option E1

8.3.6 Additional runway capacity, up to 486,000 ATMs is introduced in 2011 and to 675,000 ATMs in 2021. This runway capacity is always fully used. Most additional passengers are on short haul scheduled services. These account for 18 mppa out of the 32 mppa additional passengers (over maximum use of the existing runway) in 2015 and 29 mppa out of the 48 mppa additional passengers (over Option 1) in 2030. There are also additional long haul scheduled and charter passengers.

8.3.7 There is an increase in I to I interliners to 14 mppa in 2015 and 24 mppa in 2030. Leisure trips to/from the UK increase to 41 mppa in 2015 and 57 mppa in 2030. Business trips increase to 12 mppa in 2015 and 25 mppa in 2030.

Table 8.4: Gatwick Option: Current Land Use Planning System

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	2	2
	Short haul	12	12	14	14	14	16	14
	USA	5	6	7	8	10	12	14
	Long haul	2	2	2	3	3	4	5
	Total	20	21	25	27	29	34	35
Charter		12	12	10	9	9	9	9
Low cost		1	**	**	**	**	**	**
Total		32	**34**	**34**	**36**	**39**	**43**	**45**
ATMs, '000								
Scheduled	Domestic	38	32	27	27	28	29	29
	Short haul	133	137	144	147	136	146	125
	USA	19	21	14	30	35	40	45
	Long haul	10	11	11	15	17	19	23
	Total	200	201	207	219	216	234	222
Charter		50	52	44	38	36	35	35
Low cost		6	**	**	**	**	**	**
Total		256	**256**	**252**	**258**	**253**	**269**	**258**
Passengers/PATM								
Scheduled		100	107	116	124	136	144	158
Charter		230	231	231	241	253	259	269
Low cost		99	78	83	93	**	**	**
Average		125	132	136	142	153	159	174

Note: Figures in ***bold*** *are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

*** = less than 0.5 mppa or less than 500 ATMs*

Table 8.5: Gatwick Option: Maximum Use of Existing Runway

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	2	2
	Short haul	12	12	14	15	15	15	16
	USA	5	6	7	9	10	12	13
	Long haul	2	2	2	3	3	4	4
	Total	20	21	25	29	30	33	35
Charter		12	12	10	8	7	7	5
Low cost		1	**	**	**	**	**	**
Total		32	**33**	**35**	**37**	**38**	**40**	**41**
ATMs, '000								
Scheduled	Domestic	38	33	28	28	29	30	29
	Short haul	133	137	148	154	144	143	144
	USA	19	22	27	32	36	39	44
	Long haul	10	11	12	16	17	19	21
	Total	200	203	215	230	226	231	238
Charter		50	50	45	33	30	26	19
Low cost		6	2	**	**	**	**	**
Total		256	**255**	**260**	**263**	**256**	**256**	**257**
Passengers/PATM								
Scheduled		100	107	116	125	135	144	151
Charter		230	230	231	240	250	256	262
Low cost		99	**	**	**	**	**	**
Average		125	131	136	139	149	156	160

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

*** = less than 0.5 mppa or less than 500 ATMs*

Table 8.6: Gatwick Option 1: New Close-Parallel Runway

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	2	2
	Short haul	12	12	14	25	26	28	31
	USA	5	6	7	10	12	13	16
	Long haul	2	2	2	4	4	5	6
	Total	20	21	25	41	44	48	55
Charter		12	12	10	10	8	8	7
Low cost		1	**	**	**	**	**	**
Total		32	**33**	**35**	**52**	**53**	**56**	**61**
ATMs, '000								
Scheduled	Domestic	38	33	28	30	29	30	30
	Short haul	133	137	148	255	250	249	242
	USA	19	22	27	36	41	44	49
	Long haul	10	11	12	19	20	23	26
	Total	200	203	215	340	340	346	347
Charter		50	50	44	43	32	30	26
Low cost		6	2	**	**	**	**	**
Total		256	**255**	**260**	**383**	**372**	**377**	**373**
Passengers/PATM								
Scheduled		99	107	116	122	132	141	157
Charter		230	230	231	241	250	256	262
Low cost		99	**	**	**	**	**	**
Average		125	131	136	136	142	150	165

*Note: Figures in **bold** are capacity-constrained forecasts*

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

*** = less than 0.5 mppa or less than 500 ATMs*

Table 8.7: Gatwick Option E1: Two New Runways

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	3	3
	Short haul	12	12	14	33	35	56	60
	USA	5	6	7	11	13	17	19
	Long haul	2	2	2	9	10	14	15
	Total	20	21	25	55	60	90	97
Charter		12	12	10	12	10	14	13
Low cost		1	**	**	**	**	**	**
Total		32	**33**	**35**	**68**	**69**	**104**	**109**
ATMs, '000								
Scheduled	Domestic	38	33	28	41	30	45	36
	Short haul	133	137	148	327	331	478	489
	USA	19	22	27	39	43	54	57
	Long haul	10	11	12	39	42	56	60
	Total	200	203	215	446	446	633	642
Charter		50	50	45	50	38	53	47
Low cost		6	2	**	**	**	**	**
Total		256	**255**	**260**	**496**	**483**	**686**	**688**
Passengers/PATM								
Scheduled		99	107	116	125	134	142	150
Charter		230	230	231	240	254	261	270
Low cost		199	78	**	**	**	**	**
Average		125	131	136	137	144	151	158

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

8.4 Safety Risk

8.4.1 The Stage Two assessment of safety risk appraises the third party risk associated with both existing and new runway options. The full extent of the 1;10,000 and 1:100,000 designated risk areas are shown on the following Figures. The runway end origins of the 1:1,000,000 contours are also shown but extend beyond the limits of the drawings.

- Figure 8.6 – Maximum Use of Existing Runways
- Figure 8.7 – Option 1, New close dependent full length runway 385m south of the existing
- Figure 8.8 – Option E1, Two new full length runways – one 2900m to the north of the existing, staggered 2000m to the west, one 1035m to the south of the existing, allowing independet operations on the three runways with the existing runway in mixed mode

1:10,000 Risk Contour

8.4.2 The impacts of the 1:10,000 risk contours are shown in Table 8.8

Table 8.8: 1:10,000 Risk Contours

Impact	Max Use	1	E1
Increase in Area (ha) above Max Use (West and East)	W 6.9 E 6.6	W +3.2 E +3.1	W +11.1 E +10.6
Properties within contour (outside airport boundary) above Max Use	None	None	3
% of developed area affected, (outside airport boundary)	0	0	0

8.4.3 The 1:10,000 contours for each option fall almost entirely within the airport boundary and consequently have no impact on surrounding population, commercial areas or other prominent features. The new runway in option E1 results in approximately three properties lying within the 1:10,000 risk contour, which would require relocating.

1:100,000 Risk Contour

8.4.4 The impact of the 1:100,000 risk contours are shown in Table 8.9

Table 8.9: 1:100,000 Risk Contours

Impact (beyond 1:10,000 contour)	**Max Use**	**1**	**E1**
Increase in Area (ha) above Max Use (West and East)	W 77.5 E 74.2	W +31.8 E +30.4	W +111.2 E +106.3
Increase in Population affected above Max Use	88	+ 46	+ 34
% of developed area affected, (outside airport boundary)	W0 E<5	W0 E0 New W 0 New E <5	W0 E0 New W 0 New E 0
Other prominent features affected above Max Use	M23	None	Public House

8.4.5 The risk contour extends predominantly over farmland with no major impacts on communities or commercial areas. The eastern contour for the new northern runway in Option E1 extends to the western outskirts of Horley.

1:1,000,000 Risk Contour

8.4.6 The impact of the 1:1,000,000 risk contour is shown in Table 8.10

Table 8.10: 1:1,000,000 Risk Contours

Impact (beyond 1:100,000 contour)	**Max Use**	**1**	**E1**
Increase in Area (ha) above Max Use (West and East)	W 700.5 E 670.2	W +318.1 E +304.4	W +1111.9 E +1063.9
% developed area affected above Max Use	W – rural E – rural	W - None E - None	W – None E - None New W None New E + 55 – 60

8.4.7 Prominent features affected at Max Use:

- West – none
- East – M23, 1 church

8.4.8 Prominent features affected above Max Use:

- Option 1: West – None; East – A22, 1 church
- Option E1: West – A24; East – 1 school, A23

8.5 Surface Access

Infrastructure and service assumptions – roads

8.5.1 For the purposes of surface access demand forecasting, the changes to the existing road access arrangements were based on the findings of Stage One appraisals. This helped define a number of schemes associated with each option, as summarised in Table 8.11. No changes to the Reference Case road access arrangements are assumed for the appraisal of options with capacities limited to that incorporated in the Current Land Use Planning System and the Maximum Use of the Existing Runway.

8.5.2 As shown in Figure 8.13, Option 1 would require only the closure of the local road between Charlwood and Povey Cross, and the re-alignment (assumed at-grade) of the A23 near Lowfield Heath. Option E1 (Figure 8.14) would require closure of Balcombe Road at Tinsley Green and of the local road between Charlwood and Povey Cross; the A23 would need to be put in tunnel beneath the new runway. In addition, Option E1 would require construction of an airport access link to the new northern terminal.

Table 8.11: Changes to road access – Gatwick Options

Scheme	Current Land Use Planning System	Maximum Use of Existing Runways	Option 1	Option E1
1 Road closure Povey Cross to Charlwood			✓	✓
2 Road closure in Povey Cross				✓
3 New airport access road				✓
4 Widening of M23 Spur and Airport Access Road				✓
5 A23 realignment at Lowfield Heath (in tunnel in Option E1)			✓	✓
6 Closure of Balcombe Road, Tinsley Green				✓

Infrastructure and service assumptions – rail

8.5.3 Additions to rail infrastructure and services were based on Stage One findings, and shaped by discussions with DTLR and SRA in particular, on the potential to integrate airport-focused schemes with parallel improvements in infrastructure and services planned to accommodate future increases in non-airport demand.

8.5.4 As indicated in Figure 8.17, Gatwick is already served by an extensive network of rail services, which will be further enhanced in the Base Case/Max Use Options by planned changes to South Central, Thameslink and CrossCountry services. No further additions to the scale or scope of rail services are assumed for Option 1.

8.5.5 To accommodate the extra services to London needed to meet demand in Option E1, additional tracks are needed between Purley Oaks and Selhurst / Norwood Junction. These are assumed to be in tunnel through this densely developed urban area.

8.5.6 Schemes and services associated with each Option are summarised in Table 8.12 and shown in Figures 8.17 and 8.18.

Table 8.12: Changes to rail access – Gatwick Options

Infrastructure	Services	Current Land Use Planning System Maximum Use of Existing Runways	Option 1 (close parallel runway)	Option E1 (2 new runways)
	Cross Country service to Reading, Oxford, Birmingham	✓	✓	✓
Thameslink 2000	Additional Thameslink services to: Stevenage, Peterborough, Cambridge	✓	✓	✓
Brighton Line Upgrade	Increased frequency and capacity on services to Croydon, Victoria and London Bridge	✓	✓	✓
Croydon underpass	Accelerated Gatwick Express Additional express service to London Bridge			✓
	Increased frequency on orbital routes via Redhill (Guildford, Tonbridge etc.)			✓

Accessibility Analysis

8.5.7 The results of the catchment area analyses are summarised in the Appraisal Summary Tables under the heading "Accessibility", and presented in Figures 8.9 to 8.12. Public transport catchments remain largely the same between the Maximum Use option and Options 1 and E1 (air passengers within one hour's overall journey time increasing from 25 to 33 million pa, and resident workforce increasing from 0.9 to 1.1 million), reflecting the limited improvements in rail accessibility. Gatwick's fair accessibility by road is reflected in its smaller catchments (around 22 million air passengers pa, and 1 million potential workers within one hour's travel time). Catchments by road are similar between options.

8.5.8 The accessibility of options to the air passenger market in Central London is of particular interest and is summarised in Table 8.13. It should be noted that the public transport travel times quoted in this table exclude walking access and egress, and waiting times – they therefore indicate minimum travel times.

8.5.9 With the services assumed for the Maximum Use of Existing Runways, Gatwick has generally good public transport accessibility – with Victoria and London Bridge within 30 mins and all other main line stations within an hour's travel time of the airport via interchange. Table 8.13 also illustrates the limited effect on accessibility of the new rail services added in Options E1.

Table 8.13: Accessibility from Central London – Gatwick options.

	Current Land Use Planning System **Maximum Use of Existing Runways**	**Option 1- Close Parallel**	**Option E1**
By Car, minutes			
Cannon Street	100	As Max Use	105
Blackfriars	98	As Max Use	103
St Pancras/Kings Cross	103	As Max Use	108
Charing Cross	97	As Max Use	102
Victoria	94	As Max Use	99
Waterloo	93	As Max Use	98
London Bridge	96	As Max Use	101
By Public Transport, tph in minutes			

	Current Land Use Planning System Maximum Use of Existing Runways	Option 1- Close Parallel	Option E1
Cannon Street	4 minutes from London Bridge		
Blackfriars	6 tph in 37	As Max Use	As Max Use
St Pancras/Kings Cross	6 tph in 43	As Max Use	As Max Use
Charing Cross	8 minutes from London Bridge		
Victoria	4 tph in 30 4 tph in 33	As Max Use	4 tph in 25 4 tph in 33
Waterloo	5 minutes from London Bridge		
London Bridge	10 tph in 29	As Max Use	4 tph in 25 10 tph in 29

8.5.10 The main indicators of surface access demand in 2015 for each option at Gatwick are summarised in Tables 8.14 and 8.15. Corresponding results for the forecast year 2030 are presented in Tables 8.16 and 8.17.

8.5.11 Air passenger capacity and demand estimates have been described above. Note that both the amount of spare capacity and the number of interlining passengers vary between option – reflecting the interaction between Gatwick and other airports in the packages from which these estimates were derived. In 2015, this results in the forecast number of passengers requiring surface access being less in Package 2 than in Package 1, despite its higher capacity. By 2030 both Options 1 and E1 would be operating at capacity.

8.5.12 The forecast number of on-site employees in 2015 and 2030 is reported in Tables 8.14 and 8.16 and is assumed to be a function of overall passenger demand and productivity changes. Note the small reduction (from 35,400 to 33,400) in on-site employees between 2015 and 2030 for Option 1, despite the increased passenger throughput. (For further details of employment forecasts see section 8.10.)

8.5.13 In 2015, the number of peak hour employee-related car trips is forecast to remain roughly the same with maximum use of the existing runway as with the layout currently envisaged in the land use planning sytem, but to increase by about a third (from 1780 to 2370) with Option 1, reflecting the increases in total employment and a small shift towards public transport. Employee trips by public transport are forecast to increase by 40% (from 310 to 430) with Option 1. By 2030, Table 8.16 shows that the number of car trips with Option 1 is expected to remain around the same level as in 2015, while Option E1 is estimated to generate more than double the number of employee-related car trips when compared with the Base Case (3,880 in Option E1 in 2030, 1,780 in the Base Case in 2015).

8.5.14 Tables 8.15 and 8.17 summarise the air passenger mode split results for each option in 2015 and 2030 respectively. In 2015, Table 8.15 indicates a higher proportion of trips being made by public transport with Option 1 (38.4%), compared to 35.1% for the Base Case. In both the Maximum Use scenario and Option1, public transport is estimated to carry a larger share of air passenger trips by 2030 than was the case in 2015. Option E1 achieves the highest share (44.8%) of air passengers by public transport, but this increase results from the mix of passenger types and UK trip-end locations forecast for this option, rather than any significant change to the airport's public transport accessibility.

8.5.15 Finally, it is worth noting the changes in overall peak hour road traffic demand generated by these options, (see Table 8.15 and 8.17). Table 8.15 shows little difference between the current land use system and maximum use of existing runway layouts in 2015, but a 20% higher figure with Option 1. By 2030, the overall road traffic demand generated by Gatwick is estimated to increase with maximum use of the runway by around 15% (from 6,200 in 2015 to 7,200 vehicles per hour, 2-way in 2030). Road traffic with Options 1 and E1 is estimated to be 9,200 and 12,950 vehicles/hour, 2-way.

Table 8.14: Main indicators and employee mode shares – Gatwick 2015.

	Base Case	**Option 1 – Close Parallel**
Main Indicators		
Total capacity (mppa)	40	62
Total passengers requiring surface access (mppa)	35.4	44.6
Total employees on-site	25000	35400
Employees' Highway trips (AM peak hour): vehicles		
Origin	274	401
Destination	1508	1969
Total	**1782**	**2370**
Employees' Public Transport trips (AM peak hour): persons		
Origin	52	72
Destination	257	360
Total	**309**	**432**
% Public Transport trips		
Origin	15%	14%
Destination	14%	14%
Total	**14%**	**14%**

Table 8.15: Air passenger mode choice and overall surface access demand – Gatwick 2015.

Mode	Base Year		Base Case		Max Use		Option 1 – Close Parallel	
	No. mppa	%	No.	%	No.	%	No.	%
Bus	3.12	14.8%	3.29	9.3%	2.92	9.1%	4.56	10.2%
Taxi	2.79	13.2%	4.60	13.0%	4.27	13.3%	5.64	12.7%
Park and fly	5.70	27.0%	10.30	29.1%	9.29	28.9%	12.32	27.6%
Kiss and fly	5.04	23.8%	8.11	22.9%	7.46	23.2%	9.50	21.3%
Premium rail	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
National rail	4.50	21.3%	9.14	25.8%	8.17	25.4%	12.57	28.2%
Total	**21.15**	**100.0%**	**35.44**	**100.0%**	**32.11**	**100.0%**	**44.60**	**100.0%**
Public	7.62	36.0%	12.39	35.1%	11.09	34.5%	17.14	38.4%
Private	13.53	64.0%	23.05	64.9%	21.03	65.5%	27.46	61.6%
Total peak hour demand (including employees, air passengers, freight and service traffice								
Road (vehicles 2-way)	5,200		6,700		6,200		8,200	

Table 8.16: Main indicators and employee mode shares – Gatwick 2030.

Main Indicators	**Maximum Use of Existing Runways**	**Option 1**	**Option E1**
Total capacity (mppa)	46.5	62	115
Total passengers requiring surface access (mppa)	42.5	54.4	89.6
Total employees on-site	22100	33400	60700
Highway trips (average AM peak hour): vehicles			
Origin	304	364	599
Destination	1670	1997	3279
Total	**1974**	**2361**	**3878**
Public Transport trips (average AM peak hour): persons			
Origin	59	71	127
Destination	296	354	631
Total	**355**	**425**	**758**
% Public Transport trips			
Origin	15%	16%	17%
Destination	14%	14%	15%
Total	**15%**	**15%**	**16%**

Table 8.17: Air passenger mode choice and overall surface access demand – Gatwick 2030.

Mode	Base Year		Maximum Use of Existing Runways		Option 1		Option E1	
	No. (mppa)	%	No. (mppa)	%	No. (mppa)	%	No. (mppa)	%
Bus	3.12	14.8%	4.11	10.0%	5.53	10.4%	9.52	10.8%
Taxi	2.79	13.2%	5.40	13.1%	6.90	13.0%	10.88	12.3%
Park and fly	5.70	27.0%	10.98	26.7%	13.71	25.8%	21.28	24.1%
Kiss and fly	5.04	23.8%	8.81	21.4%	10.82	20.3%	16.53	18.7%
Premium rail	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
National rail	4.50	21.3%	11.87	28.8%	16.26	30.6%	30.04	34.0%
Total	**21.15**	**100.0%**	**41.17**	**100.0%**	**53.21**	**100.0%**	**88.25**	**100.0%**
Public	7.62	36.0%	15.99	38.8%	21.78	40.9%	30.56	44.8%
Private	13.53	64.0%	25.19	61.2%	31.43	59.1%	48.69	55.2%
Total peak hour demand including employee bs, air passengers, freight and service traffic.								
Road (vehicles 2-way)	5,200		7,200		9,200		12,950	

Highway appraisal results - Gatwick

8.5.16 The highway appraisal has identified a number of sections of the Motorway and Strategic Road Network that are expected to be under stress - close to or beyond their capacities - in the SERAS forecast years. These 'Background Highway Requirements' are shown in Figure 7.20. These problem links have been categorised into those where the potential solution required to solve the problem in the Base Case would be adequate also to accommodate the airport option under consideration, and those where an airport option would require a further intervention, categorised here as an increase in capacity. By 2030, in the vicinity of Gatwick, the following sections of the network would be under stress:

- M25: J2 to J16
- A23: south of Crawley

8.5.17 The additional potential scheme improvements required by the airport options are summarised in Table 8.18 and illustrated in Figure 8.15 (for Option 1) and Figure 8.16 (for Option E1).

Table 8.18: Highway capacity problems and potential schemes - Gatwick

Description	Initial Standard	Potential standard required by:					
		2015			2030		
		Current Land Use Planning System (Package 1)	Max Use of Existing Runways (Package 2)	Option 1 (Package 6)	Max Use of Existing Runways (Package 2)	Option 1 (Package 6)	Option E1 (Package 9)
Airport Access							
Airport Access to New Terminal (proposed)		n/a	n/a	n/a	n/a	n/a	D4(M)
A23 Access to Gatwick North	D2	D2	D2	D3	D2	D3	D4(M)
M23 J9 to J9a	D2(M)	D2(M)	D2(M)	D3(M)	D2(M)	D3(M)	D5 (M)
A23 Realignment	D2	D2	D2	D2	D2	D2	D2 tunnel
Strategic Network							
M23 J8 to J9	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D4 (M)
M23 J9 to J10	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D4 (M)
M23/A23 Junction Links							junction improvement
A264: M23 to B2028	S2	S2	S2	S2	S2	S2	improved S2

Rail Network Performance - Gatwick

8.5.18 Even with the increased capacity that Thameslink 2000 and the Brighton Main Line Upgrade make possible, the rail lines between Gatwick and London are forecast to be close to capacity in the peak by 2015. SERAS model runs predict that, given the improvement in accessibility with Thameslink 2000 compared to the Base Year, the majority of air passenger trips between the airport and central London will choose this route. This contributes to a peak hour load factor of 132% of seats between East Croydon and London Bridge in the 2015 peak hour in the base case, with 6% of the traffic being airport related. (The design capacity of the new Thameslink and South Central trains will be around 140% of seating for sections where standing is acceptable, which includes East Croydon-London Bridge. Nevertheless, such peak crowded conditions would not be suitable for air passengers accompanied by heavy luggage.) Fewer trips route via Victoria than now, and there is surplus capacity on Gatwick Express.

8.5.19 As noted, the shift of types of traffic between airports in Package 2 compared to the Base Case means that there is less surface access demand at Gatwick with Maximum Use of the Existing Runway. The peak load factor falls to 131%, of which just over 5% is airport related. However, with Option 1 in 2015 the additional airport demand contributes to increased peak crowding on Thameslink services, with a load factor of 134%, of which 7% is airport related.

8.5.20 Surface access demand rises further by 2030 – with no increase in rail network capacity, peak load factors are 143% (7% airport traffic) for Max Use and 145% (above design capacity for modern commuter rolling stock, 8% airport related) with option 1.

8.5.21 For Option E1 a Croydon underpass is assumed, allowing an increase in both capacity and speed for airport expresses. Demand for the accelerated service to Victoria increases threefold, but the majority of trips still go via London Bridge. The second airport express to London Bridge achieves a peak load factor of 93%, diverting both air passengers and long distance commuters from Thameslink, but the peak hour load factor between East Croydon and London Bridge is still 136% (slightly below design capacity), with 10% of traffic on these commuter trains airport related.

8.5.22 Further, substantial, infrastructure improvments at Redhill and between Purley and central London, not included in the SERAS models or cost estimates, would be needed to increase capacity and separate airport traffic from other passengers on this busy commuter corridor.

8.6 Environment: Land Take

Context

8.6.1 The consideration of environmental issues in Stage Two of SERAS builds on work undertaken in Stage One on land use, ecology, heritage, landscape and townscape, water, noise and air quality. Stage Two in addition appraises impacts on contamination and community issues. For each of these environmental topics a baseline is defined and then the results of the appraisal of each option are presented. Details of existing land uses and environmental features within the study area are provided in Figures 8.19 to 8.22. Summaries of the key impacts of each option are presented in the Appraisal Summary Table. Fuller environmental appraisal details of the baseline data and appraisal of options can be found in the supporting report.

Existing Conditions

Land Use – residential, commercial/industrial, public buildings, recreation, agriculture, planning constraints (Figure 8.19)

8.6.2 The Gatwick Airport Site is located approximately 40 km south of central London in the northern part of West Sussex. It lies within Crawley Borough, close to the southern border of Mole Valley with Reigate further north. The northern perimeter of the site is bounded by the town of Horley and the villages of Povey Cross and Hookwood, beyond these are the towns of Reigate and Redhill. To the south is the town of Crawley and various scattered properties and small settlements.

8.6.3 There are several commercial/industrial areas in the immediate vicinity of the site including warehouses, depots, a superstore, hotels, a caravan park, a sewage pumping station and a sewage treatment works. There are also two hospitals (one of which may be disused) and a place of worship close to the southern perimeter. There is a playing field also nearby and the Sussex Border Path runs to the east and west of the current site and round its northern perimeter.

8.6.4 Agriculture is the main land use in the study area with land to the north and north west predominantly of Grade 4 quality with some Grade 3; land to the south is a mixture of Grade 3 and 4. To the east the land is predominantly Grade 3. There are also three nurseries located at Fernhill to the east of the airport.

8.6.5 The airport is almost entirely surrounded by areas of Green Belt, Strategic Gap and Countryside Areas of Development Restraint within which there are restrictions on development.

Contamination (Figure 8.19)

8.6.6 There are 43 areas identified, which are potential sources of contamination. Of these there are seven sites which pose moderate or moderate/minor potential for contamination. These sites include a petrol station, farm sludge pit, trading estate, former works/depot, sewage works, scrap yard and the site of a major chemical spillage.

Ecology (Figure 8.20)

8.6.7 The following sites of nature conservation value within the Area of Search are all priority habitats in the Sussex and/or the Surrey Local Biodiversity Action Plan. There are no internationally designated sites of very high ecological value within the immediate vicinity of the site. There are, however, three nationally designated sites (of high ecological value):

8.6.8 Glovers Wood Site of Special Scientific Interest (SSSI) is almost entirely semi-natural broadleaved woodland with a calcareous gill that supports a very rich ground flora. Small-leaved lime and wych elm are present (rare in the Weald) and the site also provides habitat for some rare craneflies.

8.6.9 Hedgecourt Lake SSSI consists of a range of habitats, including woodland, grassland, and fen-marginated open water. The site supports a wide variety of animal life including several locally distributed beetles and a large breeding bird colony.

8.6.10 Clockhouse Brickworks is a SSSI designated for its geological interest.

8.6.11 There are 7 county designated Sites of Nature Conservation Interest (SINCs) or potential SINCs (of medium value) within the area of search, including the following:

- Ricketts Wood ancient semi-natural woodland.
- Three contiguous sites of ancient semi-natural woodland (Pockmires Wood, Rider Gill and Beggars Gill)
- Edolphs Copse supporting a mixture of ancient semi-natural woodland, secondary woodland and meadows.
- Withy Gill is wetland habitat with areas of wet meadowland, reedbed and open water.
- A wooded bank alongside the River Mole at Lee Street Sewage Treatment Works.

8.6.12 There are also a selection of sites considered to be of low ecological value in the vicinity of the airport which include:

- Eight ancient woodlands (although of low value there is no potential for substitution)
- Two district designated Areas of High Ecological Value (although classified of low ecological value for the purposes of this appraisal) comprised of woodland/ scrub and grassland
- Seven areas of woodland and scrub,
- Hedgerows border many of the arable fields (approximately 4km of hedgerows are located within the maximum option boundary) and some of these may be ancient or species-rich (hedgerows are not illustrated on the constraints map). These hedgerows provide wildlife corridors between habitats, particularly woodland (see above) and copses (see below).
- Approximately five small copses. Together with the hedgerows, these areas provide links to adjacent woodlands. Some of these copses may be remnants of ancient woodland, in which case there is no potential for substitution.

8.6.13 The following undesignated sites of low ecological value are located within the current airport perimeter, mainly in the north west of the site:

- Brockley Wood, an ash/ oak ancient woodland.
- Twenty hedgerows some of which may be ancient and/or species-rich
- Grassland areas which provide undisturbed areas for nesting skylarks
- Three balancing ponds supporting marginal species such as goat willow, common reed, soft-rush, hard rush, and bulrush.
- The diverted River Mole.
- A small area of woodland/scrub.

Heritage (Figure 8.21)

8.6.14 *Archaeology* - The Base Case airport site contains five known archaeological sites. Two of these have been designated as Archaeologically Sensitive areas in the Crawley Local Plan. The areas of proposed expansion contain an additional eight sites. The wider study area (500m around the maximum option boundary) contains a further 19 archaeological sites, of which 3 are Scheduled Ancient Monuments (national value).

8.6.15 Although the area covered by the Base Case airport and its proposed expansion contains a relatively low level of known archaeological sites, as defined by the National Monuments Record, this would appear likely to be a product of the relatively low level of archaeological investigation in the area in the past and the site is nevertheless likely to have a high potential to contain hitherto undetected sites. The nature of the archaeology within the Airport site and its environs is discussed below.

- Prehistoric Period (500,000 - 43BC) - Evidence of prehistoric settlement within the study area is demonstrated by a number of findspots spread throughout that area
- Roman settlement (43AD - 410AD) - The study area contains a low level of demonstrated Roman activity.
- Medieval - This period is well represented across the study area. Sites include eight moated settlements which also contain Listed Buildings (all of which are Grade II*).
- Post Medieval - This period is also very highly represented with a range of sites and findspots within the study area.

8.6.16 In the absence of contextual information regarding the above archaeological sites, all those other than Scheduled Ancient Monuments, which are of national value, and Archaeologically Sensitive Areas, which are considered to be of regional value, have for the purposes of this study been considered to be of county/district value, except for those identified as of potential higher or lower value in the Appraisal sections below.

8.6.17 *Listed Buildings* - The study area contains 76 Listed Buildings, including 9 Grade I/II*. Of these two Grade II Listed Buildings (Edgeworth House and Wing House) are within the Base Case airport boundary. In the 500m corridor surrounding the areas of proposed expansion there are an additional 47 Grade II Listed Buildings and 3 Grade I/II* Listed Buildings.

8.6.18 *Conservation Areas* - The areas of proposed expansion impinges upon one Conservation Area (Charlwood Village) to the west. The wider study area (500 m) contains two additional Conservation Areas (Ifield and Horley) while Burstow Conservation Area lies just beyond the 500m boundary.

8.6.19 *Historic Parks and Gardens* - There are no historic parks or gardens within the Base Case airport boundary, the proposed areas of expansion or the 500m study corridor surrounding these areas.

Landscape and Visual (Figure 8.22)

8.6.20 *Landscape/Townscape* - The landscape in the vicinity of Gatwick is generally low-lying with high levels of woodland, hedgerows and mature hedgerow trees that are typical of the Weald and which considerably limit intervisibility between different areas. Similarly, the Surrey Hills AONB (located a little over 5km to the north west of the site) is also well wooded and most views towards the site will be screened by the low ridge of hills to the north west of Charlwood village. Five areas of distinct landscape and townscape character have been identified within 5 km of the proposed development.

- Mole Catchment Towns and Urban Fringe contains the built-up areas of Crawley and Horley as well as the major north-to-south transport corridor formed by the railway, M23, A23 and A217. The value of this landscape has been assessed as low.

- Wooded Low Weald is an intimate and attractive landscape character area with undulating topography, sinuous woodlands and historic houses and villages that are distinctive to the region. The value of this landscape has been assessed as medium. The historic village and Conservation Area at Charlwood straddles the boundary of the Mole Catchment and Wooded Low Weald character areas.

- Open Low Weald is more open in character than the Wooded Low Weald, with the exception of glimpsed views from hilltops such as at Outwood. The Open Low Weald contains a designated Area of Local Landscape and a Conservation Area at Burstow. The value of this landscape has also been assessed as medium.

- High Weald AONB lies to the south-east of the town of Crawley. Although its importance and sensitivity is enhanced by a national designation and the presence of an Historic Garden (its value is assessed as high), the north-western fringe of the High Weald is heavily forested and this protects the landscape from the effects of development in the Mole Catchment below.

- High Weald Northern Fringe lies outside of the AONB boundary and is heavily settled. It also is visually contained by high levels of vegetation. The area contains two Areas of Special Environmental Quality. The value of this landscape has been assessed as medium.

8.6.21 *Visual* - The extent of the indicative zone of potential visual impact (ZVI) of the *maximum extent of Airport Options boundaries* is limited by the heavily wooded and well-treed character of the surrounding landscape character areas. The flat topography and extensive tree planting associated with major roads and railways means that there are few views of the airport from the low lying urban areas of Horley and Crawley. The ZVI therefore remains very close to the airport boundaries on the southern and eastern sides of the site.

8.6.22 Key visual receptors in the area include homes facing down into the Mole Catchment from the ridges at Norwood Hill and Russ Hill and the eastern fringes of the village of Charlwood. The fringes of Horley and Crawley lie very close to the airport site, but in the case of Crawley, much of this area is commercial (at Manor Royal) rather than residential. The network of lanes to the west of the airport fall within the ZVI but there are few footpaths that are likely to be used by visitors for recreational purposes.

Community

8.6.23 The area of proposed land take includes parts of six wards: Charlwood, Langley Green, Northgate, Horley East, Pound Hill North and Rusper.

8.6.24 *Community Infrastructure* - There are three tiers of settlement in the vicinity of Gatwick Airport. The urban areas of Horley and Crawley lie to the north and south respectively. The second tier comprises nucleated villages such as Charlwood to the west. The lowest tier comprises hamlets such as Tinsley Green, Fernhill, Povey Cross and Hookwood, together with scattered farmsteads and other properties.

8.6.25 The IMD ranking of the 12 baseline wards ranges from Langley Green (2,641) to Pound Hill North (7,865). This represents a range of 3,224 places, or about 38% of the national spectrum. The national IMD ranking of wards runs from 1 (most deprived) to 8,414 (least deprived). The three most deprived local wards, falling below the median rank of 4,207, are Langley Green, Northgate and Ifield. These wards lie within the built-up area of Crawley and its northern fringe, located immediately to the south of the airport boundary.

8.6.26 *Community Structure/Distinctiveness* – Work undertaken in Stage One of SERAS concludes that the long-term housing capacity of the Core Catchment Area (the districts of Reigate & Banstead, Crawley and Mid Sussex) is 4,700 dwellings within the Local Plan period. This assumed that such an increase could be accommodated by intensification of existing built-up areas, development of brownfield sites, a degree of urban fringe expansion and new “village” settlements.

8.6.27 The 1999 noise contour map indicates that intrusive levels of aircraft noise are likely to be experienced mainly by communities within the following wards: Rural South, Rusper, Charlwood, Langley Green, Northgate, Pound Hill North, Burstow and Horne, Felbridge and Horley East.

8.6.28 *Employment* - At 3%, unemployment levels within the Core Catchment Area are comfortably below the national average.

High Adverse Impacts: – Option 1

8.6.29 The loss of two nurseries from Fernhill to the east of the current airport boundary would result in LA effects. There would be a loss of 266 ha of agricultural land to the south, west and east. Approximately 50% of this land is Grade 4 agricultural land quality and 50% is Grade 3. Consequently, approximately 133 ha of BMV land would be lost due to Option 1, resulting in HA effects.

8.6.30 The cumulative effects on Heritage resources is considered to be HA largely as a result of the loss of 3 Grade II* and 4 Grade II listed buildings, and the potential for loss of undetected sites from an area of 301ha of land take. Although mitigation through prior excavation could reduce effects on archaeological resources, the cumulative effects would remain HA owing to the loss of the listed buildings.

High Adverse Impacts – Option E1

8.6.31 The loss of three nurseries from Fernhill would result in LA effects. 863ha of agricultural land would be lost due to Option E1. Approximately 70% of the land lost is of Grade 4 agricultural land quality and the remaining 30% is Grade 3. Consequently, approximately 259 ha of BMV land would be lost, resulting in HA effects.

8.6.32 There would be an extensive loss of Green Belt, (533 ha) in addition to 393 ha of district-designated Strategic Gap, resulting in HA effects.

8.6.33 The cumulative effects on Heritage resources is considered to be HA largely as a result of the loss of 6 Grade II* and 18 Grade II listed buildings, the loss of a small portion of the Conservation Area at Charlwood Village and the potential for loss of undetected sites from an area of 1065ha of landtake. Although mitigation through prior excavation could reduce effects on archaeological resources, the cumulative effects would remain HA owing to the loss of the listed buildings.

8.6.34 The cumulative effect on the local community would be HA. Relatively more deprived communities to the south of the existing airport would be subject to additional impacts. Less deprived communities to the north of the airport would also be brought into the zone of impact, including severe landtake impacts within Charlwood ward.

8.6.35 The works would result in a large increase in the airport land area and will be extensive. In addition the proximity of the works to residential properties in Horley, Charlwood, the northern edge of Langley Green as well as Glovers Wood SSSI, means that construction effects are potentially of HA significance.

8.7 Environment: Water

Existing Conditions

8.7.1 Gatwick Airport is situated within the Upper Mole surface water catchment. Within the study area there are numerous streams, which join the River Mole to flow northwards through the catchment (Figure 8.23). In addition to seven ponds around the airport that receive surface drainage, three watercourses; River Mole, Crawters Brook and Gatwick Stream, also receive direct drainage from the airport.

8.7.2 The water quality is monitored in the River Mole, Gatwick Stream and Burstow Brook. The quality of these rivers appears to deteriorate as a result of discharges from three sewage treatment works. Additionally, the River Mole appears to be affected by discharges from the airport, as there is a slight deterioration in quality immediately downstream of the runway.

8.7.3 The River Mole is a fairly ‘flashy’ river, due to the impermeable nature of the catchment. The development of Gatwick Airport has had a marked effect on flooding from the Mole after heavy rain, as the runoff is significantly faster.

8.7.4 The catchment is largely comprised of Weald Clay, which is a non-aquifer. There are small areas of minor aquifer that would support only small, probably private abstractions. There are no public water supplies (surface water or groundwater) or other licensed abstractions within the study area.

8.7.5 From a regional perspective, the available water resources are virtually fully committed. However this varies between water companies and resource zones across the region. The supply/demand balance for the resource zone that supplies Gatwick Airport is currently adequate. Using the total water consumption per passenger for BAA Airports, Gatwick Airport currently uses approximately 3% of the licensed resources in the resource zone.

Impact of options

8.7.6 The options have been assessed against a base case, which is the current land use planning system, and therefore only consider impacts that are *additional* to those assessed under the base case. The assessments consider the sensitivity of the water environment and the potential to cause harm, which includes scope for mitigation. Table 8.19 and the Appraisal Summary Table summarise the assessment for each of the water objectives, for each of the options.

8.7.7 Most of the options for Gatwick Airport present a potential impact of low or medium adverse, as many of them may be mitigated.

8.7.8 Water quality impacts may be mitigated using water treatment techniques such as reed beds and balancing ponds. Flooding impacts may be mitigated using balancing ponds, to attenuate runoff and take out the peak flow. The effectiveness of these measures is dependent upon adequate sizing of ponds, and the use of appropriate treatment techniques.

8.7.9 Both Option 1 and Option E1 require engineering works to several rivers. This would involve either culverting or diverting the river; the Environment Agency are generally opposed to culverting, and such works are seen as a significant impact. Due to their potential to cause harm these are considered High Adverse. Further diversion of the River Mole would be undesirable as 1.5 km have only recently been diverted.

8.7.10 Large increases in passenger numbers significantly increase the airport's demand for water, and also within the surrounding residential areas that provide the human resource base for the airport. Without any further water resource development or effort to manage demand, the area would have a deficit. However, assuming that water companies maximise existing strategic links and their use of existing and planned licensed resources between resource zones, the resource zone that supplies Gatwick Airport would have a slight surplus. This also assumes that companies will achieve their leakage reduction targets.

8.7.11 The water companies may not have planned for such extensive growth of the Airport. However, assuming appropriate supply and demand management techniques are put into place, and the Airport and other water users within the region are water efficient, by carrying out good housekeeping and management with respect to water, and using water saving technology, it should be possible to meet the demand.

Table 8.19: Appraisal Summary Table for the Water Environment

Option	**Base Case**	**Maximum Use of Existing Runway**	**Option 1**	**Option E1**
Surface Water	3 rivers receive airport drainage; one shows a decrease in water quality. **Medium Adverse**	No additional impacts as compared to the base case. **Low Adverse**	3 rivers would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	4 rivers would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**
Groundwater	Study area largely non-aquifer, with no licensed	No additional impacts as compared to the	No additional impacts as compared to the	No additional impacts as compared to the

Option	Base Case	Maximum Use of Existing Runway	Option 1	Option E1
	abstractions. **Low Adverse**	base case. **Low Adverse**	base case. **Low Adverse**	base case. **Low Adverse**
Flooding	The airport has had a marked increase on flooding. **High Adverse**	No additional impacts as compared to the base case. **Low Adverse**	Increased flood risk could be mitigated using balancing pond. **Low Adverse**	Large increase in flood risk could be mitigated using balancing pond(s). **Low Adverse**
Water Resources	No significant change to present levels of demand. **Low Adverse**	No significant change to present levels of demand. **Low Adverse**	Significant increase in water demand. Demand may be met through supply and demand management, and water saving technology. **Low Adverse**	Significant increase in water demand. Demand may be met through supply and demand management, and water saving technology. **Medium Adverse**

8.8 Environment: Noise Impacts

Aircraft Noise: Daytime

8.8.1 The Gatwick noise contours for 2000 and each of the Options in 2015 or 2030 as appropriate are shown on Figures 8.24 to 8.43. Tables 8.20 to 8.23 give the areas and estimated populations under the daytime $L_{Aeq,16h}$ noise contours for each of these scenarios. Gatwick Airport currently exposes the second largest number of people to aircraft noise of the existing airports in the study. A population of 8,600 lies within the 2000 57 dB contour, although this has reduced from 14,600 in 1994. This change should be taken as approximate as the 1994 and 2000 population estimates are based on different census years. This reduction in noise exposure is despite the steady growth in air traffic over this period. The Gatwick contours have become longer (extended to the east and west) but narrower over time. A small decrease in contour area has corresponded to a near halving in the population under the 57 dB contour as the contours have receded from the populated areas of Horley and Crawley. The explanation for the general reduction in noise contour area is the introduction of quieter aircraft types over this period, as discussed in relation to Heathrow.

Options in 2015

8.8.2 The current Land Use Planning system is the Base Case for 2015. Under this scenario the population under the 57 dB contour will reduce to 5,900 with the planned development in place, this is a 31% reduction compared with 2000. The reduction is again due to the aircraft fleet becoming quieter, with the phase out of older aircraft and the introduction of quieter models, and other noise limitation policies.

8.8.3 Comparing the Maximum Use Option with the Base, the population under the noise contours only increases very marginally. Option 1 adds a new close parallel runway to the south of the existing runway. This results in increases in contour area of around 30% over the Base which produces an increase in the population within the 57 dB contour of 3,200, to 9,100. The area in the 69 dB contour increases by 3.1 sq km, although the population only increases by around 100 due to the low population density of the newly affected area.

8.8.4 Comparing the 2015 Options with the area under the 57 dB contour in 1994, it can be seen that the Base Case and Max Use Option remain within this value while Option 1 marginally exceeds the 1994 area.

Options in 2030

8.8.5 The Maximum Use Option is the Base Case for 2030. The population under the 57 dB contour with this option in 2030 would be 54% higher than in 2015 at 9,400. However, this figure only represents an increase of 800 or 9% over the existing population under the 57 dB contour.

Table 8.20: Gatwick Daytime Aircraft Noise Contours – 2015 vs 2000 Existing Situation

LAeq (dB)	Area (sq km)							
	1994	Existing 2000	Land Use Planning		Max Use		Option 1	
			Total 2015	Change cw 2000	Total 2015	Change Cw 2000	Total 2015	Change cw 2000
>54	N/a	118.1	108	-10.1	111.8	-6.3	147.2	29.1
>57	83	71.8	63.7	-8.1	64.8	-7	83.4	11.6
>60	1	43.6	37.8	-5.8	38.4	-5.2	49.2	5.6
>63	1	26.5	22	-4.5	22.6	-3.9	29.3	2.8
>66	1	15.8	12.6	-3.2	13	-2.8	17.5	1.7
>69	1	9	7	-2	7.2	-1.8	10.1	1.1
>72	1	4.9	3.7	-1.2	3.9	-1	5.8	0.9

LAeq (dB)	Area (sq km)							
	1994	Existing 2000	Land Use Planning		Max Use		Option 1	
			Total 2015	Change cw 2000	Total 2015	Change Cw 2000	Total 2015	Change cw 2000
LAeq (dB)	**Population (000s)**							
	1994	**Existing 2000**	**Land Use Planning**		**Max Use**		**Option 1**	
			Total 2015	**Change cw 2000**	**Total 2015**	**Change Cw 2000**	**Total 2015**	**Change cw 2000**
>54	N/a	20.7	14.1	-6.6	15.7	-5	24.2	3.5
>57	14.6	8.6	5.9	-2.7	6.1	-2.5	9.1	0.5
>60	1	3.1	2	-1.1	2.1	-1	3.3	0.2
>63	1	1.4	1.1	-0.3	1.1	-0.3	1.4	0
>66	1	0.5	0.3	-0.2	0.3	-0.2	0.5	0
>69	1	0.2	0.2	0	0.2	0	0.3	0.1
>72	1	0.1	0.1	0	0.1	0	0.1	0

Table 8.21 Gatwick Daytime Aircraft Noise Contours – 2015 vs 2015 Base Case

LAeq (dB)	Area (sq km)				
	Land Use Planning	Max Use		Option 1	
	2015 Base Case	Total 2015	Change cw Base	Total 2015	Change cw Base
>54	108	111.8	3.8	147.2	39.2
>57	63.7	64.8	1.1	83.4	19.7
>60	37.8	38.4	0.6	49.2	11.4
>63	22	22.6	0.6	29.3	7.3
>66	12.6	13	0.4	17.5	4.9
>69	7	7.2	0.2	10.1	3.1
>72	3.7	3.9	0.2	5.8	2.1
LAeq (dB)	**Population (000s)**				
	Land Use Planning	**Max Use**		**Option 1**	
	2015 Base Case	**Total 2015**	**Change cw Base**	**Total 2015**	**Change cw Base**
>54	14.1	15.7	1.6	24.2	10.1
>57	5.9	6.1	0.2	9.1	3.2
>60	2	2.1	0.1	3.3	1.3
>63	1.1	1.1	0	1.4	0.3
>66	0.3	0.3	0	0.5	0.2
>69	0.2	0.2	0	0.3	0.1
>72	0.1	0.1	0	0.1	0

Table 8.22: Gatwick Daytime Aircraft Noise Contours – 2030 vs 2000 Existing Situation

LAeq (dB)	Area (sq km)						
	Existing	Max Use		Option 1		Option E1	
	2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000
>54	118.1	142.3	24.2	225.2	107.1	418.7	300.6
>57	71.8	79.5	7.7	118.5	46.7	238.4	166.6
>60	43.6	46.3	2.7	66.8	23.2	142.6	99
>63	26.5	27.3	0.8	39.2	12.7	84	57.5
>66	15.8	16	0.2	23.5	7.7	50.7	34.9
>69	9	9	0	13.9	4.9	30.3	21.3
>72	4.9	4.9	0	8	3.1	16.5	11.6
LAeq (dB)	**Population (000s)**						
	Existing	**Max Use**		**Option 1**		**Option E1**	
	2000	**Total 2030**	**Change cw 2000**	**Total 2030**	**Change cw 2000**	**Total 2030**	**Change cw 2000**
>54	20.7	22.9	2.2	38.6	17.9	114.7	94
>57	8.6	9.4	0.8	16.7	8.1	43.8	35.2
>60	3.1	2.9	-0.2	5.6	2.5	22.5	19.4
>63	1.4	1.3	-0.1	2	0.6	7.9	6.5
>66	0.5	0.5	0	1	0.5	3.4	2.9
>69	0.2	0.3	0.1	0.5	0.3	1.3	1.1
>72	0.1	0.1	0	0.2	0.1	0.5	0.4

Table 8.23: Gatwick Daytime Aircraft Noise Contours – 2030 vs 2030 Base Case

LAeq (dB)	Area (sq km)				
	Max Use	Opt 1		Opt E1	
	Total 2030	Total 2030	Change cw Base	Total 2030	Change cw Base
>54	142.3	225.2	82.9	418.7	276.4
>57	79.5	118.5	39	238.4	158.9
>60	46.3	66.8	20.5	142.6	96.3
>63	27.3	39.2	11.9	84	56.7
>66	16	23.5	7.5	50.7	34.7
>69	9	13.9	4.9	30.3	21.3
>72	4.9	8	3.1	16.5	11.6
LAeq (dB)	**Population (000s)**				
	Max Use	**Opt 1**		**Opt E1**	
	Total 2030	**Total 2030**	**Change cw Base**	**Total 2030**	**Change cw Base**
>54	22.9	38.6	15.7	114.7	91.8
>57	9.4	16.7	7.3	43.8	34.4
>60	2.9	5.6	2.7	22.5	19.6
>63	1.3	2	0.7	7.9	6.6
>66	0.5	1	0.5	3.4	2.9
>69	0.3	0.5	0.2	1.3	1
>72	0.1	0.2	0.1	0.5	0.4

8.8.6 Option 1 adds a new close parallel runway to the south of the existing runway. This results in increases in contour area of around 50% over the Base which produces a population increase within the 57 dB contour of 7,300 to 16,700. The area in the 69 dB contour increases by 4.9 sq km, although the population only increases by around 200 due to the low population density of the newly affected area.

8.8.7 Option E1 adds a third runway at Gatwick. Operations would be such that departures and arrivals did not directly overfly Horley, located just east of the new runway. However, this Option would still result in a large adverse impact. The population under the 57 dB contour would rise to approximately 44,000. This represents an increase of 34,000 over the base or 35,000 over the existing conditions. More of southern parts of Horley would come within the 57 dB contour and it would encroach further south over Crawley. The population within the 69 dB contour would rise to a still relatively small total of 1,300. The area within the 54 dB contour would increase significantly to 3.5 times that existing currently. New parts of Horley and Crawley would come under the 54 dB contour, as would part of Reigate to the north, and Tonbridge to the east.

8.8.8 Comparing the 2030 Options with the area under the 57 dB contour in 1994, it can be seen that only the Max Use Option remains within this value. Option 1 exceeds the 1994 area by 36 sq km and Option E1 by a considerable 155 sq km.

Sensitivity Test: Current Land Use Planning Assumptions and Option E1: Accelerated Retirement, Reassignment and Increased Noise Stringency

8.8.9 Key results of these sensitivity tests are summarised in Table 8.24. The 57 dB contour area reduces by 19%, relative to core assumptions, for the current land use planning capacity and by 25% for Option E1. The respective reductions in populations affected are 32% and 29%.

Table 8.24: Principal Results of Gatwick Noise Sensitivity Tests

	Current land use planning system		Option E1	
LAeq (dB)	**Core assumptions**	**Sensitivity test**	**Core assumptions**	**Sensitivity test**
	Area sq km		**Area sq km**	
>57	63.7	51.6	238.4	178.0
>63	22.0	17.7	84.0	63.4
>69	7.0	5.4	30.3	22.4
	Population (000s)		**Population (000s)**	
>57	5.9	4.0	43.8	31.2
>63	1.1	0.7	7.9	4.8
>69	0.2	0.1	1.3	0.9

Aircraft Noise: Night-time

8.8.10 Tables 8.25 and 8.26 below show the population numbers and associated house counts within the departure and arrival 90 dBA SEL footprints for easterly and westerly operations respectively. The footprints are shown in a supporting document and represent an 'average worst' QC2 aircraft, applied to each departure track (SID) and each runway's approach path for arrivals.

Table 8.25: Night Noise Population and House Counts – Easterly Operations

	Existing		Option 1				Option E1					
Runway	**08**		**08L**		**08R**		**08L**		**08C**		**08R**	
	Popl'n (000's)	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**
Departures												
All	0.9	0.3	0.8	0.3	0.7	0.3	- -		0.7	0.3	0.6	0.2
Arrivals	0.1	0.1	0.1	<0.1	0.1	<0.1	1.0	0.4	0.1	<0.1	0.3	0.1

Table 8.26: Night Noise Population and House Counts – Westerly Operations

	Existing		Option 1				Option E1					
Runway	**26**		**26R**		**26L**		**26R**		**26C**		**26L**	
	Popl'n (000's)	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**
Departures												
BOG/KEN/SAM	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	<0.1	0.5	0.2	1.1	0.5
CLN/DVR/LAM	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	<0.1	0.5	0.2	0.8	0.3
WIZ	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	<0.1	0.5	0.2	0.7	0.3
Average	*0.1*	*<0.1*	*0.1*	*<0.1*	*0.1*	*0.1*	*0.1*	*<0.1*	*0.5*	*0.2*	*0.9*	*0.4*
Arrivals	0.8	0.3	0.8	0.3	0.9	0.3	-	-	0.8	0.3	0.8	0.3

8.8.11 SID references are: BOG – Bogna; KEN – Kennet; SAM – Southampton; CLN – Clacton; DVR – Dover; LAM – Lambourne; WIZ - Wizad

8.8.12 The numbers of people and houses affected at Gatwick with both easterly and westerly arrivals and departures are relatively low. Easterly arrivals on 08L under Option E1 have a higher impact on population than on 08C by a factor of ten and on O8R by a factor of three. Westerly departures are more significant on 26L under Option E1 whilst arrivals have a similar impact under all scenarios.

Surface Access Noise: Highways

8.8.13 Table 8.27 gives the overall results (total EPA) from the GOMMMS plan level assessment for road traffic noise. The Surface Access Noise part of the Appraisal Summary Table also includes the EPA values split by noise contour bands.

Table 8.27: Gatwick Surface Access Noise Assesssment: Highways

	Total change in Estimated Population Annoyed (EPA) by road traffic noise (000's)		
Year	Maximum Use	Option 1	Option E1
2015	0	-0.4	n/a
2030	n/a	+0.6	+2.4

8.8.14 The noise impacts of changes in road traffic for the Maximum Use option and Option 1 in 2015 are compared with the Base Case, which is the road network for Package 1. There are no effects in the Gatwick area for the Maximum use option and therefore the result is assessed as no change in EPA. For Option 1 the traffic noise effects include the wider Gatwick area, extending to the Guildford, Dorking and Billingshurst areas. The total change in Estimated Population Annoyed (EPA) by road traffic noise is a decrease of 400 for Option 1.

8.8.15 For 2030, the Base Case is the road network for Package 2 and the traffic noise effects for Options 1 and E1 have been assessed for this year. For Option 1 impacts are limited to the wider Gatwick area, including the A23 south of Gatwick, some roads in Dorking, and the A24 between Beare Green and Horsham. The assessment results in a net increase in EPA of 600 people. For Option E1 the traffic noise effects are also centred around Gatwick, but spread over a wider area. These include some B roads near to Guildford and Billingshusrt, part of the A286 north of Chichester and the A280 outside Worthing. The total change in EPA for Option E1 is an increase of 2,400 people.

Surface Access Noise: Railways

8.8.16 Table 8.28 gives the results (total EPA) from the GOMMMS strategy level assessment for railway noise.

Table 8.28: Gatwick Surface Access Noise Assesssment: Railways

	Total change in Estimated Population Annoyed (EPA) by railway noise (000's)		
Year	**Maximum Use**	**Option 1**	**Option E1**
2015/2030	N/a	0.0	+1.4

8.8.17 The railway noise impacts for the Options at Gatwick are compared against the Base Case which is the Maximum Use of existing runways scenario. The impacts apply for 2015 and also for 2030 where this is appropriate. There are no increases in rail sevices for Option 1 over those applying to the Base Case (Maximum Use option). The increases in rail services and associated noise impacts for Option E1 apply between Redhill and Purley and from East Croydon to London Bridge via New Cross Gate. The total change in Estimated Population Annoyed (EPA) by railway noise for Option E1 is an increase of 1,400 people.

8.9 Environment: Local Air Quality Impacts

Introduction

8.9.1 Air quality results are provided for representative options at each airport, for 2015 and 2030 as appropriate. The air quality statistics used as assessment criteria for defining poor air quality in SERAS Stage Two are: annual mean Nitrogen Dioxide concentrations of $40\mu g/m^3$; and the 90^{th} percentile of running 24-hour mean PM_{10} concentrations of $50\mu g/m^3$. In practice, annual mean PM_{10} compared to a statistic of $40\mu g/m^3$ are also reported, as the 90^{th} percentile values are a simple factor of these. The Air Quality Key Indicator for SERAS Stage Two is 'the number of people exposed to an exceedance of the air quality standard, weighted by the degree of exceedance'. The higher the key indicator, the worse the air quality impact is.

Results 2015

8.9.2 Figures 8.45 to 8.47 illustrate the air pollution contours for Gatwick options in 2015. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM_{10} and 90^{th} percentile of 24hour mean PM_{10} where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 8.29 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 8.30 provides similar results for PM_{10}.

8.9.3 All Gatwick options in 2015 have population exposed to exceedances for annual mean Nitrogen Dioxide. Using the key indicator, the maximum use option scores best, but results in over 600 people exposed to exceedances. Option 1 scores the worst, with 1000 people exposed. Expressed as a simple average, airport related Oxides of Nitrogen across all options in 2015 account for between 56% and 62% of total Oxides of Nitrogen in the Gatwick study area. 'Airport related' includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the ends of the runways, associated with acceleration during take-off roll. The stands areas are also clearly seen. The figures also show the major roads of the M23 and A127 with areas of exceedance, although away from the airport influence these are largely limited to close to within the roadspace.

8.9.4 These results clearly show that Gatwick options in 2015 have little impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24hour mean PM_{10} in any option. Expressed as a simple average, airport related PM_{10} in 2015 accounts for 5-7%, across all options, of total PM_{10} in the Gatwick study area. Some locations do exceed air quality statistics, but these are solely over the runways. As no option results in population exposed to exceedances of the air quality statistics, figures are only provided for the package option with the largest most extensive PM_{10} contours, for illustration.

Table 8.29: Nitrogen Dioxide Key Indicators - Gatwick 2015

Package	**Option**	**Population exposed to exceedance of annual average NO_2 of 40 $\mu g/m^3$**							***Total population exposed***	**Key Indicator**
		40-50 $\mu g/m^3$	**50-60 $\mu g/m^3$**	**60-70 $\mu g/m^3$**	**70-80 $\mu g/m^3$**	**80-90 $\mu g/m^3$**	**90-100 $\mu g/m^3$**	**>100 $\mu g/m^3$**		
1	Base Case	624	0	0	47	0	0	0	*671*	**812**
2	Max Use	564	0	0	47	0	0	0	*611*	**752**
6	Option 1 - close parallel	948	52	0	0	0	0	0	*1000*	**1052**

Table 8.30: PM$_{10}$ Key Indicators - Gatwick 2015

Package	Option	Annual average PM$_{10}$ of 40 $\mu g/m^3$		90th Percentile of 24hour mean PM$_{10}$ of 50 $\mu g/m^3$	
		Total population exposed	Key Indicator	Total population exposed	Key Indicator
1	Base Case	0	**0**	0	**0**
2	Max Use	0	**0**	0	**0**
6	Option 1 - close parallel	0	**0**	0	**0**

Results 2030

8.9.5 Figures 8.48 to 8.51 illustrate the air pollution contours for Gatwick options in 2030. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM$_{10}$ and 90th percentile of 24 hour mean PM$_{10}$ where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 8.31 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 8.32 provides similar results for PM$_{10}$.

8.9.6 All Gatwick options in 2030 have population exposed to exceedances for annual mean Nitrogen Dioxide. Using the key indicator, option 1 scores better than E1, but both score worse than 2015 options. Option E1 scores the worst of all options (2015 or 2030), with over 7000 people exposed. Expressed as a simple average, airport related Oxides of Nitrogen in 2030 account across all options for between 69% and 76% of total Oxides of Nitrogen in the Gatwick study area (an increase over 2015). ‘Airport related’ includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the ends of the runways associated with acceleration during take-off roll. The stands areas are also clearly seen. The figures also show the major roads of the M23 and A127 with areas of exceedance, although away from the airport influence these are largely limited to close to within the roadspace.

8.9.7 These results clearly show that Gatwick options in 2030 (as in 2015) have little impact on PM$_{10}$, with no population exposed to exceedances of either annual mean PM$_{10}$ or 90th percentile of 24hour mean PM$_{10}$ in any option. Expressed as a simple average, airport related PM$_{10}$ in 2030 accounts across all options for 8-9% of total PM$_{10}$ in the Gatwick study area. Some locations do exceed air quality statistics, but these are solely over the runways. As no option results in population exposed to exceedances of the air quality statistics, figures are only provided for the package option with the largest most extensive PM_{10} contours, for illustration (option E1).

Table 8.31: Nitrogen Dioxide Key Indicators - Gatwick 2030

Package	**Option**	**Population exposed to exceedance of annual average NO_2 of 40 µg/m^3**							**Total popul'n exposed**	**Key Indicator**
		40-50 µg/m^3	**50-60 µg/m^3**	**60-70 µg/m^3**	**70-80 µg/m^3**	**80-90 µg/m^3**	**90-100 µg/m^3**	**>100 µg/m^3**		
6	Option 1 - close parallel	2833	869	131	0	0	0	0	*3833*	**4964**
9	Option E1 - 2 new runways	4818	1924	400	55	19	0	0	*7216*	**10181**

Table 8.32: PM_{10} Key Indicators - Gatwick 2030

Package	**Option**	**Annual average PM_{10} of 40 µg/m^3**		**90th Percentile of 24hour mean PM_{10} of 50 µg/m^3**	
		Total population exposed	**Key Indicator**	**Total population exposed**	**Key Indicator**
6	Option 1 - close parallel	0	**0**	0	**0**
6	Option 1 - close parallel	0	**0**	0	**0**
9	Option E1 - 2 new runways	0	**0**	0	**0**

8.10 Employment

Employment Forecasts

8.10.1 The employment forecasts for each option based on current employees at Gatwick and projected forwards to 2015 and 2030 are shown in Table 8.33. Based on actual surveyed data, a lower employee:passenger ratio applies at Gatwick than at Heathrow, all other employment growth factors for Gatwick are similar to those applied at all airports.

8.10.2 For options 1 and E1, total estimated direct on/off site employment at Gatwick is forecast to be 41,200 in 2015 and a maximum of 71,000 employees by 2030.

8.10.3 Option E1 is forecast to generate over twice the current level of additional employees: that is an additional 42,000 direct on/off site jobs by 2030 and 8,000 additional indirect jobs by 2030.

Table 8.33: Current and forecast employment at Gatwick by option 2015 & 2030

Current & Forecast Employment by Option	Current 1998	Max Use 2015	1 2015	Max Use 2030	1 2030	E1 2030
Direct on-site	25,600	25,000	35,400	22,100	33,400	60,700
Direct off-site	3,800	3,900	5,800	3,500	5,500	10,300
Indirect	13,100	8,700	12,300	7,700	11,600	21,300
Total Employment	42,500	37,600	53,500	33,300	50,500	92,300
Passengers (mppa)	30	37	52	41	61	109
Direct employees/mppa	981	777	793	628	639	650
Total employee/mppa	1,416	1,010	1,031	817	831	844

8.11 Land Use/Urbanisation

Summary

8.11.1 Gatwick's core catchment area consists of Crawley, Reigate and Banstead and Mid Sussex. Crawley is very built up, in comparison with Reigate and Banstead and Mid Sussex, which are potentially constrained by national designations and topography.

8.11.2 The additional employment associated with Option 1 is 11,000 jobs in 2015 and 8,000 in 2030. Option E1, by contrast, could add 49,800 jobs in 2030. To accommodate the employment needs of Option 1, the proportion of core catchment area employment at the airport would need to increase from 13.8% currently to 15% in 2015. To accommodate Option E1, it would need to increase to 24% by 2030.

8.11.3 In terms of housing capacity, it is possible that options other than Option E1 could be accommodated, although Option 1 may present a certain degree of pressure. There might be a capacity of up to 6,000 dwellings in the core catchment area, if quite extensive Green Belt releases around the main settlements in Reigate and Banstead could be justified by very special circumstances. There would, however, be political and local opposition to expansion of settlements in West Sussex, a county that has strenuously maintained that it has almost reached its environmental capacity.

8.11.4 Option E1 would require major Green Belt releases, although some of this could be offset by providing additional housing in the wider catchment area in areas linked by public transport including Brighton and south London.

8.11.5 In terms of off-airport employment, there is unlikely to be sufficient allocated employment land for anything but the smaller options, and then only if high density premises are assumed. Little vacant and redevelopable land is likely to be available given that most industry in the immediate area around Gatwick is modern. There are significant competing pressures for land from other economic sectors. Within the core catchment area there is a greater chance of accommodating off-airport employment in the West Sussex districts than in Reigate and Banstead. The possibility exists for accommodating indirect employment further from the airport, for example in the Brighton area (a Priority Area for Economic Regeneration in RPG9).

Employment Land Requirements

8.11.6 The development implications of off-airport employment vary between options, with requirements for up to 23 ha in 2015 and 101 hectares in 2030 of off-site employment land within reasonable proximity to the airport.

Crawley Borough Council

8.11.7 The Crawley local plan (adopted, April 2000) recognises the high dependency of the district on the airport and the associated employment opportunities. Crawley new town is the major employment centre in West Sussex, which, in the 1970s and 1980s enjoyed full employment and a strong economy. More recently the economy has been characterised by increases in the numbers employed in service sectors (hotels, distribution and catering, transport and communications), with the continued decline of the manufacturing industry. Throughout, Gatwick airport has been the main generator of local employment.

8.11.8 To avoid over dependency, the authority are seeking to diversify their economy and therefore, implicitly, are seeking not to encourage more airport related employment provision within the district. The local plan identifies 83,000m^2 of land (8.3 ha) for new business floorspace. Some of this is provided for off airport related employment use.

8.11.9 There is a general concern within the district about the overheating of the local economy. The district experiences a very tight labour market, as well as severe land and infrastructure constraints. Additional employment land provision is likely to generate skill shortages within the labour force as well as provide unwelcome additional pressure for other uses, including housing and transport requirements. The local plan specifically seeks to restrict this, in seeking to prevent offices and warehousing activity that generate additional traffic or housing requirements.

8.11.10 In these circumstances, it is unlikely that current employment land provision within Crawley borough will be able to accommodate significant increases in airport related employment generated by airport expansion. The drive to avoid overheating also strongly suggests that there are already tight land and labour constraints within the district, which would only be exacerbated with increased airport activity. In this context it becomes more likely that only a radical land take solution, involving developing on greenfield sites, could provide the means of significantly increasing employment, and overall development land capacity, in Crawley.

Reigate and Banstead

8.11.11 As with other districts in the Western Policy Area, the authority experienced an overheating local economy in 1990s. A high proportion of local residents work outside the district: in the early 1990s approximately half the population commuted to central London, increasingly more people work in outer London.

8.11.12 Reigate and Banstead district does not support direct airport related employment outside the airport boundary. Airport related uses are accepted especially in the south of the borough, but there is provision to prevent the development of extensive new car parking. In addition, the local plan clearly specifies that warehousing exceeding 5,000 sq m gross is considered inappropriate in relation to Gatwick Airport. The large buildings and plots would generate high levels of additional activity, and provide an inefficient worker:floorspace density in areas experiencing a shortage of employment land.

8.11.13 While Reigate and Banstead currently tolerates additional employment generated by Gatwick airport, the nature of this employment is restricted to those with high worker densities, and those which cannot be expected to locate on the airport. This suggests that in the current situation there is pressure for employment land, and that potentially it will be difficult to find land to accommodate any of the major airport expansion options.

Mid Sussex

8.11.14 Employment in the district is mainly concentrated in the three main towns of Burgess Hill, East Grinstead and Haywards Heath. The area has traditionally experienced a healthy and prosperous economy, and has grown significantly over the past 20-30 years. The economy is diverse and resilient (lower levels of unemployment in times of recession than other parts of West Sussex). The labour force has high skill levels. There is provision in the local plan for 150,000m^2 of employment space (15 ha) up to 2006, mostly in the three main towns, but it is anticipated that demand will exceed supply.

8.11.15 Haywards Heath is recognised as a source for labour for Gatwick airport due to the good public transport links provided on the Thameslink line. It may be that in future there is more scope to source labour from here, particularly following on from the development of the south west site and associated relief road when it is possible additional housing sites will come forward. There is no other commentary in the plan relating to airport related employment provision.

8.11.16 Despite existing employment land constraints, it should be possible to accommodate some additional off airport jobs here although there will be competing pressures from other sectors.

Housing Capacity

8.11.17 The largest option at Gatwick would require up to 49,800 additional employees, around 35% of the total forecast employment growth in the core and wider catchment areas. Within these areas there is a forecast housing shortfall to 2030 of around 60,000 houses, suggesting that the largest option might be responsible for some 21,000 additional houses over RPG provision being required. Option 1, on the same basis, would generate a need for around 7,000 additional houses to 2015 and 3,400 to 2030. RPG provision to 2030 is an additional 145,000 houses.

8.11.18 Crawley New Town, is the main settlement in the district. The population increased from 10,000 in 1951 to 96,000 in 1995, and is estimated to increase to 99,000 by 2006. Crawley is well served by the M23 motorway and the Thameslink rail service, both of which link the area with London and beyond via the strategic motorway and rail networks. Crawley is surrounded by countryside and a small part of the southern area is within the High Weald Area of Outstanding Natural Beauty. In addition, several strategic gaps are in place to prevent urban sprawl and retain the uniqueness of Crawley and surrounding villages.

8.11.19 Gatwick airport is entirely located within the Borough. While it benefits the borough, every effort is made to restrict adverse impacts of the airport. This includes controlling airport driven development pressure. The local plan requires that development land arising from growth at Gatwick Airport should be met primarily on the airport boundary, within which several areas for future development are allocated. The local plan recognises that a variety of airport related uses, eg hotels, could be located within the borough, on allocated employment sites.

8.11.20 Crawley has several strategic gaps in place - between Crawley and Horsham, and Crawley and Gatwick Airport/Horley. These are derived from structure plan policy. There is a recognition that the Crawley - Gatwick gap is under pressure, with tranches having been recently lost to housing development to meet ‘compelling circumstances’ as set out in the Structure Plan.

8.11.21 Reigate and Banstead extends north from Gatwick airport. The airport is located adjacent to its southernmost boundary. It has four main centres, Redhill, Reigate, Horley and Banstead. Other large villages include Woodmansterne, Chipstead, Kingswood, Lower Kingswood, Walton on the Hill and Salfords.

8.11.22 The Borough comprises a number of towns and villages set within attractive countryside, stretching either side of the North Downs escarpment. It has urban and environmental areas of high quality - Reigate has a large Conservation Area, and the Surrey Hills Area of Outstanding Natural Beauty extends from east to west north of Reigate. The district is crossed by the M25 and M23, and is therefore readily accessible to London and beyond.

8.11.23 The district is subject to strong development pressures, and uses three local plan policy devices to resist it. Green Belt accounts for a large proportion of the total land area, and seeks to prevent the outward spread of existing settlements. In addition, the local plan only allocates modest increases in housing and business provision within the district.

8.11.24 The district of Mid Sussex extends immediately south of Crawley borough. The three main settlements are Haywards Heath, Burgess Hill and East Grinstead, remaining settlements are villages of various sizes. The north part of Mid Sussex includes the Weald AONB, the southern part is straddled by the South Downs AONB, soon to become the South Downs National Park. The M23/A23 extends southwards through the district close to its western border, the A272 to Haywards Heath and the A264 to East Grinstead provide the main road infrastructure. The Thameslink line also bisects the district, with a major station at Haywards Heath.

8.11.25 The northern part of the district is subject to strong development pressures, and is on the edge of the Western Policy Area (area of overheating) as identified in RPG 9 (March 2001). There is also a significant proportion of the area not appropriate for development, by virtue of its topography and national designations (Weald and South Downs).

8.12 Integration Impacts

Regional /sub-regional policy

8.12.1 Gatwick Airport impacts upon the sub-regions of the South Coast and Crawley/Gatwick/M23 Area. The impacts of an expanded airport are discussed below under the headings of employment/labour force, housing and transport infrastructure.

Employment / Labour Force

8.12.2 The two sub-regions in the south – the South Coast and the Crawley/Gatwick/M23 area – exhibit several common features when examining their labour markets and employment demand. Any major expansion of Gatwick Airport would provide widespread difficulties in terms of meeting demand for labour. This is because both sub-regions have labour mismatches. On the South Coast, there is plenty of available labour but this is largely unskilled and does not fit with the new industry jobs developing now, nor would it be suited for the types of businesses that would develop in the area as a result of airport expansion. In the Crawley/Gatwick/M23 sub-region, there is again a lack of labour, but this time at both ends of the skills spectrum.

8.12.3 Despite this, the potential to expand the employment base is more positive. On the South Coast there are strong local universities and clusters of large high-technology industries that can provide training. This latter point applies also in the Crawley/Gatwick/M23 area, as the existing strength of the industrial clusters connected to the airport provide a strong economic base upon which to build. It is these strengths that will also provide opportunities for people entering the job market. Additionally, when considering the criterion of developing the requisite training and skills profile, the expansion of Gatwick and its associated growth in clustering of high-value, high-skill sectors, will impact on the universities in the area. The potential is then created to develop similar offshoots in R&D, high-technology sectors, etc., as experienced by Oxford and Cambridge Universities. Where there may be a weakness, particularly on the South Coast, is the existing low skills base of the workforce.

8.12.4 This leads on to the consideration of providing employment sites in sustainable locations. The effect of the development of a university ‘technology base’ is that, while it will attract employment into business clusters, it will seek its workforce from outside of the sub-region, due to the low existing skills base. This is less of an issue along the Crawley/Gatwick/M23 corridor, as the existing clusters of businesses close to the airport and to Crawley are well established.

Also, development will naturally follow the M27 corridor rather than focusing on the urban centres where the labour force is located. Despite this, the opportunity is available to provide a range of business accommodation in both sub-regions.

Housing

8.12.5 Both the South Coast and Crawley/Gatwick/M23 sub-regions are broadly able to accommodate housing demand created by the expansion of Gatwick Airport. On the South Coast there is a clear policy aim to provide affordable housing with easy access to the new developing employment areas along the M27 corridor. This will allow people to live near to their employment base. What it will also be liable to do however, is take in greenfield sites, thus not assisting the sub-region to meet its brownfield housing targets.

8.12.6 The housing market in the Crawley/Gatwick/M23 area is buoyant and matches the profile of high-skill workers employed in the existing clusters of industries attracted by the airport. There is much available housing and there is clear scope to meet the identified need for affordable housing that will support the lower skill jobs created as a result of airport expansion. With the ability to develop in the existing urban areas, this provides a sound base for reaching the brownfield targets as well as providing housing relatively close to the employment areas.

Transportation / Infrastructure Improvements

8.12.7 The high quality of both existing and proposed transport infrastructure connecting London and the rest of the South East to the key port hubs at Southampton and Portsmouth will be further enhanced by airport development at Gatwick. The airport will bring forward further improvements to road and rail connections in order to provide fast access for freight to and from continental Europe. Also, a high growth scenario could allow Gatwick, via the two ports, to become a long-haul hub for freight bound for the rest of Europe. This in particular would enhance the rail network in the two sub-regions.

8.12.8 Airport development however, is unlikely to reduce the need to travel. With the potential opening up of university technology clusters, and the spreading of clusters along corridors such as the M23 and M27, businesses are likely to look further afield for employees. This is supported by the quality of transport links and the poor supply of labour in high skill functions. As Gatwick expands and seeks more actively to gain employees from the South Coast, this area will suffer the most as more and more people commute long distances from South Coast locations into the Gatwick sub-region.

Social Impact

Low Growth Scenario

8.12.9 Under a low-growth scenario (up to 2015), some 11,000 jobs could be generated in total – Option 1. Of these, it is likely that around 3,700 will be low skill in nature, with potentially up to 2,300 being located on-site and 1,400 off-site.

8.12.10 In 1998 there was a surplus in Croydon and Brighton & Hove of 3,500 workers. Although there is forecast to be an increase in the number of jobs up to 2016, this will be more than offset by an increase in the workforce. As such, the surplus of workers will grow a small amount. Nevertheless, it will be possible for almost all the off-site jobs to be accommodated in the deprived districts. Approximately 2,000 could possibly be located in Brighton & Hove and around 1,000 in Croydon.

8.12.11 When considering what infrastructure improvements would be necessary to secure a high percentage of the generated jobs in the two deprived districts, the range of potential service improvements along the London-Gatwick-Brighton corridor, particularly in respect of rail, would be important. This is particularly necessary in order to open up the Brighton & Hove labour market, which although the more distant, has the greater labour market capacity.

High Growth Scenario

8.12.12 Under a high growth scenario (up to 2030), some 51,000 jobs could be generated – Option E1. Of these, possibly 15,500 could be low skill in nature, with over 9,700 potentially being located on-site and over 5,800 off-site.

8.12.13 Although at 2016 there is a labour surplus approaching 4,000 workers, the period from 2016 to 2030 is forecast to see a net increase of more than 3,700 jobs in the labour market. This would leave a very small surplus of workers in the labour market. This is mostly due to a large projected fall in the workforce. Provided the improvements to rail and road services outlined in the low growth scenario are in place, then continued airport growth would negate this through increasing commuting from the deprived districts.

8.12.14 As such, it is reasonable to assume that further capacity is available to take on several thousand more of the jobs between 2016 and 2030. In addition, strong regeneration policy would reinforce the Croydon-Gatwick-Brighton corridor, and assist in the potential consolidation of low skill jobs to those workers available in the regeneration corridors. As stated, the potential may be there for some of the extra jobs created to be filled by workers commuting in from along the Sussex Coast, a designated Priority Area for Economic Regeneration (PAER).

9 Appraisal of Options at Main Sites: Stansted

9.1 Options Appraised in Stage Two

9.1.1 Three options, which can be seen to build on one another, have been appraised at Stansted. The location of Stansted is shown in Figure 9.1. The capacity currently envisaged in the land-use planning system is 15 mppa: see Figures 9.2 and 9.3 for the existing airport layout and the approved Phase 2 of the airport's development to take capacity up to about 15 mppa. Stansted Airport Ltd submitted a planning application in August 2001 to increase capacity to 25 mppa by 2010, and will seek a commensurate increase in the number of passenger ATMs. The maximum capacity of the existing runway is assumed to be 35 mppa. Figure 9.4 shows a layout to make maximum use of the existing runway.

9.1.2 Option 5 (Figure 9.5) adds one new full length runway separated from the existing runway by 2450m and with a large stagger. The depth of land available allows terminal and stand capacity to be provided between the two runways. Option 5 assumes the two runways would be operated in mixed mode, and that the additional runway could be in place by 2011.

9.1.3 Option 11 (Figure 9.7) adds a further runway to Option 5. This would be a new full length, close parallel runway on the north west side of the existing runway. These two runways would be a dependent pair. It is assumed this third runway could be in place by 2021.

9.1.4 Option 7 (Figure 9.6) adds a fourth runway to the three runways in Option 11. The additional runway is a full length close parallel runway to the Option 5 new runway. It is assumed that the new runways could be in place in 2011, 2018 and 2024.

9.1.5 The options appraised at Stansted are summarised in Table 9.1

Table 9.1: Options Appraised at Stansted

Option	Description	Terminal capacity, mppa	Runway capacity, ATM	Year of Introduction
	Current Land Use Planning System	15	185,000	
	Maximum Use of Existing Runway	35	259,000	
5	New full length runway 2450m to south of existing runway	82	513,000	2011
11	Two new runways in total. Option 5 plus new full length runway close-parallel to existing runway	102	637,000	2011 and 2021
7	Three new runways in total. Option 11 plus a new full length, close parallel runway to that in Option 5, making two pairs of close parallel runways	129	756,000	2011, 2018 and 2024

9.2 Capital Costs

9.2.1 Table 9.2 below shows the estimated incremental capital costs for each option above the 35mppa capacity maximum use of the existing runway case. Table 9.3 gives the breakdown of surface access (road and rail) costs.

Table 9.2: Estimated Incremental Capital Costs for Stansted Options above Max Use Case (£ million)

Item	Option 5	Option 7	Option 11
Capacity	82 mppa	129 mppa	102 mppa
Terminals & Satellites			
Terminal Buildings	594	1129	810
Satellite Buildings	250	434	309
Baggage Handling/conveyors	100	168	118
Total	**944**	**1731**	**1237**

Item	Option 5	Option 7	Option 11
Aircraft Pavements			
Runways	34	102	68
Taxiways	52	108	82
Aprons / Stands	146	286	221
Total	**232**	**496**	**371**
Enabling Works & Infrastructure			
Demolition, Earthworks, etc	55	73	62
Car Parking	133	436	324
Utility Services	82	123	82
Airside Roads and public Road diversions	7	11	11
Tracked Transit	258	429	289
Drainage	25	38	37
Landscaping	5	10	7
Total	**565**	**1120**	**812**
Navigation Aids (ATC, ILS & AGL)	**7**	**22**	**15**
Cargo & Maintenance			
Cargo buildings & aprons	51	98	74
Hangar/ Maintenance buildings & aprons	81	132	89
Total	**132**	**230**	**163**
Support Facilities, etc			
Support facilities			
Offices	47	94	67
Other facilities / services (inc. fuel, security, pedestrian link, archaeology)	36	44	36
	39	44	39
Total	**122**	**182**	**142**
On-costs	501	945	685
Contingencies	626	1181	856
Land Costs	57	138	96

Item	Option 5	Option 7	Option 11
Sub-total: **Airport Development Costs**	**3185**	**6045**	**4378**
Airport Development Costs per mppa provided above 35 mppa Base Case	68	64	65
Costs of Associated Surface Access	**785**	**1879**	**1629**
Total Capital Costs	**3970**	**7924**	**6007**
Total Capital Costs per mppa provided above 35 mppa Base Case	84	84	90

Table 9.3: Estimated 'Airport Specific' Surface Access Costs (£ million)

Item	Option 5	Option 7	Option 11
Road Schemes			
Airport Road extension + links to A120 & M11 (all dual 2)	69	69	69
Sub Total	**69**	**69**	**69**
Rail Schemes			
Second tunnel & 2nd Airport Station	91	91	91
Loop to Elsenham + 3rd Station	n/a	94	94
Grade separation Stansted Mountfitchet	n/a	13	13
Multitrack to South Tottenham	625	1250	1250
Access to St Pancras	n/a	112	112
Bishops Stortford – Braintree line	n/a	250	n/a
Sub Total	**716**	**1810**	**1560**
Total	785	1879	1629

Airport Option Costs

9.2.2 The airport development costs associated with increasing the capacity of the airport from current land use planning of 15mppa to the Base Case of 35mppa are estimated to total £894 million, with negligible additional surface access costs.

9.2.3 Car parking costs are high, similar to Gatwick, mostly due to a high proportion being multi-storey or decked.

9.2.4 Enabling works costs are low, mainly due to nature of the site requiring comparatively small volumes of earthworks.

9.2.5 In all Options, the tracked transit system accounts for 10 to 12% of the total cost.

9.2.6 Although not included in the cost estimates, a premium may be expected for working in operational areas. This appears only to be of significance with constructing sections of taxiways associated with runways 3 and 4 adjacent to operational runways 1 and 2 (assuming phased runway construction). Interfacing of new and existing rail links would also require working outside normal hours. It is assumed that construction of new buildings would not require vehicles to go across existing aircraft pavements.

9.2.7 Additional remobilisation costs would be incurred if runway construction is phased, i.e. constructing Option 5 followed at later dates by Options 11 and 7.

9.2.8 Land costs contribute about 2% of the Airport Development Costs. These are amongst the lowest land-take costs of all sites. This is primarily due to the acquired land containing a below average number of residential properties and a very small commercial area.

Surface Access Scheme Costs

9.2.9 The rail access costs for all options include for a second tunnel and additional stations at the airport and for necessary improvements on the main line – between the airport and London. Measures to increase capacity between Cambridge and Peterborough for the services assumed for Options 7 and 11 has been excluded from the cost estimates – following the air passenger allocation and air passenger mode choice modelling exercises there was found to be insufficient demand to justify all the additional trains. Although not included in the cost estimates, the SRA advise that a premium may be expected for working on operational lines, and that where alteration to track layout is required, re-signalling maybe needed over a far wider area than the infrastructure upgrade itself, with further cost implications.

9.2.10 In all options, road costs are for providing new access roads from the M11 in the north and the A120 in the east.

9.2.11 Required improvements to the strategic road network, i.e. those not specifically required to accommodate airport related traffic, involve widening sections of the M11 from dual 3 lane to dual 4 lane. This would be required between Junctions 6 and 7 by 2030 in Options 7 and 11 at an estimated cost of £28 million. It would also be required between Junctions 7 and 8 by 2030 in Option 7 at an estimated cost of £41 million. Costs for a proposed traffic management scheme on the A1184 would be negligible by comparison.

9.3 Demand Forecasts

9.3.1 Forecast passenger movements, ATMs and passengers per passenger ATM for each Stansted option are summarised at 5 year intervals between 2000 and 2030 in the following tables:

- Table 9.4: Current Land Use Planning System
- Table 9.5: Maximum Use of the Current Runway
- Table 9.6: Option 5
- Table 9.7: Option 11
- Table 9.8: Option 7

9.3.2 In the forecasting it has been assumed that the role of Stansted will change as it increases in size. Stansted currently is a major airport for low cost services and serves a relatively local catchment for scheduled services. With an additional runway (or runways) at Stansted and no significant expansion of capacity at other South East airports, it is assumed that the role of Stansted could change into that of a second international hub airport in the South East, complementing Heathrow.

9.3.3 In the forecasting of demand at Stansted, a similar approach has been taken to the forecasting of demand as at Cliffe Marshes. It has been assumed that at both airports, with two runways being available in 2011, a major airline or an airline alliance, suffering from heavily constrained capacity at Heathrow and Gatwick, would be willing to relocate services to the expanded Stansted or the new Cliffe Marshes. The services assumed to be relocated to Stansted are 40% of Heathrow's long haul and USA scheduled services. Stansted is assumed to retain its low cost services and the short haul scheduled services will develop in any event. The forecasts produced for the options at Stansted and Cliffe Marshes with two or more runways start in 2011 on a seeded basis and test whether the services would survive or indeed grow in their new locations. The capacity assumed to be 'freed up' at Heathrow and Gatwick is still available to compete with the additional capacity at Stansted or at Cliffe Marshes.

9.3.4 The principal features of the demand forecasts for each option are summarised below.

Current Land Use Planning System

9.3.5 The current passenger capacity of 15 mppa dominates these forecasts. The total is reached before 2005 and not exceeded. Continuing growth in passengers per ATM leads to a reduction in ATMs to stay within passenger capacity. There is growth in short haul and domestic scheduled services at the expense of charter and low cost.

Maximum Use of Existing Runway

9.3.6 In this scenario Stansted is assumed to continue to operate the types of services it does currently: principally low cost services, domestic and short haul scheduled services and some charter services. The runway capacity, which is assumed to grow to 259,000 ATMs by 2011, dominates the forecasts. The forecast passenger throughput is limited to around 23 mppa by 2015 and 26 mppa by 2030. Passengers on scheduled services are forecast to increase from 4 mppa in 2000 to 16 mppa by 2015 and 20 mppa in 2030. Passengers on low cost services are forecast to increase from 8 mppa in 2000 to 10 mppa in 2005 but then begin to decline as scheduled services take an increasing share of the available capacity.

Option 5: One New Runway

9.3.7 From 2011, with the additional runway and terminal capacity and an assumed airline or alliance's willingness to relocate, a very different set of passenger and ATM forecasts result. The available runway capacity is fully utilised from 2014 and the number of passengers at Stansted is forecast to exceed 50 mppa in each year from 2012. Most of these passengers are on scheduled services, with short haul, USA and long haul services all registering large increases in volume. The number of passengers, constrained by lack of runway capacity, only reaches 74 mppa by 2030.

9.3.8 The number of I to I interliners is forecast to be 20 mppa in 2015 and 24 mppa by 2030. The number of low cost passengers declines from 2015 onwards. Stansted remains predominantly an airport for leisure passengers, who account for 74% of trips to/from the UK via Stansted in 2000, 70% in 2015 and 59% in 2030. Leaving aside I to I interliners, 90% of those making trips to/from the UK via Stansted in 2000, 87% in 2015 and 92% in 2030 are travelling to/from London, the East and South East regions.

The Effects of Seeding

9.3.9 The seeding of long haul and US services as a new runway is built at Stansted in 2011 gives a frequency of 62,000 ATMs attracting passenger demand of 17mppa (an average of over 250 passengers per ATM), with services strengthening the following year so that 70,000 ATMs are forecast. Without seeding, short haul schedule services take up the capacity that is available in the absence of long haul services, with short haul passengers making up 75% of the total throughput in 2030, compared with 46% with seeding. The average number of passengers per PATM in the seeded run is 151 in 2030, in the unseeded run this figure is 127.

Option 11: Two New Runways

9.3.10 In the modelling, the second runway has been assumed to come on stream in 2021. The new runway capacity fills up in its first year. The capacity of two runways (Option 5) had been used up in 2015 so there may be a case for introducing the third runway earlier than 2021. (NB: In the modelling of the four runway option (Option 7), this third runway is assumed to open in 2018 and its capacity is fully used in 2018.)

9.3.11 The new runway in 2021 allows an increase of 25 mppa over the 2020 forecast, from 68 mppa in 2020 to 93 mppa in 2021. Thereafter, because of the runway constraint, there is only limited passenger growth, to 98 mppa in 2030. This is 24 mppa more than the two runway Option 5 allowed. I to I interliners account for an additional 6 mppa, there are an additional 12 mppa leisure trips to/from the UK and an additional 5 mppa business trips. So, in 2030, setting I to I interliners aside, there are 41 mppa leisure trips and 25 mppa business trips to/from the UK via Stansted, i.e., leisure trips are 62% of total passengers in 2030 as opposed to 60% with Option 5. 92% of Stansted passengers in 2030 are from London, the East and South East regions.

Option 7: Three New Runways

9.3.12 As explained above, in the modelling of this option the third runway is assumed to be introduced in 2018 and its capacity is fully utilised from its introduction. The fourth runway is assumed to be introduced in 2024 and again its capacity is fully utilised from its introduction. In 2030, scheduled services account for 619,000 ATMs (83% of the total), with around 410,000 short haul ATMs, 100,000 long haul and 75,000 USA ATMs. There are 36,000 domestic ATMs. Low cost ATMs are 113,000 (15% of the total) and charter are the remaining 2%.

9.3.13 This Option allows 24 mppa more than the three runway Option 11 in 2030 (122 mppa compared with 98 mppa). Of these, 7 mppa are I to I interliners (36 mppa in total in 2030), 13 mppa are leisure passengers and 4 mppa are business passengers. By 2030, setting aside I to I interliners, this four runway option is serving 54 mppa leisure trips and 29 mppa business trips, i.e., leisure trips have increased to 65% of the total. Passengers to/from London, the East and South East regions are 91% of the total, excluding I to I interliners.

Table 9.4: Stansted Option - Current Land Use Planning System

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	1	2	2	3	2
	Short haul	2	4	6	7	8	8	9
	USA	**	**	**	**	**	**	**
	Long haul	**	**	**	**	**	**	**
	Total	3	4	7	9	10	11	11
Charter		2	1	1	1	**	**	**
Low cost		8	8	7	6	5	6	3
Total		13	**15**	**15**	**15**	**16**	**17**	**15**
ATMs, '000								
Scheduled	Domestic	19	19	21	23	24	27	25
	Short haul	31	48	59	65	67	68	74
	USA	**	**	**	**	**	**	**
	Long haul	**	**	**	**	**	**	**
	Total	50	67	80	88	91	95	99
Charter		8	7	4	4	2	2	**
Low cost		68	86	78	66	59	59	31
Total		126	**160**	**162**	**158**	**152**	**154**	**131**
Passengers/PATM								
Scheduled		75	88	90	100	110	115	114
Charter		193	192	184	187	200	199	123
Low cost		111	95	84	84	92	95	105
Average		102	96	89	95	104	107	112

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

Table 9.5: Stansted Option - Maximum Use of Existing Runway

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	3	2
	Short haul	2	6	9	14	14	16	18
	USA	**	**	**	**	**	**	**
	Long haul	**	**	**	**	**	**	**
	Total	4	8	11	16	17	19	20
Charter		2	3	2	1	1	**	**
Low cost		8	10	9	6	6	6	6
Total		13	**20**	**22**	**23**	**23**	**25**	**26**
ATMs, '000								
Scheduled	Domestic	19	21	22	23	25	27	24
	Short haul	31	64	96	136	133	137	147
	USA	**	**	**	**	**	**	**
	Long haul	**	**	**	**	**	**	**
	Total	50	86	117	159	158	164	172
Charter		8	13	11	6	4	2	1
Low cost		68	100	99	72	65	65	59
Total		126	**199**	**227**	**237**	**227**	**231**	**231**
Passengers/PATM								
Scheduled		75	90	93	98	105	113	116
Charter		193	196	195	195	209	193	151
Low cost		111	98	94	89	90	94	96
Average		102	101	99	97	103	108	111

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

Table 9.6 Stansted Option 5 - New Runway to South of Existing Runway

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	2	2
	Short haul	2	6	9	25	30	33	34
	USA	**	**	**	12	14	15	15
	Long haul	**	**	**	12	14	15	16
	Total	4	8	11	51	61	65	68
Charter		2	3	2	2	1	**	**
Low cost		8	10	9	11	7	7	6
Total		13	**20**	**22**	**64**	**69**	**72**	**74**
ATMs, '000								
Scheduled	Domestic	19	21	22	32	29	27	27
	Short haul	31	64	96	235	269	276	279
	USA	**	**	**	44	48	51	54
	Long haul	**	**	**	54	62	64	67
	Total	50	86	117	364	407	418	428
Charter		8	13	11	9	5	1	**
Low cost		68	100	99	120	76	68	65
Total		126	**199**	**227**	**493**	**488**	**488**	**492**
Passengers/PATM								
Scheduled		75	90	93	140	149	155	159
Charter		193	196	195	201	204	202	151
Low cost		111	98	94	95	96	96	96
Average		102	101	99	130	141	147	151

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

Table 9.7: Stansted Option 11 - Two New Runways

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	2	3
	Short haul	2	6	9	25	30	43	47
	USA	**	**	**	12	14	18	19
	Long haul	**	**	**	12	14	18	19
	Total	4	8	11	51	60	82	88
Charter		2	3	2	2	1	2	1
Low cost		8	10	9	11	7	10	8
Total		13	**20**	**22**	**64**	**68**	**94**	**98**
ATMs, '000								
Scheduled	Domestic	19	21	22	32	28	31	29
	Short haul	31	64	96	233	266	346	364
	USA	**	**	**	44	48	62	65
	Long haul	**	**	**	55	61	74	78
	Total	50	86	117	364	404	513	537
Charter		8	13	11	9	5	10	7
Low cost		68	100	99	120	74	96	81
Total		126	**199**	**227**	**492**	**482**	**619**	**624**
Passengers/PATM								
Scheduled		75	90	93	141	148	160	164
Charter		193	196	195	201	204	197	205
Low cost		111	98	94	94	97	106	102
Average		102	101	99	131	141	152	157

Note: Figures in **bold** are capacity-constrained forecasts
'Other' categories, not shown, are included in totals. Totals may not sum due to rounding
** = less than 0.5 mppa or less than 500 ATMs

Table 9.8: Stansted Option 7 - Three New Runways

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	1	1	2	2	2	3	3
	Short haul	2	6	9	25	38	51	55
	USA	**	**	**	12	16	21	23
	Long haul	**	**	**	12	19	23	26
	Total	4	8	11	51	76	98	106
Charter		2	3	2	2	2	3	3
Low cost		8	10	9	11	12	15	12
Total		13	**20**	**22**	**64**	**90**	**115**	**122**
ATMs, '000								
Scheduled	Domestic	19	21	22	32	36	37	36
	Short haul	31	64	96	233	326	393	409
	USA	**	**	**	44	57	70	76
	Long haul	**	**	**	55	77	91	98
	Total	50	86	117	363	496	591	619
Charter		8	13	11	9	11	15	14
Low cost		68	100	99	120	115	122	113
Total		126	**199**	**227**	**492**	**623**	**728**	**746**
Passengers/PATM								
Scheduled		75	90	93	141	152	166	172
Charter		193	196	195	202	202	202	208
Low cost		111	98	94	94	105	120	109
Average		102	101	99	131	145	159	163

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

9.4 Safety Risk

9.4.1 The Stage Two assessment of safety risk appraises the third party risk associated with both existing and new runway options. The full extent of the 1;10,000 and 1:100,000 designated risk areas are shown on the following. The runway end origins of the 1:1,000,000 contours are also shown but extend beyond the limits of the drawings:

- Figure 9.8 – Maximum use of existing runways option
- Figure 9.9 – Option 5, New full-length runway 2450m to the east of the existing, staggered to the north and operating in mixed mode
- Figure 9.11 – Option 11, Further new full-length runway creating a new close parallel dependent pair.
- Figure 9.10 – Option 7, Adds a fourth full-length close parallel runway to the three in Option 11.

1:10,000 Risk Contours

9.4.2 The impact of the 1:10,000 risk contours are shown in Table 9.9 below:

Table 9.9: 1:10,000 Risk Contours

Impact	**Max Use**	**Option 5**	**Option 11**	**Option 7**
Increase in Area (ha) above Max Use (South West and North East)	SW 6.9 NE 6.6	SW +6.9 NE +6.5	SW +10.2 NE +9.7	SW +13.4 NE +12.7
Properties within contour (outside airport boundary) above Max Use	None	None	None	4
% developed area affected, (outside airport boundary) above Max Use	0	0	0	0

9.4.3 The 1:10,000 contour in each of the options falls almost entirely within the airport boundary and consequently has no impact on surrounding population, commercial areas or other prominent features. Where it does extend beyond the airport boundary the area is predominantly rural.

1:100,000 Risk Contours

9.4.4 The impact of the 1:100,000 risk contour is shown in Table 9.10 below

Table 9.10: 1:100,000 Risk Contours

Impact (beyond 1:10,000 contour)	Max Use	Option 5	Option 11	Option 7
Increase in Area (ha) above Max Use (South West and North East)	SW 77.2 NE 73.9	SW +68.6 NE +64.8	SW +101.8 NE +96.41	SW +133.7 NE +126.8
Increase in Population affected above Max Use	1	+ 254	+ 320	+ 1,273
% developed area affected, (outside airport boundary) above Max Use	NE 0 SW <1	NE 0 SW 0 New NE <1 NewSW<5	NE 0 SW 0 New NE <1 New SW<5	NE 0 SW 0 New NE<1 New SW<5
Other prominent features affected above Max Use	None	NE- Tilty & Dalton Hall SW- Village of Brewers End and SAM	As Option 5 plus school and public house	As Option 7

9.4.5 The area is predominantly rural with scattered residential properties and farms. The higher capacity options extend over small villages with associated higher risk. The impact on communities and commercial activities is minimal.

1:1,000,000 Risk Contour

9.4.6 The impacts of the 1:1,000,000 risk contours are shown in Table 9.11

Table 9.11: 1:1,000,000 Risk Contours

Impact (beyond 1:100,000 contour)	**Max Use**	**Option 5**	**Option 11**	**Option 7**
Increase in Area (ha) above Max Use (South West and North East)	SW 702.5 NE 668.3	SW +680.8 NE +647.6	SW +1013.1 NE +963.8	SW +1322.1 NE +1267.2
% developed area affected above Max Use	SW <5 NE <5	SW 0 NE 0 New SW + <5 New NE rural	SW 0 NE -<5 New SW rural New NE rural	SW 0 NE 0 New SW + <5 New NE rural

Prominent features affected at Max Use:

- South west – M11, 1 church
- North east – 2 churches

Prominent features affected above Max Use:

- Option 5: South west – 2 churches, school; North east – Abbey remains
- Option 11: South west – M11 J8; North east – 1 church
- Option 7: South west – None; North east – None

9.5 Surface Access

Infrastructure and service assumptions - roads

9.5.1 For the purposes of surface access demand forecasting, the changes to the existing road access arrangements were based on the findings of Stage One appraisals. This helped define a number of schemes associated with each option, as summarised in Table 9.12 and shown in Figure 9.16. No changes to the Reference Case road access arrangements are assumed for the appraisal of options with capacities limited to that incorporated in the Current Land Use Planning System and the Maximum Use of the Existing Runway.

9.5.2 Options 5, 7 and 11 each involves extension of the existing Airport Access Road, and in each case this been assumed to be linked, from a point near Tilty, via new links to the M11 north near Elsenham and to the improved A120 near its junction with the existing A120 at Greencrofts.

Table 9.12: Changes to road access – Stansted Options

Scheme	Current Land use Planning System	Maximum Use of Existing runways	Options 5, 11 & 7
1 Extension of existing Airport Access Road			✓
2 D2 Link from extended Airport Access Road to A120, near Greencrofts			✓
3 D2 Link from extended Airport Access Road to M11 near Elsenham			✓

Infrastructure and service assumptions - rail

9.5.3 Additions to rail infrastructure and services were based on Stage One findings and shaped by discussions, with DTLR and SRA in particular, on the potential to integrate airport-focused schemes with parallel improvements in infrastructure and services planned to accommodate future increases in non-airport demand. Schemes and services associated with each Option are summarised in Table 9.13 and shown in Figures 9.19 to 9.22.

9.5.4 No changes to the current infrastructure and rail services are assumed for the Base Case and Maximum Use Options. For Option 5 a second tunnel from the airport to the West Anglia Main Line (WAML) is assumed, increasing the capacity of the airport's rail network from 6 to around 16 trains per hour each way. Additional services to Docklands (via Stratford), Norwich, Manchester and Leeds have been modelled. Extra tracks will be needed in places on WAML to accommodate the increased number of trains.

9.5.5 For Option 11 (3 runways) a second access line, connecting to the Cambridge line at Elsenham and allowing trains to run through the airport, is added. An additional express service (non-stop) to St Pancras and regional services to Sheffield, Newcastle and Ipswich via Cambridge are modelled. With CrossRail the Stratford service extends to Heathrow via Liverpool St., Paddington and Ealing. The increased frequencies will require multi-tracking of WAML south of the airport, and passing loops between Ely and Peterborough, plus upgrade of the Tottenham & Hampstead line for the St Pancras service.

9.5.6 With 4 runways (Option 7) reinstatement of part of the Bishop's Stortford-Braintree line is assumed, together with an upgrade of the Braintree-Witham branch. The Ipswich service diverts via Braintree and Colchester, extending to Norwich, and a service via Braintree to Chelmsford, Romford and Liverpool Street.

Accessibility Analysis

9.5.7 The results of the catchment area analyses are summarised in the Appraisal Summary Tables under the heading "Accessibility" and shown in Figures 9.12 to 9.15. Public transport catchments increase substantially between the Maximum Use option and Options 5, 11 and 7 (air passengers within one hour's overall journey time increasing from 1 to 2.3 million pa, and resident workforce increasing from 0.1 to 0.2 million), reflecting the improvements in rail accessibility. Stansted's better accessibility by road is reflected in its larger catchments (around 33 million air passengers pa, and 2.3 million potential workers within one hour's travel time). Catchments by road are similar between options.

9.5.8 The accessibility of options to the air passenger market in Central London is of particular interest and is summarised for Stansted options in Table 9.14. It should be noted that the public transport travel times quoted in this table exclude walking access and egress, and waiting times – they therefore indicate minimum travel times.

9.5.9 With the services assumed for the Maximum Use of Existing Runways (Package 2), Stansted has poor public transport accessibility relative to other existing airports – of the main line termini only Liverpool Street is served direct, the others lying between 50 and 60 minutes travel time of the airport with interchange. Table 9.14 illustrates the effect of the new rail services added in Options 11 and 7.

Table 9.13: Changes to rail access –Stansted Options

Infrastructure	Services	Maximum Use of Existing runways	Option 5 (2 wide spaced runways)	Option 11 (3 runways)	Option 7 (2 pair close parallel runways)
2nd tunnel to Cambridge line, passing loops between Harlow and Tottenham Hale	2nd Express service, to Tottenham Hale and Stratford services north to: Manchester via Birmingham, Manchester via Nottingham, Leeds and Norwich		✓	✓	✓
	Extend Ipswich-Cambridge service to airport			✓	
Upgrade Tottenham & Hampstead line S. Tottenham to Kentish Town, 3-4 tracks between Stansted Mountfitchet and Tottenham Hale	3rd Express service, non-stop to St Pancras			✓	✓
CrossRail	Extend Stratford service to Heathrow via central London, Ealing			✓	✓
2nd access line to airport (from Elsenham), (freight) passing loops between Ely and Peterborough	InterCity service to Newcastle Regional service to Sheffield via Nottingham, Derby			✓	✓

Infrastructure	Services	Maximum Use of Existing runways	Option 5 (2 wide spaced runways)	Option 11 (3 runways)	Option 7 (2 pair close parallel runways)
Re-instate Bishop's Stortford-Braintree line between airport and Braintree, upgrade Braintree branch	Services to Norwich via Colchester and Ipswich, Liverpool Street via Chelmsford and Romford				✓

Table 9.14: Accessibility from Central London – Stansted options.

	Maximum Use	Option 5	Option 11	Option 7
By Car, minutes				
Liverpool Street	54	54	54	54
St Pancras/Kings Cross/Euston	61	61	61	61
Marylebone/Paddington	68	68	68	68
By Public Transport, tph in minutes				
Liverpool Street	4 tph in 44	4 tph in 40	4tph in 39 4tph in 42	As Option 11
St Pancras/Kings Cross	Interchange required	Interchange required	4 tph in 40	As Option 11
Paddington	Interchange required	Interchange required	4 tph in 52	As Option 11

9.5.10 The main indicators of surface access demand in 2015 for each option at Stansted are summarised in Tables 9.15 and 9.16. Corresponding results for the forecast year 2030 are presented in Tables 9.17 and 9.18.

9.5.11 Air passenger capacity and demand estimates have been described above. Note that the proportion of interlining passengers varies substantially between options and between years – reflecting the different function that the airport provides in the packages from which these estimates were derived.

9.5.12 The forecast number of on-site employees in 2015 is reported in Tables 9.15 and 9.17 and is assumed to be a function of overall passenger demand and changes in productivity – note the reduction in employees between 2015 and 2030 for the Maximum Use scenario and Option 5. (Further details of the employment forecasts can be found in Section 9.10.)

9.5.13 In 2015, the number of peak hour employee-related car trips is estimated to increase by almost 80% between Packages 1 and 2 and to more than treble in Option 5, reflecting the increases in total employment and a small shift towards public transport in Option 5. The share of employee trips forecast to be made by public transport is very small, at 5% even in Option 5. Table 9.17

shows that the number of car trips is expected to reduce by 2030 as a result of the assumed productivity gains.

9.5.14 Tables 9.16 and 9.18 summarise the air passenger mode split results for each option in 2015 and 2030 respectively. In 2015, Table 9.16 indicates a fluctuation from 39.3% by public transport with the airport as defined in the current land use planning system decreasing to 34.8% with maximum use of the runway and increasing to 37.0% in Option 5. These results are influenced by the mixture of passengers by type and their geographical distribution, but indicate the limited success in increasing public transport's share of Stansted's traffic by means of improved services alone. In 2030, public transport's mode share increases in the Maximum Use Scenario and Option 5 to around 40% (compared with 35-37% in 2015), with further increases to around 46 % for Options 7 and 11. Note the very large increases in public transport demand – doubling, trebling and quadrupling in Options 5, 11 and 7 when compared to the Maximum Use scenario.

9.5.15 Finally, it is worth noting the changes in overall peak hour road traffic demand generated by these options, (see Tables 9.16 and 9.18). Table 9.16 shows increases over the current land use system of around 70% with maximum use of the runway and more than three-fold for Option 5. By 2030, the overall road traffic demand generated by Stansted is estimated to decrease in the Maximum Use scenario by around 10% (from 4,100 to 3,750 vehs per hour, 2-way). Options 5, 11 and 7 are estimated to generate substantially more road traffic, with the number of trips compared with the Maximum Use Scenario respectively doubling, trebling and increasing by a factor of 3.5.

Table 9.15: Main indicators and employee mode shares – Stansted 2015.

Main Indicators	Current Land Use Planning System	Maximum Use of Existing Runway	Option 5 – wide spaced
Total capacity (mppa)	15	35	82
Total passengers requiring surface access (mppa)	13.4	22.0	37.5
Total employees on-site	6,700	13,100	39,200
Employees' Highway trips (AM peak hour): vehicles			
Origin	118	209	394
Destination	639	1133	2136
Total	**757**	**1342**	**2530**

Main Indicators	**Current Land Use Planning System**	**Maximum Use of Existing Runway**	**Option 5 – wide spaced**
Employees' Public Transport trips (AM peak hour): persons			
Origin	4	7	21
Destination	20	35	113
Total	**24**	**42**	**134**
% Public Transport trips			
Origin	3%	3%	5%
Destination	3%	3%	5%
Total	**3%**	**3%**	**5%**

Table 9.16: Air passenger mode choice and overall surface access demand– Stansted 2015.

Mode	**Base Year**		**Current Land Use Planning System**		**Max Use of Existing Runway**		**Option 5 – wide spaced**	
	No. (mppa)	**%**	**No. (mppa)**	**%**	**No. (mppa)**	**%**	**No. (mppa)**	**%**
Bus	0.63	14.0%	1.36	10.2%	2.22	10.1%	3.99	10.6%
Taxi	0.35	7.8%	0.96	7.2%	1.53	7.0%	2.58	6.9%
Park and fly	1.44	31.9%	4.31	32.2%	7.66	34.8%	12.71	33.9%
Kiss and fly	1.13	25.1%	2.84	21.3%	5.16	23.4%	8.34	22.2%
Premium rail	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
National rail	0.96	21.3%	3.89	29.1%	5.45	24.7%	9.89	26.4%
Total	**4.51**	**100.0%**	**13.35**	**100.0%**	**22.02**	**100.0%**	**37.51**	**100.0%**
Public	1.59	35.3%	5.24	39.3%	7.67	34.8%	13.88	37.0%
Private	2.92	64.7%	8.12	60.7%	14.35	65.2%	23.63	63.0%
Total peak hour demand (including employees, air passengers, freight and service traffic								
Road (vehicles 2- way)	1.700		2.400		4.100		7.500	

Table 9.17: Main indicators and employee mode shares – Stansted 2030.

Main Indicators	Maximum Use of Existing Runways	Option 5	Option 11	Option 7
Total capacity (mppa)	35	82	102	129
Total passengers requiring surface access (mppa)	23.2	46.0	69.5	82.7
Total employees on-site	12,000	37,100	48,500	60,800
Highway trips (average AM peak hour): vehicles				
Origin	154	372	546	650
Destination	832	2017	2953	3538
Total	**986**	**2389**	**3499**	**4188**
Public Transport trips (average AM peak hour): persons				
Origin	7	19	29	33
Destination	37	105	151	176
Total	**44**	**124**	**180**	**209**
% Public Transport trips				
Origin	4%	5%	5%	5%
Destination	4%	5%	5%	4%
Total	**4%**	**5%**	**5%**	**4%**

Table 9.18: Air passenger mode choice and overall surface access demand – Stansted 2030.

Mode	Base Year	Maximum Use of Existing Runways	Option 5	Option 11	Option 7

Mode	Base Year		Maximum Use of Existing Runways		Option 5		Option 11		Option 7	
	No. (mppa)	%	No. (mppa)	%	No. (mppa)	%	No. (mppa)	%	No. (mppa)	%
Underground	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Bus	0.63	14.0%	2.13	10.0%	4.77	10.9%	7.67	11.4%	9.30	11.5%
Taxi	0.35	7.8%	1.66	7.8%	2.99	6.8%	4.36	6.5%	5.17	6.4%
Park and fly	1.44	31.9%	6.84	32.0%	13.93	31.8%	19.72	29.2%	23.63	29.3%
Kiss and fly	1.13	25.1%	4.47	20.9%	8.75	19.9%	12.34	18.3%	14.84	18.4%
Premium rail	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
National rail	0.96	21.3%	6.26	29.3%	13.42	30.6%	23.34	34.6%	27.63	34.3%
Total	**4.51**	**100.0%**	**21.37**	**100.0%**	**43.86**	**100.0%**	**67.44**	**100.0%**	**80.57**	**100.0%**
Public	1.59	35.3%	8.39	39.3%	18.19	41.5%	31.02	46.0%	36.93	45.8%
Private	2.92	64.7%	12.98	60.7%	25.67	58.5%	36.42	54.0%	43.64	54.2%
Total peak hour demand including employees, air passengers, freight and service traffic.										
Road (vehicles 2-way)	1,700		3,750		7,850		11,300		13,300	

Highway appraisal results - Stansted

9.5.16 The highway appraisal has identified a number of sections of the Motorway and Strategic Road Network that are expected to be under stress - close to or beyond their capacities - in the SERAS forecast years. These ‘Background Highway Requirements’ are illustrated in Figure 9.17 and 9.18. These problem links have been categorised into those where the potential solution required to solve the problem in the Base Case would be adequate also to accommodate the airport option under consideration, and those where an airport option would require a further intervention, categorised here as an increase in capacity. By 2030, in the vicinity of Stansted, the following sections of the network would be under stress:

- A10: Ware to A120
- A120: Braintree to Marks Tey and Bishop’s Stortford to A10

- M25: J15 to J29

9.5.17 The additional potential scheme improvements required by the airport options at Stansted are summarised in Table 9.19, and illustrated in Figures 9.17 (for Option 5) and Figure 9.18 (for Options 7 and 11).

Rail Network Performance – Stansted

9.5.18 With the existing service pattern at Stansted (assumed for the Base and Maximum Use options) there are no airport related congestion issues. While Cambridge - London commuter services are forecast to be crowded between Cheshunt and Tottenham Hale, very few airport trips are assigned to these services (0.1% of traffic). Rather, commuters are forecast to make increasing use of the fast and frequent dedicated airport express services, using Stansted Airport as a rail-head. The airport express service has a peak load factor of 63% in the Base Case (with only 35% of traffic airport-related) and 72% in the Maximum Use scenario (43% airport-related).

9.5.19 More than 50% of these airport trips are predicted to interchange at Tottenham Hale with the Victoria Line, which is forecast to be at capacity in the peak hour south of Seven Sisters and extremely crowded south of Finsbury Park by 2015. Airport trips do not contribute greatly to this crowding (less than 2% of traffic south of Finsbury Park), but will experience uncomfortable travel.

9.5.20 In Option 5 an additional Airport Express, to Stratford for Docklands, has been modelled. Calling at both Bishop's Stortford and Tottenham Hale, the new service diverts a significant number of commuters from the Cambridge - Liverpool St. services (eliminating crowding on this line), as well as attracting 50% of airport-related rail trips between the airport and London, giving a peak load factor of 80%. However, 2/3 of airport trips are projected to continue to interchange at Tottenham Hale, rather than Liverpool St or Stratford, increasing crowding on the Victoria Line compared to the Base, with nearly 4% of traffic departing Tottenham Hale being airport-related.

9.5.21 For Option 11 a further, non-stop, express service to St Pancras has been assumed, and the Stratford service extends into the CrossRail tunnel. Total demand assigned to the three airport express services is comfortably within their capacity. The assignment results, however, suggest that the stopping patterns assumed will need to be amended: the St Pancras service has a load factor of only 32%, but demand exceeds seating capacity on the CrossRail service south of Bishop's Stortford and exceeds design capacity south of Tottenham Hale. These two new services do, however, give some relief to the Victoria Line, on which passenger numbers are lower than in the base (Max Use) option even though airport-related demand is almost 300% higher.

Table 9.19: Highway capacity problems and potential schemes - Stansted

Description	Initial Standard	Potential standard required by:						
		2015			2030			
		Current Land Use Planning System	Max Use of Existing Runways	Option 5	Max Use of Existing Runways	Option 5	Option 11	Option 7
Airport Access								
Airport Access Road Extension (proposed)		n/a	n/a	D2	N/a	D2	D2	D2
Airport Link to A120 East (proposed)		n/a	n/a	D2	N/a	D2	D2	D2
Airport Link to M11 (proposed)		n/a	n/a	D2	N/a	D2	D2	D2
Strategic Network								
M11: J7 to J8	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D4(M)
M11: J6 to J7	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D3(M)	D4(M)	D4(M)
M25: J26 to J27	D3 (M)	D3 (M)	D3 (M)	D4 (M)	D4 (M)	D4 (M)	D4 (M)	D4 (M)
A1184 Sawbridgeworth							Traffic management	Traffic management

9.5.22 The same express services have been modelled with Option 7, for which demand is forecast to be 20% higher. The CrossRail service is overcrowded south of Bishop's Stortford, and also has nearly 100% of seats occupied in the contra-peak direction, whereas the Liverpool Street and St Pancras services are lightly loaded. As noted, altering the intermediate stops assumed for these services would address this imbalance in train loading. The Victoria Line is also less crowded than in the Base with this Option.

9.5.23 With most airport express services to London modelled and running non-stop between the Airport and inner London, it should be noted that the two additional tracks needed for Option 11 and 7 need not follow the existing WAML alignment which winds through heavily developed low lying land in the Lee Valley, but could follow a near alignment on which there are fewer adverse land take and environmental impacts. This may be more feasible, and cheaper, than widening and resignalling the existing rail corridor.

9.6 Environment: Land Take

Context

9.6.1 The environmental issues considered in Stage Two of SERAS builds on work undertaken in Stage One on land use, ecology, heritage, landscape and townscape, water, noise and air quality. Stage Two in addition appraises impacts on contamination and community issues. For each of these environmental topics a baseline is defined and then the results of the appraisal of each option is presented. Details of existing land uses and environmental features within the study area are provided in Figures 9.23 to 9.26. Summaries of the key impacts of each option are presented in the Appraisal Summary Table. Fuller details of the environmental appraisal baseline data and appraisal of options can be found in the supporting report.

Existing Conditions

Land Use – residential, commercial/industrial, public buildings, recreation, agriculture, planning constraints (Figure 9.23)

9.6.2 The airport is situated in largely rural surroundings with nearby towns of Bishop's Stortford, Stansted Mountfitchet and Elsenham and villages of Molehill Green, Woodgates End and Brick End. The predominant land use in the area is agriculture. The majority of this land is of Grade 2 agricultural land quality. There is also a nursery north of Molehill Green.

9.6.3 An area to the west of the site, and west of the M11, is designated as Green Belt. There is also an area extending round most of the current airport which is classified as Stansted Airport Countryside Protection Zone, the aims of which are to protect the land from new buildings and uses which promote coalescence between the airport and existing development in the surrounding countryside or which adversely affect the open characteristics of the zone. A buffer strip within and adjacent to the existing airport perimeter has been designated as Strategic Landscape Area and Open Space in which development is not normally permitted.

Contamination (Figure 9.23)

9.6.4 Fifty potential sources of contamination have been identified in the study area. Areas with potential for 'moderate' scale of contamination comprise: a fuel depot, former aircraft engineering works, sewage treatment works, a petrol station and sites of some recorded pollution incidents.

Ecology (Figure 9.24)

9.6.5 There are six nationally designated sites (of high ecological value) within the vicinity of the airport, as follows:

- Hatfield Forest is a National Nature Reserve (NNR) and Site of Special Scientific Interest (SSSI). The site comprises over 400ha of mixed ancient coppice woodland, scrub, unimproved grassland chases and plains with ancient pollards and herb-rich grassland bordering a large lake.
- Eastend and Pledgdon Woods are part of Elsenham Wood SSSI. The sites consist of mosaic ancient woodland, and the coppice layers have ash, hazel, and field maple present.
- High Wood SSSI is approximately 4.5 km east. The site has ancient woodland, with the damp grassy rides providing habitat for numerous sedges, invertebrates and birds.
- Little Hallingbury Marsh and Thorley Flood Pound SSSIs are wet grassland and wetland sites close to the village of Spellbrook
- Two flooded gravel pits to the north of Ugley Green form another SSSI.

9.6.6 The following district-designated sites are located in the vicinity of the airport site:

- Seven ancient woodlands. There is a great deal of connectivity between the sites.
- Fourteen important woodlands. There is substantial connectivity between all woodland sites in the area, due to their number and the length of hedgerows in the area.

9.6.7 The following habitats in the vicinity of the airport are undesignated but considered to be of district importance:

- The majority of arable fields to the north and east of the current airport boundary are bordered by ancient and/or species-rich hedgerows, totalling approximately 4km in length. Such hedgerows are a BAP habitat within Essex and are particularly important for butterflies and moths, the smaller farmland birds and dormice, while hedgerow trees are an important habitat for the larger birds and bats and dead wood invertebrates including stag beetles. Hedgerows are important as wildlife corridors and act as a means of ecological connectivity between woodland sites and other similar habitats: woodlands in the area around Stansted airport are extremely well-connected due to this network of hedgerows. These areas are not shown on the ecological constraints map. The hedgerows are considered to be of at least low ecological value but when considered as a network in combination with the woodlands, this value increases to medium.

- Cereal field margins are the strips of land lying between cereal crops and the field boundary and extending for a limited distance into the crop, which are deliberately managed to create conditions that benefit key farmland species. The area to the east and north of the current airport boundary is predominantly arable land, and some of the land that lies between the crops and the hedgerows, totalling approximately 4 km, will be of low conservation value.

9.6.8 There are also other semi-natural sites considered to be of low ecological value within the current airport boundary, including the following:

- A strip of semi-improved grassland and low scrub, approximately 700m long located just inside the north eastern boundary fence.

- A Wildlife Area of 4.5 ha set aside for nature conservation purposes located in the south of the current airport boundary. This site supports a diverse plant assemblage including orchids (particularly pyramidal orchids), oxlip and sulphur clover. The site also supports a pond with breeding great crested newts (a national BAP species) and an ancient hedgerow.

- A fen area (2.34 ha) with a number of small springs and oozes consisting of reeds, other wetland plants and patches of scrub is located adjacent to the eastern boundary.

- 11 woodland sites located within and near to the current airport boundaries, 4 of which support a typical ancient woodland tree/ shrub/ herbaceous flora damaged or disturbed.

- 75 hedgerows located within the current airport boundaries. These hedgerows provide links between the remnant woodlands within the current airport boundary.
- Grassland covering an area of 184 ha located within the current airport boundaries. The grassland areas are important for several LBAP species including grey partridges, brown hares, sulphur clover and skylark. Skylarks are particularly important and the airport grasslands are likely to support 120 birds during the breeding season.
- 11 ponds within the current airport boundary.

Heritage (Figure 9.25)

9.6.9 Archaeology - Two intensive programmes of archaeological investigations at the current airport site have demonstrated the presence of a rich archaeological resource covering multi-period activity dating from the neolithic to post-medieval periods. This indicates that the proposed area of expansion to the east, which has been the subject of comparatively little archaeological investigation, may also have a high potential to contain hitherto undetected archaeological deposits. The main finds recorded within the study area include a complex of Prehistoric and Roman sites.

9.6.10 The Prehistoric Period (to 50BC) is represented by a number of sites and finds are located across the entire Stansted landholding. The sites include Neolithic findspots, Bronze Age and Iron Age settlements and burials. Roman settlements (43AD-AD410) are well represented within the airport and in the wider area. Bishop's Stortford and Great Dunmow were small towns in the Roman period, situated beside Stane Street Roman road, which runs directly south of the airport along the line of the modern A120 road. Such an important line of communication is likely to have attracted settlement. Late Iron Age/Roman sites have been identified across the entire airport, though the main concentration appears to lie in its western half. The area of the proposed expansion contains no known Roman sites, although a scatter of Roman pottery just outside this area coupled with the known level of Roman archaeology within the airport site would indicate that the area has the potential to contain hitherto undetected deposits.

9.6.11 Excavations within the airport have identified six, possibly eight, medieval settlement sites, some containing houses. Within the area surrounding the airport the Boulder Clay geology has given rise to a large number of moated settlement sites. Most survive partly as earthworks, usually with a post-medieval structure in the enclosed area. The area of the proposed airport extension contains four such sites, two of which are Scheduled Ancient Monuments. Immediately outside the area of the proposed airport extension lie a further two Scheduled Ancient Monuments, the remains of Tilty Abbey and Takeley Priory.

9.6.12 *Listed Buildings* - 64 Grade II Listed Buildings and one Grade II* Listed Building are located within the proposed area of expansion. The Grade II listed buildings are fairly evenly spread across the area of proposed expansion, although there are substantial clusters in the village centres such as Bamber's Green, Molehill Green and Brick End. In addition a Grade I Listed Building and Scheduled Ancient Monument (Warish Hall Farm) building is situated under the 1:10,000 southern risk contour of the most eastern proposed runway. The current airport site also contains three Grade II Listed buildings comprising the $16^{th}/17^{th}$ century Bury Lodge (now converted to a hotel) and two associated 15^{th}-16^{th} century barns to the east.

9.6.13 *Conservation Areas* - There are no Conservation Areas within the area of proposed development although the Great Easton Conservation area lies 350m outside of the area.

Landscape and Visual (Figure 9.26)

9.6.14 Landscape/Townscape - Stansted falls within the South Suffolk and North Essex Clayland - an especially extensive regional landscape character area identified by the Countryside Agency. For the purposes of this assessment the landscape in the vicinity of Stansted has been divided into three distinct landscape character areas.

- North Essex Clayland Plateau is an open, but well wooded landscape of arable farmland with frequent small to medium sized woodlands that result in a generally wooded skyline. The landscape contains a number of Historic Parklands – although these are generally visually enclosed. The pattern of medium to large-scale arable fields is generally open, but sometimes enclosed by a variety of informal hedgerows with frequent mature hedgerow trees. Despite the proximity of the existing airport, the landscape of the plateau retains a rural and unspoilt character in many places. This landscape is highly sensitive to the proposed development. The value of this landscape has been assessed as Medium due to its distinct historic character but extensive area.

- Chelmer Upper Valley Reaches comprise a number of tributaries to the main river. This shallow but intimate landscape is distinct from the surrounding plateau due to its enclosed views (with relatively close skyline) and the presence of several historic towns and villages along the course of the river. The value of this landscape has been assessed as Medium/High.

- Stort Valley is broader, less intimate and more linear than the valley of the Upper Chelmer, this landscape is visually separated from the plateau by woodland and topography. The value of this landscape has been assessed as Medium.

9.6.15 *Visual* - The site is well screened to the south and to the north-west by woodland. The principal areas of potential site visibility comprise glimpsed views across the plateau from the south-east; views across the Chelmer Valley from west facing slopes towards the fringe of the plateau above Tilty; and occasional views from higher ground to the north and north-east – again principally towards the plateau fringe above Tilty. The existing airport facilities are rarely visible and there are few existing detractors present in the landscape.

9.6.16 Key potential visual receptors in the area include the villages of Takeley, Broxted and Great Easton – the latter a Conservation Area with many listed buildings and with views across the Chelmer valley towards the plateau site. The principal road network is generally well contained by vegetation but footpaths in the area provide access to higher and more open areas.

Community

9.6.17 *Community Infrastructure* – There are four tiers of settlement in the vicinity of Stansted Airport: the urban area of Bishop's Stortford; the small towns of Stansted Mountfitchet and Great Dunmow; and nucleated villages such as Great Hallingbury, Takeley, Elsenham and Thaxted. The lowest tier comprises hamlets such as Bamber's Green, Molehill Green and Brick End, with scattered farmsteads and other properties. All the potentially affected wards fall comfortably above the median national Index of Multiple Deprivation (IMD) ranking.

9.6.18 *Community Structure/Distinctiveness* – Work undertaken in Stage One concluded that (within the Local Plan period) the long-term housing capacity of the Core Catchment Area (i.e. the districts of Uttlesford and East Hertfordshire) is between 10,000-12,000 dwellings. It was assumed that such an increase could be accommodated by intensification of existing built-up areas, development of brownfield sites, a degree of urban fringe expansion and new "village" settlements.

9.6.19 *Employment* – at 4% the unemployment levels within the Core Catchment Area (the districts of Uttlesford and East Hertfordshire) are below the national average.

High Adverse Impacts: – Option 5

9.6.20 There would be a negligible loss of commercial facilities, although the loss of 680 ha of grade 2 agricultural land from within the Option boundary is considered to represent a HA effect. A HA effect is anticipated from encroachment onto land (457 ha) as a result of the potential conflict with its district designation as Stansted Airport Countryside Protection zone to protect the open characteristics of the area.

9.6.21 Two Scheduled Monuments, which are considered to be of national value, would be lost as a result of this option. In addition, this option would involve 697ha of new landtake from an area of unknown archaeological resource, but of likely high archaeological potential, suggesting that hitherto undetected sites, of unquantified value, may be affected by the proposals. The severity of effects resulting from loss of known archaeological resources or sites of archaeological potential is therefore considered to be HA.

9.6.22 This option would involve the loss of 29 Grade II Listed Buildings. Most are scattered across the area of the proposed airport expansion to the east of the current airport site, although there are significant concentrations within the village/hamlet centres at Molehill Green, Woodgates End and Brick End. Owing to the numbers lost, the severity of effects resulting from such losses would be HA. The cumulative effect on Heritage resources is considered to be HA largely as a result of the loss of the two Scheduled Ancient Monuments and at least 29 Grade II Listed Buildings.

9.6.23 Community Structure/Distinctiveness - Stage One work forecast that this option could give rise to a demand for an additional 18,170 dwellings within the Core Catchment Area. This equates to a population of approximately 43,000, which represents a 22% increase in the population of the Core Catchment Area and is likely to be additional to "baseline" demand as reflected in current housing capacity. Such an increase would represent a significant change in the structure (including physical coalescence of settlements and mix of residents) of the local community, since it would be achieved mainly by in-migration, and is regarded as an HA effect. The housing demand associated with Option 5 would substantially exceed the capacity of the Core Catchment Area. This suggests that such demand could be met only by fundamental change in the settlement pattern (e.g. large-scale excisions from the Green Belt or creation of new urban communities). This degree of change would represent a HA effect on local communities.

High Adverse Impacts: – Option 7

9.6.24 The loss of 1179 ha of grade 2 agricultural land is considered to represent a HA effect. A HA effect is anticipated from encroachment onto land (747 ha) as a result of the potential conflict with its district designation as Stansted Airport Countryside Protection zone, to protect the open characteristic of the zone.

9.6.25 Ecology impacts would be as for Option 5 except that over 50% of Elsenham Wood SSSI would be lost, resulting in HA effects. In summary five areas of well connected woodland, including a large part of a SSSI, three ancient woodland sites and part of another ancient woodland site will be lost. In addition, over 4 km of species-rich, ancient hedgerow will be lost, resulting in HA cumulative effects on ecology.

9.6.26 Heritage: The two Scheduled Monuments lost with Option 5 would be lost and this option may also involve the loss of a third SAM, the site of the medieval Takeley Priory at Warish Hall. Four additional undesignated sites, as listed on the National Monuments Record, would also be lost. In addition 1216ha of new land would be taken from an area of unknown archaeological resource, but of likely high archaeological potential. The severity of effects resulting from loss of known archaeological resources or sites of archaeological potential is therefore considered to be HA.

9.6.27 This option would involve the loss of one Grade II* Listed Building, and 64 Grade II Listed Buildings. These are scattered across the area of the proposed airport expansion to the east of the current airport site, although there are substantial concentrations within the village/hamlet centres at Molehill Green and Brick End. Effects arising from loss of listed buildings are therefore likely to be of HA severity.

9.6.28 The cumulative effects on Heritage are considered to be HA largely as a result of the loss of the three Scheduled Ancient Monuments, one Grade I Listed Building, one Grade II* Listed Building and 64 Grade II Listed Buildings.

9.6.29 Option 7 locates main buildings and extensive car parking facilities at the eastern end of the site which encroaches onto the upper slopes of the landscape of the Chelmer Valley. The landtake extends closer to the village of Great Easton than either Option 5 or 11. Large-scale facilities in this location would be difficult to mitigate. These facilities would potentially be extremely visible in views from the east and north east and, due to the close proximity of the Great Easton Conservation Area, the overall visual effect is likely to be HA.

9.6.30 This option was not specifically addressed in the Stage One investigation of land use and urbanisation impacts. However, on the assumption that housing demand would increase approximately in line with airport capacity, this option could generate nearly half as much demand again as Option 5. This would represent a HA effect in terms of community structure. The cumulative effects on community are considered to be HA, taking account of direct loss of infrastructure due to landtake, and the indirect impacts of population growth, housing demand and employment.

High Adverse Impacts: - Option 11

9.6.31 The loss of 1174 ha of grade 2 agricultural land from within the airport is considered to represent a HA effect. A HA effect is anticipated from encroachment onto land (683 ha) as a result of the potential conflict with its district designation as Stansted Airport Countryside Protection Zone, to protect the open characteristic of the zone.

9.6.32 Ecology impacts would be as for Option 5. In summary, four areas of well connected woodland, including a large part of a SSSI and three ancient woodland sites will be lost. In addition, over 4 km of species-rich/ancient hedgerow will be lost, resulting in HA cumulative effects on ecology.

9.6.33 Heritage: Two Scheduled Monuments would be lost. Three additional sites as listed on the National Monuments Record would also be lost. In addition, this option would involve 1044ha of new landtake from an area of unknown archaeological resource, but of likely high archaeological potential. The option would involve the loss of 50 Grade II Listed Buildings. The cumulative effects on Heritage are considered to be HA largely as a result of the loss of two Scheduled Ancient Monuments and the 50 Grade II Listed Buildings.

9.6.34 The cumulative effects on community are considered to be HA, taking account of direct loss of infrastructure due to landtake, and the indirect impacts of population growth, housing demand and employment.

9.7 Environment: Water

Existing Conditions

9.7.1 Stansted Airport is situated within the Upper Stort and the Upper Roding surface water catchments (***Figure 9.27***). Within the study area, three watercourses flow in a southerly direction to join with the River Stort, which flows to the west of the Airport. One of these, the Pincey Brook, receives runoff from the Airport once it has passed through balancing ponds. The River Roding rises to the north east of the Airport and flows southwards. In addition to the watercourses in the study area, there are a number of natural ponds, and a spring within the airport boundary itself.

9.7.2 The water quality is monitored in four watercourses within the study area. The chemical quality in all of the watercourses is good, however the biological quality varies more widely. The Pincey Brook appears to be affected by discharges from a sewage treatment works; none of the watercourses appear to be directly impacted by activities at the Airport. It is more likely that changes in quality arise from agricultural impacts or other sources of contamination. There are four small licensed surface water abstractions to the south of the study area.

9.7.3 Less than 1% of the study area has been designated within the 1 in 100 year flood risk area identified by the Environment Agency.

9.7.4 All the rivers within the study area are classified as Chalk Rivers. In the study area the Chalk, which is a major aquifer, is overlain by Tertiary deposits of Reading Beds and London Clay, which serve to protect the underlying aquifer from contamination. There is one small licensed groundwater abstraction to the north west of the study area.

9.7.5 From a regional perspective, the available water resources are virtually fully committed. There is limited scope for further groundwater development within the resource zone that supplies Stansted Airport. Additionally, there are unsustainable groundwater abstractions occurring within adjacent resource zones.

Impact of Options

9.7.6 The options have been assessed against a base case, which is the current land use planning system, and therefore only considers impacts that are additional to those assessed under the base case. The assessments consider the sensitivity of the water environment and the potential to cause harm, which includes scope for mitigation..

9.7.7 All of the options at Stansted present a potential impact on water resources as High or High* Adverse. Options 5, 7 and 11 represent High Adverse impacts on surface water quality. The impacts on the other water objectives are either Medium or Low Adverse, as many of them may be mitigated. Impacts are summarised in Table 9.20 and in the Appraisal Summary Table.

9.7.8 Water quality impacts may be mitigated using water treatment techniques such as reed beds and balancing ponds. All of the options potentially impact upon a spring. To prevent contamination of the underlying aquifer, appropriate measures would need to be taken during both construction and operation of the airport development option. Flooding impacts may be mitigated using balancing ponds, to attenuate runoff and take out the peak flow. The effectiveness of these measures is dependent upon adequate sizing of ponds, and the use of appropriate treatment techniques.

9.7.9 Options 5, 7 and 11 require engineering works to several rivers, hence the high adverse score. This would involve either culverting or diverting the river; the Environment Agency is generally opposed to culverting, and such works are seen as a significant impact.

9.7.10 Large increases in passenger numbers significantly increase the airport's demand for water, and also within the surrounding residential areas that provide the human resource base for the airport. Without any further water resource development or effort to manage demand, the resource zone that supplies Stansted Airport would have a deficit. Assuming that water companies maximise existing strategic links and their use of existing and planned licensed resources between resource zones, the Stansted resource zone would still have a slight deficit. This also assumes that companies will achieve their leakage reduction targets, and also allows for environmental demands. Abstraction recovery for the benefit of the environment will be a significant impact upon Three Valleys Water (the water company that supplies the airport).

9.7.11 Given the large increases in demand for water imposed by these options, and the pressures described above, it may be difficult to meet this demand, even assuming that appropriate supply and demand management techniques are put into place, and other water users within the region are water efficient.

Table 9.20: Stansted Water Appraisal Summary Table

Option	Base Case	Maximum Use of Existing Runway	Option 5	Option 11	Option 7
Surface Water	1 river would need to be either diverted or culverted. 4 licensed abstractions within study area. **Medium Adverse**	No additional impacts as compared to the base case. **Low Adverse**	3 rivers would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	3 rivers would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**	3 rivers would need to be either culverted or diverted. Potential water quality impacts could be mitigated. **Medium Adverse**
Groundwater	Study area largely non-aquifer, with no public water supplies. **Low Adverse**	Potential impact on spring may be mitigated using appropriate construction techniques. **Low Adverse**	Potential impact on spring may be mitigated using appropriate construction techniques. **Low Adverse**	Potential impact on spring may be mitigated using appropriate construction techniques. **Low Adverse**	Potential impact on spring may be mitigated using appropriate construction techniques. **Low Adverse**
Flooding	Less than 1% of the study area contains floodplain. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**	Increased flood risk could be mitigated using balancing pond. **Low Adverse**	Large increase in flood risk could be mitigated using balancing pond(s). **Low Adverse**	Large increase in flood risk could be mitigated using balancing pond(s). **Low Adverse**
Water Resources	No significant change to present levels of demand. **Low Adverse**	It may be difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High Adverse**	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**

9.8 Environment: Noise Impacts

Aircraft Noise: Daytime

9.8.1 The Stansted contours for 2000 and each of the Options in 2015 or 2030 as appropriate are shown on ***Figures 9.28 to 9.50***. Tables 9.21 to 9.24 give the areas and estimated populations under the daytime $L_{Aeq,16h}$ noise contours for each of these scenarios with changes against the Existing Situation and the Base Case. Stansted Airport currently exposes a relatively small number of people to aircraft noise. A population of 6,000 lies within the 2000 57 dB contour, and this has increased from 3,400 in 1994 as the airport has been developed and traffic has grown, although the increase has been from a low baseline. This change should be taken as approximate only, as the 1994 and 2000 population estimates are based on different census years. Since 1994 the contours have become longer (extended to the north west and south east) but have not widened significantly, except at the southern end. This has meant that the population affected has remained relatively small, as the 57 dB contour has not encroached over Bishop's Stortford significantly.

9.8.2 The Current Land Use Planning system is the Base Case for 2015. With this scenario the population under the 57 dB contour would reduce to 4,000 with the planned development in place, this is a 33% reduction compared with 2000. The reduction is again due to the aircraft fleet becoming quieter with the phase out of older aircraft and the introduction of quieter models.

Options in 2015

9.8.3 Comparing the Maximum Use Option with the Base, the population under the noise contours will increase substantially. The populations within the 57 dB to 69 dB contours will increase by 60-100%. The population in the 57 dB contour will increase by 2,800, to 6,800. Option 5 adds a new full length runway to the south of the existing runway. This results in an increase in the 57 dB contour area of 180% compared with the Base, bringing a further 6,600 (ie, 10,600 in total) to this level of noise exposure. Bishop's Stortford is the main settlement affected. There will also be a substantial increase in population within the 66 dB contour, from 400 to 2,300.

9.8.4 Comparing the 2015 Options with the area under the 57 dB contour in 1994, it can be seen that the Base Option remains within this value while Max Use and Option 5 exceed the 1994 area.

Table 9.21 : Stansted Daytime Aircraft Noise Contours – 2015 vs 2000 Existing Situation

LAeq (dB)	Area (sq km)							
	1994	Existing 2000	Land Use Planning		Max Use		Option 5	
			Total 2015	Change cw 2000	Total 2015	Change cw 2000	Total 2015	Change cw 2000
>54	n/a	92	63.9	-28.1	101.2	9.2	172.5	80.5
>57	37.9	52.9	37.5	-15.4	56.6	3.7	105.9	53
>60	23.3	32.6	22.1	-10.5	32.9	0.3	63.5	30.9
>63	14.4	20.3	13.1	-7.2	19.3	-1	32.8	12.5
>66	9	12.5	7.5	-5	11.4	-1.1	18.6	6.1
>69	5.7	7.5	4.2	-3.3	6.5	-1	10.3	2.8
>72	3.6	4.4	2.2	-2.2	3.6	-0.8	5.5	1.1
LAeq (dB)	**Population (000s)**							
	1994	**Existing 2000**	**Land Use Planning**		**Max Use**		**Option 5**	
			Total 2015	**Change cw 2000**	**Total 2015**	**Change cw 2000**	**Total 2015**	**Change cw 2000**
>54	n/a	13.4	8.1	-5.3	13	-0.4	24.6	11.2
>57	3.4	6	4	-2	6.8	0.8	10.6	4.6
>60	1.3	2.3	1.5	-0.8	2.6	0.3	5.2	2.9
>63	0.7	1.3	0.6	-0.7	1.2	-0.1	3.4	2.1
>66	0.3	0.5	0.2	-0.3	0.4	-0.1	2.3	1.8
>69	0.2	0.2	0.1	-0.1	0.2	0	1	0.8
>72	0.2	0.1	0.1	0	0.1	0	0.1	0

Table 9.22 Stansted Daytime Aircraft Noise Contours – 2015 vs 2015 Base Case

Laeq (dB)	Area (sq km)				
	Land Use Planning	Max Use		Option 5	
	2015 Base Case	Total 2015	Change cw Base	Total 2015	Change Cw Base
>54	63.9	101.2	37.3	172.5	108.6
>57	37.5	56.6	19.1	105.9	68.4
>60	22.1	32.9	10.8	63.5	41.4
>63	13.1	19.3	6.2	32.8	19.7
>66	7.5	11.4	3.9	18.6	11.1
>69	4.2	6.5	2.3	10.3	6.1
>72	2.2	3.6	1.4	5.5	3.3
Laeq (dB)	Population (000s)				
	Land Use Planning	Max Use		Opt 5	
	2015 Base Case	Total 2015	Change cw Base	Total 2015	Change Cw Base
>54	8.1	13	4.9	24.6	16.5
>57	4	6.8	2.8	10.6	6.6
>60	1.5	2.6	1.1	5.2	3.7
>63	0.6	1.2	0.6	3.4	2.8
>66	0.2	0.4	0.2	2.3	2.1
>69	0.1	0.2	0.1	1	0.9
>72	0.1	0.1	0	0.1	0

Table 9.23: Stansted Daytime Aircraft Noise Contours – 2030 vs 2000 Existing Situation

LAeq (dB)	Area (sq km)								
	Existing	Max Use		Option 5		Option 7		Option 11	
		Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change cw 2000	Total 2030	Change Cw 2000
>54	92	129.5	37.5	302.9	210.9	544	452	479.9	387.9
>57	52.9	70.7	17.8	176.9	124	302.6	249.7	272	219.1
>60	32.6	41	8.4	105.8	73.2	177.6	145	159.2	126.6
>63	20.3	24.2	3.9	61.9	41.6	106.7	86.4	93.2	72.9
>66	12.5	14.3	1.8	32.3	19.8	59.4	46.9	51.5	39
>69	7.5	8.4	0.9	18.6	11.1	32.3	24.8	28.8	21.3
>72	4.4	4.7	0.3	10.3	5.9	19.3	14.9	16.9	12.5
LAeq (dB)	**Population (000s)**								
		Max Use		**Option 5**		**Option 7**		**Option 11**	
	Existing	**Total 2030**	**Change cw 2000**	**Total 2030**	**Change cw 2000**	**Total 2030**	**Change cw 2000**	**Total 2030**	**Change Cw 2000**
>54	13.4	17.6	4.2	37.7	24.3	83.1	69.7	69	55.6
>57	6	8.8	2.8	24.1	18.1	35.1	29.1	34.5	28.5
>60	2.3	4.3	2	10.2	7.9	23.1	20.8	18.2	15.9
>63	1.3	1.6	0.3	5.1	3.8	9.3	8	8.8	7.5
>66	0.5	0.7	0.2	3.4	2.9	4.8	4.3	4.5	4
>69	0.2	0.3	0.1	2.4	2.2	3.1	2.9	3	2.8
>72	0.1	0.1	0	1	0.9	2.4	2.3	1.7	1.6

Table 9.24 Stansted Daytime Aircraft Noise Contours – 2030 vs 2030 Base Case

Laeq (dB)	Area (sq km)						
	Max Use	Option 5		Option 7		Option 11	
		Total 2030	Change cw Base	Total 2030	Change cw Base	Total 2030	Change Cw Base
>54	129.5	302.9	173.4	544	414.5	479.9	350.4
>57	70.7	176.9	106.2	302.6	231.9	272	201.3
>60	41	105.8	64.8	177.6	136.6	159.2	118.2
>63	24.2	61.9	37.7	106.7	82.5	93.2	69
>66	14.3	32.3	18	59.4	45.1	51.5	37.2
>69	8.4	18.6	10.2	32.3	23.9	28.8	20.4
>72	4.7	10.3	5.6	19.3	14.6	16.9	12.2
Laeq (dB)	**Population (000s)**						
	Max Use	**Option 5**		**Option 7**		**Option 11**	
		Total 2030	**Change Cw Base**	**Total 2030**	**Change Cw Base**	**Total 2030**	**Change Cw Base**
>54	17.6	37.7	20.1	83.1	65.5	69	51.4
>57	8.8	24.1	15.3	35.1	26.3	34.5	25.7
>60	4.3	10.2	5.9	23.1	18.8	18.2	13.9
>63	1.6	5.1	0.5	9.3	4.7	8.8	4.2
>66	0.7	3.4	2.7	4.8	4.1	4.5	3.8
>69	0.3	2.4	2.1	3.1	2.8	3	2.7
>72	0.1	1	0.9	2.4	2.3	1.7	1.6

Options in 2030

9.8.5 The Maximum Use Option is the Base Case for 2030. The population within the 57 dB contour would be 2,000 more than in 2015, with the additional population affected being in Sawbridgeworth as well as in Bishop's Stortford. However, the total number within the 57 dB contour remains below 9,000. This represents a 2,800 increase over existing conditions. The population increase for the 63 dB contour is 3,300 over existing conditions.

9.8.6 Option 5 adds a new full length runway to the south of the existing runway. This results in an increases in the 57 dB contour area of 50% compared with the Base, bringing a further 15,300 to this level of noise exposure, an 18,000 increase over existing conditions. Bishop's Stortford is the main settlement affected. There will also be a substantial increase in the population within the 69 dB contour over the Base, from 300 to 2,400.

9.8.7 Option 7 would have two pairs of parallel runways. This proposal would result in a 26,300 increase in the population within the 57 dB contour over the base, and 29,100 increase over existing conditions. New areas affected over Option 5 would include most of Sawbridgeworth and more of Bishop's Stortford. The number of people under the 69 dB contour would increase substantially to 3,100 compared with 300 in the Base and 200 in existing conditions.

9.8.8 Option 11 is similar to Option 7 with two western runways but only one eastern runway. The populations under the 57 dB and 69 dB contours are much the same as for Option 11. However, the population under the 54 dB contour would be 17% lower at 69,000.

9.8.9 To summarise, comparisons of populations within the 57 dB contours against existing conditions indicate that Maximum Use of existing runway will affect a further 800 people in 2015 while adding a further runway would cause a further 4,600 people to be affected. By 2030 the new runway will affect an additional population of around 18,000. The 3 or 4 runway layouts raise the numbers exposed to 57 dB by approximately 29,000 to around 35,000 people.

Sensitivity Tests: Land Use Planning System Option and Option 7 with Accelerated Retirement, Reassignment and Increased Noise Stringency

9.8.10 Table 9.25 below presents the results of sensitivity tests combining assumptions relating to aircraft type retirement rates, the reassignment of aircraft types and a Chapter 3 – 14dB noise stringency requirement. The areas within the 57dB contours fall by 26% and 25% respectively for the land use planning system option in 2015 and the largest option, Option 7, in 2030. The area under the 57dB contour for the land use planning system option in 2015 falls to 27.6 sq km, 27% less than the 1994 area.

Table 9.25: Stansted Options Noise Sensitivity Test Results

LAeq (dB)	Area (sq km)			
	Land Use Planning System Option 2015		Option 7 2030	
	Core run	Sensitivity test	Core run	Sensitivity test
>54	63.9	46.3	544.0	392.8
>57	37.5	27.6	302.6	228.4
>60	22.1	16.3	177.6	135.8
>63	13.1	9.5	106.7	78.4
>66	7.5	5.3	59.4	42.4
>69	4.2	2.8	32.3	24.7
>72	2.2	1.5	19.3	14.7
	Population (000s)			
>54	8.1	5.1	83.1	49.5
>57	4.0	1.9	35.1	27.9
>60	1.5	1.0	23.1	13.6
>63	0.6	0.3	9.3	7.3
>66	0.2	0.1	4.8	3.5
>69	0.1	<0.1	3.1	2.6
>72	0.1	<0.1	2.4	2.3

Aircraft Noise: Night-time

9.8.11 Tables 9.26 and 9.27 below show the population numbers and associated house counts within the departure and arrival 90 dBA SEL footprints for easterly and westerly operations respectively. The footprints are shown in a supporting document and represent an ‘average worst’ QC2 aircraft, applied to each departure track (SID) and each runway’s approach path for arrivals.

9.8.12 SID references are: BUZ – Buzad; WES - Wescott; CLN - Clacton; DVR – Dover; LAM - Lambourne

Table 9.26: Night Noise Population and House Counts – Easterly Operations

	Existing		Option 5				Option 11					
Runway	**05**		**05L**		**05R**		**05L**		**05C**		**05R**	
	Popl'n (000's)	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**
Departures												
BUZ/WES	0.4	0.2	0.4	0.1	0.5	0.2	0.1	0.1	0.2	0.1	0.5	0.2
CLN	0.4	0.2	0.4	0.2	0.5	0.2	0.2	0.1	0.2	0.1	0.5	0.2
DVR/LAM	0.2	0.1	0.4	0.2	0.5	0.2	0.2	0.1	<0.1	,0.1	0.5	0.2
Average	0.3	0.2	0.4	0.2	0.5	0.2	0.2	0.1	0.2	0.1	0.5	0.2
Arrivals	1.5	0.6	1.5	0.6	1.5	0.6	0.6	0.2	1.5	0.6	1.5	0.6

	Option 7							
Runway	**05LL**		**05L**		**05R**		**05RR**	
	Popl'n (000's)	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**
Departures								
BUZ/WES	0.1	0.1	0.2	0.1	0.4	0.2	0.7	0.3
CLN	0.2	0.1	0.2	0.1	0.4	0.2	0.7	0.3
DVR/LAM	0.2	0.1	<0.1	<0.1	0.4	0.2	0.7	0.3
Average	0.2	0.1	0.2	0.1	0.4	0.2	0.7	0.3
Arrivals	0.6	0.2	1.5	0.6	1.5	0.6	1.8	0.8

Table 9.27: Night Noise Population and House Counts – Westerly Operations

	Existing		Option 5				Option 11					
Runway	23		23R		23L		23R		23C		23L	
	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)
Departures												
BUZ/WES	0.8	0.3	0.8	0.3	2.0	0.8	0.2	0.1	0.8	0.3	2.0	0.8
CLN	0.4	0.2	0.4	0.2	2.0	0.8	0.3	0.1	0.4	0.2	2.0	0.8
DVR/LAM	0.6	0.2	0.6	0.2	2.0	0.8	0.3	0.1	0.6	0.2	2.0	0.8
Average	0.6	0.2	0.6	0.2	2.0	0.8	0.3	0.1	0.6	0.2	2.0	0.8
Arrivals	1.7	0.7	1.7	0.7	0.4	0.2	1.0	0.4	1.7	0.7	0.4	0.2

	Option 7							
Runway	23RR		23R		23L		23LL	
	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)	Popl'n (000's)	Hse (000's)
Departures								
BUZ/WES	0.2	0.1	0.8	0.3	1.9	0.8	2.0	0.8
CLN	0.3	0.1	0.4	0.2	1.9	0.8	2.0	0.8
DVR/LAM	0.3	0.1	0.6	0.2	1.9	0.8	2.0	0.8
Average	0.3	0.1	0.6	0.2	1.9	0.8	2.0	0.8
Arrivals	1.0	0.4	1.7	0.7	0.4	0.2	0.3	0.1

9.8.13 The numbers of people and houses affected at Stansted are relatively low across all options.

Surface Access Noise: Highways

9.8.14 Table 9.28 gives the overall results (total EPA) from the GOMMMS plan level assessment for road traffic noise. The Surface Access Noise part of the Appraisal Summary Table also includes the EPA values split by noise contour bands.

Table 9.28: Stansted Surface Access Noise Assessment: Highways

	Total change in Estimated Population Annoyed (EPA) by road traffic noise (000's)			
Year	**Maximum Use**	**Option 5**	**Option 11**	**Option 7**
2015	+0	+0.7	n/a	n/a
2030	n/a	+0.3	+1.5	+3.0

9.8.15 The noise impacts of changes in road traffic for the Maximum Use option and Option 5 in 2015 are compared with the Base Case, which is the road network for the current land use planning system option. The roads around Stansted affected for Option 5 include the M11, A120 and B1004 in Bishop's Stortford. The net changes in Estimated Population Annoyed (EPA) by road traffic noise are zero for Maximum Use and 700 for Option 5.

9.8.16 For 2030, the traffic noise effects for Options 5, 11 and 7 have been assessed against a Base Case of the road network for Package 2, maximum use of the existing runway. For Option 5, a similar set of roads to that in 2015 is affected. The assessment results in a net increase in EPA of 300 people. For Option 11 the traffic noise effects spread over a wider area. The M11 between the A120 and the A505 shows noise impacts, as well as the A1301 south of Cambridge. Impacts would also arise in Braintree and Chelmsford. The total change in EPA for Option 11 is an increase of 1,500 people. The impacts for Option 7 extend over a greater area than for Option 11. Effects extend south on the M11 down to the M25 and to the east. The total increase in EPA for Option 7 is 3,000.

Surface Access Noise: Railways

9.8.17 Table 9.29 gives the results (total EPA) from the GOMMMS strategy level assessment for railway noise.

Table 9.29: Stansted Surface Access Noise Assessment: Railways

	Total change in Estimated Population Annoyed (EPA) by railway noise (000's)			
Year	**Maximum Use**	**Option 5**	**Option 11**	**Option 7**
2015/2030	N/a	+1.8	+3.4	+4.5

9.8.18 The railway noise impacts for the Options at Stansted are compared against the Base Case which is the Maximum Use of the existing runway scenario. The impacts apply for 2015 and also for 2030 where this is appropriate. The increases in rail services and associated noise impacts for Option 5 apply to the railway line from Stratford in East London, through South Tottenham, through Bishop's Stortford, to Cambridge and Ely. The change in Estimated Population Annoyed (EPA) by railway noise for Option 5 is an increase of 1,800 people. For Option 11, in general, the same sections of line would be affected. The greater service increases result in larger noise impacts. The assessment for Option 11 is an increase in EPA of 3,400.

9.8.19 With Option 7 a new line is assumed between the airport and Braintree. The new train services would give rise to noise impacts for people living near to this line and the lines between Braintree and Norwich, via Witham, Colchester and Ipswich. The change in EPA with this Option would be an increase of 4,500 people.

9.8.20 The above assessment should be considered as a worst case appraisal. It may be that the additional airport rail services would not be as extensive as those appraised. However, any changes would not be expected to alter the relative positions between the railway noise impacts for the airport options.

9.9 Environment: Local Air Quality Impacts

Introduction

9.9.1 Air quality results are provided for representative options at each airport, for 2015 and 2030 as appropriate. The air quality statistics used as assessment criteria for defining poor air quality in SERAS Stage Two are: annual mean Nitrogen Dioxide concentrations of 40µg/m^3; and the 90th percentile of running 24-hour mean PM_{10} concentrations of 50µg/m^3. In practice, annual mean PM_{10} compared to a statistic of 40µg/m^3 are also reported, as the 90th percentile values are a simple factor of these. The Air Quality Key Indicator for SERAS stage2 is 'the number of people exposed to an exceedance of the air quality standard, weighted by the degree of exceedance'. The higher the key indicator, the worse the air quality impact is.

Results 2015

9.9.2 Figures 9.51 to 9.53 illustrate the air pollution contours for Stansted options in 2015. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM_{10} and 90th percentile of 24 hour mean PM_{10} where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 9.30 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 9.31 provides similar results for PM_{10}.

9.9.3 In 2015, only Option 5 at Stansted results in population exposed to exceedances for annual mean Nitrogen Dioxide, with around 20 people exposed. This is a result of the new runway being very close to the eastern airport boundary, with population close by. Expressed as a simple average, airport related Oxides of Nitrogen in 2015 account for between 25% (base) and 50% (option 5) of total Oxides of Nitrogen in the Stansted study area. ‘Airport related’ includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the ends of the runways, associated with acceleration during take-off roll. The stands areas are also clearly seen. The figures also show that major roads in the area are not contributing to areas of exceedance.

9.9.4 Results clearly show that Stansted options in 2015 have no impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24 hour mean PM_{10}, in any option. Expressed as a simple average, airport related PM_{10} in 2015 accounts for just 2-5% of total PM_{10} in the Stansted study area across all options. Very few locations exceed air quality statistics, solely over the ends of runways. As no option results in population exposed to exceedances of the air quality statistics, figures are only provided for the package option with the largest most extensive PM_{10} contours, for illustration.

Table 9.30: Nitrogen Dioxide Key Indicators - Stansted 2015

Package	Option	Population exposed to exceedance of annual mean NO_2 of 40 µg/m³							*Total popul'n exposed*	Key Indicator
		40-50 µg/m³	50-60 µg/m³	60-70 µg/m³	70-80 µg/m³	80-90 µg/m³	90-100 µg/m³	>100 µg/m³		
1	Base Case	0	0	0	0	0	0	0	*0*	**0**
2	Max Use	0	0	0	0	0	0	0	*0*	**0**
7	Option 5 - wide spaced	21	0	0	0	0	0	0	*21*	**21**

Table 9.31: PM_{10} Key Indicators - Stansted 2015

Package	Option	Annual mean PM_{10} of 40 µg/m³		90th Percentile of 24hour mean PM_{10} of 50 µg/m³	
		Total population exposed	Key Indicator	Total popul'n exposed	Key Indicator
1	Base Case	0	**0**	0	**0**
2	Max Use	0	**0**	0	**0**
7	Option 5 - wide spaced	0	**0**	0	**0**

Results 2030

9.9.5 Figures 9.54 to 9.58 illustrate the air pollution contours for Stansted options in 2030. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM_{10} and 90th percentile of 24 hour mean PM_{10} where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 9.32 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 9.33 provides similar results for PM_{10}.

9.9.6 In 2030, all three options at Stansted result in population exposed to exceedances for annual mean Nitrogen Dioxide. Option 5 has the best key indicator, but has 45 people exposed to exceedances. Option 7 has the worst key indicator score, and has nearly 300 people exposed to exceedances. Options in 2030 are worse than 2015 options. Expressed as a simple average, airport related Oxides of Nitrogen in 2030 account for between 66% and 76% of total Oxides of Nitrogen in the Stansted study area across all options, (much higher than in 2015). 'Airport related' includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the ends of the runway, associated with acceleration during take-off roll. The stands areas are also clearly seen. The figures also show that major roads in the area are not contributing to population exposed to areas of exceedance.

9.9.7 Results clearly show that Stansted options in 2030 (as in 2015) have no impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24 hour mean PM_{10}, in any option. Expressed as a simple average, airport related PM_{10} in 2030 accounts for 6-9% of total PM_{10} in the Stansted study area across all options (higher than in 2015). Very few locations, limited to the runways, exceed air quality statistics. As no option results in population exposed to exceedances of the air quality statistics, figures are only provided for the package option with the largest most extensive PM_{10} contours, for illustration (Option 7).

Table 9.32: Nitrogen Dioxide Key Indicators - Stansted 2030

Package	Option	Population exposed to exceedance of annual mean NO_2 of 40 μg/m^3							*Total popul'n exposed*	Key Indicator
		40-50 μg/m^3	50-60 μg/m^3	60-70 μg/m^3	70-80 μg/m^3	80-90 μg/m^3	90-100 μg/m^3	>100 μg/m^3		
7	Option 5 - wide spaced	5	19	0	21	0	0	0	*45*	**127**
14	Option 7 - 2 pair close parallel	133	141	24	0	0	0	0	*298*	**487**
10	Option 11 - 3 runways	66	28	0	19	21	0	0	*134*	**303**

Table 9.33: PM_{10} Key Indicators - Stansted 2030

Package	Option	Annual mean PM_{10} of 40 μg/m^3		90th Percentile of 24hour mean PM_{10} of 50 μg/m^3	
		Total population exposed	Key Indicator	Total population exposed	Key Indicator
7	Option 5 - wide spaced	0	**0**	0	**0**
14	Option 7 - 2 pair close parallel	0	**0**	0	**0**
10	Option 11 - 3 runways	0	**0**	0	**0**

9.10 Employment

Employment Forecasts

9.10.1 Employment forecasts for each option based on current employees at Stansted and projected forwards to 2015 and 2030 are shown in Table 9.34. Current data show that Stansted has a lower employee:passenger ratio than either Heathrow or Gatwick. All other applied growth factors are similar to those applied at other airports.

9.10.2 In 2015, total direct on/off site employment at Stansted ranges between 15,300 employees with maximum use of the existing runway and 46,000 with an additional runway. At the maximum by 2030, Option 7 results in 71,400 total direct on/off site employees, a nine-fold increase over current direct employment levels. Compared with current employment levels, this represents an additional 64,000 direct on/off site new jobs and a further 19,000 additional indirect jobs.

Table 9.34: Current and forecast employment at Stansted by option 2015 & 2030

Current & Forecast Employment by Option	Current 1998	Max Use 2015	Option 5 2015	Max Use 2030	Option 5 2030	Option 11 2030	Option 7 2030
Direct on-site	6,700	13,100	39,200	12,000	37,100	48,500	60,800
Direct off-site	1,000	2,200	6,800	2,000	6,400	8,500	10,600
Indirect	2,300	4,600	13,800	4,200	13,100	17,200	21,400
Total Employment	10,100	19,900	59,800	18,200	56,600	74,200	92,800
Passengers (mppa)	10	23	64	26	74	98	122
Direct employees/mppa	816	664	715	544	585	584	587
Total employee/mppa	1,061	864	930	708	761	760	764

9.11 Land Use/Urbanisation

Summary

9.11.1 Current employment generated by the airport (on- and off-site direct employment and indirect employment) is around 10,000 jobs. With the largest options appraised, employment totals could increase to around 60,000 jobs in 2015 and just over 90,000 in 2030. The current core catchment area is defined as Uttlesford, Harlow and East Hertfordshire districts. A wider catchment area, potentially embracing Braintree, Chelmsford, Enfield and Epping Forest, would need to be considered for the larger options.

9.11.2 The employment growth associated with the larger options (up to 49,700 jobs to 2015 and up to 82,700 jobs to 2030) is large in relation to total TEMPRO employment growth in the core and wider catchment areas (45,000 jobs to 2015 and 74,000 jobs to 2030) and to housing provision (RPG provision is for 83,000 additional houses in the core and wider catchment areas to 2030, making 475,000 households in total). Meeting this additional labour demand will require a sectoral shift in current employment patterns (from the low base of 5% of current core catchment area jobs being at the airport), some remote sourcing of employees (in the Lee Valley for example) and additional development, requiring a change in current planning policies. In practice there might be a capacity of up to 12,000 dwellings in the core catchment area as a progression of current planning policies, assuming two new settlements and some Green Belt releases.

9.11.3 Development on this scale would result in a fundamental change in the urban-rural character of the two districts, and such a scenario is unrealistic within current planning policy for the area. The context could be changed, however, through the sub-regional study currently being undertaken.

9.11.4 In terms of off-airport employment, significant land allocation alteration is needed to provide for the larger options. It should be possible for the scale of anticipated indirect employment to be accommodated for development of the existing runway if additional land allocations are made. Current core catchment area planning policies assume that airport related development would take place on the airport itself. Further alteration to land allocations would be needed to accommodate the off-site employment associated with new runway options in either 2015 or 2030 within the immediate airport core catchment area. There are fewer competing pressures from other industries than around Heathrow and Gatwick, but as the amount of direct employment that has to be accommodated off site grows, it would become successively difficult to find sites within the existing planning framework.

Employment Land Requirements

9.11.5 The off-airport employment implications vary significantly (given the very different scales of development) between options, with requirements for up to 94 hectares in 2015 and 164 hectares in 2030 of off-site employment land within reasonable proximity to the airport.

9.11.6 While options confined to the existing single runway do not fundamentally change the airport's share of the CCA and WCA workforce, the larger options imply major sectoral shifts, with the airport's share projected to increase to around 36% of the CCA workforce with the largest option, Option 7, by 2030.

Uttlesford District Council

9.11.7 Within Uttlesford, the combination of low unemployment and the expected scale of growth in employment associated with an airport capacity of 15 mppa (within the existing planning permission), has meant that in planning policy terms there has been no real need to identify significant areas for further economic development. The Essex Structure Plan, for example, indicates the scale of provision required between 1990 and 2001 to be 22 hectares.

9.11.8 The existing local plan also assumes that airport related developments would take place on the airport itself. There is a joint policy stance agreed between Hertfordshire, Essex, Uttlesford and East Hertfordshire Councils to direct all "airport related employment generating developments" onto the airport site

9.11.9 These circumstances mean that in practice the local plan makes no provision for the scale of off-airport employment that may be required for an expanded airport, if indeed a substantial proportion of this is to be located off the airport site.

9.11.10 If, as seems likely, the development to accommodate direct and a proportion of indirect employment cannot be accommodated on site, then similar issues concerning additional land releases will apply to those discussed under housing capacity. Given the nature of employment uses, provision of additional employment land is most likely to take the form of town edge expansions or through redevelopment of larger brownfield sites.

East Herts District Council

9.11.11 As might be expected given the joint agreed policy stance noted above, this takes a similar approach to the Uttlesford plan, with the assumption that indirect employment will be located within the airport site.

9.11.12 As at March 1995 the outstanding capacity for employment uses within the district was approximately 62 ha.

9.11.13 If further allocations are required, they would raise similar issues to finding new housing land as discussed below.

Harlow District Council

9.11.14 A review of the local plan suggests there is only limited land available currently within the district boundary drawn tightly around the town. However there are extensive built up employment areas which have been redeveloped in recent years, resulting in a reasonable supply of employment land. This process seems likely to continue. In addition, unemployment rates higher than the regional average may prompt limited town edge expansions if insufficient employment land were available to accommodate local job requirements.

Housing Capacity

9.11.15 The options appraised in 2015 would require 8,100 additional jobs (maximum use of the existing runway) or as many as 49,700 jobs (Option 5). While maximum use of the existing runway would not cause undue problems in the labour market, Option 5 could only be accommodated with a major sectoral shift in employment. It would equate to 25% of core catchment area and 7% of wider catchment area jobs in 2015. Further expansion of the airport to 2030 would see these proportions increase to 36% in the core catchment area and11% in the wider catchment area. The pressure major airport expansion would put on the labour market is demonstrated by the growth in potential airport employment to 2030 (46,500 to 82,700 jobs with different options) and the projected TEMPRO employment growth in the airport's core and wider catchment areas of 74,000.

9.11.16 The housing shortfall in the combined catchment areas is small. TEMPRO housing projections exceed housing provision by 21,000 to 2015 and 17,000 to 2030. On this basis, the largest development option would require some 19,000 dwellings in excess of RPG provision, equivalent to an annual average provision of over 630 additional dwellings per year in the period to 2030.

9.11.17 Within Uttlesford, the principal north-south transport corridor runs close to the west of Stansted and contains the M11 London - Cambridge motorway and London Liverpool Street - Cambridge railway line. Both are directly connected to the airport. The single carriageway A120 runs immediately to the south of the Airport which connects Harwich and Colchester, through to the district of East Hertfordshire. This pattern of accessibility means that most of the existing towns of the M11 and A120 corridors meet the criteria for access to the airport.

9.11.18 Much of the rural parts of the district up to the edge of existing built up areas are designated as Areas of Special Landscape Value. However, this is not an absolute constraint to new development, with policy suggesting that any development that is permitted in these areas will need to be particularly well designed and in scale, to accord with the special characteristics of the area.

9.11.19 East Herts district lies immediately to the west of Stansted and includes the town of Bishop's Stortford, about 2 miles from the airport. The district's main connection with the airport is the A120 single carriageway road, which runs west from the airport for about 15 miles as far as the A10, the former main route from London to Cambridge and providing links with centres such as Hertford and Ware. There are also road connections to the south west linking the airport with towns such as Sawbridgeworth and Harlow (Harlow District).

9.11.20 The southern part of the district forms part of the Metropolitan Green Belt which surrounds several of the larger towns. This Green Belt was extended in the mid 1980s to include some areas to the north of Bishop's Stortford.

9.12 Integration Impacts

Regional/sub-regional policy

9.12.1 Stansted Airport impacts upon the sub-regions of the East London/Lower Lea Valley, London/Stansted/Cambridge/Harlow and Cambridge. The impacts of an expanded airport are discussed below under the headings of employment/labour force, housing and transport infrastructure.

Employment / Labour Force

9.12.2 All three sub-regions in the East (East London/Lower Lea Valley, London/Stansted/ Cambridge/Harlow and the Cambridge sub-region) clearly have the potential to support the additional employment created by growth at Stansted and, to a lesser extent, at Cliffe Marshes. In East London/Lower Lea Valley there is both a large labour force and much brownfield employment land available. With heavy reliance on the manufacturing sector, the existing skills profile would make it difficult to diversify the employment base. However, there is an abundance of available institutions that are capable of developing these skills if they are able to access the workforce, which suffers from heavy deprivation; often a difficult task without considerable funding and support.

9.12.3 In the London/Stansted/Cambridge sub-region, the demand for labour can equally be met, although there is more opportunity to diversify the employment base. With the sub-region covering such a range of areas, people and skills, the opportunity afforded by airport expansion to capitalise on these is clear. In the Cambridge sub-region however, the existing skills profile is far more entrenched, being centred around the high technology and R&D sectors. This extends to considerations of developing the requisite training and skills profile for the sub-region. In the other two sub-regions however, the clustering of high-profile businesses in the vicinity of Stansted Airport will go some way towards assisting the development of skills that these areas need. This extends to those entering the job market, with the high skill sectors in the Cambridge area being considerably less flexible in terms of job requirements than the lower skill sectors likely to be more dominant in the East London/Lower Lea Valley/ Harlow sub-regions.

9.12.4 The degree to which these sub-regions are suited to developing business clusters is variable. East London and the Lower Lea Valley are not particularly close to any of the airports, and the only clear sectoral strength in the area is logistics. As such, there are several other PAERs in the region that will have a competitive advantage in developing clusters of businesses, specifically the northern parts of the London-Stansted-Cambridge sub-region, Harlow and Cambridge itself. These areas are more proximate to the airports and in the case of Cambridge, it already has a considerable cluster developing. Harlow is in the best potential new location, being able to feed off the economically buoyant areas of Cambridge and London Docklands yet with the scope for economic restructuring and growth to occur. While this provides the opportunity for clusters of both high technology businesses and further expansion of existing strong sectors such as logistics to occur, it suffers from boundaries restricted by green belt designations that may hinder development of clusters in a high growth scenario. This may restrict the range of business accommodation on offer, as it may also in the wider Cambridge sub-region.

Housing

9.12.5 All of the Eastern sub-regions are tightly constrained by metropolitan green belt. As such, large-scale housing development to support possible growth in airport-related employment would be difficult. Most of this growth in East London/Lower Lea Valley would be affordable in nature and built on brownfield sites, and would therefore assist in reaching targets set in regional guidance. However, in contrast, most of the development in the Cambridge sub-region would come in the form of a new settlement, particularly if large-scale expansion of Stansted took place.

9.12.6 Whether brownfield development would be sustainable in East London/Lower Lea Valley in terms of being located near to employment destinations is uncertain. Whilst there is a reasonable supply of employment land available, businesses drawn to Stansted Airport are likely to locate much closer and on better transport routes to the airport and Central London. As such, workers may be coming from East London and the Lower Lea Valley, yet will be commuting to other parts of the sub-region nearer to Stansted and Cambridge.

9.12.7 The resultant effect is a redistribution of workers to the northern and eastern parts of the amalgamated sub-regions, i.e. Harlow, the Stansted area and the Cambridge sub-region. Again, a new settlement close to Cambridge would be perfect to house workers in the local high technology clusters that would continue to grow with the expansion of Stansted.

Transportation / Infrastructure Improvements

9.12.8 The impact of airport development on the sub-regions in the East varies in terms of sustainable regional policy for transportation. Development at Stansted will have little effect on reducing the need to travel. With a large proportion of the workforce based close to the major areas of potential employment, travel will be minimised. However, the increases of people in employment will inevitably have the effect of increasing travel overall. As the high growth scenario is approached, this will have an overall negative effect.

9.12.9 In contrast, in the Cambridge sub-region, the potential development of a new settlement will bring with it a clustering of employment opportunities. Provided that workers in the new settlement can be broadly matched to the requirements of the businesses, there will be a large reduction on the need to travel for these workers.

9.12.10 One criterion within which airport development will accrue benefit to the sub-regions is the need to improve the rail network. With the links to London well established, major airport growth and development will consolidate these links as well as developing radial links connecting along the major corridors in the sub-regions. This is particularly in respect of freight, with the eastern regions being the major area through which freight will pass to access the rest of the country. Also freight will pass in the other direction from Stansted Airport to access the rest of the South East and continental Europe via the ports and the Channel Tunnel.

Social Impacts

Low Growth Scenario

9.12.11 Under a low-growth scenario (up to 2015), around 10,000 jobs could be generated in total. Of these, over 3,300 could be low skill in nature, with 2,100 possibly being located on-site and 1,200 off-site.

9.12.12 In 1998 there was a shortage in Harlow and Enfield of over 5,700 jobs. This is forecast to increase further by almost 1,500 jobs up to 2016. As such, there would be a strong possibility that all of the jobs created could be filled by the Harlow and Enfield labour markets.

9.12.13 With reasonable transport infrastructure already in place between Harlow and Stansted, it is likely that the majority of on-site employment can be accommodated by workers from the district. It could also take a large percentage of the off-site jobs, although improvements to local bus services would be needed. It is extremely unlikely that Enfield workers would take any more than 10% of the jobs created, regardless of the transport improvements made.

High Growth Scenario

9.12.14 Under a high growth scenario (up to 2030), around 82,000 jobs are forecast to be generated in the highest case. Of these, more than 27,000 may be low skill in nature, with as many as 17,000 potentially located on-site and 10,000 off-site.

9.12.15 As stated above, by 2016 there is a very large labour surplus in the two districts. By 2031, with a net balance of 1,900 jobs gained, the worker surplus is likely to fall again to as low as 5,000. As such, it is still likely that several thousand of the available workers in Harlow can take up airport-generated positions. Consolidation of this is provided by Harlow being a focus point for regeneration policy and with the existing transport infrastructure being reasonable. Provided further improvements are made to local bus and train services, it is reasonable to assume that this scenario can be achieved.

9.12.16 Enfield workers also have the scope to fill as many as 2,000 low skill jobs. However, in order to achieve this, the relatively poor connectivity of Enfield to Stansted needs to be rectified. In addition, the district does not benefit from being the focus of regeneration policy. This is concentrated more on west Essex (in Harlow), East Hertfordshire (Hoddesdon) and East London.

9.12.17 It should be noted, in conclusion, though, that such a large development at Stansted will not be serviced by recourse to surplus labour pools. The paragraphs above suggest that up to half of the low skill jobs might be filled from the labour sources in Enfield and Harlow, but the remainder will need to be sourced from further afield or by in-migration.

10 Appraisal of Options at Main Sites: Luton

10.1 Options Appraised in Stage Two

10.1.1 The Base Case at Luton, limited to development currently envisaged in the land-use planning system, has a capacity of 10 mppa, as reflected in the Bedfordshire Structure Plan. Figure 10.1 indicates the airport's location and Figure 10.2 the existing layout. In the Stage One Report, the capacity of the existing 2160m runway and terminal zone at their maximum use was taken to be 15 mppa. At the end of Stage One, it was agreed that, in the absence of options that added a runway, options making maximum use of the single runway could have a capacity of around 30 mppa, allowing for extension of the runway, the development of taxiways and other facilities. In Stage Two, in Package 2 (maximum use of existing runways) therefore, Luton has an assumed capacity of 31 mppa. Two versions of an extended and re-aligned runway have been appraised.

10.1.2 Option 2 has a new 3000m runway built 200m south of and parallel to the present runway. The latter would be retained to form the basis of a parallel taxiway (Figure 10.3).

10.1.3 Option E3 creates a new 3000m runway on a NNE-SSW alignment, similar to that at Stansted. The intention of this was to reduce airspace interaction between Luton and Stansted and to reduce noise impacts in the vicinity of Luton airport (Figure 10.5).

10.1.4 In both cases it is assumed that the new runway could be in place by 2011 and would have a runway capacity of 240,000 ATMs supported by a terminal capacity of 31 mppa. Initial modelling of air freight in Stage Two of SERAS indicated that in constrained South East scenarios, a large volume of air freight, to be carried on freighters, might wish to take advantage of any runway capacity at Luton not taken up by passenger ATMs. There are various reasons, including commercial and environmental feasibility, why Luton might not be able to accommodate these demands. To assess what may be feasible, alternative layouts at Luton which provide for substantial freight movement as well as passenger movement have also been subjected to some appraisal (Figures 10.4 and 10.6).

10.1.5 The options appraised at Luton are summarised in Table 10.1 and illustrated in Figures 10.2 to 10.6.

Table 10.1: Options appraised at Luton

Option	Description	Terminal Capacity mppa	Runway Capacity ATM	Year of Introduction
	Current Land Use Planning System	10	100,000	
2	New 3000m runway to south of existing	31	240,000	2011
E3	New 3000m runway realigned NE-SW adjusted to avoid Someries	31	240,000	2011

10.2 Capital Costs

10.2.1 Table 10.2 below shows the estimated incremental capital costs for each option above the 10 mppa capacity Base Case. Table 10.3 gives the breakdown of surface access (road and rail) costs.

Table 10.2: Estimated Incremental Capital Costs for Luton Options above Base Case (£ million)

Item	Option 2 Core Layout	Option 2 with Freight Facilities	Option E3 Core Layout	Option E3 with Freight Facilities
Capacity	31 mppa	31 mppa	31 mppa	31 mppa

Item	Option 2 Core Layout	Option 2 with Freight Facilities	Option E3 Core Layout	Option E3 with Freight Facilities
Terminals & Satellites				
Terminal Buildings	265	265	265	265
Satellite Buildings	132	132	132	132
Baggage Handling/conveyors	55	55	57	57
Total	**452**	**452**	**454**	**454**
Aircraft Pavements				
Runways	18	18	18	18
Taxiways	8	8	17	17
Aprons / Stands	66	66	66	66
Total	**92**	**92**	**101**	**101**
Enabling Works & Infrastructure				
Demolition, Earthworks, etc	93	144	96	110
Car Parking	57	59	57	59
Utility Services	18	24	18	24
Airside Roads and public road diversions	5	13	8	8
Tracked Transit	103	103	99	99
Drainage	16	21	16	21
Landscaping	4	6	3	7
Total	**297**	**371**	**297**	**329**
Navigation Aids (ATC, ILS & AGL)	**2**	**2**	**4**	**4**
Cargo & Maintenance				
Cargo buildings & aprons	10	63	10	60
Hangar/ Maintenance Buildings & aprons	49	49	49	49
Total	**59**	**112**	**59**	**109**
Support Facilities, etc				
Support facilities	8	8	6	6
Offices	2	2	2	2
Other facilities / services (inc. fuel, security)	19	24	19	19
Total	**29**	**34**	**27**	**27**
On-costs	233	266	235	256

Item	Option 2 Core Layout	Option 2 with Freight Facilities	Option E3 Core Layout	Option E3 with Freight Facilities
Contingency	291	332	294	320
Land Costs	12	14	52	53
Sub-total: Airport Development Costs	**1465**	**1673**	**1524**	**1653**
Airport Development Costs per mppa provided above 10 mppa Base Case	70	80	73	79
Costs of Associated Surface Access	**72**	**72**	**72**	**72**
Total Capital Costs	**1537**	**1745**	**1596**	**1725**
Total Capital Costs per mppa provided above 10 mppa Base Case	73	83	76	82

Table 10.3: Estimated 'Airport Specific' Surface Access Costs (£ million)

Item	Option 2 Core Layout	Option 2 with Freight Facilities	Option E3 Core Layout	Option E3 with Freight Facilities
Road Schemes				
NE by-pass – Years 2015 & 2030	60	60	60	60
Widen A1081 & A505 - Year 2030	12	12	12	12
Sub Total for 2015	**60**	**60**	**60**	**60**
Sub Total for 2030	**72**	**72**	**72**	**72**
Rail Schemes Subtotal	**0**	**0**	**0**	**0**
Total 2015	**60**	**60**	**60**	**60**
Total 2030	**72**	**72**	**72**	**72**

Airport Option Costs

10.2.2 In all options, 9 to 15% of the total cost is attributed to enabling works – mostly due to earthworks. Since the site level is pre-determined by levels of connecting taxiways etc, a balanced cut / fill exercise is not possible and hence there is a requirement for large volumes of imported fill material.

10.2.3 In both options with added freight capacity, approximately 6% of the total cost is attributed to cargo handling facilities, compared with about 1% in the options with core facility only.

10.2.4 Terminal and satellite rates per mppa (about £21.5M) are high compared to other SERAS sites. This is partly explained by a new space provision of 7000 m^2/mppa, slightly above the SERAS standard to raise the whole facility, combining an existing, remodelled terminal and new terminal space, closer to the standard.

10.2.5 Car parking provision is the highest of all SERAS sites per mppa, but this is not reflected significantly in the cost due to most being surface parking.

10.2.6 Although not modelled in SERAS, it has been estimated that construction of a full length parallel taxiway on the existing site could increase the airport capacity to 27 mppa. The estimated Airport Development Cost for this together with associated facilities is £986 million (£58M per additional mppa).

10.2.7 Although not included in the cost estimates, a premium may be expected for working in operational areas. This would be of significance at Luton in any terminal and stand expansion; in Option 2 when constructing link taxiways across a live runway; in Option E3 while constructing about 600m of runway and taxiway where they cross the existing airfield pavements.

10.2.8 With a low office space provision of $95m^2$ per mppa it is not likely to contribute revenue generating floorspace.

10.2.9 The cost of a tracked transit system, linking the core terminal to the rail station in the valley to the west, is included in both options. Both options also include for conveyor systems for passenger access between the core terminal and the piers. In addition, Option 2 costs include a conveyor system in tunnel beneath the apron area, connecting the core terminal and the satellite.

10.2.10 Land costs are relatively low for Option 2 with mostly agricultural land-take. They increase significantly for E3 due to a higher proportion of industrial land-take .

Surface Access Costs

10.2.11 At £3.4m per mppa, the surface access scheme costs are low. This is particularly because there are no proposals to introduce a direct rail link. It is assumed that the proposed Luton and Dunstable guided bus route will link to the airport but no costs have been allowed. It has been assumed that, despite the currently proposed runway location in Option E3, the North East by-pass will not have a tunnelled section.

10.2.12 Improvements to the strategic road network already proposed, ie those not specifically required to accommodate airport related traffic, are on the M1 southbound from junctions 10 to 9 (3 lane up to 4 lane in 2015), on the M1 from junctions 12 to 13 (dual 3 lane up to dual 4 lane in 2015) and on the M1 from junctions 10 to 12 (dual 3 lane up to dual 4 lane in 2030). The cost of these schemes would be about £9 million, £37 million and £45 million respectively.

10.3 Demand Forecasts

10.3.1 Forecast passenger movements, ATMs and passengers per passenger ATM for each Luton option are summarised at 5 year intervals between 2000 and 2030 in the following tables:

- Table 10.4: Current Land-Use Planning System
- Table 10.5: Options 2 and E3

10.3.2 Options 2 and E3 have the same runway characteristics and the same runway and terminal capacities. One set of forecasts therefore applies to both options. The forecasts assume that Luton develops the types of services that currently operate: some domestic and short haul scheduled services, charter and, principally, low cost services. Principal features of the forecasts with each option are set out below.

Current Land-Use Planning System

10.3.3 In the current land-use planning system, Luton's passenger capacity is limited to 10 mppa. The forecasts indicate that this capacity will be taken up by a mix of low cost and charter passengers, with very few scheduled passengers. The number of passenger ATMs stays below 80,000 throughout the forecast period.

Options 2 and E3

10.3.4 Runway capacity is assumed to increase from 100,000 ATMs to 240,000 ATMs in 2011 when the new runway comes into use. For all but the early years from 2000, the airport is forecast to be operating at or close to its runway capacity. Together with the assumed service types and forecast passengers per ATM, the runway capacity prevents the assumed terminal capacity of 31 mppa being reached. Passenger forecasts grow to 17 mppa in 2015 and 29 mppa in 2030, with an average of 129 passengers per ATM, up from 113 in 2000 and 115 in 2015. Currently Luton airport is used almost exclusively by leisure and business passengers on low cost and charter services. The new runway capacity in 2011 gives a large increase in short haul scheduled services (carrying around 30% of passengers from 2020 onwards) and some increase in both charter and low cost services. It is forecast that business passengers are currently around 23% of total passengers, in 2015 there are forecast to be 3.6 million business passengers (21% of the total) and in 2030, 8.1 mppa (29% of the total).

Table 10.4: Luton – Current Land-Use Planning System

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	**	**	**	**	**	**	**
	Short haul	**	**	**	**	**	**	1
	USA							
	Long haul							
	Total	**	**	**	**	**	**	1
Charter		2	2	4	4	6	8	5
Low cost		5	5	5	4	3	2	2
Total		7	**7**	**8**	**8**	**9**	**11**	**8**
ATMs, '000								
Scheduled	Domestic	2	2	2	2	2	2	2
	Short haul	**	**	**	**	**	**	19
	USA							
	Long haul							
	Total	**	**	**	**	**	**	21
Charter		16	19	26	28	40	48	31
Low cost		42	48	48	43	31	27	19
Total		61	**70**	**77**	**74**	**74**	**78**	**72**
Passengers/PATM								
Scheduled								61
Charter		123	129	138	137	154	167	148
Low cost		110	95	97	97	90	94	93
Average		108	102	109	110	123	137	106

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less that 500 ATMs

Table 10.5: Luton - Options 2 and E3

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	**	**	**	**	**	**	**
	Short haul	**	**	**	1	7	8	9
	USA	0	0	0	0	0	0	0
	Long haul	0	0	0	0	0	0	0
	Total	**	**	**	1	7	8	9
Charter		1	2	2	5	6	7	9
Low cost		5	5	6	11	11	11	10
Total		6	7	**9**	17	**24**	**27**	**29**
ATMs, '000								
Scheduled	Domestic	2	2	2	2	2	2	2
	Short haul	**	**	**	18	85	88	88
	USA	0	0	0	0	0	0	0
	Long haul	0	0	0	0	0	0	0
	Total	2	2	2	20	87	90	89
Charter		11	14	19	33	41	44	51
Low cost		42	50	55	93	89	85	80
Total		56	67	**77**	146	**217**	**220**	**221**
Passengers/PATM								
Scheduled		35	37	37	67	84	92	101
Charter		120	123	126	145	151	161	179
Low cost		117	109	116	121	125	131	130
Average		113	109	115	119	113	121	129

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

10.4 Safety Risk

10.4.1 The Stage Two assessment of safety risk appraises the third party risk associated with both existing and new runway options. The full extent of the 1;10,000 and 1:100,000 designated risk areas are shown on the following figures. The 1:1,000,000 contours are partially shown.

- Figure 10.7 – Base Case
- Figure 10.8 – Option 2 Core Layout, New 3000m parallel runway 200m to the south of the existing runway.
- Figure 10.9 – Option E3 Core Layout, New 3000m runway aligned NNE:SSW and to avoid Someries Castle.

10.4.2 PSZ contours have been generated using the passenger plus freight ATM totals.

1:10,000 Risk Contours

10.4.3 The impacts of the 1:10,000 risk contours are shown in Table 10.6 below:

Table 10.6: 1:10,000 Risk Contours

Impact	Base	2	E3
Increase in Area (ha) above Base (West and East)	W 4.1 E 3.9	W +3.0 E +2.8	W +3.0 E +2.8
Population count within contour (outside airport boundary)	None	None	None
% developed area affected, (outside airport boundary)	0	0	0

10.4.4 In the base case, the west 1:10,000 PSZ crosses the main rail line and the A1081, while the east PSZ crosses only an unclassified road in an area of farmland. In Option 2, with the runway moved south, the west PSZ crosses the rail line and the B653, and the east PSZ cuts a minor road. The area at both ends is otherwise predominantly undeveloped. The realigned runway in Option E3 leaves the west PSZ entirely in agricultural land, with the east zone again cutting only minor roads.

1:100,000 Risk Contours

10.4.5 The impacts of the 1:100,000 risk contours are shown in Table 10.7 below:

Table 10.7: 1:100,000 Risk Contours

Impact (beyond 1:10,000 contour)	Base	2	E3
Increase in Area (ha) above Base (West and East)	W 48.5 E 46.2	W +30.4 E +28.8	W +30.4 E +28.8
Increase in Population affected above Base	114	+127	-74
% developed area affected, (outside airport boundary)	W <5 E 0	W <5 E 0	SW 0 NE 0
Other prominent features affected	School A1081 Motor Vehicle Works	As Base, School not affected	None

10.4.6 In the base case and Option 2 the western 1:100,000 contour extends over the southern suburbs of Luton, in the latter case just reaching the M1. In both these cases the east end PSZs are in agricultural land crossed by minor roads. Option 3 moves the west PSZ away from the built-up area, leaving both zones in essentially rural areas. The impact on communities and commercial activities is minimal.

1:1,000,000 Risk Contours

10.4.7 The impacts of the 1:1,000,000 risk contours are shown in Table 10.8 below:

Table 10.8: 1:1,000,000 Risk Contours

Impact (beyond 1:100,000 contour)	Base	2	E3
Increase in Area (ha) above Base (West and East)	W 413.4 E 393.2	W +303.1 E +288.4	W +303.1 E +288.4
% developed area affected	W 5–10 E rural	W 5-10 E + <5	New SW <5 New NE 5 –10

10.4.8 Prominent features enclosed by the 1:1,000,000 PSZs in the base case include:

- West; M1, A5 (T)
- East; None

10.4.9 Prominent features affected in the case of Option 2 include:

- West; M1, Stockwood Park Golf Course
- East;1 church, A1(M)

10.4.10 Prominent features affected in the case of Option E3 include:

- West; M1 Junction 9
- East; A505, 1 church

10.5 Surface Access

Infrastructure and service assumptions - roads

10.5.1 For the purposes of surface access demand forecasting, the changes to the existing road access arrangements were based on the findings of Stage One appraisals. This helped define the schemes associated with each option, as summarised in Table 10.9 and shown in Figure 10.12. No changes to the Reference Case road access arrangements are assumed when appraising the option with capacity limited to that incorporated in the Current Land Use Planning System (Package 1).

10.5.2 Options 2 and E3 would have the same capacities and requirements for road access improvements.

Table 10.9: Changes to road access – Luton Options

Scheme	Current Land Use Planning System	Option 2	Option E3
1 Luton North East By-pass		✓	✓
2 Widen A1081, M1 to Airport Way		✓	✓

Infrastructure and service assumptions - rail

10.5.3 Additions to the Base Case and Maximum Use of existing runway rail infrastructure and services were based on Stage One findings and shaped by discussions, with DTLR and SRA in particular, on the potential to integrate airport-focused schemes with parallel improvements in infrastructure and services planned to accommodate future increases in non-airport demand.

10.5.4 Schemes and services associated with the options are summarised in Table 10.10 and shown in Figures 10.13 and 10.14. As indicated in Figure 10.13, the airport is currently served by Thameslink services at the nearby Luton Airport Parkway station, with the Thameslink 2000 project further increasing both the capacity and scope of these services. While no changes to rail infrastructure are associated with the options, it is assumed that all services (both Thameslink 2000 and Midland Mainline) will call at Luton Airport Parkway given increased airport demand in Options 2 and E3.

10.5.5 It is also assumed that the Luton-Dunstable guided busway will be extended to the airport in Options 2 and E3, improving accessibility between the airport and the rail station.

Table 10.10: Changes to rail access – Luton Options

Infrastructure	Services	Current Land Use Planning System	Options 2 and E3
	Midland Mainline Derby semi-fast service calls at Luton Airport Parkway off-peak	✓	✓
Thameslink 2000	Increased capacity and scope of Thameslink services (e.g Dartford)	✓	✓
Luton – Dunstable guided busway extended to Airport via Parkway Station			✓
	St Albans-Sevenoaks Thameslink service extended to Airport Parkway		✓
	More/all Midland Mainline services call, all day		✓

10.5.6 The results of the catchment area analyses are summarised in the Appraisal Summary Tables under the heading “Accessibility” and in Figures 10.9 and 10.10. Public transport catchments remain the same for the Maximum Use option and Options 2 and E3 (with around 7 million air passengers per year within one hour’s overall journey time, and a resident workforce within an hour of 0.4 million). Luton’s better accessibility by road is reflected in its larger catchments (around 50 million annual air passengers, and 1.2 million potential workers within one hour’s travel time). Catchments by road are similar between options.

10.5.7 The accessibility of options to the air passenger market in Central London (and beyond) is of particular interest and is summarised for Luton options in Table 10.11. It should be noted that the public transport travel times quoted in this table exclude walking access and egress, and waiting times – they therefore indicate minimum travel times.

10.5.8 With the services assumed for the Maximum Use of Existing Runway case (Package 2), Luton has fair public transport accessibility relative to other existing airports – King’s Cross/St Pancras lying within 30 minutes, and all other main line termini lying between 40 and 60 minutes’ travel time of the airport, allowing for interchange.

Table 10.11: Accessibility from Central London –Luton options (minutes)

	Current Land Use Planning System	Options 2 & E3
By Car, minutes		
Blackfriars	91	As current land use planning system
St Pancras/Kings Cross/Euston	85	As current land use planning system
London Bridge	100	As current land use planning system
By Public Transport, tph in minutes		
Blackfriars	6 tph in 40	As current land use planning system
St Pancras/Kings Cross/Euston	1 tph in 26 6 tph in 36	4 tph in 26 6 tph in 36
London Bridge	6 tph in 46	As current land use planning system

10.5.9 The main indicators of surface access demand in 2015 for each option at Luton are summarised in Tables 10.12 and 10.13. Corresponding results for the forecast year 2030 are presented in Tables 10.14 and 10.15. Air passenger capacity and demand estimates have been described above. It should be noted that the amount of unused capacity varies between options – reflecting the interaction between Luton and other airports in the packages from which these estimates were derived. The net effect of these changes between packages 1 and 2 in 2015 is that the number of passengers requiring surface access increases by a factor of just over 2 compared with a three-fold increase in capacity.

10.5.10 The forecast number of on-site employees is assumed to be a function of overall passenger demand and productivity changes. Further details of the employment forecasts can be found in Section 10.10.

10.5.11 In 2015, the number of peak hour employee-related car trips is estimated to increase by around 75% between packages 1 and 2, reflecting the increases in total employment and a small shift towards public transport in Options 2 and E3. Employee trips by public transport are forecast to more than double. By 2030 Table 10.14 shows that little change is expected in the number of employee related trips for Options 2 or E3.

10.5.12 Tables 10.13 and 10.15 summarise the air passenger mode split results for each option in 2015 and 2030 respectively. In 2015. Table 10.13 indicates a higher proportion of trips being made by public transport in Option 2/E3 (20%), compared to 14.5% for Package 1. These results are influenced by the mixture of passengers by type and their geographical distribution, but it appears that air passengers are more inclined to switch mode in response to the introduction of improved rail services than is the case with employees. By 2030, public transport is estimated to increase its share of air passengers trips for Options 2 and E3 from 20% to 22% - still well below that forecast for other airports.

10.5.13 Finally, it is worth noting the changes in overall peak hour road traffic demand generated by these options, (see Tables 10.13 and 10.15). Table 10.13 shows a near trebling in traffic between the base year and Package 1 and a further increase of 75% between Package 1 and Options 2 or E3. By 2030, the overall road traffic demand generated by these options at Luton is estimated to increase by around 25%.

Table 10.12: Main indicators and employee mode shares – Luton 2015.

Main Indicators	Current Land Use Planning System	Options 2& E3
Total capacity (mppa)	10	31
Total passengers requiring surface access (mppa)	8.1	17.4
Total employees on-site	6200	10900
Employees' Highway trips (AM peak hour): vehicles		
Origin	98	174
Destination	534	944
Total	**632**	**1118**
Employees' Public Transport trips (AM peak hour): persons		
Origin	10	23
Destination	56	122
Total	**66**	**145**
% Public Transport trips		
Origin	9%	12%
Destination	9%	11%
Total	**9%**	**11%**

Table 10.13: Air passenger mode choice and overall surface access demand– Luton 2015.

Mode	Base Year		Current Land Use Planning System		Option 2 & E3	
	No. mppa	%	No.	%	No.	%
Underground	0.00	0.0%	0.00	0.0%	0.00	0.0%
Bus	0.33	14.5%	0.58	7.2%	1.67	9.6%
Taxi	0.27	11.8%	0.80	9.9%	1.78	10.2%
Park and fly	0.73	32.0%	3.53	43.6%	6.70	38.5%
Kiss and fly	0.95	41.7%	2.58	31.9%	5.43	31.2%
Premium rail	0.00	0.0%	0.00	0.0%	0.00	0.0%
National rail	0.00	0.0%	0.60	7.4%	1.81	10.4%
Total	**2.28**	**100.0%**	**8.08**	**100.0%**	**17.38**	**100.0%**
Public	0.33	14.5%	1.18	14.6%	3.49	20.0%
Private	1.95	85.5%	6.90	85.4%	13.90	80.0%
Total peak hour demand (including employees, air passengers, freight service traffic)						
Roads (vehicles 2-way)			4,750		8,300	

Table 10.14: Main indicators and employee mode shares – Luton 2030.

Main Indicators	Options 2 and E3
Total capacity (mppa)	31
Total passengers requiring surface access (mppa)	28.6
Total employees on-site	13800
Highway trips (average AM peak hour): vehicles	
Origin	170
Destination	924
Total	**1094**
Public Transport trips (average AM peak hour): persons	
Origin	22
Destination	120
Total	**142**
% Public Transport trips	
Origin	11%
Destination	11%
Total	**11%**

Table 10.15: Air passenger mode choice and overall surface access demand – Luton 2030

Mode	**Base Year**		**Option 2 & E3**	
	No. (mppa)	**%**	**No. (mppa)**	
Underground	0.00	0.0%	0.00	0.0%
Bus	0.33	14.5%	2.96	10.4%
Taxi	0.27	11.8%	2.81	9.8%
Park and Fly	0.73	32.0%	10.98	38.5%
Kiss and Fly	0.95	41.7%	8.41	29.4%
Premium rail	0.00	0.0%	0.00	0.0%
National rail	0.00	0.0%	3.42	11.9%
Total	**2.28**	**100.0%**	**28.56**	**100.0%**
Public	**0.33**	**14.5%**	**6.37**	**22.3%**
Private	**1.95**	**85.5%**	**22.20**	**77.7%**
Total Peak hour demand including employees, air passengers, freight and service traffic				
Roads (vehicles 2-way)			**10,600**	

Highway appraisal results – Luton

10.5.14 The highway appraisal has identified a number of sections of the Motorway and Strategic Road Network that are expected to be under stress (close to or beyond their capacities) in the SERAS forecast years. The 'Background Highway Requirements' are illustrated in Figure 10.13. These "problem" links have been categorised into those where the potential solution required to solve the problem in the Base Case would be adequate also to accommodate the airport option under consideration, and those where an airport option would require a further intervention (categorised here as an increase in capacity). By 2030, in the vicinity of Luton, the following sections of the network would be under stress:

- M1: J7 to J9
- M25: J20 to J21

10.5.15 The additional potential scheme improvements required by the airport options at Luton are summarised in Table 10.16, and illustrated in Figure 10.12.

Table 10.16: Highway capacity problems and potential schemes

Description	Initial Standard	Potential standard required by:		
		2015		2030
		Current Land Use Planning System	Options 2/E3	Options 2/E3
Airport Access				
Luton North East Bypass (proposed)		n/a	D2	D2
A1081 from M1 J10a to Luton NE Bypass	S2	D2	D2	D3
Strategic Network				
M1 J10 to J9 (southbound)	D3(M)	D3(M)	D4(M)	D4(M)
M1 J10 to J12	D3(M)	D3(M)	D3(M)	D4(M)
M1 J12 to J13	D3(M)	D3(M)	D4(M)	D4(M)

Rail Network Performance - Luton

10.5.16 With the increase in capacity arising from longer (12-car) trains on Thameslink services following the Thameslink 2000 project, airport related congestion issues are not expected between the Airport Parkway station and London. Airport related traffic is projected to comprise just 1.3% of peak Thameslink traffic on the most crowded section of the line (Mill Hill to West Hampstead) with the Current Land Use Planning System Option.

10.5.17 With additional services assumed to call at Luton Airport Parkway in the Maximum Use option, the proportion of airport related traffic on Thameslink is projected only to rise to just over 2%, with more than 1/3 of airport trips forecast to use the non-stop Midland Mainline service to St Pancras. Airport traffic would comprise 14% of peak demand on these trains, leading to high load factors, but lengthening of these services, assumed to comprise only 2 cars in the modelling, by 50% is being considered by the train operating comnpany independently of airport growth issues. Further lengthening is likely to meet increased demand.

10.5.18 Airport related demand in this rail corridor is forecast to increase further by 2030, comprising just over 3% of peak trips on Thameslink and 17% on Midland Mainline. These will, however, not contribute significantly to crowding on either service.

10.6 Environment: Land Take

10.6.1 The environmental issues considered in Stage Two of SERAS builds on work undertaken in Stage One on land use, ecology, heritage, landscape and townscape, water, noise and air quality. Stage Two in addition appraises contamination and community issues. For each of these environmental topics a baseline is defined and then the results of the appraisal of each option is presented. Details of existing land uses and environmental features within the study area are provided in Figures 10.15 to 10.18. Summaries of the key impacts of each option are presented in the Appraisal Summary Table. Fuller details of the baseline data and appraisal of options can be found in the supporting environmental appraisal report.

10.6.2 The details of further land take in each option for additional freight facilities was provided after the environmental appraisal had been completed and reported on. The appraisal of the impact of the additional freight facilities therefore has not been done to the same level of analysis and provides only an indicative estimation of the likely levels of impact.

Existing Conditions

Land Use – residential, commercial/industrial, public buildings, recreation, agriculture, planning constraints (Figure 10.15)

10.6.3 The Luton Airport Site is located in South Bedfordshire, with the county of Hertfordshire immediately to the south and east. It is situated within the area covered by Luton Borough Council. The airport is sited in largely rural surroundings with the town of Luton to the north and west. There are villages and scattered farms and properties to the south and east.

10.6.4 Commercial areas within the maximum option boundary include some small scale works and part of an employment area defined in the Local Plan. Suggested commercial uses within this employment area include light industrial and office employment, warehousing, leisure facilities and a hotel. There are no schools, hospitals or places of worship within the area of proposed expansion. There are no nationally designated footpaths within the area, although there is one recreational area. These playing fields are classified as Open Space, a district designation to preserve the area for recreational use.

10.6.5 Other than the above uses and scattered woodlands, the predominant land use in the area is agriculture. All land surrounding the airport is of Grade 3 agricultural land quality.

10.6.6 The areas to the south west, south and east of the current site are designated as Green Belt, with further such areas to the west beyond the M1 and to the north-east of Luton.

Contamination (Figure 10.15)

10.6.7 There are 22 possible sources of contamination identified in the study area. Of these 6 are considered to have potential for greater than 'minor' scale contamination. The only area with the potential for a 'great' scale of contamination is a landfill site covering approximately 49 hectares. One area, an industrial estate, has the potential for a 'moderate' scale of contamination. Areas with the potential for a 'moderate/minor' scale of contamination comprise: a 'Works', an engineering works and two fuel sites.

Ecology (Figure 10.16)

10.6.8 The following sites of nature conservation value within the Area of Search are all priority habitats in the Bedfordshire Local Biodiversity Action Plan. The following designated sites are located within the area of search:

- A nationally designated site (of high ecological value) Wain Wood is ancient semi-natural woodland dominated by oak and hornbeam. Within the woodland are areas of calcareous and acidic grassland. The presence of the Purple Hairstreak butterfly is notable.

- Three County Wildlife Sites (of medium ecological value), George Wood, Luton Hoo woods, and Hardingdell and Fernell's Woods. These are important as ancient woodland sites and for the invertebrates, fungi and lichens that these areas can support. Luton Hoo is also a parkland and wood pasture.

- A further County Wildlife Site, Wigmore Park (also of medium ecological value) is an area of rough grassland and scrub. From this site there is a strip of wooded lane (a green lane), also a part of the county wildlife site, that extends to woodland at the eastern end of the runway (see below).

- Five sites of district importance (Burnt Wood, Withstocks Wood, Limekiln Wood and Diamondend Springs and Sewett's Wood, Sellbarn's Dell, Hurst Wood and an unnamed wood immediately east of the current runway).

10.6.9 Two of these sites, Burnt Wood and the site immediately east of the current airport boundary, are situated within the area of proposed development. These are all mixed or broadleaved woodland sites, that are likely to be ancient woodland, supporting a mixture of trees species as well as being important for ground plant communities. Important species of birds, mammals, insects and lichens are also likely to be present.

10.6.10 From aerial photographs and the London Luton Airport development brief, it has also been possible to identify five other sites that are likely to be of low (district) ecological value, though they do not have a conservation designation. Together these sites add to the ecological connectivity of the woodland in the area and include:

- An area of neutral/calcareous grassland with areas of scattered broadleaved woodland;

- A belt of broadleaved woodland linked to the designated woodland;

- Recently developed rough grassland and scrub;

- A small area of acid grassland;

- Dane Street Meadow which is managed for nature conservation purposes;

- Approximately 90 ha of grassland surrounds the runway and taxiways and although managed for operational purposes, this habitat supports skylarks and brown hares.

10.6.11 The arable farmland that surrounds the current airport boundary has two nationally important priority habitats for conservation as outlined in the Local Biodiversity Action Plan, these being cereal field margins and ancient and/or species-rich hedgerow. There could be approximately 2km of both habitats within the maximum option boundary.

Heritage (Figure 10.17)

10.6.12 *Archaeology* - Although the area of the current airport and its proposed extension contains a relatively low level of known archaeological sites, as defined by the National Monuments Record, this would appear likely to be a product of the relatively low level of archaeological investigation in the area in the past and it is significant to note that the recent archaeological fieldwork in the area has revealed a range of multi-period sites. These include prehistoric and Roman sites discovered during recent excavations. This would suggest that the proposed area of expansion is likely to contain further hitherto undetected archaeological sites. The nature of the archaeology in the area is discussed below:

- *Prehistoric* – the proposed development area contains two prehistoric findspots, comprising a handaxe and a quantity of flints and pot sherds;
- *Roman* – There are two known Roman sites and another possible site which may be a substantial Roman building;
- *Early Medieval* - The area contains one early medieval site comprising the possible site of an Anglo-Saxon cemetery (complete with rich grave goods) discovered in 1913. The exact location of the site is uncertain.
- *Medieval* –There is one likely medieval site. Unspecified medieval features have been uncovered. The area around these sites is also designated in the Local Plan as an Archaeologically Sensitive Area. Immediately to the south of the area of proposed expansion lies the Scheduled Ancient Monument of Someries Castle, a medieval magnate's residence containing surviving 15th century buildings and the remains of a formal garden; and
- *Modern* – there is one modern (1900-2001) site, Spittlesea Hospital, the former Luton Infectious Diseases Isolation Hospital, which was constructed in 1912.

10.6.13 In the absence of contextual information regarding the above archaeological sites, all those other than Scheduled Ancient Monuments, which are of national value, and Archaeologically Sensitive Areas, which are considered to be of regional value, have for the purposes of this study been considered to be of county/district value, except for those identified as of potential higher or lower value in the Appraisal sections below.

10.6.14 *Listed Buildings* - The study area contains 10 Listed Buildings all of which are of Grade II.

Landscape and Visual (Figure 10.18)

10.6.15 *Landscape/Townscape* - The landscape in the vicinity of Luton falls within the Chilterns although most of the study area falls outside of that part of the Chilterns that has been designated an Area of Outstanding Natural Beauty (AONB). The landscape within 5km of the site at Luton has been divided into four areas of distinct landscape and townscape character and these reflect the types of landscapes that are typical throughout the Chiltern Hills.

- North Luton Rolling Plateau extends over the dip slope from the principal Chiltern escarpment. This is an area of open, rolling arable landscape of large fields with very few hedgerows. The landscape has high levels of intervisibility and is dominated by the presence of the urban areas of Luton. Pylons are a highly visible feature in the landscape. The general value of this landscape is assessed as low;

- Luton Escarpments comprise a group of relatively small areas that retain a distinctive scarp character reminiscent of the principal Chiltern scarp to the north. The scarp slopes are highly visible landforms and provide panoramic views of the surrounding areas. Several areas of the scarp are designated at either the county or local level and Warden Hill falls within the Chilterns AONB boundary. The overall value of these landscapes is assessed as medium/high;

- Plateau with Valleys is an extensive area of typically Chiltern landscape. The landscape is characterised by the combination of well-wooded plateau areas separated by more intimate dry valleys. There is an extensive network of winding lanes, which are usually enclosed by banks or hedgerows, and many small villages. The area is designated locally as a Landscape Conservation Area but is for the most part excluded from the Chilterns AONB. The overall value of this landscape is assessed as medium; and

- Lee Valley is a distinct river valley to the south east of Luton. Although the valley shares many characteristics with other principal arterial valleys in the Chilterns, the Lee Valley has been less adversely affected by transport and other urban fringe influences. The valley has a mature and well-wooded character and is designated as an Area of Great Landscape Value. The value is assessed as medium/high.

10.6.16 *Visual* - The indicative zone of potential visual impact (ZVI) of the *maximum extent of Airport Options boundaries* extends principally over the Plateau with Valleys to the north and east of the existing airport and to the opposite slopes of the Lee Valley. Much of the urban area of Luton is screened from the airport by the steep scarp slope. The present airport occupies some of the highest ground in the vicinity and occasional glimpses can be gained from more distant hilltops to the north and north-east in both the Plateau with Valleys and the North Luton Rolling Plateau.

10.6.17 Key visual receptors within 5km of the site would include residents in the farms, villages, hamlets and other settlements. The village of Breachwood Green is particularly sensitive due to its ridge-top location and open views towards the site of the airport. Other sensitive receptors would include visitors to Luton Hoo Park.

Community

10.6.18 *Community Infrastructure* – There are four tiers of settlement in the immediate vicinity of the site: the urban area of Luton; villages such as Breachwood Green and Whitwell; hamlets such as Tea Green, Wandon End and Peters Green; and scattered farmsteads and other properties.

10.6.19 *Community Structure/Distinctiveness* – The population is 183,300. Luton is the largest urban area, and is surrounded by largely rural areas. To the west it merges with the built-up area of Dunstable. 87% of the Core Catchment Area is already built-up and Luton is unable to meet its own future housing needs even without major expansion of the airport.

10.6.20 *Employment* – Luton has experienced a protracted decline in its core employment base, which is dominated by the Vauxhall car plant (the closure of which was announced recently). Unemployment levels, at 5.3%, are above the national average.

10.6.21 The High Adverse impacts of Options appraised at Luton are summarised below.

High Adverse Impacts: Option 2

10.6.22 The cumulative effects on the Heritage resources is considered to be HA as a consequence of the potential for loss without record of undetected sites from an area of 88ha of landtake. This effect could however be substantially mitigated through the implementation of an agreed programme of archaeological prospection, evaluation and excavation prior to the construction programme. Since there are no direct impacts upon designated archaeological sites, Conservation Areas or Historic Parks and Gardens such mitigation through prior excavation is likely to reduce effects on heritage resources, to LA.

10.6.23 Since housing capacity in Luton is already constrained the additional demand generated by airport expansion either would have to be met elsewhere, or could be met locally only by substantial change to the settlement pattern. This would be likely to take the form of major incursions into the Green Belt or the establishment of a new settlement. In either case, urban development would be likely to subsume the surrounding pattern of rural settlement. This would represent an HA effect on the structure and distinctiveness of local communities.

10.6.24 The loss of one locally designated site reduces the scope for mitigation. There will also be a loss of 109 ha of Grade 3 agricultural land.

High Adverse Impacts: Option 2 plus Freight

10.6.25 Option 2 with additional facilities for freight is expected to have similar impacts to Option 2, but also the loss of more agricultural land, the loss of a designated archaeological site and an area of unknown archaeological potential.

10.6.26 HA impacts on housing development would be the same as Option 2.

High Adverse Impacts: Option E3

10.6.27 Option E3 will be as for Option 2 with regard to the heritage resource but with 116ha of new landtake.

10.6.28 Housing capacity would be constrained with additional demand needing to be met elsewhere leading to HA impacts

10.6.29 There are likely to be Medium/High Adverse impacts to properties in Wigmore, as well as on access routes, during construction.

High Adverse Impacts: Option E3 plus Freight

10.6.30 The impacts of Option E3 plus freight will be as for E3 with HA impacts relating to housing capacity issues and construction disturbance. There would also be a reduced buffer zone at Someries Castle Scheduled Ancient Monument.

10.7 Environment: Water Resources

Existing Conditions

10.7.1 Luton Airport is situated within the Upper Lee surface water catchment. The only surface waterbody within the study area is the Luton Hoo Lake, which has been artificially modified; the inflow and outflow of the lake is the River Lee. The lake also receives the runoff from the airport by surface water outfall (see Figure 10.19).

10.7.2 The water quality in the River Lee through Luton reflects the pressures of urban runoff and discharges, including storm sewer outfalls. The quality improves immediately south of the urban area, which corresponds to the location of Luton Hoo Lake. There is a high proportion of contaminated suspended solids within the River Lee through Luton; these settle out in the Luton Hoo Lake resulting in improved water quality downstream.

10.7.3 Less than 1% of the study area has been designated within the 1 in 100 year flood risk area identified by the Environment Agency.

10.7.4 The Upper Chalk is at outcrop within the study area, with the Middle Chalk being exposed in the valley bottom of the River Lee. The Upper Chalk is the major aquifer in the area from which large quantities of water are abstracted; the study area intersects the source protection zones for ten public water supplies, and contains six other licensed abstractions. The Chalk is able to provide large quantities of water due to its system of fissures, which allow rapid flow; there are also several springs in the study area. This characteristic, however, makes the aquifer highly vulnerable to contamination.

10.7.5 From a regional perspective, the available water resources are virtually fully committed. There is limited scope for further groundwater development within the resource zone that supplies Luton Airport. Additionally, there are unsustainable groundwater abstractions occurring within adjacent resource zones.

Impact of Options

10.7.6 The options have been assessed against a base case, which is the current land use planning system, and therefore only considers impacts that are additional to those assessed under the base case. The assessments consider the sensitivity of the water environment and the potential to cause harm, which includes scope for mitigation. Table 10.17 below summarises the assessments for each of the water objectives, for each of the options.

10.7.7 The options at Luton present a potential impact on groundwater and water resources as 'High' and 'High* Adverse' respectively. The impacts on the other water objectives are 'Low Adverse', as many of them may be mitigated.

10.7.8 Option 2 (with and without freight) potentially impacts upon a spring. To prevent contamination of the underlying aquifer, appropriate measures would need to be taken during both construction and operation of the airport development option. Flooding impacts may be mitigated using balancing ponds, to attenuate runoff and take out the peak flow. The effectiveness of these measures is dependent upon adequate sizing of ponds, and the use of appropriate treatment techniques.

10.7.9 The runways in both options (2 and E3, with and without freight), intersect a zone 3 of a source protection zone for a public water supply. Zone 3 represents the total catchment area to the source, and therefore any contaminants reaching the groundwater within this area may reach the supply. It is essential that this does not occur, however *all* groundwater should be afforded equal protection as the aquifer forms an important resource.

10.7.10 Large increases in passenger numbers significantly increase the airport's demand for water, and also within the surrounding residential areas that provide the human resource base for the

Airport. Without any further water resource development or effort to manage demand, the resource zone that supplies Luton Airport would have a deficit. Assuming that water companies maximise existing strategic links and their use of existing and planned licensed resources between resource zones, the Luton resource zone would still have a slight deficit. This also assumes that companies will achieve their leakage reduction targets, and also allows for environmental demands. Abstraction recovery for the benefit of the environment will be a significant impact upon Three Valleys Water (the water company that supplies the Airport).

10.7.11 Given the large increases in demand for water imposed by these options, and the pressures described above, it may be difficult to meet this demand, even if appropriate supply and demand management techniques are put in place, and other water users within the region are water-efficient.

Table 10.17: Luton Water Appraisal Summary Table

Option	**Base Case**	**2 (with or without freight)**	**E3 (with or without freight)**
Surface Water	River receives treated Airport drainage. The quality in the river increases. No licensed abstractions within the study area. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**	No additional impacts as compared to the base case. **Low Adverse**
Groundwater	Study area is major aquifer. 16 licensed abstractions (including SPZs for 10 PWS) within the study area. **High Adverse**	Study area is major aquifer. Potential impact on spring may be mitigated using appropriate construction techniques. Runway intersects a zone 3 of an SPZ for a PWS. **High Adverse**	Study area is major aquifer. Runway intersects a zone 3 of an SPZ for a PWS. **High Adverse**
Flooding	Less than 1% of the study area contains floodplain **Low Adverse**	Increased flood risk could be mitigated using balancing pond. **Low Adverse**	Increased flood risk could be mitigated using balancing pond. **Low Adverse**

Option	Base Case	2 (with or without freight)	E3 (with or without freight)
Water Resources	No significant change to present levels of demand. **Low Adverse**	It may be difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**	It may be difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**

10.8 Environment: Noise Impacts

Aircraft Noise: Daytime

10.8.1 The Luton contours for 1999 and each of the Options in 2015 or 2030 as appropriate are shown on Figures 10.20 to 10.33. Tables 10.18 to 10.20 give the areas and estimated populations under the daytime $L_{Aeq,16h}$ noise contours for each of these scenarios with changes against the Existing Situation and the Base Case respectively. It is noted that the 1999 Luton contours were produced for the airport using the INM noise model. The predicted contours for this study were produced using the ANCON 2 model. As there are systematic differences between the two models, comparisons between the existing situation and future contours for Luton should only be taken as an approximate indication of the likely changes.

10.8.2 Luton currently exposes a larger population than Stansted to aircraft noise. A population of 8,300 lies within the 1999 57 dB contour. From the 'London Luton Airport Development Brief' (LLAOL, 2000) the 57 dB contour area in 1984 was 31.1 km^2. The daytime noise climate around Luton has therefore improved overall since the mid-1980s in line with Gatwick and Heathrow. However, the noise contours are now growing again due to the airport's rapid growth in traffic since 1996.

Options in 2015

10.8.3 The current Land Use Planning system is the Base Case for 2015. With this scenario the population under the 57 dB contour will reduce to 6,400. The reduction is again due to the aircraft fleet becoming quieter with the phase out of older aircraft and the introduction of quieter models, and other policies.

10.8.4 Comparing Option 2 with the Base, the population under the 57 dB to 69 dB noise contours will increase substantially. The population within the 57 dB contour will increase by 6,700 and in the 63 dB contour by approximately 900. Against the 1999 contours the population subject to 57 dB would increase by 4,800 and that exposed to 63 dB by 1,000.

10.8.5 Option E3 involves a full length runway realigned NE-SW to replace the existing runway. This results in considerably reduced noise impacts than Option 2. In 2015, the population forecast within the 57 dB contour would be 10,400 compared with 13,100 with option 2 and 6,400 in the Base Case. Within 63 dB contours, the respective populations affected are 200 (Option E3), 2,000 (Option 2) and 1,000 (Base Case). Option E3 will cause some areas to be newly affected by aircraft noise. These include some western parts of Hitchin, northern parts of Harpenden and some eastern areas of Luton, which would fall under the 57 dB contour.

Options in 2030

10.8.6 The area under the 57 dB contour of Option 2 in 2030 increases by 60% over that in 2015, from 43.6 sq km to 69.8 sq km. The corresponding population increases by around 20,000 to 33,000. The additional population would be concentrated in central and southern parts of Luton and in Stevenage.

Table 10.18 : Luton Daytime Aircraft Noise Contours – 2015 vs 1999 Existing Situation

LAeq (dB)	Area (sq km)						
	Existing 1999	Land Use Planning		Option 2		Option E3	
		Total 2015	Change cw 1999	Total 2015	Change cw 1999	Total 2015	Change cw 1999
>54	n/a	33.9	N/a	72.0	N/a	72.4	n/a
>57	19.4	19.7	0.3	43.6	24.2	40.8	21.4
>60	12	11.1	-0.9	25.5	13.5	23.1	11.1
>63	7.5	6.2	-1.3	14.5	7.0	13.6	6.1
>66	4.6	3.3	-1.3	8.2	3.6	8.1	3.5
>69	2.7	1.8	-0.9	4.5	1.8	4.6	1.9
>72	1.5	0.9	-0.6	2.4	0.9	2.5	1
	Population (000s)						
	Existing 1999	Land Use Planning		Option 2		Option E3	
		Total 2015	Change cw 1999	Total 2015	Change cw 1999	Total 2015	Change cw 1999
>54	n/a	10.5	n/a	35.7	n/a	19.4	n/a
>57	8.3	6.4	-1.9	13.1	4.8	10.4	2.1
>60	3.5	2.9	-0.6	5.7	2.2	1.4	-2.1
>63	1	1.1	0.1	2.0	1	0.2	-0.8
>66	0.5	<0.1	n/a	0.4	-0.1	0.1	-0.4
>69	0	<0.1	n/a	0.1	0	0.1	0.1
>72	0	<0.1	n/a	0.1	0	<0.1	n/a

* *Contours produced using INM, not ANCON 2*

Table 10.19 : – 2015 vs 2015 Base Case

LAeq (dB)	Area (sq km)				
	Land Use 2015 Base Case	Option 2		Option E3	
		Total 2015	Change Cw Base	Total 2015	Change Cw Base
>54	33.9	72.0	38.1	72.4	38.5
>57	19.7	43.6	23.4	40.8	21.1
>60	11.1	25.5	14.4	23.1	12
>63	6.2	14.5	8.3	13.6	7.4
>66	3.3	8.2	4.9	8.1	4.8
>69	1.8	4.5	2.7	4.6	2.8

LAeq (dB)	Area (sq km)				
	Land Use	Option 2		Option E3	
	2015	Total	Change	Total	Change
	Base Case	2015	Cw Base	2015	Cw Base
>72	0.9	2.4	1.5	2.5	1.6
	Population (000s)				
>54	10.5	35.7	25.2	19.4	8.9
>57	6.4	13.1	6.7	10.4	4
>60	2.9	5.7	2.8	1.4	-1.5
>63	1.1	2.0	0.9	0.2	-0.9
>66	<0.1	0.4	0.3	0.1	0
>69	<0.1	0.1	0	0.1	0
>72	<0.1	0.1	0	<0.1	0

Table 10.20 : Luton Daytime Aircraft Noise Contours – 2030 vs 2015 & 1999

LAeq (dB)	Area (sq km)					
		Max Use		Option 2		
	Existing	Total	Change	Total	Change	Change
	1999*	2030	Cw 1999	2030	Cw 1999	cw 2015
>54	n/a	33.9	N/a	122.6	N/a	88.7
>57	19.4	19.7	0.3	69.8	50.4	50.1
>60	12	11.1	-0.9	42.1	30.1	31
>63	7.5	6.2	-1.3	24.6	17.1	18.4
>66	4.6	3.3	-1.3	14	9.4	10.7
>69	2.7	1.8	-0.9	7.8	5.1	6
>72	1.5	0.9	-0.6	4.3	2.8	3.4
LAeq (dB)	Population (000s)					
		Max Use		Option 2		
	Existing	Total	Change	Total	Change	Change
	1999*	2015	Cw 1999	2030	Cw 1999	Cw 2015
>54	n/a	10.5	N/a	63.5	N/a	53
>57	8.3	6.4	-1.9	33	24.7	26.6
>60	3.5	2.9	-0.6	11.2	7.7	8.3
>63	1	1.1	0.1	5.5	4.5	4.4
>66	0.5	<0.1	N/a	1.8	1.3	1.2
>69	0	<0.1	N/a	0.3	0.3	0.2
>72	0	<0.1	N/a	0.1	0.1	0.1

* *Contours produced using INM, not ANCON 2*

Aircraft Noise: Night-time

10.8.7 Tables 10.21 and 10.22 below show the population numbers and associated house counts within the departure and arrival 90 dBA SEL footprints for easterly and westerly operations respectively. The footprints are shown in a supporting document and represent an 'average worst' QC2 aircraft, applied to each Standard Instrument Departure track (SID) and each runway's approach path for arrivals.

10.8.8 SID references are: CLN – Clacton; DET – Detling; CPT – Compton; OLN - Olney

Table10.21: Night Noise Population and House Counts – Easterly Operations

	Existing		Option 2		Option E3	
Runway	**08**		**08**		**05**	
	Popl'n (000's)	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**
Departures						
CLN/DET	0.6	0.2	0.6	0.2	0.5	0.2
CPT/OLN	0.6	0.2	0.6	0.2	1.2	0.5
Average	*0.6*	*0.2*	*0.6*	*0.2*	*0.9*	*0.4*
Arrivals	7.2	2.9	4.3	1.7	0.2	0.1

Table 10.22: Night Noise Population and House Counts – Westerly Operations

	Existing		Option 2		Option E3	
Runway	**26**		**26**		**23**	
	Popl'n (000's)	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**	**Popl'n (000's)**	**Houses (000's)**
Departures						
CLN/DET	3.7	1.5	1.8	0.7	0.6	0.2
CPT/OLN	3.7	1.5	1.8	0.7	0.1	0.1
Average	*3.7*	*1.5*	*1.8*	*0.7*	*0.4*	*0.2*
Arrivals	0.9	0.4	2.6	1.4	6.0	2.7

10.8.9 Both Option 2 and, particularly, E3 significantly reduce the numbers of people and houses affected on easterly arrivals, whilst easterly departures have little relative impact. The number of people affected by westerly arrivals however increases with both Option 2 and, particularly, E3, while the impact from westerly departures is improved.

Surface Access Noise: Highways

10.8.10 Table 10.23 gives the overall results (total EPA) from the GOMMMS plan level assessment for road traffic noise. The Surface Access Noise section of Appraisal Summary Table 10.13 also includes the EPA values split by noise contour bands.

Table 10.23 – Luton Surface Access Noise Assesssment: Highways

	Total change in Estimated Population Annoyed (EPA) by road traffic noise ('000)	
Year	**Option 2**	**Option E3**
2015	+ 6.3	+ 6.3

10.8.11 The noise impacts of changes in road traffic for Option 2 and option E3 in 2015 are compared with the Base Case road network. The same changes arise from both of these Options. A number of roads in the Luton area are affected, including the minor road between Chalton and Streatley and the B655 from Barton-le-Clay to Hitchin, parts of the A505 and the A1081 and a link road in Stevenage. The total increase in Estimated Population Annoyed (EPA) by road traffic noise is 6,300 for both Option 2 and E3.

Surface Access Noise: Railways

10.8.12 There would be no significant increases in railway services for Option 2 and Option E3 over the Base Case. Therefore, there would be no increases in railway noise attributable to these Options.

10.9 Environment: Local Air Quality Impacts

Introduction

10.9.1 Air quality results are provided for representative options at each airport, for 2015 and 2030 as appropriate. The air quality statistics used as assessment criteria for defining poor air quality in Stage Two of SERAS are: annual mean Nitrogen Dioxide concentrations of 40µg/m^3; and the 90th percentile of running 24-hour mean PM_{10} concentrations of 50µg/m^3. In practice, annual mean PM_{10} compared to a statistic of 40µg/m^3 are also reported, as the 90th percentile values are a simple factor of these. The Air Quality Key Indicator for SERAS Stage 2 is 'the number of people exposed to an exceedance of the air quality standard, weighted by the degree of exceedance'. The higher the key indicator, the worse the air quality impact is.

Results

10.9.2 Figures 10.36 to 10.40 illustrate the air pollution contours for Luton options in 2015. For each option, figures are for annual mean Nitrogen Dioxide, and for annual mean PM_{10} and 90th percentile of 24hour mean PM_{10} where relevant. The outer box is the study area for air quality in each case. Each figure also includes a table of the numbers of people exposed under each contour. Table 10.24 also summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator, to allow direct comparison between options and packages. Table 10.25 provides similar results for PM_{10}.

10.9.3 Only Option 2 at Luton results in population exposed to exceedances for annual mean Nitrogen Dioxide in 2015, with around 45 people exposed. Expressed as a simple average, airport related Oxides of Nitrogen in 2015 account for between 17% (base) and 35% (option 2) of total Oxides of Nitrogen in the Luton study area. ‘Airport related’ includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and particularly the ends of runways, associated with acceleration during take-off roll. The figures also show that major roads in the area are not contributing to areas of exceedance.

10.9.4 These results clearly show that Luton options in 2015 have no impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24hour mean PM_{10}, in any option. Expressed as a simple average, airport related PM_{10} in 2015 accounts for just 2-3% of total PM_{10} in the Luton study area across all options. Very few locations, limited to over the runways, exceed air quality statistics.

Table 10.24: Nitrogen Dioxide Key Indicators - Luton 2015

Package	Option	Population exposed to exceedance of annual mean NO_2 of 40 μg/m^3							Total popul'n exposed	Key Indicator
		40-50 μg/m^3	50-60 μg/m^3	60-70 μg/m^3	70-80 μg/m^3	80-90 μg/m^3	90-100 μg/m^3	>100 μg/m^3		
1	Base Case	0	0	0	0	0	0	0	*0*	**0**
2	Option 2	46	0	0	0	0	0	0	*46*	**46**
2	Option E3	0	0	0	0	0	0	0	*0*	**0**

Table 10.25: PM_{10} Key Indicators - Luton 2015

Package	Option	Annual mean PM_{10} of 40 μg/m^3		90th Percentile of 24hour mean PM_{10} of 50 μg/m^3	
		Total population exposed	Key Indicator	Total popul'n exposed	Key Indicator
1	Base Case	0	**0**	0	**0**
2	Option 2	0	**0**	0	**0**
2	Option E3	0	**0**	0	**0**

Results 2030

10.9.5 Options at Luton are in place in 2015. There are no additional results for 2030.

10.10 Employment

Employment Forecasts

10.10.1 Employment forecasts for each option based on current employees at Luton and projected forwards to 2015 and 2030 are shown in Table 10.26. Luton's employee: passenger ratio reflects the proportion of low cost passengers and separate allowance is made for the forecast high freight volumes. All other applied growth factors are similar to those applied at other airports.

10.10.2 Total direct on/off site employment at Luton is estimated to almost double by 2015 from current levels of just over 7,000, to just under 13,000 direct employees. By 2030 the number of direct on/off site employees could increase to just over 16,000 with growth in forecast passenger traffic more than offsetting productivy gains. Handling the high volumes of freight forecast at Luton could generate a further 7,000 or so direct on/off site jobs and 2,000 indirect jobs in 2015 and 2030.

Table 10.26: Current and forecast employment at Luton by option 2015 & 2030

Current & Forecaset Employment by Option	Current 1998	2/E3 Core 2015	2/E3 * + Freight 2015	2/E3 Core 2030	2/E3 * + Freight 2030
Direct on-site	6,200	10,900	17,300	13,800	19,700
Direct off-site	900	1,800	2,900	2,300	3,400
Indirect	2,100	3,800	6,100	4,800	6,900
Total Employment	9,300	16,500	26,300	20,900	30,000
Passengers (mppa)	4	21	21	29	29
Freight tonnes (000s)	60	N/a	1,092	N/a	1,245
Direct employees/mppa	1,624	731	1,162	564	809
Total employee/mppa	2,111	949	1,513	732	1,051

* Includes estimated employees from substantial change in assumed freight component

10.11 Land Use/Urbanisation

Summary

10.11.1 In terms of housing, there is unlikely to be sufficient capacity within the Luton Borough boundaries to accommodate the anticipated new housing demand associated with any option. However, there should be sufficient flexibility in the immediate wider catchment area to accommodate the scale of housing and employment development likely to be required by these airport options.

10.11.2 In terms of off airport employment, there may be scope to accommodate all the land requirements for indirect airport employment associated with the options, as industrial restructuring may yield brownfield sites for redevelopment, in addition to the Vauxhall site. Luton is a Priority Area for Economic Regeneration (PAER) in RPG9 and can be expected to welcome new sources of employment.

10.11.3 In summary, the impact of all the proposed development options is deemed to be low.

Employment Land Requirements

10.11.4 The off-airport employment requirements vary between options and with the potential role of the airport in relation to air freight. At a maximum, up to 39 hectares of off-site employment land within reasonable proximity to the airport could be required. In terms of workforce share, the largest options considered at Luton would raise the airport's share of the core catchment area workforce from 7% to around 20% by 2015 and 24% by 2030.

10.11.5 Given its relatively tightly drawn boundaries, the overall scope for accommodating additional large scale employment uses within the Borough of Luton itself may be relatively limited. The Bedfordshire Structure Plan identified a requirement for 80 hectares of industrial land between 1988 and 2001. As at January 1996 the local plan suggests that the Borough was likely to face a deficit of just over 13 hectares on this provision.

10.11.6 However, Luton contains extensive areas of existing industrial land, some of which will fall vacant over the next thirty or so years thereby adding to the future land availability. The implications of the recently announced closure of the Vauxhall plant immediately adjacent to the airport and consequent effects in supplier industries may be significant in this respect. There are also other areas, including extensive areas of former railway sidings, that may come forward in the future.

10.11.7 There may well be scope to accommodate the above levels of airport related employment as a result of industrial restructuring. If this land is not available, then development would probably have to be accommodated outside the Borough.

Housing Capacity

10.11.8 The higher employment forecasts suggest that an additional 17,000 jobs by 2015 and 20,700 by 2030 might be provided at the airport. These growth rates represent 30% of all employment growth in the core and wider catchment areas to 2015 and 23% to 2030. RPG provision is for 22,000 additional households in the core catchment area and a further 59,000 in the wider catchment area to 2030. There is a shortfall of 8,700 dwellings to 2015 (TEMPRO requirement minus RPG provision) of which 2,600 would be required to meet the housing requirements of a developed Luton Airport. These levels of expansion represent modest amounts of excess provision over RPG projections, even for the larger options which incorporate freight development.

10.11.9 The Luton catchment area is heavily built up and already under considerable development pressures and constraints.

10.11.10 The Borough of Luton, by its own admission, suffers from a serious deficiency of open space (LLP, 1997, p.12). This judgement is in accord with conclusions made by the Secretary of State for the Environment, Transport and the Regions that Luton cannot meet its own housing requirements within its own tightly-drawn boundary.

10.11.11 Luton is unlikely, therefore, to meet its own future housing needs even without major airport expansion. The possible exception would be if brownfield or windfall sites become available for housing.

10.11.12 If the immediate wider catchment area is considered, however, there are a wide range of potential options for accommodating growth. Options include:

- Brownfield redevelopment within neighbouring Dunstable where industrial restructuring within the vehicle manufacturing sector may be envisaged. Public transport improvements including a guided bus between Dunstable and Luton (and the airport) are under consideration;

- New/expanded settlements in the Thameslink/A6 corridor, north of the airport on former airfields/brownfield land, including the proposed new settlement at Elstow;

- Intensification or town-edge expansion in Bedford, which has significant areas of industrial land that may fall vacant in the future.

10.12 Integration Impacts

Regional/Sub-regional policy

10.12.1 Luton Airport impacts upon the sub-regions of Luton/Dunstable/Houghton Regis and Milton Keynes. The impacts of an expanded airport are discussed below under the headings of employment/labour force, housing and transport infrastructure.

Employment / Labour Force

10.12.2 The Luton/Dunstable/Houghton Regis sub-region has great potential for supporting any employment and labour market growth created by expansion at Luton Airport. There is plenty of capacity in the labour market that can fill jobs created in either a low growth or high growth scenario. There is a similar situation in Milton Keynes, although the labour market is less slack and more highly skilled in composition. The growth can have an equally great effect in terms of diversifying the employment base, however with so many people previously employed in the manufacturing sector, this would require retraining and skills development.

10.12.3 The growth of Luton University can facilitate the alleviation of skills mismatches to a degree, in tandem with training programmes put in place by new and existing employers. Regeneration funding can be used to this end. Milton Keynes also has a strong learning seat for technical skills with the presence of the Open University. However, it is likely that higher value clusters will develop in Milton Keynes, thus there will be a higher level of national and international import of labour skills from outside the sub-region.

10.12.4 Substantial growth at Luton Airport will assist the development of business clusters generally, a common theme around most large airports worldwide. However, a stumbling block for inward investors in Luton/Dunstable/Houghton Regis could be a lack of availability of a range of business accommodation. Whilst there are vast swathes of previously developed land, much of this requires considerable remedial treatment. The success of these areas to attract businesses depends on how the remediation can be funded, how easy it is to achieve and whether new businesses can be given further incentives to locate in the sub-region, e.g. tax exemptions. As such, there is a certain critical mass in this type of regeneration area for business clustering. In Milton Keynes, the infrastructure has a more firm existing foundation, thus clustering has a far greater chance of success, particularly in the higher value functions that inevitably tend to group close to airports. Its proximity to the Oxford Cambridge arc and good transport links should secure continued growth of these clusters.

Housing

10.12.5 In the Luton/Dunstable/Houghton Regis sub-region, the housing growth requirements associated with the expansion of Luton Airport, are far less likely to be compatible with existing regional policy than the employment-related requirements. The towns are very densely populated and are constrained by tight green belt designations. In a low growth scenario there is potential to follow regional guidance and reallocate some of the large areas of brownfield employment land for residential development. However, if growth continues further, it is likely that the housing capacity of the sub-region will be reached and there will be a shortage. Clearly though, it will be possible to achieve brownfield targets and most of this housing, due to the composition of the residential workforce, will be affordable in nature.

10.12.6 Milton Keynes in contrast, is focusing on continued growth of employment and housing over the next 20 years. As such, airport expansion, certainly in a low growth scenario will fit in well with maintaining the sub-region's growth profile.

10.12.7 What the reallocation of certain employment land in Luton/Dunstable/Houghton Regis for residential use will do is locate housing nearer to the employment areas, thus fulfilling one of the key sustainability criteria for the PAER.

Transportation / Infrastructure Improvements

10.12.8 Low growth at Luton Airport is liable to have the effect of reducing the need to travel for workers in both the Luton/Dunstable/Houghton Regis and Milton Keynes sub-regions. However, as growth continues there will be an inevitable spreading of employment locations as clustering in the regeneration area loses its critical mass. Similarly with long distance commuting, in a low growth scenario this will decrease. However, as growth continues but gets more tightly squeezed and more workers develop a range of skills, it is inevitable that with better links, some of these workers will be lost to the London labour market.

10.12.9 As stated, the growth of Luton Airport will improve transport links, in particular rail links, with Thameslink 2000 and improvements to the Midland Mainline service becoming more likely to go ahead swiftly.

Social Impacts

Low Growth

10.12.10 Under a low-growth scenario (up to 2015), around 10,000 jobs could be generated in total – Maximising Use of the existing runway. Of these, 3,000 are likely to be low skill in nature, with 1,900 possibly located on-site and 1,100 off-site.

10.12.11 Worker surplus in Luton district in 1998 stood at over 3,000. By 2016, this is forecast to have increased up to 4,000. Clearly it would be possible for all the off-site jobs to be accommodated in the deprived district, particularly given the fact that unemployment alone stood at 3,000 in October 2000. The location of the workforce so close to the airport and all likely off-site employment sites minimises the need for major improvements to transport infrastructure.

High Growth

10.12.12 Under a high growth scenario (up to 2030), 19,000 jobs could be generated – under Option 7a. Of these, over 6,300 could be low skill in nature, with potentially 4,000 being located on-site and 2,300 off-site.

10.12.13 With the high growth scenario peaking around 2015, the labour market situation will be similar to the low growth scenario, i.e. a surplus of workers numbering as many as 4,000. As such, the worker capacity will be available but not to fill all the jobs generated.

10.12.14 There is, however, strong evidence to suggest that all the labour market capacity in Luton district can be taken by the airport-generated employment. One of the reasons for this is the role of regeneration policy which focuses on the district itself. Indeed, it is also possible that regeneration policy is strong enough to redirect several hundred of the remaining jobs to other parts of the regeneration area, specifically to Dunstable in South Bedfordshire, making up part of the Luton/Dunstable/Houghton Regis PAER. This will increase in likelihood if the transport links within the PAER are strengthened. Improved bus networks and the provision of employer bus services are likely to have the greatest effect.

11 Appraisal of Options at Main Sites: Cliffe

11.1 Options Appraised in Stage Two

11.1.1 Between Stages One and Two a substantial review of the options at Cliffe Marshes has been undertaken, to identify layouts that minimise relevant impacts (land take, residential property take, on important ecological resources, noise): see Figure 11.1 (in this volume) for the reconsidered location. Consideration has also been given to:

- the potential role of a new airport, the way in which an airport might operate and the capacity it might provide;
- a mitigation strategy to deal with the worst of the impacts on important ecological resources; and
- a strategy for attracting airlines to a new airport, intended to act as a major hub airport with a full range of scheduled services and air freight services, perhaps supplemented by charter or low cost services.

11.1.2 The options appraised at Cliffe in Stage Two reflect this further consideration. The basic layout has, in its largest form, two pairs of close parallel runways, oriented approximately east:west. In its earlier phase, one of each pair of runways would be built to give a pair of wide-spaced independent runways.

11.1.3 Either the initial pair of wide-spaced runways or the later two pairs of close parallel runways might be accompanied by a further runway to the west of the main body of the airport and oriented in a north east:south west direction. This runway would be used for arrivals on easterly operations at night or at other times when only one runway was being used for arrivals and one for departures. This would be intended to minimise noise impacts. At busy periods of the day, when two runways were required to be operating in mixed mode, the runways used would have to be the parallel east:west pair, in order to avoid conflicting flight paths.

11.1.4 There is no airport currently envisaged in the land-use planning system at Cliffe and the concept of making maximum use of the existing runways does not apply. In these two cases, Cliffe has a capacity of zero.

11.1.5 OptionA2(2) has a pair of wide-spaced runways, (Figure 11.2) assumed to come into use in 2011.

11.1.6 Option A2(3) supplements this pair of wide-spaced runways with the NE:SW runway, again assumed to come into use in 2011 (Figure 11.3).

11.1.7 OptionsA2(4) and A2(5) add close parallel runways to the east:west runways in A2(2) and A2(3) respectively (Figures 11.4 and 11.5). These additional runways are assumed to come into use in 2021.

11.1.8 The options appraised at Cliffe are summarised in Table 11.1

Table 11.1: Options Appraised at Cliffe

Option	Description	Terminal capacity, mppa	Runway capacity, ATM	Year of Introduction
A2(2)	Pair of wide-spaced independent runways	77	530,000	2011
A2(3)	Pair of wide-spaced independent runways & NE:SW runway	77	530,000	2011
A2(4)	Two pairs of close-parallel runways	113	781,000	2011 and 2021
A2(5)	Two pairs of close-parallel runways plus NE:SW runway	113	781,000	2011 and 2021

11.2 Capital Costs

11.2.1 Table 11.2 below gives the estimated absolute costs for each option. They represent complete costs for each scheme up to full option capacity. Table 11.3 gives the breakdown of surface access (road and rail) costs.

Table 11.2: Estimated Capital Costs for Cliffe Options (£ million)

Item	Option A2			
	A2(2) 2 runways	A2(3) 2 runways + NE-SW	A2(4) 4 runways	A2(5) 4 runways + NE-SW
Capacity	77 mppa	77 mppa	113 mppa	113 mppa
Terminals & Satellites				
Terminal Buildings	913	913	1346	1346
Satellite Buildings	466	466	686	686
Baggage Handling	100	100	150	150
Total	**1479**	**1479**	**2181**	**2181**
Aircraft Pavements				
Runways	83	125	166	208
Taxiways	63	95	115	147
Aprons / Stands	539	539	543	543
Total	**686**	**759**	**825**	**899**
Enabling Works & Infrastructure				
Demolition, Earthworks, etc	1873	1985	1992	2097
Car Parking	127	127	186	186
Utility Services	180	180	180	180
Airside Roads and public road diversions	42	46	42	46
Tracked Transit	309	309	456	456
Drainage	100	109	115	124
Landscaping	99	111	104	116
Total	**2730**	**2867**	**3076**	**3207**
Navigation Aids (ATC, ILS & AGL)	**72**	**78**	**84**	**90**
Cargo & Maintenance				
Cargo buildings & aprons	212	212	309	309
Hangar/ Maintenance Buildings & aprons	71	71	104	104
Total	**283**	**283**	**413**	**413**

Item	Option A2			
	A2(2) 2 runways	**A2(3) 2 runways + NE-SW**	**A2(4) 4 runways**	**A2(5) 4 runways + NE-SW**
Support Facilities, etc				
Support facilities	114	114	171	171
Offices	190	190	285	285
Other facilities / services (inc. fuel, fire, security, light rail)	190	190	190	190
Total	**494**	**494**	**646**	**646**
On-costs	1436	1490	1806	1859
Contingency	1795	1862	2258	2324
Land Costs	189	194	190	195
Sub-total: Airport Development Costs	**9162**	**9505**	**11480**	**11812**
Airport Development Costs per mppa provided	119	123	102	105
Costs of Associated Surface Access	**680**	**680**	**1790**	**1790**
Total Capital Costs	**9844**	**10187**	**13272**	**13604**
Total Capital Costs per mppa provided	128	132	117	120

Table 11.3: Estimated 'Airport Specific' Surface Access Costs (£ million)

Item	Option A2			
	A2(2) 2 runways	A2(3) 2 runways + NE-SW	A2(4) 4 runways	A2(5) 4 runways + NE-SW
Road Schemes				
Access Road A2 to Lower Higham	52	As A2(2)	52	As A2(4)
Access Rd Lower Higham to Airport	38		38	
Access Road M2 to Lower Higham	51		51	
Cargo Area Link	45		45	
Benfleet Tunnel & approach roads	n/a		360	
LT Crossing Approaches	35		35	
Lower Thames Road/Rail crossing not included				
Sub Total	**221**		**581**	
Rail Schemes				
Upgrade Grain Branch		As A2(2)		As A2(4)
+ New Chord at Hoo Junction				
+ High speed line to CTRL				
+ extension. of 4 track on CTRL	280		280	
Airside tunnel & station	156		156	
Aylesford chord NE of Maidstone	25		25	
High speed line to CTRL at Wennington	n/a		750	
Lower Thames Road/Rail crossing not included				
Sub Total	**461**		**1211**	
Total	680	680	1790	1790

Airport Option Costs

11.2.2 Although the table shows complete scheme costs, it is probable that additional runways under Options A2(4) and A2(5) would be constructed at a later date in line with demand. Incremental costs in this respect for those options can be deduced by simple subtraction.

11.2.3 Phased construction would be subject to additional mobilisation and a premium may be expected for working in operational areas.

11.2.4 Of the 'enabling works and infrastructure' figures shown above, a significant portion is attributable to earthworks. In Option A2(2) they account for £2.1 billion and in Option A2(3)

£2.2 billion including contingencies. These figures reflect a balanced cut and fill operation, creating a platform at approximately 18m above sea level, designed to optimise cost by avoiding the need for excessive and costly disposal or import of material and thereby minimising construction impacts on the local community. At this stage of estimating, no provision has been made for any import of soil or disposal of material off site; requirements for treating existing marshland have not been investigated, nor have the exact details of the soil and rock strata. Refinements to the location of the platform reveal that there may be better locations in terms of the overall volume and cost of earthworks. It is proposed that this be addressed through a sensitivity appraisal of volumes at various locations to the west of the current site. Initial calculations suggest that a saving of 10 to 20% may be feasible, representing £210 to £420 million in Option A2(2).

11.2.5 It has been assumed at this stage that the earthworks platform for the two outer runways in the parallel pairs (giving the third and fourth parallel runways) will be formed at the same time as the platform for the two runway option. This will avoid the costly requirement for disposal or storage of excess material at the initial phase and costly import of material at a later stage. Pavements and supporting infrastructure such as AGL would be implemented when the demand for the additional runways arises. Alternatively, if it were clear from the outset that only two east:west runways would ever be provided, a smaller platform, with some cost savings, could be built.

11.2.6 As a new site, costs for providing infrastructure such as drainage (for the whole site area), utility services, support facilities and pavements are high when compared with other existing airports. This is primarily due to the fact that there are no pre-existing operational facilities, such as those that other existing sites are able to share, or use more efficiently, when providing additional capacity.

11.2.7 Office space is provided at about 2500m^2 per mppa. This appears to be high when compared with Luton (95m^2/mppa), Stansted (600) and Gatwick (730). However, at Heathrow, the rate is over 5000m^2 per mppa. It is probable that much of this floorspace at Cliffe could generate revenue through rent or leasing.

11.2.8 Cargo handling provision is high, reflecting the proposed function of this airport as a major cargo hub, representing a ratio of 15 tonnes of annual freight per m^2 of cargo building space.

11.2.9 No account has been taken in the main appraisal of the costs associated with ecological mitigation measures. They will be more significant than at other sites.

11.2.10 Land purchase costs are amongst the most expensive of all airports. However, when considered in terms of the area of the site, at about £0.1million per hectare, they are amongst the lowest: this results from a high proportion of undeveloped land being acquired. In terms of numbers of passengers, a cost of £2.5m per mppa in Option A2(2) is comparatively high for a rural site; due partly to this being a new site with no pre-existing facilities and the proposed accommodation of a high proportion of freight-only flights.

Surface Access Costs

11.2.11 Surface access costs represent 7 to 13% of the total capital cost – higher than at Gatwick (about 6%) and Luton (5%), but less than at Heathrow (30%) and Stansted (20%). The costs are for all new construction of road and rail routes on the Isle of Grain and a new road tunnel to Benfleet for the larger options. They include for a single two-lane road to connect to the cargo and maintenance areas at the east of the site; this route would probably continue to the existing container terminal. At this stage of estimating, ground profiles have not been taken into account and actual volumes of earthworks have not been considered, though they could have a greater bearing on costs than at other sites. Costs for construction of the Lower Thames Road/Rail Crossing have not been included: it has been assumed that this will be built in any event prior to the new airport.

11.2.12 Required improvements to the strategic road network, i.e. those not specifically required to accommodate airport related traffic, are on the A13 near Tilbury, from A1089 junction to meet the Lower Thames Crossing approach road (dual 2 lane up to dual 3 lane). The estimated cost for these works is about £6 million.

11.3 Demand Forecasts

11.3.1 Forecast passenger movements, ATMs and passengers per passenger ATM for each Cliffe Marshes option are summarised at 5 year intervals between 2000 and 2030 in the following tables:

- Table 11.4: Options A2(2) and A2(3)
- Table 11.5: Options A2(4) and A2(5)

11.3.2 The additional NE:SW runway in Options A2(3) and A2(5) does not affect the passenger forecasts. One set of forecasts applies to both A2(2) and A2(3), and one to both A2(4) and A2(5).

11.3.3 In the forecasting it has been assumed that a new airport at Cliffe Marshes could, as could an expanded Stansted, be a second international hub airport in the South East, complementing Heathrow.

11.3.4 The forecasting of demand at Cliffe Marshes has assumed that, on its opening in 2011, a major airline or an airline alliance, suffering from heavily constrained capacity at Heathrow and Gatwick, would be willing to relocate services to the new site. The services assumed to be relocated are: 40% of all Heathrow's scheduled services, 23% of Gatwick's charter services and 11% of Stansted's 2000 low cost services. The forecasts produced for the options at Cliffe Marshes start in 2011 on that basis and test whether the services would survive or indeed grow in their new locations. The capacity assumed to be 'freed up' at Heathrow and Gatwick is still available to compete with the additional capacity at Cliffe Marshes.

11.3.5 The principal features of the demand forecasts for each option are summarised below.

Options A2(2) and A2(3): Two Runways

11.3.6 The passenger forecasts in the assumed opening year of 2011 are 33 mppa: they grow to 58 mppa by 2015 and to the assumed terminal capacity of 77 mppa in the early 2020s. The runway capacity of 530,000 ATMs is reached in 2018. Forecast ATMs are 213,000 in 2011, 436,000 in 2015 and 530,000 by 2018. Scheduled services dominate: principally short haul but with some domestic, USA and long haul. They account for 83% of ATMs in 2015 and 88% by 2030. Charter services make up most of the rest. The forecast number of I to I interliners is 18 mppa in 2015 and 19 mppa in 2030, with a slight fall in between. As at Stansted, leisure passengers dominate movement to/from the UK at Cliffe, accounting for 80% of all trips to/from the UK in 2015 and 71% in 2030. Leaving aside I to I interliners, 89% of Cliffe Marshes passengers in 2015 and 96% in 2030 are travelling to/from London, the East and South East regions.

The Effects of Seeding

11.3.7 The services seeded at Cliffe in 2011 generally pass a commercial viability test. The main forecasts presented in the following tables are based on seeded forecasts. Forecast ATMs in 2012 are 302,000, considerably higher than the seeded ATMs in 2011 of around 214,000: ie, the forecast demand for services at Cliffe more than matches the assumed capacity, implying that the airlines that move there would be able to achieve commercially satisfactory load factors. Forecasts of international scheduled services, charter and low cost services substantially exceed seeded levels: it is only domestic scheduled services that fall short of seeded levels.

11.3.8 Without the seeding of services, however, if services and demand were left to grow without the major boost of an airline or alliance moving to Cliffe, lower passenger numbers are forecast. Passengers in the year of opening, 2011, would be 9 mppa, not 34 mppa; in 2015 passengers would be 34 mppa, not 62 mppa; and in 2020 passengers would be 60 mppa, not 74 mppa. Use of the airport grows more slowly, but by 2024, even without the seeding of services, the runway capacity is fully utilised.

Options A2(4) and A2(5): Four Runways

11.3.9 In the modelling of this option, the additional runway capacity is assumed to be introduced in 2021, but the analysis of Option A2(2) has indicated that the capacity provided by two runways is fully utilised by 2018. The additional capacity allows the 2025 forecast to increase from 78 mppa to 104 mppa and the 2030 forecast to increase from 79 mppa to 110 mppa. The assumed terminal capacity of 113 mppa is effectively reached in 2028 but there is some unused runway capacity.

11.3.10 The additional capacity is used by more passengers in all categories. By 2030, I to I interliners are 26 mppa, up from 18 mppa in 2015; scheduled passengers are 92 mppa, up from 46 mppa in 2015; and there are 15 mppa charter passengers, up from 10 mppa in 2015. The additional capacity in 2030 allows 58 mppa leisure trips to be made, compared with 42 mppa with only two runways, and 24 mppa business trips compared with 17 mppa with only two runways.

Table 11.4: Cliffe Marshes: Options A2(2) and A2(3)

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic				2	2	2	1
	Short haul				27	37	41	44
	USA				10	11	12	12
	Long haul				8	9	10	11
	Total				46	59	65	68
Charter					10	13	12	11
Low cost					2	2	1	**
Total		0	0	0	58	**74**	**78**	**79**
ATMs, '000								
Scheduled	Domestic				20	24	18	15
	Short haul				273	344	361	365
	USA				35	38	40	41
	Long haul				33	37	40	42
	Total				360	443	459	464
Charter					58	70	66	60
Low cost					18	18	13	4
Total		0	0	0	436	**531**	**538**	**528**
Passengers/PATM								
Scheduled					126	130	140	146
Charter					171	182	184	184
Low cost					120	139	94	97
Average		0	0	0	134	139	145	146

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

Table 11.5: Cliffe Marshes: Options A2(4) and A2(5)

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic				2	2	3	3
	Short haul				27	37	54	59
	USA				10	11	18	17
	Long haul				8	9	14	14
	Total				46	59	88	92
Charter					10	13	14	15
Low cost					2	2	3	3
Total					**58**	**74**	**104**	**110**
ATMs, '000								
Scheduled	Domestic				20	24	26	26
	Short haul				273	344	470	485
	USA				34	38	57	55
	Long haul				33	37	51	51
	Total				360	443	603	617
Charter					58	70	73	77
Low cost					18	18	19	19
Total					**436**	**531**	**696**	**712**
Passengers/PATM								
Scheduled					126	130	143	146
Charter					171	182	189	197
Low cost					1209	139	151	154
Average					134	139	150	154

Note: Figures in **bold** are capacity-constrained forecasts

'Other' categories, not shown, are included in totals. Totals may not sum due to rounding

** = less than 0.5 mppa or less than 500 ATMs

11.4 Safety Risk

11.4.1 The Stage Two assessment of safety risk appraises the third party risk associated with both existing and new runway options. The full extent of the 1;10,000 and 1:100,000 designated risk areas are shown on the following Figures. The runway end origin of the 1:1,000,000 contours are also shown but the contours extend beyond the limit of the drawings:

- Figure 11.6 – Option A2(2), One pair of wide spaced full length runways operating in mixed mode.
- Figure 11.7 – Option A2(3), One pair of wide spaced full length runways operating in mixed mode, supplemented by a single NE/SW runway to the west for easterly night time freight arrivals.
- Figure 11.8 – Option A2(4), Two pairs of full length close spaced parallel runways, each pair operating in dependent segregated mode.
- Figure 11.9 – Option A2(5), Two pairs of full length close spaced parallel runways, each pair operating in dependant segregated mode, supplemented by a single NE/SW runway to the west for easterly night time freight arrivals.

1:10,000 Risk Contours

11.4.2 The impacts of the 1:10,000 risk contours are shown in Table 11.6 below:

Table 11.6: 1:10,000 Risk Contours

Impact	Option A2(2)	Option A2(3)	Option A2(4)	Option A2(5)
Area (ha) (West and East)	W 14.0 E 13.4	W 14.0 E 13.4 SW 0.4 NE 0.2	W 20.0 E 19.3	W 20.0 E 19.3 SW 0.5 NE 0.3
Properties within contour (outside airport boundary)	1	1	None	None
% developed area affected, (outside airport boundary)	0	0	0	0

11.4.3 The 1:10,000 contours in each of the options fall almost entirely within the proposed airport boundary. The area is predominantly rural and marshland.

1:100,000 Risk Contours

11.4.4 The impacts of the 1:100,000 risk contours are shown in Table 11.7 below.

Table 11.7: 1:100,000 Risk Contours

Impact (beyond 1:10,000 contour)	Option A2(2)	Option A2(3)	Option A2(4)	Option A2(5)
Area (ha) (West and East)	W 147.6 E 142.1	W 147.6 E 142.3 SW 11.6 NE 6.4	W 208.7 E 200.8	W 208.7 E 200.8 SW 12.8 NE 7.1
Population affected. (Outside airport boundary)	208	208	24	24
% developed area (outside airport boundary)	<1	<1	<1	<1
Other prominent features affected	Coastal marshland			

11.4.5 The area is predominantly agricultural and marshland. The impact on communities and commercial activities is minimal.

1:1,000,000 Risk Contour

11.4.6 The impacts of the 1:1,000,000 risk contours are shown in Table 11.8 below:

Table 11.8: 1:1,000,000 Risk Contours

Impact (beyond 1:100,000 contour)	Option A2(2)	Option A2(3)	Option A2(4)	Option A2(5)
Area (ha) (West and East)	W 1404.5 E 1351.6	W 1404.5 E 1351.6 SW 49.5 NE 27.3	W 2015.1 E 1939.2	W 2015.1 E 1939.2 SW 61.1 NE 33.6
% developed area affected	W <5 E <5	W <5 E <5 SW rural NE rural	W <5 E <5	W <5 E <5 SW rural NE rural

11.4.7 The prominent features within 1:1,000,000 risk areas are set out below. They do not represent major concentrations of people and are therefore of low risk:

- *Option A2(2):* West – Cooling Castle, nature reserve; East – none.
- *Option A2(3):* West – Cooling Castle, nature reserve; East – none; South West – none; North east - none
- *Option A2(4):* West – Cooling Castle, nature reserve; East – 80% of Lower Stoke village
- *Option A2(5):* West – Cooling Castle, nature reserve; East – 80% Lower Stoke village; South West – none; North east - none

11.5 Surface Access

Infrastructure and service assumptions - roads

11.5.1 For the purposes of surface access demand forecasting, the changes to the existing road access arrangements were based on the still relevant findings of Stage One appraisals. This helped define a number of schemes associated with each option, as summarised in Table 11.9 and shown in Figures 11.14 and 11.15.

11.5.2 Options A2(2) and A2(3) have the same capacities (77mppa) and are assumed to require the same access arrangements. This comprises a link from the new airport to the A2 west of Shorne Wood, and a road linking between the A2/M2 interchange (at Shorne Ridgeway) and the A13 at Orsett, with an interchange between these two new links near Church Street for access to the airport from north of the Thames. The northern part of the M2/A2 to A13 link would comprise the multi-modal, tunnelled Lower Thames Crossing, with provision for road and rail traffic.

11.5.3 Options A2(4) and A2(5) again have the same capacities (113mppa). This size of airport has been assumed to require an additional access and a second road-only crossing of the Thames, linking the airport to the A130 on Canvey Island and then to Benfleet, is assumed. This would connect the airport to the labour markets of the Southend area as well as providing an alternative access for passengers.

Table 11.9: Road access arrangements – Cliffe Marshes Options

Scheme	Options A2(2) & A2(3)	Options A2(4) & A2(5)
1 Access from airport to A2 west of Shorne Wood	✓	✓
2 Link between M2/A2 and A13 at Orsett	✓	✓
3 Access from airport to A130, including Thames tunnel		✓

Infrastructure and service assumptions - rail

11.5.4 Rail infrastructure and service assumptions were based on Stage One findings and shaped by discussions, with DTLR and SRA in particular, on the potential to integrate airport-focused schemes with parallel improvements in infrastructure and services planned to accommodate future increases in non-airport demand. Schemes and services associated with each Option are summarised in Table 11.10 and summarised in Figures 11.17 and 11.18.

11.5.5 Rail connections from the airport to the existing rail networks on both sides of the Thames are planned in both Options. To the south, an upgrade of the existing Grain freight branch is assumed, joining the North Kent Line at Hoo (local services) and extended to CTRL I at Singlewell (express services). To the north west, the Lower Thames Crossing will join the Tilbury-Southend line near East Tilbury. As shown in Figure 11.17, these connections will permit a number of local services to be diverted/extended to the airport.

11.5.6 For Option A2(2) services south to Dover/Ramsgate via the Medway Towns; Tonbridge and Gatwick via Maidstone (West); and Charing Cross via Gravesend, Dartford and all three Dartford Loop lines are assumed. With a new chord south of Aylesford, services can also run to Maidstone (East) and Ashford. In the north, services to Shoeburyness via Pitsea (Basildon) and Southend; Grays, Upminster, Barking and Fenchurch Street are assumed. With CrossRail, services could run via Barking and Stratford, central London, Ealing and Heathrow.

11.5.7 Express services are assumed to run via CTRL I to Bromley South and Waterloo, and via CTRL I & II to Ebbsfleet, St Pancras and Birmingham.

11.5.8 For Option A2(4), a further high-speed link is assumed, extending from the Lower Thames Crossing at East Tilbury to CTRL II at Wennington, sharing the A13 transport corridor. This relieves congestion in CTRL II's Thames Tunnel, with the diversion of the St Pancras Express, Birmingham and CrossRail services to the new link. Additional Express services to Leeds and

Newcastle are assumed for the accessibility modelling, which would require a new chord between CTRL II and the East Coast Main Line at Belle Isle (Islington).

Accessibility Analysis

11.5.9 The results of the catchment area analyses are summarised in the Appraisal Summary Tables under the heading “Accessibility” and in Figures 11.10 to 11.13. Public transport catchments vary significantly between Options A2(2) and A2(4), increasing from around 7 million air passengers pa within one hour’s overall journey time in Option A2(2) to around 21 million for Option A2(4). The resident workforce within an hour’s travel time by public transport varies between 0.5 and 1 million. Cliffe’s accessibility by road is reflected in its larger catchments of around 21-22 million air passengers pa, and 2.3-2.4 million potential workers within one hour’s travel time. Catchments by road are similar between options.

11.5.10 The accessibility of options to the air passenger market in Central London is of particular interest and is summarised for Cliffe options in Table 11.11. It should be noted that the public transport travel times quoted in this table exclude walking access and egress, and waiting times – they therefore indicate minimum travel times.

11.5.11 With the services assumed for Option A(2), Cliffe has fair to good public transport accessibility relative to other existing airports – King’s Cross/St Pancras lying within 30 minutes, and all other main line termini being within 60 minutes’ travel time of the airport, many with direct services. Public transport access times are further reduced in Option A2(4), with Blackfriars, King’s Cross/St Pancras, Euston and Charing Cross being within around 30 minutes travel time and all other main line termini being within 40 minutes.

Table 11.10: Rail Access – Cliffe Options

Infrastructure	Services	Option A2(2) 2-runways	Option A2(4) 4-runways
Upgrade of Grain freight branch, junction with North Kent Line at Hoo	Local services to: Ramsgate / Dover via Chatham and Faversham; Tonbridge and Gatwick via Maidstone West; Charing Cross via Gravesend, Dartford and Woolwich/Sidcup/Bexleyheath	✓	✓
Chord south of Aylesford on Medway Valley Line	Local service to Ashford via Maidstone East	✓	✓
High Speed link from Hoo to CTRL I at Singlewell	Express service to Waterloo via Bromley South; St Pancras via CTRL I, Ebbsfleet and CTRL II	✓	✓
	Express services to St Pancras non-stop via CTRL I and CTRL II; Birmingham via CTRL I and CTRL II, Milton Keynes, Coventry	✓	
Multi-modal Lower Thames Crossing to East Tilbury	Local services to: Shoeburyness via Pitsea and Southend; Fenchurch Street via Grays , Upminster, Barking	✓	✓
CrossRail	Heathrow via Grays, Purfleet, Barking, Stratford, Liverpool St, Paddington and Ealing	✓	
High speed link from East Tilbury to Wennington	Express services to St Pancras non-stop via CTRL II; Birmingham via CTRL II, Milton Keynes, Coventry		✓
Chord between CTRL and ECML	Express services to Newcastle and Leeds		✓
CrossRail	Heathrow via Barking, Stratford, Liverpool St, Paddington and Ealing		✓
	Local service to Fenchurch Street via Grays , Purfleet, Barking		✓

Table 11.11: Accessibility from Central London – Cliffe options.

	Options A2(2) & A2(3)	Options A2(4) & A2(5)
By Car, minutes		
Fenchurch Street	66	66
Blackfriars	71	71
Liverpool Street	67	67
St Pancras/Kings Cross/Euston	77	77
Marylebone/Paddington	85	85
Charing Cross	72	72
Waterloo	71	71
London Bridge	67	67
By Public Transport, tph in minutes		
Fenchurch Street	2 tph in 49	2 tph in37
Blackfriars	5 minutes from London Bridge	
Liverpool Street	4 tph in 53	4 tph in 37
St Pancras/Kings Cross/Euston	2 tph in 26 2 tph in 30	4 tph in 22 2 tph in 30
Paddington	4 tph in 63	4 tph in 47
Charing Cross	6 tph in 62	as Option 8
Waterloo	4 tph in 33	as Option 8
London Bridge	6 tph in 54	as Option 8

11.5.12 The main indicators of surface access demand in 2015 for each option at Cliffe are summarised in Tables 11.12 and 11.13. Corresponding results for the forecast year 2030 are presented in Tables 11.14 and 11.15. Air passenger capacity and demand estimates have been described above. Note that both the amount of spare capacity and the number of interlining passengers vary between Cliffe and other airports – reflecting its interaction with other airports in the packages from which these estimates were derived. Around 20% of Cliffe's passengers are forecast to be interliners in both 2015 and 2030 (this compares with around 33% at Heathrow).

11.5.13 The forecast number of on-site employees in 2015 and 2030 is reported in Tables 11.12 and 11.14 and is assumed to be a function of overall passenger demand and productivity changes. (Further details of the employment forecasts can be found in Section 11.10.) The surface access appraisal assumes just over 30,000 on-site employees for the 2-runway option in 2015 and around 54,000 for the 4-runway option in 2030.

11.5.14 For the 2-runway option, the number of peak hour employee-related car trips in 2015 is estimated to be around 1650 two-way, with around 850 (35%) using public transport. By 2030, with the 4-runway options these figures increase to around 2,850 car trips and 1,500 public transport trips.

11.5.15 Tables 11.13 and 11.15 summarise the air passenger mode split results for Cliffe. In 2015, Table 11.13 indicates that 36.5% of trips will be made by public transport. (This compares with 37-41% at Heathrow, 35-38% at Gatwick, 35-39% at Stansted and 15-20% at Luton.) Table 11.15 shows a substantial increase by 2030 in public transport's share of air passenger trips for the 4-runway option – reflecting the improved public transport services assumed in this option.

11.5.16 Finally, it is noted that overall peak hour road traffic demand generated by these options, (see Tables 11.13 and 11.15), amount to some 6,900 vehicles, two-way for the 2-runway option in 2015, rising to 13,550 for the 4-runway option by 2030.

Table 11.12: Main indicators and employee mode shares – Cliffe 2015.

Main Indicators	**Option A2(2) & A2(3)**
Total capacity (mppa)	77
Total passengers requiring surface access (mppa)	40.6
Total employees on-site	35000
Employees' Highway trips (AM peak hour): vehicles	
Origin	302
Destination	1324
Total	**1626**
Employees' Public Transport trips (AM peak hour): persons	
Origin	157

Main Indicators	**Option A2(2) & A2(3)**
Destination	691
Total	**848**
% Public Transport trips	
Origin	33%
Destination	33%
Total	**33%**

Table 11.13: Air passenger mode choice and overall surface access demand – Cliffe 2015.

Mode	Options A2(2) & A2(3)	
	No.	%
Underground / LRT	0.01	0.0%
Bus	4.35	11.1%
Taxi	6.33	16.2%
Park and fly	9.12	23.4%
Kiss and fly	9.31	23.8%
Premium rail	5.80	14.8%
National rail	4.13	10.6%
Total	**39.05**	**100.0%**
Public	14.29	36.5%
Private	24.76	63.5%
Road (vehicles, 2-way)	6,900	

Table 11.14: Main indicators and employee mode shares – Cliffe 2030.

Main Indicators	**Options A2(4) & A2(5)**
Total capacity (mppa)	113
Total passengers requiring surface access (mppa)	91.6
Total employees on-site	52300
Highway trips (average AM peak hour): vehicles	
Origin	527
Destination	2312
Total	**2839**
Public Transport trips (average AM peak hour): persons	
Origin	275
Destination	1207
Total	**1482**
% Public Transport trips	
Origin	33%
Destination	33%
Total	**33%**

Table 11.15: Air passenger mode choice and overall surface access demand – Cliffe 2030.

Mode	**Base Year**		**Options A2(4) & A2(5)**	
	No. (mppa)	**%**	**No. (mppa)**	**%**
Underground	0	0	0.02	0.0%
Bus	0	0	11.72	13.1%
Taxi	0	0	13.05	14.6%
Park and fly	0	0	15.68	17.5%
Kiss and fly	0	0	18.06	20.2%
Premium rail	0	0	17.07	19.1%
National rail	0	0	13.87	15.5%
Total	**0**	**0**	**89.48**	**100.0%**
Public	0	0	42.69	47.7%
Private	0	0	46.79	52.3%
Total peak hour demand including employees, air passengers, freight and service traffic.				
Road (vehicles 2-way)			13,550	

Highway appraisal results

11.5.17 The highway appraisal has identified a number of sections of the Motorway and Strategic Road Network that are expected to be under stress - close to or beyond their capacities - in the SERAS forecast years. These "Background Highway Requirements" are illustrated in Figure 7.20. These problem links have been categorised into those where the potential solution required to solve the problem in the Base Case would also be able to accommodate the airport option under consideration, and those where an airport option would require a further intervention, categorised here as an increase in capacity. By 2030, in the vicinity of Cliffe, the following sections of the network would be under stress:

- M25 J2 to J12
- M25 J23 to J29

11.5.18 The additional potential scheme improvements required by the airport options at Cliffe are summarised in Table 11.16 and illustrated in Figure 11.16.

Rail Network Performance – Cliffe

11.5.19 With Option A2(2) in 2015, the major flow of airport related demand between the airport and central London routes predominantly via the CTRL expresses to St Pancras, which carry around two thirds of the traffic. Smaller numbers use the express to Waterloo and CrossRail, with limited numbers on the slower regional services to Charing Cross and Fenchurch Street.

11.5.20 None of these airport services experiences any crowding. The Waterloo service attracts nearly as many employee trips as air passenger trips towards the airport in the morning peak, and also attracts commuters towards London. Overall, the number of long-distance commuter trips diverting to airport expresses exceeds the number of air passengers using the commuter services extended to the airport, relieving crowding elsewhere, especially on the Chatham Main Line services to Victoria.

11.5.21 With Option A2(4) modelled in 2030, there is a significant change in passenger mix and trip-end distribution compared to the smaller option, resulting in a marked increase in public transport's mode share. Public transport is projected to attract nearly 45% of 2030 air passenger access demand with the service pattern assumed for Option A2(2), rising to nearly 48% if journey times to London are reduced and frequencies increased with a second high-speed link, to the CTRL corridor at Wennington near Purfleet.

11.5.22 Demand to central London exceeds 10,000 trips over the morning peak period, with more than 60% using the express services to St Pancras (load factor 75-80%) and a further 25% the accelerated CrossRail service. The latter route is also forecast to attract a high number of commuter trips (many of them longer distance, diverting via the airport to join the trains), with a peak load factor of 75% leaving the airport and severe overcrowding west of Barking.

11.5.23 In the light of these initial assignment results, the stopping pattern of services assumed for the modelling exercise may need to be adjusted to balance out flows of air passengers and commuters, and avoid overcrowding on some trains. However, the diversion of so many commuter trips to airport services will significantly reduce crowding on other, non-airport, services.

Table 11.16: Highway capacity problems and potential schemes - Cliffe

Description	Initial Standard	Potential standard required by:			
		2015		2030	
		Current Land Use Planning System	Option A2(2) & A2(3)	Maximum Use Existing Runways	Option A2(4) & A2(5)
Airport Access					
Airport access to A2 west of Shorne Wood (proposed)	n/a	n/a	D2	n/a	D2
Airport access, Lower Higham – Airport (proposed)	n/a	n/a	D3(M)	n/a	D3(M)
Airport access, Lower Higham – M2 (proposed)	n/a	n/a	D2(M)	n/a	D2(M)
Lower Thames Crossing (proposed)	n/a	n/a	D2 tunnel	n/a	D2 tunnel
Link from Lower Higham to airport cargo and maintenance area (proposed)	n/a	n/a	S2	n/a	S2
Benfleet Tunnel (proposed)	n/a	n/a	n/a	n/a	D2
Strategic Network					
M25: J26 to J29	D3 (M)	D3 (M)	D4 (M)	D4 (M)	D4 (M)
A13: A1089 to A128/LTC	D2	n/a	D3	n/a	D3

11.5.24 As noted in Section 11.3, SPASM forecasts demand at Cliffe to be predominantly 95% from the South East. Demand assigned to the Inter City Routes (Birmingham, Leeds and Newcastle) is negligible. These services would not be needed, either to accommodate demand or increase the public transport mode share at the airport, avoiding the need for a chord at Belle Isle.

11.6 Environment: Land Take

11.6.1 The environmental issues considered in Stage Two of SERAS builds on work undertaken in Stage One on land use, ecology, heritage, landscape and townscape, water, noise and air quality. Stage Two in addition appraises impacts on contamination and community issues. For each of these environmental topics a baseline is defined and then the results of the appraisal of each option is presented. Details of existing land uses and environmental features within the study area are provided in Figures 11.19 to 11.22. Summaries of the key impacts of each option are presented in the Appraisal Summary Table. Fuller details of the baseline data and appraisal of options can be found in the supporting environmental appraisal report.

Existing Conditions

Land Use – residential, commercial/industrial, public buildings, recreation, agriculture, planning constraints (Figure 11.19)

11.6.2 The proposed airport site development would take a large area of land on the Hoo peninsula. The site has currently no airport-associated use. Current land uses are described below.

11.6.3 *Residential* - The towns of Gravesend, Rochester, Strood, Chatham, Gillingham, Sheerness and Canvey Island lie within a 7km radius of the proposed development. A series of smaller settlements are located closer to (but outside the footprint of) the proposed site and include Cliffe which lies just 500m to the west. Several small villages (AllHallows – on – Sea, Allhallows, St Mary Hoo, and parts of High Halstow and Lower Stoke) are located within the footprint of the proposed site. The areas between these villages are generally open land, containing scattered properties.

11.6.4 *Commercial/Industrial* - There are various small-scale commercial areas including: a caravan site, a hotel, a pumping station, a water tower and a radio/TV mast.

11.6.5 *Recreation* -The North Kent Marshes are used for unofficial recreation by birdwatchers and ramblers. The Saxon Shore Way national footpath runs through the maximum option boundary. In addition, several formal recreational areas are situated within the footprint of the proposed site development and include a yacht club, a community woodland and allotments. Many of these are also designated at district level as Open Space.

11.6.6 *Public Buildings* - Two places of worship are located within the footprint of the proposed airport development site (one each within Allhallows and St Mary Hoo). One school is also located within this area (at Allhallows).

11.6.7 *Agriculture* - The remainder of land on the Hoo Peninsula is predominantly in agricultural use. A significant proportion of land is of high agricultural quality including orchards. Nearer the Thames, much of the land is coastal grazing marsh of predominantly Grade 3 agricultural land quality with some Grade 4.

11.6.8 *Land Use Planning Constraints* - An area of Green Belt is located to the east of Gravesend. Canvey Island and Southend on the north shore of the Thames are also surrounded by Green Belt. The coastlines along the south shore of the Thames, the north shore of the Medway and islands within the Medway Estuary are largely covered by the district designation of Undeveloped Coast.

Contamination (Figure 11.19)

11.6.9 There are 14 sites with potential for contamination that have been identified in the study area. Of these 3 are considered to have potential for a 'great' scale of contamination, all of which are landfill sites. The presence on some of the mapping of a firing range/danger zone/battery north west of Grain village and of other possible military structures north of Fenn Street on older maps, may suggest the potential for buried ordnance along or close to the foreshore of the Thames.

Ecology (Figure 11.20)

11.6.10 There are three Special Protection Areas (SPAs) and Ramsar sites in the study area (see below) and a candidate Special Area of Conservation (cSAC). Such sites are of international importance (very high ecological value). All four sites form part of a network of international sites within Kent and Essex in the wider Thames Estuary. All areas covered by cSAC, SPA or Ramsar designations are also designated as SSSI (national).

11.6.11 The Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar site (of very high ecological value) extends along the shores of the River Thames and includes land in the west, north and east of the Hoo Peninsula. The majority of the site is designated as both SPA and Ramsar site, however Shorne Marshes to the south west of the maximum option boundary and Cooling Marshes (part of which are within the maximum option boundary) are designated as Ramsar only. All of these areas are of international importance and comprise a wetland with a mosaic of intertidal habitats, saltmarsh, coastal grazing marsh, saline lagoons and chalk pits. The site provides wintering and breeding habitats for important assemblages of wetland bird species and supports migratory birds on passage. The site regularly supports over 20,000 waterfowl in any one season. The Thames Estuary and Marshes site is also important for its plant assemblages, particularly in the grazing marsh dykes and fleets. The site also supports endangered, vulnerable and rare invertebrates. There are large populations of water vole and brown hare on the North Kent marshes. The site is considered to have low potential for substitution due to its large area and the complex mixture of habitats present.

11.6.12 The Medway Estuary and Marshes SPA and Ramsar site (of very high ecological value) extends along the River Medway and its shores, from south of Hoo St Werburgh in the west to Grain container terminal in the east where it abuts the boundary of the River Thames estuary and Marshes SPA. The majority of the site is designated as both SPA and Ramsar site, however, Smithfield Marshes on the Isle of Grain is designated as Ramsar only. The site has a complex arrangement of drainage channels, which drain around large islands of saltmarsh, mudflats and peninsulas of grazing marsh. Grazing marshes are also located behind the sea walls and are intersected by dykes and fleets. The Medway estuary and Marshes SPA provides wintering and breeding habitats for important assemblages of wetland bird species and supports migratory birds on passage. There is an outstanding assemblage of plant species on the saltmarsh, sea walls, dykes and their margins, including several nationally scarce plants. The site also supports at least 12 Red Data Book invertebrates. The site is considered to have low potential for substitution due to its large area and the complex mixture of habitats present.

11.6.13 A small part of the nationally-designated Medway Estuary and Marshes SSSI (of high ecological value) within the area of search is not covered by the SPA and Ramsar designation. This small site is located on the eastern coast of the Isle of Grain (St James Park). The shell sand beaches of the Isle of Grain are the only examples of such habitat remaining so far up the Thames estuary and have a distinctive flora, including sand couch, sea holly, sea sandwort, sea rocket and prickly saltwort. The site also comprises woodland/ scrub and grassland. This habitat has a medium-low potential for substitution.

11.6.14 A further internationally-designated SPA and Ramsar site (Southend and Benfleet Marshes) (of very high ecological value) is located along the north shore of the Thames, east of Canvey Island. The site comprises a large area of intertidal mudflats in addition to saltmarsh, scrub and grassland. Benfleet and Southend marshes have been designated because they regularly support over 20,000 waterfowl in winter and support internationally or nationally important wintering populations of migratory waterfowl including dark-bellied brent geese, grey plover, knot, ringed plover and dunlin. These habitats are considered to have a low potential for substitution.

11.6.15 The internationally designated Essex Estuaries candidate Special Area of Conservation (of very high ecological value) is located immediately east of Benfleet and Southend Marshes SPA and Ramsar site, covering an extensive area to the north (including the Blackwater Estuary, the Colne Estuary, the Crouch and Roach Estuaries, Dengie and Foulness). The site has been recommended for SAC status as it supports 7 habitats of European importance (including upper and lower saltmarsh, saltmarsh supporting cord-grass swards, saltmarsh scrub, estuaries, intertidal mud and sandflats and subtidal sandbanks).

11.6.16 Two nationally-designated SSSIs (of high ecological value) are located within the area of search:

- Northward Hill SSSI and NNR are located within the centre of the proposed airport site. The site comprises ancient woodland and grazing marsh and is owned and managed by the RSPB.; and

- Chattenden Wood SSSI is located approximately 2km south of the proposed airport site and east of Cliffe Woods. The woodland is ppredominantly coppice-with-standards (a scarce habitat in Kent) and includes neutral grassland with scattered scrub.

11.6.17 There are a number of undesignated areas of nature conservation importance (predominantly of low ecological value unless otherwise specified) which include:

- An extensive network of drainage ditches and dykes across arable land that is likely to be of value for plants and invertebrates as well as waterfowl (including herons) and water voles. This network provides valuable wildlife corridors between areas of neutral grassland and grazing marsh and has a low potential for substitution due to the large number of ditches and dykes across a wide area. The network of ditches is considered to be of medium ecological value; and

- Nine small copses which are poorly connected by hedgerows although well-connected by ditches.

Heritage (Figure 11.21)

11.6.18 *Archaeology* – The proposed airport site is located in an area of high archaeological value, containing a range of multi-period sites. The North Kent Marshes, within which the site lies, has been the subject of a number of recent detailed surveys. These suggest that the area of coastal marshes and the area of higher ground to the south represent areas of significant archaeological interest, containing areas of waterlogged, palaeo-environmental deposits of potentially national or international importance.

11.6.19 The area's particular value results from its potential to contain well preserved and stratigraphically complex waterlogged deposits providing evidence relating to climatic and hydrological change during the Palaeolithic period. The area is also likely to be of interest for its potential to contain important sites providing evidence of Neolithic and Bronze Age activity, including well preserved settlement sites and buried land surfaces which may have been sealed and protected by later alluvial layers associated with a rise in sea level. In addition it could contain important sites associated with later prehistoric (Iron Age), Roman and medieval utilisation of the inter-tidal (marshland) zone, primarily in the form of salt making or pottery kiln sites, which are fairly common within this area. Previous surveys have noted the considerable potential of the marshland areas to contain well preserved, multi-period waterlogged deposits and artefacts such as boats, wooden objects and palaeo-environmental deposits which would not have survived in more aerobic circumstances. Generally, therefore, it can be demonstrated that the area of marshland and the land to its south is likely to represent an area of potentially significant archaeological interest. The area of proposed development contains 34 archaeological sites or groups of sites with an additional 21 lying within the 500m study corridor around the site.

11.6.20 *Listed Buildings* - The study area for the proposed development contains 23 Listed Buildings. These include five designated Grade I/II* (national value) of which four are Grade I Listed and one is a Grade II* Listed (national value). The Grade I buildings are Cooling Castle Gatehouse, the inner ward to Cooling Castle, the Church of St. Margaret, High Halstow, and the Church of All Saints, All Hallows while the Grade II* Listed Building is the Church of St. Mary St Mary Hoo (when last surveyed this building was redundant and being converted into a house).

11.6.21 Of the identified Listed Buildings, 10 are contained within the area of proposed development, including the Church of All Saints (Grade I) and the Church of St. Mary (Grade II*). The remaining 13 Listed buildings, including the three Grade I/II* buildings, fall within the 500m corridor surrounding the area of proposed development (a small concentration (seven) of these are located at Cooling and includes the two Grade I Listed Buildings of Cooling Castle Gatehouse and the inner ward to Cooling Castle).

11.6.22 *Conservation Areas* **-** The area of proposed development includes one Conservation Area, at St. Mary Hoo (national).

Landscape and Visual (Figure 11.22)

11.6.23 *Landscape/Townscape* - The landscape in the vicinity of Cliffe is defined by the broad, expansive, openness of the Greater Thames Estuary (regional character area identified by the Countryside Agency) which is distinctive for its huge scale, general absence of trees and high levels of intervisibility over considerable distances. The flat areas of marshland and mudflats create a strong estuarine/coastal character that, despite the presence of many large scale industrial facilities, means that the area retains a sense of wildness and remoteness in many places. At Cliffe, this openness is offset by the low ridge of the Hoo Peninsula which extends from the north Kent Downs (a nationally designated Area of Outstanding Natural Beauty that lies beyond the 5km study area and without visual links to the site) into the estuary landscape to separate the Rivers Thames and Medway and create a low backdrop to local views. The landscape within 5km of the site at Cliffe has been divided into four areas of distinct landscape and townscape character.

- Greater Thames Estuary (South Essex) is located on the northern banks of the Thames and extends inland over the flat marshes of Vange and Benfleet Creeks. The character area is enclosed by the hills of South Benfleet, Hadleigh and Southend on Sea. Much of the coastline of the more urbanised northern side of the estuary is developed with power stations and oil refineries forming prominent features. Although some natural areas remain (such as the ancient landscape of Fobbing Marshes), the general value of the landscape is assessed as low.

- Eastern Thames Marshes are bounded by the River Thames to the north and the low ridge of the Hoo Peninsula to the south. This character area comprises an extensive area of semi-natural mudflats, marshland and grazed pasture and a considerable length of accessible undeveloped river frontage/coastline. Buildings are almost entirely absent and, despite views across the estuary to distant detractors, the landscape provides a valuable sense of wildness and remoteness. The eastern part of this area includes a section of the North Kent Marshes which are designated at a county level as a Special Landscape Area (with additional local designations to the west of Cliffe). The value of this area is assessed as medium/high.

- Hoo Peninsula forms a low ridge of open, rolling arable fields that gently dip towards the sea at Allhallows. The Peninsula generally has few trees, but occasional landmark woods (such as at High Halstow), occasional fruit growing areas and lanes (including several designated rural lanes) enclosed by hedgerows do occur. Although the landscape character lacks distinction, the value of this landscape is assessed as medium due to its historic associations and its importance as a backdrop to surrounding views.

- Medway Marshes are enclosed to the south east of the Hoo Peninsula. This extensive system of low islands and creeks retains a sense of naturalness and wildness despite surrounding towns and the visibility of other developments. Parts of the Medway estuary are within the county designated Special Landscape Areas and the value of this landscape is assessed as medium.

11.6.24 *Visual* - The extensive area covered by the indicative zone of potential visual impact (ZVI) of the maximum extent *of Airport Options boundaries* is defined by the flat, openness of the estuarine landscape, limited only by the visibility 'shadow' caused by the ridge of the Hoo Peninsula. The landscape contains few trees, woodlands, hedgerows or other landcover to reduce visibility of large structures from within this area.

11.6.25 Key visual receptors within 5km of the site would include residents in the villages, hamlets and other settlements of the Hoo Peninsula not directly affected by the landtake of the proposed development. These include the Conservation Area at Cliffe and the elevated town of Higham. Although these receptors' views are already affected by distant detractors, the airport development would be significantly closer with little to filter views of potential large structures.

Other sensitive receptors would include walkers using the Saxon Shore Way and the present coastal footpath.

11.6.26 Owing to the exceptionally open character of the landscape around Cliffe, a selective number of major visual receptors beyond the 5km study area have been identified which are likely be affected by the development. These include the elevated towns of South Essex, the seaside resort of Southend and the villages and Riverside Country Park located on the southern shores of the Medway and which face the distant ridgeline of the Hoo Peninsula. The sensitivity of these visual receptors is limited by the exceptional openness of the Thames Estuary landscape and the presence of many detractors.

Community

11.6.27 *Community Infrastructure* – There are three tiers of settlement in the immediate vicinity of the site: sizeable villages such as Cliffe, High Halstow, Lower Stoke and Allhallows; small villages or hamlets, such as Cooling, St Mary Hoo, Fenn Street and Stoke; and scattered farmsteads and other properties. The IMD ranking of the two baseline wards is 2,616 for All Saints and 6,156 for Thames Side. This represents a range of 3,540 places, or about 42% of the national spectrum, which suggests that levels of deprivation are relatively polarised.

11.6.28 *Community Structure/Distinctiveness* – The population of the Core Catchment Area, as defined in Stage One of the study (ie the districts of Medway, Gravesham, Basildon, Castle Point and Southend) is 878,000. Much of the study area comprises the Thames Side marshes, which are largely uninhabited. The nearest urban communities are the Medway towns, Gravesend, Sheerness, Canvey Island and Southend-on-Sea.

11.6.29 Work undertaken in Stage One of SERAS indicates that the long-term housing capacity of the Core Catchment Area is probably around 25,000 dwellings within the relevant Structure Plan periods. It is assumed that such an increase could be accommodated by intensification of existing built-up areas, development of brownfield sites, a degree of urban fringe expansion and new “village” settlements.

11.6.30 The area is not known to be subject to intrusive levels of aircraft noise.

11.6.31 *Employment* – At 4.4%, unemployment levels within the Core Catchment Area are below the national average.

High * Adverse Impacts: Option A2(2)

11.6.32 The High* adverse impacts of Option A2(2) at Cliffe Marshes are summarised below.

11.6.33 Option A2(2) would result in the loss of 1,968 ha of agricultural land and a significant proportion of this total would be Grade 1. It is estimated that approximately 75% of the land lost is BMV land (i.e. 1476 ha) and effects would consequently be HA*.

11.6.34 There would be landtake from the Thames Estuary and Marshes SPA of very high ecological value (also designated as Ramsar and SSSI), including part of St Mary's Marshes, Salt Fleet, and Blyth sands in the north and part of Allhallows Marshes in the east. In addition, a percentage of Cooling Marshes, part of the Thames Estuary and Marshes Ramsar site, would be lost due to Option A2(2) (this area is also designated as SSSI but not SPA). The loss of this substantial area from an international site is considered to cause HA* effects.

11.6.35 In addition, 100% of the nationally important Northward Hill SSSI and NNR (of high ecological value) would be lost, resulting in HA-HA* effects due to the inability to substitute ancient woodland.

11.6.36 The cumulative effect on the Heritage resource is considered to be at least HA as a result of the loss of one Grade I, one Grade II* and seven Grade II listed buildings, the destruction of St. Mary Hoo Conservation area, the loss of 26 known archaeological sites and significant landtake from an area of proven high archaeological potential, all of which would contribute to a HA effect. This could, however, rise to HA* through the loss of a large area of former or existing marshland containing possibly nationally or internationally significant palaeo-environmental deposits. The precise determination of this level of severity would require further detailed research of the marshland within this area, to establish the nature of the deposits present, their likely level of preservation and hence their value.

11.6.37 Both the Thames Estuary and Marshes SPA and the Medway Estuary and Marshes SPA are located within 50m of the Option A2(2) boundary (to the north and east). Disturbance of birds in all seasons would be likely to constitute the most severe construction effects and such disturbance could be critical in the winter. Construction effects on these international sites could consequently be HA- HA*.

High Adverse Impacts: Option A2(2)

11.6.38 It is anticipated that noise and visual effects on the Thames Estuary and Marshes SPA and Ramsar site could be at least HA due to sensitivity of wetland bird populations on the site. In particular, feeding waders on the mudflats would suffer noise disturbance due to their location 1 km from the side of a runway and 1 km from the end of a runway.

11.6.39 Both the Thames Estuary and Marshes and the Medway Estuary and Marshes SPAs may be affected by changes in water levels and/or quality due to raising of the airport site to 18m above sea level and consequent changes in drainage. Although detailed studies on water balance within and around the site have not been undertaken, these effects are provisionally estimated at MA-HA.

11.6.40 The overall impact of Option A2(2) upon the landscape would be HA due to the loss of a large area of County designated Special Landscape Area (and presently undeveloped coastline) and the impact on the highly visible landform and ridgeline of the Hoo Peninsula. Effects resulting from direct loss of specific heritage resources, including Conservation Areas and designated rural lanes, are addressed in the Heritage Topic above.

11.6.41 The housing demand could be met only by substantial change in the settlement pattern (e.g. excisions from the Green Belt or consolidation of existing communities). This degree of change would represent an MA effect on the structure and distinctiveness of communities within the Core Catchment Area. However, the effect within the immediate vicinity of the new airport would be HA if substantial new urban development were to be permitted, since the Hoo Peninsula is at present predominantly rural in character. Extensive development would be likely to subsume the existing settlement pattern of small and medium-sized villages.

High* Adverse Impacts: Option A2(3)

11.6.42 The High* adverse impacts of Option A2(3) are as for A2(2) with:

- Additional loss of agricultural land
- Greater area of Cooling Marshes within the Thames Estuary and Marches Ramsar site lost
- Further loss of archaeological sites and historic marshland
- Reduced buffer zone around the Scheduled Ancient Monument at Cooling Castle

High Adverse Impacts: Option A2(3)

11.6.43 The High Adverse impacts of Option A2(3) are as for A2(2) with:

- Additional loss of a Grade II Listed Building – a 16th century barn
- Greater visual intrusion

High* Adverse Impacts: Option A2(4)

11.6.44 The High* Adverse impacts of Option A2(4) are as for A2 (2) with:

- Additional loss of agricultural land

- Greater potential for disturbance of birds on the mudflats of the Thames Estuary and Marshes SPA and Ramsar site due to proximity of additional parallel runway
- Greater loss of archaeological sites and historic marshland

High Adverse Impacts: Option A2(4)

11.6.45 The High Adverse impacts of Option A2(4) are as for Option A2(2) but with:

- Greater visual intrusion

High* Adverse Impact: Option A2(5)

11.6.46 The High* Adverse impacts of Option A2(5) are as per option A2 (2) with:

- Additional loss of agricultural land
- Greater loss of Cooling Marshes
- Greater potential for disturbance of birds on the mudflats of the Thames Estuary and Marshes SPA and Ramsar site due to proximity of additional parallel runway
- Greater loss of archaeological sites and historic marshland

High Adverse Impacts: Option A2(5)

11.6.47 The High Adverse impacts of Option A2(5) are as per Option A2 (2) with:

- Greater visual intrusion
- Greater impact from construction

Potential Strategy for Mitigating Ecological Impacts

11.6.48 Following Stage One, Scott Wilson were commissioned to investigate further the ecological value of the area, to outline potential impacts and to identify potential mitigation/compensation measures. The findings of this study are presented in a separate report *SERAS North Kent Marshes Ecological Study: Phase 1 Repor*" and are summarised here.

11.6.49 The site for the proposed airport is mainly agricultural land. However, surrounding the proposed site is a suite of internationally recognised wetland sites of outstanding importance associated with the wider Thames Estuary. The three statutory sites of importance for nature conservation on the Hoo Peninsula are:

- Thames Estuary and Marshes SPA and Ramsar site. The SPA is a wetland of European importance comprising a mosaic of intertidal habitats, saltmarsh, coastal grazing marshes, saline lagoons and chalk pits. The marshes extend for approximately 15 km along the south side of the Thames Estuary (South Thames Estuary and Marshes SSSI) and also include intertidal areas on the north side of the Estuary (Mucking Flats and Marshes SSSI). To the south of the river, much of the area is brackish grazing marsh, although some of this has been converted to arable use. At Cliffe, there are flooded clay and chalk pits, some of which have been infilled with dredgings. Saline lagoons are found at Cliffe and Allhallows. Outside the sea wall, there is a small extent of saltmarsh and broad intertidal mudflats covering over 2,250 ha on the south bank of the Thames. The estuary and adjacent grazing marsh areas support an important assemblage of wintering waterbirds, including grebes, geese, ducks and waders. The site is also important during the spring and autumn migration periods. The designation as a Ramsar site is due to the international importance of the wetland for supporting vulnerable, endangered or critically endangered species or threatened ecological communities. It is also used regularly by over 20,000 wintering waterfowl.

- Medway Estuary and Marshes SPA and Ramsar site. The SPA is a wetland of international importance comprising grazing marshes, intertidal flats and saltmarshes. The site boundary reflects that of the Medway Estuary and Marshes SSSI. The SPA has a complex arrangement of tidal channels, which drain around large islands of saltmarsh and peninsulas of grazing marsh. The mudflats are rich in invertebrates and also support beds of algae and eelgrass. Small shell beaches are found, particularly in the outer part of the estuary. Grazing marshes are present inside the sea walls around the estuary. The complex and diverse mixes of coastal habitats support important numbers of waterbirds throughout the year. In summer, the estuary supports breeding waders and terns, whilst in winter it holds important numbers of geese, ducks, grebes and waders. The site is also of importance during spring and autumn migration periods, especially for waders. The designation as a Ramsar site is as noted above for the Thames Estuary and Marshes SPA and Ramsar site.

- Northward Hill SSSI/NNR. This site comprises 53 ha of ancient woodland. It is owned and managed by the Royal Society for the Protection of Birds (RSPB) and forms part of the Northward Hill RSPB Nature Reserve. The RSPB Reserve covers 249 hectares of woodland and grazing marsh. The 54 ha woodland is being almost doubled in size by natural regeneration from arable farmland. It supports a wide variety of birds through the year and includes the largest heronry in Great Britain, which has been the subject of one of the longest-running monitoring programmes seen in the United Kingdom.

11.6.50 Other designated sites in the vicinity of the proposed development include Benfleet and Southend Marshes Special Protection Area (SPA)/Ramsar site to the north-east of the Hoo Peninsula, and The Swale SPA/Ramsar site to the south-east.

11.6.51 It is currently not possible to predict accurately all potential impacts. A comprehensive assessment of all existing data available for the affected areas, in conjunction with detailed surveys, would be required before an accurate understanding of impacts could be gained. The following briefly describes potential impacts.

11.6.52 While various options are still under consideration, given the size of the proposed airport, there is likely to be landtake to the following areas as a consequence of their location: Cooling, Whalebone, Halstow and St Mary's Marshes; part of Allhallows Marshes; Hope, Buckland and Decoy Fleets; and Northward Hill SSSI/NNR. Whalebone Marshes and part of Cooling Marshes lie within the Thames Estuary and Marshes Ramsar site but outside the SPA. The Fleets lie within the SPA, as does Allhallows Marshes. One option causes minor encroachment to the mudflats, just to the west of Allhallows-on-Sea.

11.6.53 The area of landtake includes grazing marshes, creeks and ancient woodland; it is likely to include almost all of Northward Hill RSPB Nature Reserve. These impacts are likely to cause highly significant effects, which it will be difficult to mitigate. Northward Hill SSSI/NNR, an area of ancient woodland, will, by the very nature of the age of the habitat being lost, prove impossible to replace. The loss of this site is of particular concern because of its historic, social and educational role as a National and RSPB Nature Reserve. During the development of the airport options, serious consideration was given to the retention of the Nature Reserve but it became clear that from a topographic and, more importantly, birdstrike viewpoint, retention of the wooded slope was incompatible with the establishment of an airport on the Peninsula.

11.6.54 As well as direct landtake, there will be issues of 'indirect landtake', where sites lose their value for wildlife as a result of changed management. The immediate surrounds of the runways etc. (i.e. airside areas) will need to be managed in accordance with CAA Guidelines as set out in CAP 680. As the Thames Estuary attracts large numbers of many of the key birdstrike species (e.g. gulls, crows, lapwings, waders, starlings etc.), it will be essential for the airport operating authority to have an active bird control policy on the site and this could extend outside operational areas if the need arises.

11.6.55 Given that the Thames Estuary is a major migratory pathway for birds (both for long and short distance movements), it is likely that the surrounding SPAs will pose a significant risk to aircraft using the site, e.g. the current flight paths cross (probably at 1000-2000ft) the lagoons at Cliffe, which hold large numbers of wintering and breeding birds. The birdstrike issue could potentially directly conflict with management within the SPA, as the UK Government is committed to maintain and enhance the area for the important species it protects.

11.6.56 Outside the zone where bird use is actively discouraged by land management and bird scaring techniques, birds will be subject to disturbance during both the construction and operational phases of the airport project.

11.6.57 All bird species using the site are highly sensitive to disturbance, particularly during severe weather. Disturbance can have the effect of displacing birds, thus reducing their feeding efficiency while increasing their energy requirements. This factor is a particular concern during prolonged periods of cold weather. Disturbance may be caused by sudden movements and increases in noise over and adjacent to feeding and roosting areas. Sensitivity to noise and visual disturbance is particularly high on open areas such as mudflats. The potential for disturbance to both SPAs is considerable, the severity being determined by proximity, season and the precise nature of the ecological attributes at any one location.

11.6.58 Location of the airport within the peninsula will have a significant effect upon the SPAs (and NNR). Indeed, the construction and operation of the airport is likely to adversely affect the integrity of the site. As a consequence, under its obligations under the Habitat Directive, the Government can only grant permission for the development if it is accepted that:

- There are no alternative solutions (locations).
- There are imperative reasons of over-riding public interest.

11.6.59 In this case, compensatory measures must be taken to ensure that the overall coherence of the Community-wide network of SPAs (and SACs) known as Natura 2000 is protected.

11.6.60 Refining the layout of the airport may enable direct landtake to internationally important sites to be reduced. To some extent, it may also be possible to minimise disturbance to birds, although the need to reduce the risk of birdstrike is also a critical factor in siting the airport and its component elements. It is a recognised if regrettable fact that the design of the airport must focus upon reducing the risk of birdstrike even if this is likely to increase the ecological impact of the airport. It is also clear that compensation for the effect upon the Thames Estuary and Marshes SPA/Ramsar site and the Northward Hill SSSI/NNR/RSPB Nature Reserve should take place away from the immediate surroundings of the airport in order to avoid exacerbating the risk of birdstrike.

11.6.61 In order to ensure that the populations of species supported by the Thames Estuary and Marshes SPA/Ramsar site are maintained elsewhere, further detailed information on the use of the different components of the SPA/Ramsar site and of adjacent sites will be required. There is also a question as to how far habitat enhancement (e.g. of adjacent SPAs) represents compensation for habitat loss; there are those who believe that habitat loss can be balanced only by habitat *creation*. Certainly under Article 6 of the Habitats Directive (which applies to both SACs and SPAs), Member States are already obliged to 'take appropriate steps to avoid the deterioration of natural habitats and the habitats of species'. Thus, as the Government already has a legal obligation to protect and, to a certain extent, enhance existing SACs and SPAs, habitat enhancement within these areas may not be seen as adequate compensation for the development. The creation of significant areas of new habitat (off-site compensation) is likely to be the only accepted form of compensation.

11.6.62 To identify existing suitable areas where the necessary habitats could be created or re-created, a major desk study of coastal sites has been undertaken. All designated areas (including SPAs, SACs, Ramsar sites, SSSIs and NNRs) have been plotted, from the Harwich/Felixstowe area on the Essex/Suffolk border to Hastings on the East Sussex coast. A brief review of the French coast from the Somme Estuary northwards across the Belgium and southern Dutch coasts has also been carried out. From this review process an area in north Kent has been identified which could potentially be managed to create grazing marshes, freshwater and brackish water ditches, lagoons and reed-beds. It would also be possible to create inter-tidal mudflats (and possibly saltmarshes) on its northern edge if a managed retreat option were implemented.

11.6.63 The costs of such a scheme, which have only been developed at a conceptual level, are difficult to estimate. In making a broad assessment of costs it has been assumed that most of the habitat creation could be achieved without disturbing or altering the existing infrastructure in this area. The following very preliminary costings for this scheme alone have been prepared by Scott Wilson.

- The area (roughly 35km^2 or 8,500 acres) could be purchased for approximately £21 million (this is assuming a land value of around £2500/acre). There would also need to be compensation in some areas for the loss of properties and/or livelihoods, which could double this figure (say to £40 million).
- The coastal defence works necessary to create the coastal lagoons/inter-tidal mudflats would cost approximately £75 million.
- The hard and soft landscaping works across the whole area that would be needed to create freshwater lagoons, pools and reedbeds would cost in the region of £50 million. In addition it is estimated that approximately £30-40 million would need to be set aside for the long-term management of this area and to assist in fundamentally altering the farming practices on this area (e.g. bringing in herds of beef cattle). New sluice gates

and other water management infrastructure would be required, costing around £10 million.

11.6.64 Totalling the above figures, it appears that this area could be turned into a wetland complex for around £230 million.

11.7 Environment: Water

Existing Conditions

11.7.1 Cliffe Marshes is situated adjacent to the southern coast of the Thames Estuary. The study area is typified by a number of relatively short drains and creeks that feed into the estuaries from the spring line between the Chalk/Lower London Tertiaries and the London Clay. The grazing marshes of the Hoo Peninsula are notable for their value for wildlife. The long drought intervals of recent years have had their effect here in reduced spring flows and depleted wetland levels.

11.7.2 There are no classified fresh surface watercourses within the study area. Additionally, at present the Agency has no nationally agreed system for assessing water quality in estuaries. There are 33 licensed surface water abstractions within the study area.

11.7.3 The north Kent coastline is particularly vulnerable to tidal surges from the North Sea. A large extent of the study area falls within the Environment Agency 1 in 1000 year flood level. Additionally, the soils overlying the London Clay are heavy and poorly drained, resulting in any excess water being held up at the surface, thereby exacerbating any flooding problem.

11.7.4 The Chalk, a major aquifer, underlies the study area and is at outcrop in the western part of the site. Towards the centre of the site the Woolwich and Reading Beds (sands and clays) and the Thanet Sands (which comprise minor aquifers) overlie the Chalk, and these are in turn overlain by London Clay in the eastern part of the site (non-aquifer). Those areas that border the estuary also have a thick sequence of alluvium overlying the solid geology. A high water table may be expected in the study area due to the generally low lying, marshy nature of the ground. There are 30 licensed groundwater abstractions within the study area.

11.7.5 From a regional perspective, the available water resources are virtually fully committed. The majority of the area around Cliffe is currently over-licensed. This means that if abstraction reaches full licensed volumes it will be unsustainable with respect to the environment.

Impact of Options

11.7.6 The options have been assessed against a base case, which is the current land use planning system, and therefore only considers impacts that are *additional* to those assessed under the base case. The assessments consider the sensitivity of the water environment and the potential to cause harm, which includes scope for mitigation. Table 11.17 summarises the assessments for each of the water objectives, for each of the options.

11.7.7 All of the options at Cliffe Marshes present a potential impact of either High or High* Adverse on all of the water objectives, except for groundwater.

11.7.8 Options A2(3) and A2(5) present a potential impact of 'High Adverse' on groundwater. The NE-SW runway within these options overlies the Chalk outcrop, which is highly vulnerable to contamination.

11.7.9 Due to the topography of the site it is anticipated that it would need to be raised to produce a level platform area approximately 18 m above sea level. This would require up to 15 m of fill over the low lying marshes. A number of marshes and creeks, which are noted for their wildlife, would effectively be destroyed.

11.7.10 Although the raised platform would essentially solve any flooding problems at the Airport itself, it is likely to increase the risk of flooding elsewhere on the Peninsula. The existing area is largely rural, and by converting it to hardstanding it not only removes land previously used for valuable flood storage, but also increases the rate of runoff. Given that a large proportion of the area is already designated as flood risk, the potential impact is regarded as high.

11.7.11 There would be a large increase in demand for water corresponding to the new airport development. Without any further water resource development or effort to manage demand, the water resource zone that would supply the new airport would have a deficit. However, assuming that water companies maximise existing strategic links and their use of existing and planned licensed resources between resource zones, the resource zone that supplies the Cliffe area would have a surplus. This assumes the development of the Bewl-Darwell reservoir system in East Sussex, which will be essential for resources within the region as a whole. This also assumes that companies will achieve their leakage reduction targets, and also allows for environmental demands. Locally, the Medway Estuary and Marshes Special Protection Areas are being investigated to determine whether existing licences are having an adverse effect. The outcome of these investigations may have an impact upon future abstractions within the immediate area.

11.7.12 Given the large increase in demand for water imposed by the development and the pressures described above, it may be difficult to meet this demand, even assuming that appropriate supply and demand management techniques are put into place, and other water users within the region are water efficient.

Table 11.17: Water Summary Table

Option	Option A2(2)	Option A2(3)	Option A2(4)	Option A2(5)
Surface Water	Ecologically significant marshes and creeks destroyed by raising level of site. 33 licensed abstractions within the study area (no PWS). **High Adverse**	Ecologically significant marshes and creeks destroyed by raising level of site. 33 licensed abstractions within the study area. **High Adverse**	Ecologically significant marshes and creeks destroyed by raising level of site. 33 licensed abstractions within the study area. **High Adverse**	Ecologically significant marshes and creeks destroyed by raising level of site. 33 licensed abstractions within the study area. **High Adverse**
Groundwater	Groundwater vulnerability increases from east to west across the site. 30 licensed abstractions within the study area (no PWS). **Medium Adverse**	Groundwater vulnerability increases from east to west across the site. 30 licensed abstractions within the study area (no PWS). **High Adverse**	Groundwater vulnerability increases from east to west across the site. 30 licensed abstractions within the study area (no PWS). **Medium Adverse**	Groundwater vulnerability increases from east to west across the site. 30 licensed abstractions within the study area (no PWS). **High Adverse**
Flooding	Approx. 65% of study area within tidal floodplain. Significant increased flood risk to previously largely undeveloped area. **High Adverse**	Approx. 65% of study area within tidal floodplain. Significant increased flood risk to previously largely undeveloped area. **High Adverse**	Approx. 65% of study area within tidal floodplain. Significant increased flood risk to previously largely undeveloped area. **High Adverse**	Approx. 65% of study area within tidal floodplain. Significant increased flood risk to previously largely undeveloped area. **High Adverse**

Option	A2(2)	A2(3)	A2(4)	A2(5)
Water Resources	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**	It may be very difficult to meet the significant increase in demand, even through supply and demand management, and water saving technology. **High* Adverse**

11.8 Environment: Noise Impacts

Aircraft Noise: Daytime

11.8.1 The Cliffe Marshes contours for the Options in 2015 or 2030 as appropriate are shown on Figures 11.24 to 11.27. Tables 11.18 and 11.19 give the areas and estimated populations under the daytime $L_{Aeq,16h}$ noise contours for each of these scenarios with changes against the Base Case. Cliffe Marshes is the proposed site for a new airport and the area in this vicinity is currently not subject to any significant levels of aircraft noise. The site has been selected, and runways and flight paths have been designed, to minimise noise impact on people. Cliffe Marshes itself is an area which is only sparsely populated and flight paths to the east of the proposed airport will overfly the Thames Estuary

Options in 2015

11.8.2 Option A2(2) is the Base Case and this proposed development comprises a pair of wide spaced 4000m runways. With this scenario the population under the 57 dB contour will only be 4,900 despite the contour covering an area of 94 sq km (part of which is the Thames estuary). The population within the 69 dB threshold is estimated at 200. The part of the 54 dB contour associated with northbound departures does extend northwards over East Tilbury, Linford and Southfields on the north side of the Thames Estuary. Lower Higham and Grain are the only other significant settlements within the 54 dB contour.

11.8.3 Option A2(3) adds a cross-wind runway to the Base Case. However, this would only normally be used during the night. Therefore, comparing Option A2(3) with A2(2), there are no differences for the daytime noise contours.

Table 11.18 Cliffe Daytime Aircraft Noise Contours – 2015 vs 2015 Base Case (Option A2(2))

LAeq (dB)	Area (sq km)		
		Option A2(2)	Option A2(2)
	No airport	Total	Change
	2015	2015	cw Base
>54	0	151.1	151.1
>57	0	94.2	94.2
>60	0	60.2	60.2
>63	0	36.0	36.0
>66	0	17.6	17.6
>69	0	9.3	9.3
>72	0	4.9	4.9
LAeq	**Population (000s)**		
		Option A2(2)	**Option A2(2)**
	No airport	**Total**	**Change**
	2015	**2015**	**cw Base**
>54	0	12.8	12.8
>57	0	4.9	4.9
>60	0	2.9	2.9
>63	0	2.1	2.1
>66	0	0.3	0.3
>69	0	0.2	0.2
>72	0	<0.1	<0.1

Options in 2030

11.8.4 Option A2(4) would have two pairs of close parallel runways and is forecast to handle 712,000 PATMs compared with 528,000 for Option A2(2). This would result in a 157% increase in the 57 dB contour area in 2030 to 252 sq km compared with 94 sq km for Option A2(2) in 2015. The corresponding population would also increase by around 22,000 to 26,800. The additional properties affected are predominantly to the north east and south east of the airport. To the north east the settlements that would be affected would include Tilbury, Chadwell St Mary, Orsett, Horndon on the Hill and parts of Stanford-le-Hope. To the south east the settlements affected would include Higham and eastern parts of Gravesend.

11.8.5 The population within the 69 dB contour would rise significantly over Option A2(2) to 2,100. However, this compares favourably with figures of 13,000 for Heathrow, both for current use and the 2030 Base Case, especially given that in Option A2(4) the Cliffe Marshes runways would be handling more flights.

11.8.6 Option A2(5) adds a cross-wind runway to Option A2(4). However, this would only normally be used during the night. Therefore, comparing Option A2(5) with Option A2(4), there are no differences for the daytime noise contours.

Table 11.19 Cliffe Daytime Aircraft Noise Contours – 2030

LAeq (dB)	Area (sq km)		
		Option A2(4)	Option A2(4)
	No airport	Total	Change
	2030	2030	cw Base
>54	0	421.1	421.1
>57	0	251.6	251.6
>60	0	151.4	151.4
>63	0	95.8	95.8
>66	0	60.6	60.6
>69	0	37	37
>72	0	18.9	18.9
LAeq (dB)	**Population (000s)**		
		Option A2(4)	**Option A2(4)**
	No airport	**Total**	**Change**
	2030	**2030**	**cw Base**
>54	0	65.9	65.9
>57	0	26.8	26.8
>60	0	12.8	12.8
>63	0	5.8	5.8
>66	0	3.8	3.8
>69	0	2.1	2.1
>72	0	0.3	0.3

Aircraft Noise: Night-time

11.8.7 Tables 11.20 and 11.21 below show the population numbers and associated house counts within the departure and arrival 90 dBA SEL footprints for easterly and westerly operations respectively. The footprints are shown in a supporting document and represent an 'average worst' QC2 aircraft, applied to each departure track (SID) and each runway's approach path for arrivals.

11.8.8 SID references are: BUZ – Buzad; WES - Wescott; CLN - Clacton; DVR – Dover; Lam - Lambourne

Table 11.20: Night Noise Population and House Counts – Easterly Operations

	All Options									
Runway	**09LL**		**09L**		**09R**		**09RR**		**NE/SW**	
	Popl'n (000's)	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**
Departures										
All	0.2	0.1	0.2	0.1	0.2	0.1	0.8	0.3	-	-
Arrivals	<0.1	<0.1	<0.1	<0.1	1.8	0.7	1.0	0.4	2.3	0.9

Table 11.21: Night Noise Population and House Counts – Westerly Operations

	All Options							
Runway	**27RR**		**27R**		**27L**		**27LL**	
	Popl'n (000's)	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**	**Popl'n (000's)**	**Hse (000's)**
Departures								
BPK/CLN	<0.1	<0.1	<0.1	<0.1	0.8	0.3	2.0	0.8
DVR/SFD	<0.1	<0.1	<0.1	<0.1	0.3	0.1	1.3	0.5
Average	<0.1	<0.1	<0.1	<0.1	0.6	0.2	1.7	0.7
Arrivals	<0.1	<0.1	0.2	0.1	<0.1	<0.1	1.2	0.4

11.8.9 SID references are: BPK – Brookmans Park; CLN - Clacton; DVR – Dover; SFD - Seaford

11.8.10 The most significant issue to note at Cliffe Marshes is that the numbers affected are small. The number of people affected by easterly arrivals on the NE/SW runway is higher than numbers affected in other scenarios. On easterly operations, these data suggest that noise impacts would be minimised by using one of the northerly pair of runways (09LL or 09L) for arrivals and one of the southern pair (09R or 09RR) for departures, thereby obviating the need for the NE/SW runway.

Surface Access Noise: Highways

11.8.11 Table 11.22 gives the overall results (total EPA) from the GOMMMS plan level assessment for road traffic noise. The Surface Access Noise section of Appraisal Summary Table also includes the EPA values split by noise contour bands.

Table 11.22 – Cliffe Marshes Surface Access Noise Assessment: Highways

	Total change in Estimated Population Annoyed (EPA) by road traffic noise (000's)			
	Option A2(2)	**Option A2(3)**	**Option A2(4)**	**Option A2(5)**
2015	+13.4	+13.4	n/a	N/a
2030	n/a	n/a	+18.6	+18.6

11.8.12 The noise impacts of changes in road traffic for the Options A2(2) and A2(3) in 2015 are compared with the Base Case, which is the road network for Package 1. The roads around Cliffe Marshes affected for these Options include parts of the A2 and much of the length of the A13 east of the M25. Traffic would use a new tunnel linking the A2/M2 and A13, which would surface near East Tilbury, on the north side of the Thames Estuary. The tunnel approach road would give rise to increased noise impacts. The total increases in Estimated Population Annoyed (EPA) by road traffic noise are 13,400 for Options A2(2) and A2(3).

11.8.13 For 2030, the Base Case is the road network for Package 2 and the traffic noise effects for Options A2(4) and A2(5) have been assessed for this year. For these options a similar road network to that for the 2015 assessment, but more extensive, would be affected. To the south, the effects would extend to the M25 east of Junction 5. With a second Thames tunnel further to the east, linking into the A130 at Canvey Island, traffic noise impacts would extend through the Basildon area as far north as Chelmsford. The assessment results in increases in EPA of 18,600 people for Options A2(4) and A2(5).

Surface Access Noise: Railways

11.8.14 Table 11.23 gives the results (total EPA) from the GOMMMS strategy level assessment for railway noise.

Table 11.23 – Cliffe Marshes Surface Access Noise Assessment: Railways

Year	Total change in Estimated Population Annoyed (EPA) by road traffic noise (000's)			
	Option A2(2)	**Option A2(3)**	**Option A2(4)**	**Option A2(5)**
2015/2030	**+3.4**	**+3.4**	**+3.4**	**+3.4**

11.8.15 The railway noise impacts for the Options at Cliffe Marshes are compared against the Base Case, which is the Do Minimum railway network. The impacts assessed apply to 2015 for Options A2(2) and A2(3) and for 2030 for Options A2(4) and A2(5). The new rail services and associated noise impacts for Options A2(2) and A2(3) would affect the railway line from the airport to Strood, Maidstone and Ashford, a new high speed link from Hoo to Singlewell, the CTRL through Ebbsfleet to Barking, from Southfleet through Bromley South to Waterloo and through East Tilbury, Grays and Wennington. There would also be impacts between Southend and Shoeburyness and between Faversham and Dover. The change in Estimated Population Annoyed (EPA) by railway noise for both Option A(2) and A2(3) is an increase of 3,400 people. The noise effects for Options A2(4) and A2(5) are largely similar to those for the two and three runway options, also giving an increase in EPA of 3,400.

11.9 Environment: Local Air Quality Impacts

Introduction

11.9.1 Air quality results are provided for representative options at each airport, for 2015 and 2030 as appropriate. The air quality statistics used as assessment criteria for defining poor air quality in SERAS Stage Two are: annual mean Nitrogen Dioxide concentrations of 40µg/m^3; and the 90th percentile of running 24-hour mean PM_{10} concentrations of 50µg/m^3. In practice, annual mean PM_{10} compared to a statistic of 40µg/m^3 are also reported, as the 90th percentile value are a simple factor of these. The Air Quality Key Indicator for SERAS Stage 2 is 'the number of people exposed to an exceedance of the air quality standard, weighted by the degree of exceedance'. The higher the key indicator, the worse the air quality impact is.

Results 2015

11.9.2 Figure 11.28 illustrates the annual mean Nitrogen Dioxide air pollution contours for Cliffe in 2015. The outer box is the study area for air quality. The figure includes the numbers of people exposed under each contour. Table 11.24 shows, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator. Table 11.25 provides similar results for PM_{10}.

11.9.3 For the two-runway option at Cliffe in 2015, no people are exposed to exceedances of the air quality statistic for annual mean Nitrogen Dioxide. Locations do exceed the air quality statistics, but the figures clearly show the highest annual mean Nitrogen Dioxide contours fall directly on the runways, and over the terminal. With the airport in place, it is some distance to the nearest populated areas. Expressed as a simple average, airport related Oxides of Nitrogen in 2015 account for 56% of total Oxides of Nitrogen in the Cliffe study area. Airport related includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures show that road access to Cliffe is not creating areas of exceedance.

11.9.4 The two-runway option has a variant, with a NE/SW cross-wind runway west of the main runways. This takes nightime easterly freight arrivals only, amounting to a small percentage of total ATMs. As the results for the main runways do not result in any population exposed to exceedances of pollutants, the variant would not be expected to change this. In addition, the location of the variant crosswind runway is advantageous for the prevailing wind direction (mainly away from areas of population).

11.9.5 Results clearly show that Cliffe in 2015 has little impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24 hour mean PM_{10}. Expressed as a simple average, airport related PM_{10} in 2015 accounts for just 2% of total PM_{10} in the Cliffe study area. Very few locations do exceed air quality statistics, solely over the ends of the runways. The variant of this option with crosswind runway would be expected to show similar results, with no population exposed to exceedance contours.

Table 11.24: Nitrogen Dioxide Key Indicators - Cliffe 2015

Package	Option	Population exposed to exceedance of annual mean NO_2 of 40 $\mu g/m^3$							Total popul'n exposed	Key Indicator
		40-50 $\mu g/m^3$	50-60 $\mu g/m^3$	60-70 $\mu g/m^3$	70-80 $\mu g/m^3$	80-90 $\mu g/m^3$	90-100 $\mu g/m^3$	>100 $\mu g/m^3$		
A2 (2)	Option A2 - 2 runways w/o crosswind	0	0	0	0	0	0	0	0	0

Table 11.25: PM_{10} Key Indicators - Cliffe 2015

Package	Option	Annual mean PM_{10} of 40 $\mu g/m^3$		90th Percentile of 24hour mean PM_{10} of 50 $\mu g/m^3$	
		Total population exposed	Key Indicator	Total population exposed	Key Indicator
A2 (2)	Option A2 - 2 runways without crosswind	0	0	0	0

2030 results

11.9.6 Figures 11.29 to 11.31 illustrate the air pollution contours for Cliffe in 2030, for annual mean Nitrogen Dioxide and the two PM_{10} measures respectively. The outer box is the study area for air quality. The figures also include tables of the numbers of people exposed under each contour. Table 11.26 summarises, for Nitrogen Dioxide, the population exposed to exceedances and determines the SERAS Key Indicator. Table 11.27 provides similar results for PM_{10}.

11.9.7 For the four-runway option at Cliffe in 2030, no people are exposed to exceedances of the air quality statistic for annual mean Nitrogen Dioxide. The majority of the operational airport space (rather than the airport boundary) exceeds the air quality statistics, with the highest contours fall directly on the runways, and to some extent over the terminal. Expressed as a simple average, airport related Oxides of Nitrogen in 2030 account for 77% of total Oxides of Nitrogen in the Cliffe study area. ‘Airport related’ includes aircraft emissions, airside emissions, and airport related surface access emissions. The figures show that road access to Cliffe is not creating areas of exceedance.

11.9.8 As in 2015, the four-runway option has a variant, with a NE/SW cross-wind runway west of the main runways, which takes nightime easterly freight arrivals only, amounting to a small percentage of total ATMs. As the results for the main runways in 2030 do not result in any population exposed to exceedances of pollutants, the variant would not be expected to change this.

11.9.9 Results clearly show that the four-runway option at Cliffe in 2030 has little impact on PM_{10}, with no population exposed to exceedances of either annual mean PM_{10} or 90th percentile of 24 hour mean PM_{10}. Expressed as a simple average, airport related PM_{10} in 2030 accounts for less than 6% of total PM_{10} in the Cliffe study area. Very few locations do exceed air quality statistics, solely over the ends of the runways. The variant of this option with crosswind runway would be expected to show similar results, with no population exposed to exceedance contours.

Table 11.26: Nitrogen Dioxide Key Indicators - Cliffe 2030

Package	Option	Population exposed to exceedance of annual mean NO_2 of 40 µg/m^3							Total popul'n exposed	Key Indicator
		40-50 µg/m^3	50-60 µg/m^3	60-70 µg/m^3	70-80 µg/m^3	80-90 µg/m^3	90-100 µg/m^3	>100 µg/m^3		
A2 (4)	Option A2 - 4 runways w/o crosswind	0	0	0	0	0	0	0	0	0

Table 11.27: PM_{10} Key Indicators - Cliffe 2030

Package	Option	Annual mean PM_{10} of 40 µg/m^3		90th Percentile of 24hour mean PM_{10} of 50 µg/m^3	
		Total population exposed	Key Indicator	Total population exposed	Key Indicator
A2(4)	Option A2 - 4 runways without crosswind	0	0	0	0

11.10 Employment

Employment Forecasts

11.10.1 It is assumed that Cliffe will perform similar functions to Heathrow in terms of the mix of traffic it would accommodate. Employment forecasts for Cliffe are based on those of Heathrow, but Cliffe is assumed to have a lower employee:passenger ratio than Heathrow as a new airport should be able to adopt labour-saving technology. All other growth factors are similar to those applied at other airports. Employment forecasts at Cliffe in 2015 and 2030 are presented in Table 11.28.

11.10.2 Total direct on/off site employment at Cliffe is estimated at 41,000 employees in 2015 for Option A2 (2)/(3) increasing to 61,000 employees by 2030 with Options A2 (4)/(5). 12,000 indirect jobs are created in 2015 with an additional 6,000 indirect jobs by 2030.

Table 11.28: Forecast employment at Cliffe by option – 2015 & 2030

Forecast Employment by Option	Option A2(2)/(3) 2015	Option A2(4)/(5) 2030
Direct on-site	35,000	52,300
Direct off-site	5,800	9,000
Indirect	12,200	18,300
Total Employment	53,000	79,600
Passengers (mppa)	58	110
Direct employees/mppa	696	557
Total employee/mppa	905	724

11.11 Land Use/Urbanisation

Summary

11.11.1 A new airport at Cliffe Marshes would generate new economic development within that part of south east England most in need of regeneration, namely the Thames Gateway. The Cliffe Marshes site is located within the Thames Gateway sub-regional planning region, which represents the main 'opportunity for growth' in the South East, with capacity for both significant levels of housing and employment development up to 2030. The Thames Gateway sub-region extends east and west beyond the catchment area. Its northern boundary extends along the A13 corridor north of the estuary, with the southern boundary along the M2.

11.11.2 Historically, there has been under-achievement in the amount and types of new development secured and employment opportunities offered in the Thames Gateway. Thames Gateway authorities commonly experience a faster growth in available labour force than actual jobs, resulting in high unemployment rates and high out-commuting rates. This is particularly the case in Essex, with Basildon and Southend-on-Sea authorities experiencing congestion and shortages of sites for economic development. In North Kent in particular, the priority is to recycle derelict and brownfield land, which provides opportunities for new employment and housing sites.

11.11.3 The core catchment area for a new airport at Cliffe is taken to include boroughs on both sides of the Thames estuary: Medway Towns, Gravesham and Dartford in Kent and Thurrock, Castle Point, Southend-on-Sea, Basildon and Rochford in Essex. The housing provided for in RPG in these districts amounts to 162,000 households in addition to the existing 776,000. By 2030, RPG provision exceeds TEMPRO requirements, reflecting RPG policy to achieve a redistribution of growth from the west to the east of the South East region. This housing growth, together with higher rates of unemployment and out-commuting in relevant catchment areas, suggests that the airport's employment needs should be met with only limited additional housing development. The location of any additional development will be strongly influenced by new infrastructure routes.

11.11.4 The possible exception to accommodating labour requirements from current and planned housing might arise from the rapid build up of employee requirements during the period to 2015 if the airport achieves a high level of patronage from its outset.

11.11.5 Large brownfield sites in Medway Towns District alone would be able to meet the airport's needs for off-site employment land. Further sites are available in other local districts.

Employment Land Requirements

11.11.6 The off-airport employment is forecast to require 103 hectares of off-site employment land in 2015 and 158 hectares in 2030 within reasonable proximity to the airport.

11.11.7 In terms of the share of forecast catchment area workforce, it is projected that the 2015 options would generate a 7% share of the core and wider catchment area workforce, rising to around 10% by 2030 with further runway development.

Medway Towns District Council

11.11.8 Medway Towns District comprises several key towns, including Rochester, Chatham, Gillingham, Rainham and Strood - a population of over 250,000, and over 4,000 companies. It is the largest labour market in Kent, and one of the biggest communities in the South East outside Greater London. The towns are linked together in a conurbation extending along the northern edge of the A2/M2. The remainder of the district, south of the M2 and the Hoo Peninsula is predominantly rural, and development plan policies seek to concentrate development away from these areas, with the exception of identified strategic brownfield sites.

11.11.9 The Kent Structure Plan (Adopted 1996) provides for 130,000 m^2 of A2/B1 space (26 ha) between 2001 and 2011, and 170,000 sq m of B2/B8 space (34 ha) for the same period. The

County and District Council are providing for significant growth in demand for employment land up to 2011. Half of the employment land supply in the district is accounted for by four large sites outside the urban area (Medway Towns Local Plan, Deposit, 1999), these are not expected to come forward in the current plan period and therefore provide potential opportunities to accommodate both airport generated employment and to a lesser extent housing requirements. Key sites are described below:

- The former BP Oil Refinery site at Grain (630ha site). This includes the fastest growing container port in the southeast at Thamesport. This site is the largest economic development in the Thames Gateway and is of regional importance. It is currently unoccupied and its proximity adjacent to the proposed airport site on the Hoo Peninsula suggests it would be appropriate for indirect employment uses generated by the airport.

- The Kingsnorth Power station site, comprising 219ha, is a large area of bad neighbour industrial uses, earmarked for redevelopment in the longer term, once development at Crossways at Dartford and Chatham Maritime are complete. Medway Towns identify Kingsnorth as an ideal site for relocation from the existing urban area, but recognise the potential of the site as a focus for inward investment.

- The Rochester Airfield site (56.5ha) is appropriate for high technology related employment due to the adjacency of the Marconi Avionics R & D facility. It is anticipated that this site will come forward beyond the local plan period (2006) and therefore it too could provide a location for employment generated by a new airport.

- Strood Waterfront, bounded to the west by A228 and lying between Rochester Bridge and the M2 Bridge. This is a predominantly industrial area of low quality. A 73ha site is designated as an Action Area for redevelopment and improvement up to 2011; potentially therefore part of the site could provide space for employment uses generated by airport provision at the Cliffe Marshes site.

11.11.10 Together these sites alone provide scope to accommodate a significant proportion of the indirect employment land take generated by a new airport at Cliffe Marshes, even at low densities.

Housing Capacity

11.11.11 Meeting the employment needs of an airport at Cliffe Marshes is expected to require, at worst, only a small increase over currently proposed additional dwellings in the period to 2030. It is estimated that the 2015 options can be accommodated within existing RPG provisions. This estimate is influenced by the high policy component of both RPG provision and TEMPRO, which makes a high level of dwelling provision relative to projected household growth and employment forecasts. In other words a comparison of RPG and TEMPRO forecasts suggests that the regeneration of Thames Gateway will be housing led.

11.11.12 It may, of course, be the case that the TEMPRO forecasts are unduly pessimistic with respect to employment growth because they are trend based and additional employment opportunities may arise as a consequence of economic development initiatives that may emerge in the future. While the figures from the land use and urbanisation model suggest that up to 2015 no additional housing will be required, it is conceivable that this development phase could place more pressure on housing requirements due to the employee requirements during the period to 2015. This is because of the very rapid build up of the airport that is assumed in the option. A summary assessment of the scope for future additional provision is provided below. This has taken into account the possible requirement for additional dwellings in excess of our estimates.

11.11.13 All eight boroughs in the core catchment (Basildon, Castle Point, Dartford, Gravesham, Medway, Rochford, Southend and Thurrock) identify in their development plans the desire to accommodate future housing needs within the existing urban areas, and recognised increasing dependency on windfall sites to meet allocations. Indeed, for many, the scale of allocations was decreasing in the longer term due to the shortage of housing sites.

11.11.14 The main opportunities for large scale housing development as currently identified are found within the southern boroughs, on the brownfield sites suggested for mixed use development, and at the new settlement site on the Chattenden Engineering site on the Hoo Peninsula. It is unlikely that this would proceed if a major new airport were developed at Cliffe. There are other potential brownfield sites north of the Thames.

11.11.15 A possible alternative to offset the impact of both options on housing would involve taking into account the resident labour force, and the very high incidence of out-commuting. More of the new airport employment, both direct and indirect, could be staffed by existing residents of the study area, i.e. those currently commuting long distances to work out of the study area.

11.11.16 These potential local workers could be attracted to the new airport using a variety of incentives, including training and various subsidies. If additional out-commuting residents are attracted to the new site, there could be significantly less demand for housing as a result of new airport development, and therefore less pressure to fundamentally alter the existing settlement hierarchy in the study region.

11.12 Integration Impacts

Regional/sub-regional policy

11.12.1 The proposed airport at Cliffe Marshes impacts upon the sub-regions of the Thames Gateway and East Kent/Ashford. The impacts of an expanded airport are discussed below under the headings of employment/labour force, housing and transport infrastructure.

Employment / Labour Force

11.12.2 The major problem in the Thames Gateway, and to a lesser extent in East Kent, is a lack of skills to access employment in the new service-based economy. With the development of a new airport at Cliffe Marshes, the employment generated would be huge, and would cover the full skills range. The Thames Gateway itself covers a very wide area with several different and distinct sub-areas from Docklands in the west, with the focus on financial and business services, through Barking Reach with the dominance of manufacturing, to Thurrock with its logistics functions. As such, the skills necessary across the sub-region are wide-ranging and this often causes shortages in certain areas. A new airport would amplify this situation exponentially, particularly in a high growth scenario.

11.12.3 A further inevitable effect of airport development near the Thames Gateway and East Kent would be to go some way towards diversifying the employment base. As stated, the sub-region has many different areas which will be able to develop their own business profiles, such as Ashford developing as an intermediate hub which could benefit from through trade on the CTRL. The airport would help to consolidate these. Also, it would assist people entering the job market, especially if their skills profile matched the shortages in the area. The sheer number of jobs created would clearly allow new entrants to the job market to successfully find employment. For many there would be the need for training and skills development. Despite the current lack of skills in the sub-region, the scope is there for change with the large numbers of higher and further education institutions in the area, particularly in the Thames Gateway. As more businesses and people are attracted to the area, these institutions will gain in importance as feeders of skills and knowledge to the business base.

11.12.4 Many of the major employment areas identified in RPG for the Thames Gateway are close to residential areas and on brownfield land. The pattern of employment development created by a new airport is likely to follow a similar pattern, particularly given the infrastructural strength of the Thames Gateway and East Kent corridors. Furthermore, it would have the effect of consolidating business development, and would give the sub-region greater chance of attracting high profile inward investment and developing business clusters. On the latter point, there are a range of key clusters already present in the sub-region, in particular the financial and business services in Docklands and logistics in Thurrock, that will inevitably be strengthened further by the development of a new airport. As stated, Ashford could act as a major growth pole in East

Kent. A new airport would automatically increase market confidence in the area, one of its major existing weaknesses.

11.12.5 Inevitably however, in a high growth scenario there would generally be more of a squeeze created on land, and sustainable locations would be more difficult to find. Despite the availability of considerable areas of brownfield land which are capable of supporting a range of business accommodation, such a large increase in businesses and employment created in a high growth scenario would put an extremely high degree of pressure not only on the sub-region, but on the wider region itself. This is particularly the case in the Thames Gateway.

Housing

11.12.6 RPG 9a allocates a housing provision level in the Thames Gateway up to 2006 in excess of the capacity for housing that has been identified. As a result, it is likely that the Thames Gateway will have difficulty housing the additional numbers of people that are forecast for the sub-region. The development of an airport will significantly worsen this situation by bringing large numbers of new workers into the sub-region, particularly given the skills deficit in evidence. In East Kent however, further development of housing is a stated objective, and the levels of land available for this purpose should assist greatly in reaching the targets.

11.12.7 The housing that will be developed, will mostly be achievable on brownfield land, thus assisting to achieve the targets. Targets will also be reached for affordable housing, particularly as a result of the influx of lower skill workers that will move into the area to take advantage of the job opportunities stemming from airport development.

11.12.8 With this profile of housing development being created, it is likely that sustainable objectives with regard to housing being located near to employment areas will be enhanced, certainly under a low growth scenario. However, it is recognised that without sufficient provision of housing in the sub-region, economic competitiveness may be impaired. In addition to the housing need created by a new airport, sustainable principles may be compromised as the employment need is filled by workers from further afield. The chances of this increase considerably under a high growth scenario.

Transportation / Infrastructure Improvements

11.12.9 Both the Thames Gateway and East Kent are located in a highly important strategic area with regard to major hubs. This particularly applies to port access, with several major ports including Tilbury, Thamesmead, Folkestone and Dover providing key access points to continental Europe and beyond. An airport will have the effect of consolidating and improving linkages to these ports by a variety of modes, particularly rail.

11.12.10 Strengthening of the Thames Gateway transport corridors that will stem from airport development, will also have the effect of reducing the flows away from the corridor. The multi-modal linkages between the Thames Gateway and East Kent and their major air and sea hubs, and Central London will reduce the need for business or commuting journeys to be made away from the area. As such, there will be a reduction in the need to travel and also a reduction in long distance commuting. This latter point will be consolidated if adequate housing is provided and skill mismatches are resolved, a situation that, as explained earlier, could be difficult under a high growth scenario.

11.12.11 Clearly central to the transport strategy is the package of river crossings. A crossing in the Gallions Reach area is important in achieving the proposed level of development at the Royals. Similarly, a Woolwich Rail Crossing would link the Royals with a wider labour market. In addition, the airport would necessitate a freight crossing in the vicinity which would dramatically improve freight journey times across the rest of the country and also into Europe. This would add a new function to an already strong logistics sector. Without the development of an airport, it is extremely unlikely that this type of development could be justified.

Social Impacts

Low Growth Scenario

11.12.12 Under a low-growth scenario (up to 2015), some 53,000 jobs could be generated in total. Of these, up to 18,000 are likely to be low skill in nature, with 12,000 possibly located on-site and 6,000 off-site.

11.12.13 In 1998, there was a shortage of jobs in the four deprived districts totalling well over 13,000. This is forecast to increase further by almost 400 jobs by 2016. Then, from 2016-2031, this could contract by as much as 6,500 workers, leaving a worker surplus of less than 7,000 people. As such, it appears that it may be possible for these districts to accommodate up to half of the jobs that could be generated at Cliffe Marshes.

11.12.14 The biggest recipient (possibly of up to 3,000 jobs would be Medway Towns due to their proximity to the airport site and location on the ‘right side’ of the river. In addition, Medway Towns in 1998 had over 8,000 commuters to other areas which could potentially be clawed back with such high numbers of available jobs. The other deprived districts would rely greatly on transport improvements.

11.12.15 What would be required is a combination of strong regeneration policy and considerable transport improvements. The regeneration policy is already largely in place through the identification of the Thames Gateway and the focus of renewal in the South East on this area. Of particular importance for these levels to be achieved would be cross-river links between North Kent and South Essex. This would link up the airport to Basildon, Thurrock and Southend-on-Sea. Without this, these districts would realistically provide minimal labour for the airport, both in terms of on-site jobs and off-site jobs that would cluster on the main transport routes south of the river. Clearly, with Medway Towns the primary recipient of the majority of jobs, there is also a need for improved road and rail links for local workers – not just fast links provided by CTRL, but improved bus and local train services.

High Growth Scenario

11.12.16 Under a high growth scenario (also up to 2030), around 80,000 jobs could be generated. Of these, towards 26,000 could be low skill in nature, with potentially up to 16,500 being located on-site and 9,500 off-site.

11.12.17 As stated above, by 2031 there would be a maximum worker surplus of just under 7,000 people. Clearly not all of these jobs could be accommodated by the four deprived districts, but the labour market surplus in each district could certainly be eliminated. Again, the nature of transport improvements would be essential to whether this is achieved.

11.13 Attracting Airlines to a New Site

11.13.1 It is to be expected that, capacity and environmental considerations permitting, airlines will continue to provide and expand current types of services at existing airports as demand grows. The large-scale development of a full range of services at a major new site could not, however, be taken for granted, even if further expansion of Heathrow and Gatwick were constrained. DTLR therefore commissioned Booz Allen & Hamilton to undertake an examination of what would be necessary to attract airlines to a new site, having regard to a number of factors (*New South East of England Airport – Airline Development Strategy Study*, October 2001).

11.13.2 Two new multi-runway sites were taken as the basis for that examination: Cliffe Marshes and a major redevelopment of Stansted. The factors taken into account in assessing the conditions under which airlines would be attracted to such sites included:

- The impact of airline strategy and economics, individually and through alliances, on the appeal of a new facility within the London airport system, taking a range of system capacity scenarios into consideration.
- The market position a new facility might be able to achieve within the UK and European airport networks.
- The impact of a new facility on the other London airports in terms of such parameters as market share (passengers and freight) and changes in market segmentation (eg, business, leisure and low cost passengers, general and express freight).
- The need for and effects of policy, regulatory or fiscal instruments to promote best use of all the capacity available in different scenarios.

Hub Airports

11.13.3 The study assessed what might be required to support a second hub airport, alongside Heathrow, in the South East airports system. Hub airports were shown to provide benefits to airlines, passengers and the economy. Advantages of hub and spoke operations to airlines include allowing airlines or, significantly in recent times, alliances to construct their route networks in the most yield-efficient way, using connecting passengers to increase load factors and effectively subsidise routes that would otherwise be uneconomic to operate. Hubbing also allows higher utilisation of the aircraft fleet.

11.13.4 Advantages to passengers and the economy include an increase in the number of destinations served directly from the hub airport (or, with one transfer, from the spoke airports) and higher service frequencies than would otherwise be provided. Lower fares may result from the efficiency gains to airlines. Additional traffic flow through a hub airport will also contribute to local economic activity.

11.13.5 Requirements to support the functioning of an airport as a hub include:

- A suitable geographic location,
- A sufficiently large catchment to generate necessary levels of traffic,
- Infrastructure to support the level of demand and to provide operational flexibility, and
- The presence of one or two major airlines or alliances providing services through a co-ordinated and coherent network, to maximise connectivity.

11.13.6 Other relevant features of the operation and evolution of hub airports are that they are scale-dependent, requiring a ‘critical mass’ of services, which may be built up over a period of time, and that they represent long-term, strategic investments, that are not easy to move and uneconomic to divide between sites.

London Airport System

11.13.7 The study’s analysis of the London airport system, focusing on Heathrow as the only London airport with significant hubbing activity, drew the following conclusions.

11.13.8 There is evidence of operations at Heathrow being severely constrained, with fewer destinations served, lower service frequencies and lower hub connectivity than would be expected from an airport with Heathrow’s throughput.

11.13.9 Despite the constraints at Heathrow, airlines appear reluctant to establish additional point-to-point services at other airports within the London system that do presently have unused capacity, for example Stansted.

11.13.10 Heathrow has a high level of direct long haul services, but lower levels of short haul and domestic services than, for example, Paris Charles de Gaulle. This is despite the greater availability of direct high speed rail services to major European hubs.

11.13.11 There is a considerable threat to Heathrow's position as the predominant hub in established markets, principally from Schiphol and Paris CDG, with some evidence that passengers from regional UK airports are already hubbing through Schiphol, rather than Heathrow. There is a further risk that secondary hubs, such as Copenhagen and Munich, will compete in emerging markets, for example to Central and Eastern Europe. Heathrow has limited capability to react to this competition and will have even less as constraints there limit its ability to react to increases in demand.

11.13.12 One possible response would be to expand Heathrow to provide sufficient capacity to meet unconstrained demand, but more than one additional runway would be required. An alternative would be to provide a large increment of new capacity at a single site, such as Cliffe Marshes or Stansted, to enable London to maintain its predominant position in European and world air transport.

Criteria for Two Hub Airports

11.13.13 Criteria to be fulfilled for two major hub facilities to be simultaneously viable and successful include the following.

11.13.14 Airline economics. Given the inefficiencies (if not the impracticality) of operating split hubs, it is likely that each hub will have to be 'home' to a dominant alliance to generate a critical mass of services. In London, the presence of both the oneworld and Star alliances makes this a possibility, as long as one alliance could be persuaded to consolidate its operations at the new site and the other to consolidate at Heathrow.

11.13.15 Sufficient demand. The London and South East market generates a very high level of point-to-point traffic and is ideally located to act as a hub for the largest international air transport market, that between Western Europe and North America.

11.13.16 Surface access. Surface access from the major demand centres must be at least equivalent to and preferably better than that to Heathrow, in order to persuade travellers to use the facility, and to give airlines confidence that a move will not result in their being disadvantaged in terms of access to key markets.

Need for Policy, Regulatory and Fiscal Incentives

11.13.17 Airlines and passengers who did elect to move to a new hub might expect to receive some or all of the following benefits:

- Decreased delays,
- Consolidated airline/alliance operations and associated efficiency savings,
- Relaxed night-time operations constraints, enabling full 24 hour scheduling,
- Airport development with the airport-airline interface as a priority, maximising operational efficiency, reducing costs and minimising conflicts.

11.13.18 The first two of these benefits could also be expected to accrue to airlines/alliances that chose to stay at Heathrow rather than move to a new site, but most of the risks and costs would be borne by those that move to the new site. It would be necessary, therefore, to create an environment where incentives are provided to those who move, to balance these costs and risks.

11.13.19 Even if a mechanism could be devised that ensured that costs and risks were distributed among those using the London airports system consistently with the benefits received, there would still be impediments to an airline or alliance moving to a new site:

- Reluctance to be the first to move, in part driven by a tendency for each player to follow the actions of others thereby minimising any differentiation,
- The fragile and unstable nature of alliances, with airlines rather than alliances being the legal, decision-making entities,
- The high cost associated with failure of any move, and
- The risk of giving advantage to competitors by relinquishing valuable slots at Heathrow.

11.13.20 Mechanisms for balancing costs and risks with the benefits obtained in different locations could include regulatory instruments or slot trading mechanisms.

11.13.21 Regulatory instruments that might be needed as part of a balanced package of constraints and incentives to encourage the development of a pair of alliance hubs are as follows. The key question is whether these could be accepted as components of a package designed to serve the interests of consumers:

- Noise and emission controls at Heathrow,

- A commitment not to provide enhanced capacity at Heathrow or the other London airports so as not to undermine the viability of the new facility,
- A commitment to provide the necessary supporting infrastructure at the new facility in a timely manner, particularly surface access, as a 'confidence builder', and
- A mechanism for facilitating investment in the new facility, which would be expensive to build and is only likely to achieve an attractive rate of return if airport charges are set above current charges.

11.13.22 A slot-trading mechanism could offer relevant benefits to the process of establishing a second hub, by:

- Facilitating a fair distribution of costs and risks across the London airports system. The costs and risks of staying at Heathrow are low so the price of slots will be high: the reverse would be expected to be true of a new facility.
- Leaving a moving airline the (costly) option of returning to Heathrow or any other airport.
- Providing a mechanism through which funds could be raised and hypothecated to the new facility.
- Multi-annual or continuous trading could allow new entrants access to the airports, thereby satisfying competition requirements. Trading in futures or options and secondary trading might allow airlines the additional flexibility they would need to create workable timetables.

11.13.23 Impediments to a slot-trading scheme would need to be overcome:

- Legislation: Changes to existing legislation would be needed to enable any slot-trading mechanism at all.
- Title: The European Commission has proposed that slots be designated as public goods, not entailing any property rights to airports or airlines.
- Definition: Just what entitlement a slot confers on its user, in terms, for example, of its duration and the grouping of slots into series to facilitate practical operations would need to be agreed.
- The control of the overall slot allocation system and control of the trading process will be an important issue.

12 Appraisal of Options at Main Sites: Alconbury

12.1 Option Appraised in Stage Two

12.1.1 As detailed in Chapter 4, three options were appraised in Stage One of SERAS. For Stage Two, Options 1 and 2 were rejected in favour of Option 3, which envisages a specialised low cost passenger airport with substantial air freight capabilities, an express parcel hub and a major 3rd-party aircraft maintenance operation. Figure 12.2 shows the Option 3 layout.

12.1.2 Alconbury's geographical location (Figure 12.1) and good surface access connections afford it the potential to become a low-cost passenger airport with an annual throughput of 5 and, possibly, up to 10mppa. However, with the other facilities envisaged in this option, land and airside frontage limitations are likely to restrict throughput to a level in the order of 5mppa. Facility planning assumes a typical passenger aircraft of B737-700 size, with a seating capacity of approximately 125, operating at an average load factor of 85%, giving an average aircraft load of 107. Annual movements of about 47,000 PATM would be required for this throughput. For such a single market sector operation a relatively peaked traffic profile is assumed, allowing also for movements generated by freight and maintenance activity. This indicates a sustainable hourly movement rate of less than 20 (excluding GA and Business Aviation movements) which is well within the capacity of the existing runway.

12.1.3 Passenger facilities, a Business Aviation area and some ancillary sites are located to the south of the runway with a 700m apron frontage providing space for 20 stands, based on a utilisation rate of 3 to 4 turnarounds per day. To the north of the runway are the freight facilities, express parcel hub and the aircraft maintenance facility.

12.1.4 With a capacity of about 1 million tonnes annually, the freight facility consists of two main elements; a main terminal fronting on to the aircraft parking apron and a Freight Forwarders' complex on its landward side. The main building accommodates the storage, make-up, breakdown and handling of loads to and from the aircraft. The Forwarders' facility houses the receipt, consolidation and dispatch of consignments, plus office space. Truck docks and parking areas are provided to serve both facilities. Analysis of payload and range data indicates that most freighter aircraft types could operate from Alconbury's 2,743m long runway, at or close to maximum payload/range. A sorting and distribution centre for conventional mail is also provided, adjacent to the freight terminal, together with adequate truck parking.

12.1.5 The size of the parcels hub is assumed to be similar to that at East Midlands Airport, which can handle up to 1,100 tonnes of express parcels per night or approximately 350,000 tonnes per year. A large area for truck docking and parking is provided, as a large proportion of parcels tonnage will be collected and distributed by road. 18 aircraft parking stands of various size are provided with a stand frontage of approximately 1,100m.

12.1.6 An aircraft maintenance facility is sited to the rear of the freight forwarders' complex and is equivalent in size to the Marshall Aerospace facility at Cambridge Airport. It is capable of handling up to six B747-type aircraft or a variety of smaller types, on a frontage of 600m. Access is via a single taxiway running between the parcels and freight complexes.

12.1.7 The appraisal presented in this section draws to a large extent on that completed during Stage One. No further detailed appraisal work was carried out in the areas of surface access, land take, water resources, local air quality impacts, employment, land use and urbanisation or integration. The level of detail in these areas was considered sufficient to draw significant conclusions for Stage Two purposes. Capital costs have been re-worked to be consistent with the approach adopted at the other SERAS sites, actual passenger forecasts arising from SPASM are presented and detailed noise modelling, similar to that done for other sites, has also been undertaken.

12.2 Capital Costs

12.2.1 Table 12.1 gives the estimated capital costs for the option taken forward in Stage Two.

Table 12.1 Estimated Capital Costs for Option 3 at Alconbury (£ million)

Item	Option 3
Capacity	5 mppa (+ 1 M Tonnes freight)
Terminals & Satellites	
Passenger Terminal	61
GA & Business Terminal	5
Satellite Buildings	0
Baggage Handling/conveyors	0
Total	**66**
Aircraft Pavements	
Runways (resurfacing)	11
Taxiways (resurfacing & new)	7
Passenger Aprons / Stands	15
Total	**32**
Enabling Works & Infrastructure	
Demolition, Earthworks, etc	22

Item	Option 3
Car Parking	5
Utility Services	30
Airside Roads and public road diversions	11
Tracked Transit	0
Drainage	14
Landscaping	1
Total	**83**
Navigation Aids (ATC/ILS/etc)	**26**
Cargo & Maintenance	
Cargo buildings & aprons	68
Express parcel hub building & aprons	54
Hangar/ Maintenance buildings & aprons	87
Total	**209**
Support Facilities, etc	
Support facilities	4
Offices	4
Other facilities / services (inc. fuel, security, pedestrian link, archaeology)	26
Total	**34**
On-costs	112
Contingencies	140
Land Costs	2
Sub-total: Airport Development Costs	**705**
Airport Development Costs per mppa provided	141
Costs of Associated Surface Access (Freight line + Passenger Station)	**29**
Total Capital Costs	**734**
Total capital costs per mppa provided	147

12.2.2 The rates applied have been deflated by 15% relative to other (non-Heathrow) airport sites, in order to reflect the lower cost of capital works in the region.

12.3 Demand Forecasts

Passengers

12.3.1 Forecast passenger movements, ATMs and passengers per passenger ATM are summarised at 5 year intervals between 2000 and 2030 in Table 12.2

12.3.2 In the forecasting, Alconbury is assumed to open in 2011, with a small number of Low-Cost routes assumed to be in place from the beginning.

12.3.3 Alconbury is assumed to have a runway capacity of 200,000 ATMs and a terminal capacity of 5 mppa. This terminal capacity is reached within 2 years of opening, through the development of short haul routes. Although seeded with Low-Cost routes, these account for less than 5% of opening year passenger numbers. This proportion declines further with time. The average load per ATM rises over time, flattening out at around 76 passengers per ATM.

Table 12.2: Alconbury Option 3

		2000	2005	2010	2015	2020	2025	2030
Passengers, mppa								
Scheduled	Domestic	0	0	0	0	0	0	0
	Short haul	0	0	0	4.9	5.4	4.7	5.5
	USA	0	0	0	0	0	0	0
	Long haul	0	0	0	0	0	0	0
	Total	0	0	0	4.9	5.4	4.7	5.5
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0.02	0.01	0	0
Total		0	0	0	4.9	5.4	4.7	5.5
ATMs, ‘000								
Scheduled	Domestic	0	0	0	0	0	0	0
	Short haul	0	0	0	68	71	61	72
	USA	0	0	0	0	0	0	0
	Long haul	0	0	0	0	0	0	0
	Total	0	0	0	68	71	61	72

		2000	2005	2010	2015	2020	2025	2030
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	0.2	0.2	0	0
Total		0	0	0	68	71	61	72
Passengers/PATM								
Scheduled		0	0	0	72	76	77	76
Charter		0	0	0	0	0	0	0
Low cost		0	0	0	79	85	0	0
Average		0	0	0	72	76	77	76

Note: 'Other' categories, not shown, are included in totals

Freight

12.3.4 Together with the envisaged specialised low-cost services Alconbury is intended as a significant freight airport. However, it is assumed that its limited catchment would constrain freight demand to a level lower than at other airports in the South East and Midlands, in some cases to a level of only 10% of demand elsewhere (i.e. at Stansted and Cliffe Marshes). Nevertheless the airport is well positioned to receive overspill traffic from the South East. By 2015 Alconbury is forecast to handle 0.2 million tonnes, nearly all of which would be freighter traffic. As constraints in the South East become tighter more freight traffic is likely to travel through Alconbury with eventual demand being possibly much higher. By 2020 it could reach 1.3 million tonnes.

Summary

12.3.5 These forecasts differ from the assumptions underlying Option 3 in the following respects:

- The 5 million passengers per year are carried on scheduled short haul services rather than the low cost services assumed in the optioneering
- average number of passengers per ATM is around 80, requiring 70,000 ATMs per year, not the 47,000 assumed in the optioneering
- the freight forecasts for Alconbury are heavily influenced by the capacity for freighter traffic at other South East airports, but could reach 1.3 million tonnes in a heavily constrained scenario, compared with the 1 million tonnes assumed in the optioneering.

12.3.6 If realised, these differences in traffic volume and type would require a different configuration of ultimate facilities from that developed as Option 3. In that layout, a business park occupied the available land south of the runway not required for the passenger terminal. The park area is substantial and would readily accommodate a larger terminal area without substantial impact on commercial viability. This could be combined with a reconfiguration of support facilities to free the additional airside frontage needed for increased (and probably more peaked) aircraft movements.

12.3.7 The creation of more freight handling capacity may be more problematic, as the freight aprons in Option 3 occupy all the airside frontage north of the runway. If the additional demand was to be concentrated at peak times, particularly in the express freight sector, more apron space would be necessary. Additional warehousing and handling space can be absorbed, again by reducing other commercial land content, but increasing apron frontage would require the acquisition of some further land. The most likely area for this would be between the airfield and the East Coast Main Line railway.

12.4 Safety Risk

12.4.1 The extent of the 1:10,000 and 1:100,000 designated risk areas are shown on Figure 12.3. The runway and origins of the 1:1,000,000 contours are also shown but extend beyond the limits of the drawing.

12.4.2 Stage Two calculation of PSZ contours, based on 2030 forecast demand, indicates that the safety risk within the 1:100,000 contours would be low. The 1:10,000 contours are largely within the developed airport boundary whilst the 1:100,000 contours extend over areas that are primarily rural. There would be some risk to surface access infrastructure; at the western end where the 1:100,000 contour extends across the A1(M), just north of its junction with A604, and to the east where the same contour crosses the East Coast Main Line. Current PSZ guidelines would indicate that this would not be a case for re-alignment of these routes, but that measures should be taken where practical to prevent vehicles routinely coming to a stand on the sections within the 1:100,000 contour. New infrastructure, such as the rail spur or access roads, should be aligned to avoid the 1:10,000 contour.

12.5 Surface Access

12.5.1 No further detailed assessment of surface access impacts were appraised beyond Stage One, where impacts were examined through a series of estimates that allowed for: the airport option capacity; the relationship between airport capacity (in mppa and tonnes) and airport employment; the distribution of cargo-related surface access traffic; alternative air passenger distributions; the proportion of passenger and freight surface access movements assumed to take place in peak hours

12.5.2 Consideration was also given to the potential use of rail for either passenger or freight surface access. The principal objective was to assess what surface access schemes might be required to provide adequate capacity and an appropriate level of service.

12.5.3 The A1(M), between Peterborough, some 20km to the north of the airfield, and its junction with the A14 adjacent to the airfield has recently been upgraded to dual 4-lane standard. The A1(M)/A14 junction needs to be revised with an elevated roundabout to allow movements in all directions at that junction, including movements to/from the A14 which would provide the principal access into the airport, and a road running to the north east which provides access to the facilities north of the runway. No further improvements to the strategic network beyond this junction are required.

12.5.4 Optioneering work assumes a spur from the East Coast Main Line (ECML) into the airfield cargo terminal, and a new passenger station on the ECML, 1 km east of the runway. It is unlikely, however, that the construction of the rail freight facilities could be justified without a shift from road access to rail access being dictated by government policy.

12.5.5 Future passenger services on ECML are uncertain. The planned re-franchising of GNER's express services between London and the North East of England and Scotland is on-hold, but the potential competing bidders have plans to further develop the line as a 140 mph railway, or replace it with a new high speed line which could remove most express passenger services from the existing line. West Anglia Great Northern's (WAGN) current 1 to 2 local services per hour between Peterborough and King's Cross were to become part of Thameslink 2000 services, increasing in frequency to 2 to 4 trains per hour and extended via Farringdon and London Bridge to Brighton and East Grinstead. These plans await the result of a Public Inquiry expected in 2002.

12.5.6 The potential rail demand generated by airport development would be sufficient to support 2 Thameslink services per hour, 1 Inter City service per hour and an hourly Rail-Air coach linking with Midland Main Line services at Wellingborough.

12.5.7 Rail freight access to Alconbury could be provided in one of two ways. Rail freight vehicles might be attached to the Inter City services calling at the airport, although this would leave them remote from the air freight facilities. Alternatively, air freight might be carried on cargo-sprinters (if this German idea is embraced in the UK in the future) direct to the air freight facility via the dedicated spurs.

12.6 Environmental: Land Take

12.6.1 The references below to classification of impact, i.e. LA for low adverse, etc, are in accordance with the system of classification developed and presented in Stage One.

12.6.2 No residential properties are lost, resulting in Neutral effects. A small area (<20 ha) of factories, workshops and offices within the current airport boundary are lost, of LA significance. There is no loss of public buildings or recreational areas, of Neutral significance. The loss of 61 ha of agricultural land represents a LA effect. There would be no loss of Green Belt or other similarly designated areas. Agricultural land is taken north east of the current airport perimeter, increasing agricultural land take to 85 ha but with a LA effect.

12.7 Environment: Water Resources

12.7.1 The impact on water resources is summarised as Medium, as a result of the potential impact on rivers. The lack of flying activity at the airfield currently gives a Low score in all of its impacts on water resources. Two watercourses – Alconbury Brook and Ripton Brook – receive surface runoff from the airfield; the airfield footprint does not coincide with the 1 in 100 year floodplain; and the study area consists of Oxford Clay, which has low permeability and helps protect the groundwater from contamination.

12.7.2 The risk of increased surface runoff contaminating Alconbury Brook and Ripton Brook raises the score for the potential impact on rivers from Low to Medium. The score for the potential impact on floodplain and aquifers remains Low.

12.8 Environment: Noise Impacts

Aircraft Noise: Daytime

12.8.1 The 2015 daytime $L_{Aeq,16h}$ noise contours for Option 3 are shown on Figure 12.4. Table 12.3 below gives the areas, estimated populations and numbers of houses under each contour. The minimal level of current flying activity and absence of existing contours prevents meaningful conclusions about relative noise impacts.

Table 12.3 Alconbury Daytime Aircraft Noise Contours – 2015

LAeq (dB)	Area (sq km)	Population (000's)	Houses (000's)
>54	24.1	2.5	0.8
>57	14.0	0.9	0.1
>60	7.8	0.6	0.1
>63	4.2	<0.1	<0.1
>66	2.2	<0.1	<0.1
>69	1.2	<0.1	<0.1
>72	0.7	<0.1	<0.1

12.8.2 The relatively low population and numbers of houses affected reflect the rural nature of the surrounding areas. It is reasonable to surmise, however, that with low levels of current activity and despite the surrounding areas being sparsely populated, the relative impact, due to a significant increase in activity, will be high. Optioneering allows for the installation of a noise screen to protect Little Stukeley and the former military housing areas to the south east of the site from ground manoeuvring noise. Maintenance activity to the north of this site is away from local settlements.

Aircraft Noise: Night-time

12.8.3 Tables 12.4 and 12.5 below show the population numbers and associated house counts within the departure and arrival 90 dB SEL footprints for easterly and westerly operations respectively. The footprints are shown in a supporting document and represent an 'average worst' Quota Count 2 aircraft, applied to each departure track and the approach path.

Table 12.4 Night Noise Population and House Counts – Easterly Operations

	Existing	
Runway	12	
	Population (000's)	Houses (000's)
Departures All tracks	0.3	<0.1
Arrivals	0.3	0.1

Table 12.5 Night Noise Population and House Counts – Westerly Operations

	Existing	
Runway	**30**	
	Population (000's)	**Houses (000's)**
Departures All tracks	0.6	0.1
Arrivals	10.6	4.3

12.8.4 Night time operations with the greatest impact are westerly arrivals, reflecting exposure of the western edge of the town of St Ives. This is some 8 km from the end of the runway and it is probable that flight paths that avoided overflying St Ives could be developed.

Surface Access Noise: Highways

12.8.5 The increased traffic volumes associated with Option 3 are likely to cause a change in noise level of at least 1 dB to a significant urban area. Some 4.4 km^2 of urban area are likely to be so affected.

Surface Access Noise: Railways

12.8.6 A spur into the airport from the East Coast Main Line would not result in any significant noise effects on the scattered population in the area. There would be no significant change in the number of train movements on the main line.

12.9 Environment: Local Air Quality Impacts

12.9.1 Background levels are expected to fall within National Air Quality Standards, with none of the grid squares over which measurements are made likely to have Nitrogen Dioxide levels in 2005 or PM_{10} levels in 2004 in excess of 30 micrograms per cubic metre.

12.9.2 A more informed view might be derived by comparing potential pollutant levels arising from the scale of activity envisaged at Alconbury with a regional airport elsewhere in the country where a similar scale of activity is predicted. East Midlands Airport (EMA) was one of 23 UK regional airports studied under RASCO, within which an air quality assessment was made using a two stage appraisal technique. If Alconbury can be likened to EMA then it is not unreasonable to postulate that air quality conclusions drawn about EMA may also be broadly applicable to Alconbury.

12.9.3 Both airports are sited close to major highway corridors, both are in predominantly rural areas and, although the scale of operation at EMA in 2015 is likely to be larger (7.5 mppa passenger capacity against 5 mppa and approximately 120,000 annual ATMs against 70,000 forecast at Alconbury), both are likely to have a broadly similar mix of passenger and freight operations.

12.9.4 Stage A of the RASCO air quality appraisal was a screening process identifying, without using full dispersal modelling, those airport scenarios that would not generate exceedances of air quality objectives. For NO_2, EMA failed at least one of the Stage A criteria and was tested further in Stage B using dispersion modelling. This found that the exceedance contour did not enclose any residential properties. The conclusion can therefore be drawn that, although Alconbury would need to be examined for the precise location of surrounding properties, it is unlikely that there will be an exceedance problem of any significance.

12.9.5 PM_{10} analysis at EMA concluded that there was no predicted off-airport exceedances of the current objective for the 90^{th} percentile of 24-hour mean PM_{10} concentrations. It is reasonable to assume that Alconbury would also meet this criterion.

12.10 Employment, Land Use and Urbanisation and Integration

12.10.1 The relatively coarse assumptions made at Stage One appraisal have been refined for Stage Two. For a mature mix of services, employee numbers per passenger have been confirmed at 1,000 per 1mppa, whilst for the low cost operations envisaged at Alconbury a number of 800 per mppa is assumed.

12.10.2 Employment rates associated with air freight have been amended since Stage One, from 1 employee per 100 tonnes of freight to 1 employee per 150 tonnes of freight.

12.10.3 On the basis of the above, the direct employment associated with Option 3 development at Alconbury (in 2015) is:

- Low-cost passenger employees – 5mppa x 800 per mppa = 4,000
- Air freight employees – 1 million tonnes / 150 tonnes = 6,700
- Maintenance activities and others - say 1,000
- Total = 11,700 (Say 12,000)

12.10.4 These figures show a reduction from the numbers calculated in Stage One, down from 14,000 employees. The difference, however, is not such as to invalidate the implications derived, which are restated below. Further, the SPASM forecasts for Alconbury suggest that demand might be on scheduled short haul services rather than low cost services and the volume of freight handled could, in some circumstances, eventually exceed 1 million tonnes per year. Both of these factors might push employment levels higher, towards the number assumed in Stage One.

12.10.5 A review of the potential employment impact of development shows that much of the potential direct and indirect employment could be met from local labour markets, in particular the District of Huntingdonshire and the City of Peterborough which lies about 15 km to the north. The assumed unemployment proxy (those claiming unemployment benefit plus latent unemployment) is almost 4%. This means that airport jobs could be filled from the existing labour supply and additional housing already planned for, without necessarily resulting in in-migration and additional housing.

12.10.6 The Cambridgeshire Structure Plan made provision for 18,600 new dwellings in the Peterborough sub-area between 1986 and 2001. This consists of 15,600 dwellings in Peterborough City and 3,000 in Huntingdonshire. Of the new dwellings in Peterborough, some 5,200 were proposed for the new southern township. The plan assumes that, given expected rates of development, only half of these would be complete by 2001.

12.10.7 In terms of employment land, the Peterborough Local Plan (Adopted January 1996) made provision for an additional 206 hectares which, when combined with unused allocations from previous plan periods, resulted in a total allocation of some 364 hectares for the period 1986-2001. This is a generous provision which reflects the designations made in the Greater Peterborough Master Plan, which was based on the needs of a New Town with a population significantly greater than that which has been achieved to date. The Local Plan also notes that while all of this provision could have been made in the period to 2001, in practice development of all sites is unlikely and the overall provision is designed to allow a choice of sites.

12.10.8 The 1995 Adopted Huntingdonshire Local Plan identifies sites for employment totalling 80 hectares, of which 18 hectares are in the immediate vicinity of the airfield. The Local Plan also identifies pressures for employment sites arising from ‘Cambridge-related’ high technology activities, and suggests there may be difficulties in accommodating these pressures.

12.10.9 Nevertheless, the identified employment land in the two relevant local plans is such that the off-site, airport-related employment could probably be accommodated within the core catchment area.

13. Small Sites Summary

13.1 Introduction

13.1.1 Chapter 4 explains the background to the inclusion of the small sites in Stage One of SERAS and gives a brief overview of the options addressed and the principal constraints at each site. For further detail, the two reports referenced in that Chapter should be consulted.

13.1.2 This Chapter presents the conclusions drawn in the Demand and Impact Appraisal report, and sets them in the context of the Stage Two findings. The small sites examined are; Biggin Hill, Cambridge, Farnborough, Lydd, Manston, Norwich, Shoreham, Southampton and Southend.

13.1.3 The options appraised at London City Airport in Stage One have also been summarised in Chapter 4. That Chapter indicated that the airport is one of the most constrained sites in respect of future development potential, and therefore for completeness of analysis it has been included here.

13.2 Development Potential

13.2.1 All of the sites studied have the potential for a degree of capacity development. Equally, all are constrained in one way or another; by physical limitations such as land availability and surrounding development, or by the potential impact of increased capacity and activity on their surroundings.

13.2.2 In physical terms, Lydd and Manston are probably the least constrained. Manston has a long runway and a sizeable land holding. There is sufficient undeveloped land around Lydd, if it could be acquired, for substantial development. At the other end of the spectrum, the sites at Shoreham and Southend are strongly constrained by surrounding development, roads, rail lines or environmentally sensitive areas.

13.2.3 The potential for capacity development at London City and Southampton Airports was assessed at the Stage One optioneering work, to a similar level of detail as applied to the major airports. In both cases a number of development options were examined, yielding various amounts of additional capacity, within existing or expanded site boundaries.

13.2.4 At Southampton, existing site boundaries are strongly defined by a main rail line, a motorway, a river and a country park. Runway length is constrained by the motorway and commercial and residential development. While the runway may not be a constraint on the domestic and short haul traffic likely to favour the airport, a limit would be set by the amount of land available for terminal, apron and supporting development. With the runway on its present alignment, the only practical axis of site expansion would be eastwards across the River Itchen and into the adjacent Itchen Valley Country Park. An option for runway realignment and extension, with greatly expanded terminal and apron capacity was also considered. None of the options for major expansion beyond the existing site boundaries was considered viable, mainly due to their potential impact on environmentally sensitive areas and features.

13.2.5 Similarly detailed study was applied to London City Airport. Options were examined for runway extension on the existing alignment and revised alignments designed to avoid limits imposed by aeronautical obstacles in the area. Various locations and layouts for expanded terminal, apron and access facilities were also examined. A significant increase in runway length is severely constrained by tall buildings and other structures on approach and departure paths. These cannot be entirely avoided, even with major changes of runway orientation or location. Land for facility expansion is limited by surrounding residential and commercial development, and by the extent of the tidal dock basin in which the airport is located. It was concluded that a degree of expansion is feasible, given some additional land and further extension over the dock, to enable passenger and aircraft handling capacity to better match the potential capacity of the existing runway.

13.2.6 In practice, as the following discussion of demand indicates, the viability of development at all the small sites, and at London City and Southampton, is likely to be determined, in the first instance, more by their ability to attract traffic than by their physical potential for expansion.

13.3 Likely Demand

13.3.1 Different approaches to forecasting the demand for commercial air services at these sites have been followed. Consultants were appointed to give an initial estimate of the maximum potential market demand for services at these airports (excluding London City) and the potential interest of airlines in providing different services at these airports respectively. This advice had to recognise the principal constraints surrounding increased activity and development at these sites and deal with the difficulties imposed by:

- the long, 30-year SERAS planning period;
- alternative scenarios of constraint at the major South East airports, ranging from highly constrained (no new capacity of any sort) to making maximum use of existing runways in the South East and to relatively unconstrained scenarios with additional runways, with the small airports making a greater contribution to meeting demand the greater the constraint at the main airports;

- estimating the ability of the smaller airports to generate their own services serving local catchments, and the destinations, aircraft types and frequencies of these services; and
- estimating the ability of these airports to compete for overspill traffic from the main south east airports with larger, more distant, regional airports (eg, Bristol, Birmingham, East Midlands) which would have a wider range of higher frequency services.

13.3.2 The broad findings from this initial assessment are summarised in Table 13.1 for passenger forecasts, and Table 13.2 for ATM forecasts. The great majority of traffic envisaged as being displaced from the major airports to the small sites is on domestic and EU area routes, mainly scheduled services but including some charter. Some long haul charter and low cost airline operations were forecast. The total passenger forecast at all of these sites taken together (excluding Farnborough, which is assumed not to cater for commercial aviation, and London City) was in the range of 6 to 9 mppa in 2015 and 11 to 15 mppa in 2030.

13.3.3 Three of these airports – London City, Southampton and Norwich – are included in the SPASM model, and forecast use of these airports has therefore been made within all the SPASM runs undertaken for SERAS. In this chapter, forecasts at these three airports are summarised for two scenarios: one of constraint (no new runways) at the principal South East airports and one scenario which includes new runway provision at Heathrow, Gatwick and Stansted.

London City

13.3.4 Table 13.3 presents passenger forecasts at London City from SPASM runs for a constrained scenario (Package 3) and a less constrained scenario (Package 15). Assumed capacities in both scenarios are 73,000 ATMs and 3.5 mppa to 2004 and 5 mppa from 2005.

13.3.5 In 2000 London City served 1.6 million passengers on 50,000 passenger ATMs. In both forecast scenarios, London City passengers are forecast to increase to over 2 million by 2005 and 4 million by 2010. By 2010, London City is constrained by its assumed ATM capacity of 73,000 ATMs.

13.3.6 In the constrained scenario (Package 3) London City ATMs continue at capacity with some increase in passengers to 5 million by 2030 as passengers per ATM increase from 58 in 2010 to 73 in 2030.

13.3.7 In the less constrained scenario (Package 15) London City loses about half of its total 2010 demand, so that in 2015, with an additional runway at Heathrow, it is serving only 2 million passengers.

Table 13.3: London City Forecasts

	2000 actual	2005	2010	2015	2020	2025	2030
SE Capacity Constrained Scenario (Package 3)							
Passengers, mppa	1.6	2.1	**4.3**	**4.3**	**4.8**	**5.1**	**5.1**
Passenger ATMs, '000	50	44	**74**	**72**	**72**	**71**	**69**
Passengers per ATM	32	46	58	59	66	71	73
SE Less Capacity Constrained Scenario (Package 15)							
Passengers, mppa	1.6	2.1	**4.1**	2.0	4.0	4.2	4.8
Passenger ATMs, '000	50	44	**71**	40	67	69	74
Passengers per ATM	32	46	57	48	60	60	65

*Note: Figures in **bold** are capacity-constrained forecasts*

Southampton

13.3.8 Forecasts for Southampton in a constrained scenario (Package 3) and a less constrained scenario (Package 15) are summarised in Table 13.4. Assumed capacities in both scenarios are 150,000 ATMs per year and 2 mppa to 2003 and 6 mppa from 2004.

13.3.9 In the constrained scenario (Package 3) growth is forecast in mainly short haul passengers to 2.8 mppa by 2015. After 2015 there is more growth in short haul scheduled services increasing total passengers to 6.3 mppa by 2020 and 7.1 mppa by 2030. After 2020, forecasts are constrained by the assumed ATM capacity.

13.3.10 In the less constrained scenario (Package 15), growth in short haul services is altogether slower. Total passengers increase to 2.2 mppa by 2020 and 3.0 mppa by 2030. Capacity constraints do not come into play.

Table 13.4: Southampton Forecasts

	2000 actual	2005	2010	2015	2020	2025	2030
SE Capacity Constrained Scenario (Package 3)							
Passengers, mppa	0.9	1.2	1.7	2.8	6.3	**7.2**	**7.1**
Passenger ATMs, ‘000	28	37	49	70	134	**150**	**146**
Passengers per ATM	30	32	34	40	47	48	49
SE Less Capacity Constrained Scenario (Package 15)							
Passengers, mppa	0.9	1.2	1.6	1.6	2.2	2.5	3.0
Passenger ATMs, ‘000	28	37	48	45	55	60	70
Passengers per ATM	30	32	34	35	39	42	44

*Note: Figures in **bold** are capacity-constrained forecasts*

Norwich

13.3.11 Table 13.5 summarises forecasts at Norwich in constrained (Package 3) and less constrained (Package 15) scenarios. ATM capacities are assumed to increase from 150,000 to 225,000 by 2020. Passenger capacities are assumed to be 1 mppa to 2010 and 12 mppa from 2011.

13.3.12 In the constrained scenario (Package 3), forecast demands increase from 0.4 mppa in 2000 only to 0.7 mppa by 2015, equally split between scheduled and charter. After 2015 there is a forecast increase particularly in short haul scheduled traffic pushing the passenger total up to 1.6 mppa by 2020 and 4.4 mppa by 2030.

13.3.13 In the less constrained scenario (Package 15), this post-2015 growth does not happen and there are only 0.7 mppa by 2030.

Table 13.5: Norwich Forecasts

	2000 actual	2005	2010	2015	2020	2025	2030
SE Capacity Constrained Scenario (Package 3)							
Passengers, mppa	0.4	0.5	0.6	0.7	1.6	1.8	4.4
Passenger ATMs, '000	17	6	8	8	20	21	54
Passengers per ATM	22	76	80	83	77	84	80
SE Less Capacity Constrained Scenario (Package 15)							
Passengers, mppa	0.4	0.5	0.6	0.5	0.6	0.6	0.7
Passenger ATMs, '000	17	6	6	6	7	8	8
Passengers per ATM	22	76	79	73	78	72	77

Summary

13.3.14 The SPASM forecasts for Southampton and Norwich differ considerably between the constrained and less constrained scenarios. The London City forecasts are more robust to alternative assumptions about runway development at the principal airports. It was concluded for the SPASM modelling that the potential contribution of London City, Norwich and Southampton to meeting demand in the South East is of the order of 15 mppa or somewhat more in a capacity constrained scenario in the South East, even though much the larger part of traffic spilled over from capacity-constrained South East airports is forecast to use regional airports. In addition, there may be some contribution from other sites.

13.3.15 From an airport capacity viewpoint, it should be possible to continue to accommodate GA and Business Aviation activity at these sites, even with anticipated growth in these sectors. At the busiest sites it might prove necessary, in time, to reduce the recreational flying element during peak periods.

13.4 Air Freight

13.4.1 A total of about a quarter of a million tonnes of air cargo may be carried to and from the nine small sites by 2030. About 70% of this is anticipated as being carried on freighter aircraft at Manston, mainly on long-haul routes. Freighter traffic is also anticipated at Lydd, but on a smaller scale. The remainder is expected to fly predominantly as belly cargo on passenger services at the other six airports (excluding Farnborough). The freight throughput at the small sites is unlikely to be greatly affected by spill from major South East airports due to poor accessibility and environmental concerns.

13.4.2 Table 13.6 shows demand forecasts for freight.

13.5 Impacts and Constraints

13.5.1 The impacts of development to support the anticipated levels of demand vary widely across the nine sites, reflecting the differences in their situations. Following are the key points arising from the qualitative impact appraisal.

Local planning

13.5.2 Development in strategic planning 'gaps' would be an issue of concern at four sites; Biggin Hill, Cambridge, Norwich and Shoreham. Impact on heritage property or valuable landscape areas is potentially an issue at Manston and Southend. London City development options would have relatively low impacts on heritage and townscape, but medium to high impacts on land-use.

Safety

13.5.3 Third party risk arising from aircraft operations, as represented by the extent of Public Safety Zones, is unlikely to be a significant concern at the anticipated levels of activity, except possibly at Shoreham, Southend, and for a reorientated runway at London City (Option 3), where impact is assessed as medium.

Noise

13.5.4 Aircraft noise can be expected to be a significant factor potentially constraining development at Biggin Hill, Cambridge, Manston, Southend, and for any reorientation of the runway at London City. It would be of moderate concern at Shoreham and Southampton, and could become an issue at Norwich if residential development is allowed to continue close to the airport. Concerns over noise have already resulted in a constraint on future aircraft movements at Farnborough.

Air quality

13.5.5 Moderate to high air quality impacts of capacity development may be expected at three sites; Cambridge, Norwich and Southampton. These arise from a combination of proximity to residential areas and probable increased congestion on local roads. At London City, Development Options 1A & 1B have the least impact in terms of air quality, whereas Option 3 has the most impact.

Surface access

13.5.6 Quality of surface access to these sites varies widely, as does the practicality of improvement measures. Good access to high-capacity roads is available at all except Biggin Hill, Lydd and Norwich. Upgrading of local roads or a new link from the M25 to Biggin Hill would be costly. Lydd is remote from the regional road network and extensive upgrading of existing routes would be required to make access times attractive. Norwich suffers from its main access being via a City Ring Road that is very congested at peak times; upgrading would be a far-reaching and costly process.

13.5.7 London City has no direct rail access, but an extension of the DLR to the airport has recently received planning consent. The airport has also benefited from the Jubilee Line extension. Southampton has a very well located rail station and Southend has imminent plans to construct a station close to the terminal area. A station on the South Coast line immediately adjacent to Shoreham Airport is feasible but there are no firm proposals for such a development at present. Rail access could be provided at Cambridge, either by dedicated bus link to the nearby city centre station on the main line, or by construction of a new station on an adjacent, connecting line. The remaining sites, Biggin Hill, Farnborough, Lydd, Manston and Norwich have no rail access point. Provision of a direct rail link would be very costly at all except Farnborough. There however, due to the nature of the air market served, a rail connection would be of significant value only to the airport workforce.

13.5.8 Table 13.7 shows the principal impacts and constraints at each of the sites.

13.6 Airspace

13.6.1 Impact in relation to airspace needs to be considered from two standpoints; the effect of increased traffic at the small sites, and the effect on operations at the small sites if there was to be significant development of capacity at any of the major airports.

13.6.2 In the first case, some changes to existing airspace structure and management may be anticipated to efficiently accommodate increased numbers of Instrument Flight Rules (IFR) movements. The degree of change would depend on the specific configuration of local airspace and level of interaction with other traffic streams. Although detailed analysis of each case would be required to define the necessary measures precisely, and significant changes would be needed in some cases, it is not anticipated that the requirements would be a major obstacle to the scale of operations envisaged at any one site.

13.6.3 An initial review of the potential impact on the small sites of capacity development at the major airports indicates that airspace capacity could be a significant issue in a number of cases. Sites most peripheral to the London Terminal Area are least likely to be affected in this way, including Lydd, Norwich, Shoreham and Southampton. Cambridge is likely to be significantly affected only by development at Stansted. IFR operations at Manston would be constrained significantly by development at Cliffe. Continued operations of any sort at Southend would probably be impractical if Cliffe was developed and, because of the airport's proximity to very busy airways into Europe, it would also be constrained by substantial growth at any of the existing major airports. Because of its proximity to the central area, Farnborough would be impacted by development at any of the major sites, and severely affected if that development was to be at either Heathrow or Gatwick. Similarly, Biggin Hill is almost certain to be severely affected by traffic growth at any major site, and particularly so by development at either Gatwick or Cliffe.

13.6.4 Table 13.8 shows the airspace related impacts on small sites of major airport development.

13.7 Summary

13.7.1 The nine small sites reviewed in these studies have the potential to make a contribution to meeting future commercial air service demand in the South East and East in circumstances where capacity at the main South East airports is heavily constrained, and to support the GA and business aviation sectors. London City's demand is more robust to alternative assumptions about runway development at the principal airports.

13.7.2 Capacity development to meet anticipated traffic levels at any of the sites would have varying degrees and types of local impact, which could constrain their ability to accept the forecast traffic. Aircraft noise, surface access or land-related impacts are the key constraints in many cases.

13.7.3 Airspace capacity is likely to be a major factor affecting the ability of those small airports closest to the London area to realise the traffic levels anticipated in this study.

Table 13.1: Demand Forecasts, Passengers

Site	Actual passengers '000	Forecast passengers* '000		Comments
	2000	2015	2030	
Biggin Hill	6	300 – 500	500 – 800	Domestic and EC scheduled and non-scheduled.
Cambridge	20	1,600 – 1,900	3,400 - 3,200	Domestic and EC scheduled (including low-cost airline), possibly domestic and EC non-scheduled.
Farnborough	-	-	-	General and business aviation only
Lydd	2	0 – 70	0 – 130	Possibly a low level of EC scheduled and even lower level of domestic and EC non-scheduled.
Manston	8	550 - 1,600	1,000 - 2,700	Domestic, EC and non-EC scheduled and non-scheduled (including long-haul).
Norwich	367	600 - 1,100	1,100 - 1,800	Domestic and EC scheduled, EC non-scheduled, possibly some domestic and non-EC non-scheduled.
Shoreham	1	300 – 500	400 – 700	Mainly domestic and EC scheduled with a much lower level of EC non-scheduled and possibly domestic non-scheduled.
Southampton	857	1,800 – 2,400	3,000 - 3,700	Domestic and EC scheduled, a much lower level of EC non-scheduled and possibly some domestic non-scheduled.
Southend	4	900 - 1,200	1,900 - 2,000	Domestic and EC scheduled (including low cost airlines) and a much lower level of domestic and EC non-scheduled.
TOTAL		**6,000 – 9,300**	**11,200 – 15,400**	

* Forecast values have been rounded from the original data, totals may not add.

Table 13.2: Demand Forecasts, ATMs

Site	Actual ATMs	Forecast ATMs*		Comment
	2000	2015	2030	
Biggin Hill	1,323	6,900	9,400	Mainly Regional jets. A significant number of Business and GA aircraft are not included in the totals.
Cambridge	1,643	28,000	37,500	Mainly B737 type aircraft. Some larger aircraft using the runway in connection with the Marshall maintenance operation
Farnborough	-	-	-	General and business aviation only
Lydd	267	1,000	1,500	Mainly freight aircraft.
Manston	984	15,000	20,400	Mainly Regional jets with a few charter aircraft of B757 type.
Norwich	16,951	16,500	21,500	Regional jets and B737 type aircraft.
Shoreham	665	12,000	17,300	Limited to commuter aircraft and Regional jets. Major airport for GA (not included in totals)
Southampton	28,134	33,800	43,700	Regional jets.
Southend	874	17,900	24,200	Mainly B737 types subject to runway extension to 1750m. Business and GA movements in addition.
TOTAL	**50,841**	**131,000**	**175,600**	

* Forecast values have been rounded from the original data, totals may not add.

Table 13.6: Demand Forecasts, Freight

Site	Actual freight Tonne	Forecast freight Tonne		Comment
	2000	2015	2030	
Biggin Hill	1	2,500	3,500	Carried on passenger aircraft.
Cambridge	43	12,500	18,500	Carried on passenger aircraft.
Farnborough	-	-	-	General and business aviation only
London City	_	-	-	Passenger aviation only
Lydd	6	9,500	15,500	To and from NW Europe on freighter aircraft.
Manston	32,239	118,000	168,000	Mainly on long-haul freighter aircraft.
Norwich	144	11,000	15,500	Carried on passenger aircraft.
Shoreham	13	1,000	1,500	Carried on passenger aircraft.
Southampton	260	11,000	16,500	Carried on passenger aircraft.
Southend	780	5,000	8,000	Carried on passenger aircraft.
TOTAL	**33,486**	**170,500**	**247,000**	

Table 13.7: Impacts and Constraints

Site	Planning Impact	3rd Party Risk	Noise	Rail Access	Road Access	Air Quality	Airspace	Principal Constraints
Biggin Hill	Development in Strategic Gap. LA strongly opposed on noise and road access grounds	Low	High Impact	Poor. No direct rail link	Poor. Current access roads of low standard: upgrading would be difficult. Improved access to M25 would be required	Low to medium impact	Major interaction with LHR, LGW, STN and potential new site	Airspace Surface Access Noise
Cambridge	Development in Strategic Gap.	None	High Impact	Reasonable access could be provided	Good access via ring road. Some would access through Cambridge City	Medium to high impact	Interaction with STN	Noise
Farnborough	Recent agreement on number of movements for GA and BusAv	None	Medium Impact	No direct rail link	Good access	Low impact	Major interaction with LHR, LGW	Airspace Recent agreement on role of airfield
London City	Parts surrounding area to NE & W classified as Metropolitan Open Land, Green Space	Low	Low/Med Impact	No direct rail link, but DLR branch planned.	Good access to Canary Wharf and City of London	Low to medium impact	Major interaction with LHR, LGW	Surrounding physical contraints
Lydd	LA in favour from employment perspective	None	Low Impact	Remote. Unreasonable cost to provide a service	Remote from market. Higher quality road access needed	Low impact	None	Location relative to market
Manston	Landscape impact but LA generally in favour	None	High Impact on housing to east of runway	Rail access difficult and costly	Good but fairly remote from market	Low to medium impact	Interaction with potential new site	Noise Distance from market

Site	Planning Impact	3rd Party Risk	Noise	Rail Access	Road Access	Air Quality	Airspace	Principal Constraints
Norwich	LA in favour of additional jobs but concerned if development required in Strategic Gap	None	Impact on housing being built at east end of site	No direct rail link	Road access poor. Ring road congested	Medium to high impact	None	Surface Access Limited catchment
Shoreham	Development in Strategic Gap. LA not in favour of development	Low to Medium Impact	Medium Impact	Rail access possible	Good access to south coast towns	Low to moderate impact	None	Runway length
Southampton	Development within airport boundary not an issue	Not significant	Medium Impact	Good	Good except for local congestion	Medium to high impact	No significant problems	Runway length
Southend	Runway extension needed for low cost services would take listed church and other properties	Medium Impact	High Impact	Good. Airport station planned	Good except for immediate access	Medium impact	Major interaction with potential new site	Noise Property take for runway extension

Table 13.8 Airspace related effects on operations at small sites due to development at the major airports

Site		Major airport development scenario				
	Type of Activity*	No new runways, ex. Capacity maximised	Additional runway at LHR	Additional runway at LGW	Additional runway at STN	Cliffe site developed
Biggin Hill	VFR	✓	✓	limited	✓	limited
	IFR	Limited	limited	✖	limited	✖
Cambridge	VFR	✓	✓	✓	✓	✓
	IFR	✓	✓	✓	limited	✓
Farnborough	VFR	✓	limited	limited	✓	✓
	IFR	Limited	✖	✖	limited	limited
London City	IFR	✓	limited	limited	✓	limited
Lydd	VFR	✓	✓	✓	✓	✓
	IFR	✓	✓	✓	✓	✓
Manston	VFR	✓	✓	✓	✓	✓
	IFR	✓	✓	✓	✓	limited
Norwich	VFR	✓	✓	✓	✓	✓
	IFR	✓	✓	✓	✓	✓
Shoreham	VFR	✓	✓	✓	✓	✓
	IFR	✓	✓	✓	✓	✓
Southend	VFR	✓	✓	✓	✓	✖
	IFR	Limited	limited	limited	limited	✖

* VFR (Visual Flight Rules) is intended to denote GA and most Business Aviation; IFR (Instrument Flight Rules) denotes commercial scheduled and large-scale charter traffic. London City traffic is assumed to be all IFR

"limited", indicates that this category of activity at the small airport would be limited by competing demands for available airspace capacity

✓ indicates little or no restriction beyond that seen today

✖ indicates that this category of activity would not be viable to any significant level

Table excludes Southampton, where no significant interaction is envisaged.

14 Appraisal of Packages

14.1 Introduction

14.1.1 Chapters 5 and 6 indicated how the options at different airports to be appraised at Stage Two were to be combined into packages, and the potential timing of the implementation of options within packages. Chapters 7 to 11 have summarised the appraisal findings for those options at the five major airports. Those option-related impacts which can be aggregated into package-wide impacts are summarised in the package ASTs which accompany this report. This chapter presents the system-wide impacts which can only be addressed on a package basis and not on an option basis. Principal among these are: demand forecasts and the performance of packages at a system-wide level, the economic and financial impacts of different packages and the impacts of packages on global air quality, proxied here by their impacts on CO_2. These impacts are presented in this chapter.

14.1.2 It is appropriate to appraise how well packages perform, in terms of accommodating demand, according to the time periods by which they might be in place. We have assumed that there will not be a new runway in place before 2011. By 2010, therefore, the additional capacity that can be in place will be limited primarily to terminal capacity and increased ATM capacity to enable better use to be made of available runways. The first time period of interest is therefore from 2000 to 2010.

14.1.3 We are assuming that by 2015 a single new runway (or the wide-spaced pair of runways at Cliffe) might be in place. 2015 is also one of the SERAS appraisal years. The second time period of interest is therefore from 2011 to 2015.

14.1.4 The third time period of interest will be from 2016 to 2030, when combinations of new runways are assumed to be feasible. 2030 is also one of the SERAS appraisal years.

Core Appraisals and Sensitivity Tests

14.1.5 There is a core appraisal for each of the 21 packages identified in Chapter 5 There are variations within some of these packages, the principal of which are:

- Packages 5A, 5B and 5C include different runway options or ways of using additional runways at Heathrow – options E6, E4 and E8 respectively. They have different costs and capacities, different traffic forecasts and different economic and financial impacts. They are effectively three different packages.

- Packages 8(1) and 8(2) differ only in that 8(1) omits the crosswind runway at Cliffe and 8(2) includes it. These packages therefore have different costs and economic and financial impacts but the same traffic forecasts.

- Packages 21(1) and 21(2) similarly differ in that 21(1) omits the crosswind runway from the four east – west runways at Cliffe, while 21(2) adds it.

14.1.6 These variations are included in the core appraisals. The core appraisals are supplemented by sensitivity tests, which consider the following variations:

- Runway size variations: the incorporation of different Heathrow runway options in multi-runway packages,

- Opening year variations: variations in the years in which runways are assumed to open or variations in the order in which runways open,

- Additional runways: adding additional runways to multi-runway packages,

- Seeding variations: the implications of not seeding options at Cliffe or the larger options at Stansted, and

- Environmental policy tests, which consider the implications of air travel demand being reduced by environmental taxes.

14.1.7 This chapter deals with the core model runs first, then the different sensitivity tests. The structure of the chapter is as follows:

- Section 14.2: core package demand forecasts,

- Section 14.3: economic appraisal of core packages,

- Section 14.4: financial appraisal of core packages,

- Section 14.5: wider economic impacts,

- Section 14.6: CO_2 impacts,

- Section 14.7: runway size sensitivity tests,

- Section 14.8: opening year sensitivity tests,

- Section 14.9: additional runway sensitivity tests,

- Section 14.10: seeding sensitivity tests, and
- Section 14.11: environmental policy sensitivity tests.

14.2 Core Package Demand Forecasts

2000 – 2010 Packages

14.2.1 In the period to 2010, the packages of relevance are packages 1 to 4. They represent:

- Package 1: Current land-use planning system
- Package 2: Maximum use of existing runways
- Package 3: Partial mixed mode operation at Heathrow
- Package 4: Full mixed mode operation at Heathrow

14.2.2 Tables 14.1 and 14.2 indicate forecast usage of these packages in the period to 2010. They show unconstrained demand, package capacities and the forecast use of those capacities. In Tables 14.1 to 14.7 where there is a reference to South East airports, the totals quoted are the sums for Heathrow, Gatwick, Stansted, Luton and, where relevant, Cliffe Marshes airports. Table 14.1 deals with ATM forecasts and Table 14.2 with passenger forecasts. Figure 14.1 shows forecast ATMs and passengers at each airport in each package in 2005; Figure 14.2 shows ATMs in 2010 and Figure 14.3 shows passengers in 2010.

Table 14.1: Package ATM Forecasts for 2000, 2005 and 2010

		2000	**2005**	**2010**
Package 1: Current Land Use Planning System				
SE Airports	Capacity ('000)	1009	1015	1025
	Forecast use ('000)	923	986	1001
Package 2: Maximum Use of Existing Runways				
SE Airports	Capacity ('000)	1009	1052	1092
	Forecast use ('000)	923	1024	1076
Package 3: Partial Mixed Mode at Heathrow				
SE Airports	Capacity ('000)	1009	1052	1105
	Forecast use ('000)	923	1024	1091
Package 4: Full Mixed Mode at Heathrow				
SE Airports	Capacity ('000)	1009	1052	1145
	Forecast use ('000)	923	1024	1125

14.2.3 In interpreting the ATM forecasts in Table 14.1, it has to be understood that an artifice of the modelling process implies that there is no excess demand at any of the South East airports in 1998. This is accepted as under-stating the current balance between demand and capacity. In practice, Heathrow and Gatwick already operate close to runway throughput capacity throughout much of the operating day, and additional capacity at either airport would release currently suppressed demand. The ATM forecasts in Table 14.1 indicate that by 2005 the demand for movement through these four airports taken together will use 97% of the available runway capacity in the current land-use planning system. By 2010, 99% of the capacity available if maximum use is made of the existing runways (Package 2) is forecast to be used. Small amounts of additional runway capacity are available by 2010 through mixed mode operation, but even with Package 4, the largest capacity assumed to be possible, only 2% of runway capacity across these airports is forecast not to be used.

Table 14.2: Package Passenger Forecasts for 2000, 2005 and 2010

		2000	2005	2010
Unconstrained Passenger Demand (mppa)	SE Airports	117	146	173
	all UK airports	181	230	277
Package 1: Current Land Use Planning System				
SE Airports	Capacity (mppa)	122	135	151
	Forecast use (mppa)	115	127	131
Non SE Airports	Forecast use (mppa)	65	90	115
Passengers Lost to UK System	(mppa)	1	14	31
Package 2: Maximum Use of Existing Runways				
SE Airports	Capacity (mppa)	122	145	174
	Forecast use (mppa)	115	131	141
Non SE Airports	Forecast use (mppa)	65	88	113
Passengers Lost to UK System	(mppa)	1	11	24
Package 3: Partial Mixed Mode at Heathrow				
SE Airports	Capacity (mppa)	122	145	178
	Forecast use (mppa)	115	131	144
Non SE Airports	Forecast use (mppa)	65	88	112
Passengers Lost to UK System	(mppa)	1	11	22
Package 4: Full Mixed Mode at Heathrow				
SE Airports	Capacity (mppa)	122	145	190
	Forecast use (mppa)	115	131	151
Non SE Airports	Forecast use (mppa)	65	88	111
Passengers Lost to UK System	(mppa)	1	11	16

14.2.4 The passenger forecasts in Table 14.2 indicate unconstrained demand at these South East airports rising from 116 mppa in 2000 to 146 mppa in 2005 and 172 mppa in 2010. Terminal capacities are assumed to just keep pace with passenger demands, particularly given Terminal

5 at Heathrow. Realised demand at the South East airports, however, falls short of unconstrained demand because of the lack of runway capacity.

14.2.5 At best, in 2010, with Package 4, some 21 million passengers, (12% of the passenger demand at South East airports), will not use South East airports, in addition to the current un-modelled suppressed demand. There will be additional use of UK airports outside the South East, but some 16 million passengers (6% of national demand) will be lost to the UK airport system. Without mixed mode operation at Heathrow, some 24 million passengers, almost 10% of national air passenger demand, will be lost to the UK airport system.

14.2.6 Figure 14.1 shows forecast ATMs and passengers at each airport in 2005. Additional runway capacity is assumed in Packages 2 to 4 at Stansted. There is virtually no unused runway capacity at any airport, but some unused terminal capacity at Gatwick and Stansted, which are assumed to have capacities of 40 mppa and 25 mppa respectively.

14.2.7 Figures 14.2 and 14.3 illustrate forecast ATMs and passengers respectively at each airport in 2010. Packages 2, 3 and 4 are all heavily constrained. All ATM capacity at Heathrow and Gatwick is taken and there are only very small amounts of unused capacity at Stansted (where the ATM capacity is assumed to be 252,000) and Luton (assumed capacity of 100,000). Figure 14.3 illustrates that the restricted ATM capacity creates some unused terminal capacity at all airports. Full mixed mode operation at Heathrow (Package 4) brings passenger forecasts above 80 mppa, close to the 86 mppa terminal capacity with T5.

14.2.8 Through the decade to 2010, therefore, the major South East airports will be characterised by their operation at runway throughputs very close to physical runway capacities. The intensive use of the airports throughout the operating day masks the excess demand for slots that cannot be satisfied, particularly at peak times of the day, which are important to long haul schedule curfew windows and to the preferences of short haul business travellers.

14.2.9 The forecast growth in excess demand will require a tighter slot management system than that already applied at the major South East and other UK airports approaching capacity limits. The implications of an increasing scarcity of slots will be widespread. Air services will be affected:

- The priority allocation of slots to the most profitable routes by the airlines restricts the range of services.
- The inability to introduce new routes, or to increase frequencies on existing routes, restricts otherwise viable services.
- The predominance of 'grandfather rights' to slots restricts competition by new entrants.

- The use of larger aircraft on lower frequencies restricts service convenience, limiting the realisation of passenger preferences for departure and arrival times and interline connections.

14.2.10 Operating inefficiencies are likely to worsen. The pressure of demand for slots has already led to the progressive lowering of delay standards to maximise throughput. Further lowering of standards cannot be ruled out. Block times have been increased as a consequence, to allow for probable delay. Delay imposes additional costs on airlines, through a less effective use of the aircraft fleet and airline staff, and through increased fuel consumption. Additional airport infrastructure and facilities are required to cope with delay and passengers suffer, adding to the overall economic cost of a lack of capacity.

2011 - 2015 Packages

14.2.11 In the period from 2011 to 2015, the packages of relevance are as set out in Table 14.3. Package 1 is the capacity currently envisaged in the land-use planning system and Package 2 is the maximum use of existing runways. Each subsequent package contains a development option at one airport and assumes that at the other airports there is the capability to make maximum use of the existing runways. Packages 3 and 4 are the continued operation of the existing runways at Heathrow in mixed mode. Packages 5 to 8 are additional runways at Heathrow, Gatwick, Stansted and Cliffe Marshes respectively. There are three alternatives at Heathrow.

Table 14.3: Packages and Options of Relevance, 2011 to 2015

Package	Airport	Option
1	All	Current land-use planning system
2	All	Maximum use of existing runways
3	Heathrow	Partial mixed mode operation on existing runways (0700-1200)
4	Heathrow	Full mixed mode operation on existing runways
5A	Heathrow	New 2000m runway. Mixed mode operation on existing runways
5B	Heathrow	New 2000m runway. Segregated mode operation on existing runways
5C	Heathrow	New 4000m runway. One of three runways in mixed mode operation
6	Gatwick	New close-parallel runway
7	Stansted	New wide spaced runway
8(1) and 8(2)	Cliffe Marshes	Wide spaced pair of parallel runways (package 8(1)) with NE:SW runway (package 8(2))

14.2.12 Tables 14.4 and 14.5 give key performance indicators for these packages between 2011 and 2015. The totals quoted are the sums for Heathrow, Gatwick, Stansted and Luton airports. Table 14.4 deals with ATM forecasts and Table 14.5 with passenger forecasts. Figures 14.4 and 14.5 show ATMs and passengers at each airport in each package in 2011: Figures 14.6 and 14.7 show ATMs and passengers at each airport in each package for 2015.

Table 14.4: Package ATM Forecasts for 2011 to 2015

		2011	2015
Package 1			
SE Airports	Capacity ('000)	1025	1025
	Forecast use ('000)	1006	988
Package 2			
SE Airports	Capacity ('000)	1239	1239
	Forecast use ('000)	1095	1142
Package 3			
SE Airports	Capacity ('000)	1256	1256
	Forecast use ('000)	1111	1131
Package 4			
SE Airports	Capacity ('000)	1310	1310
	Forecast use ('000)	1146	1168
Package 5a			
SE Airports	Capacity ('000)	1513	1513
	Forecast use ('000)	1202	1314
Package 5b			
SE Airports	Capacity ('000)	1414	1414
	Forecast use ('000)	1217	1261
Package 5c			
SE Airports	Capacity ('000)	1397	1397
	Forecast use ('000)	1200	1246
Package 6			
SE Airports	Capacity ('000)	1357	1357
	Forecast use ('000)	1169	1219
Package 7			
SE Airports	Capacity ('000)	1493	1493
	Forecast use ('000)	1215	1346
Package 8(1/2)			
SE Airports	Capacity ('000)	1769	1769
	Forecast use ('000)	1264	1476

14.2.13 In 2011, it is assumed that additional runway capacity is introduced at Luton in all packages and maximum use of the Stansted runway is assumed. Additional runways are assumed at other airports from package to package. Table 14.4 indicates that, other than in Package 1, there is some spare runway capacity. Figure 14.4 indicates that this is principally at Luton and at Stansted or Cliffe Marshes if additional runways are provided there (Packages 7 and 8). The new runways at Heathrow (packages 5A/5B/5C) attract over 600,000 ATMs in 2011, filling the additional runway capacity as it opens in packages 5B and 5C. In the case of package 5A, which assumes mixed mode operation on the existing runways as well as the new runway, there is some runway capacity available to 2015. The additional runway capacity at Heathrow does not significantly reduce the pressure on runway capacity at Gatwick or Stansted.

14.2.14 By 2015, Table 14.4 indicates that forecast ATMs are around 90% of runway capacity across these airports, when additional runway capacity is provided at Heathrow, Gatwick or Stansted, and around 83% of capacity when two runways are added at Cliffe Marshes. Figure 14.6 indicates that the spare runway capacity is invariably at Luton, with a little at Cliffe Marshes in Package 8.

Table 14.5: Package Passenger Forecasts for 2011 to 2015

		2011	2015
Unconstrained Passenger Demand (mppa)			
	SE Airports	178	202
	all UK airports	288	335
Package 1: Current Land Use Planning System			
SE Airports	Capacity (mppa)	151	151
	Forecast use (mppa)	134	136
Non SE Airports	Forecast use (mppa)	126	155
Passengers Lost to UK System	(mppa)	29	43
Package 2: Maximum Use of Existing Runways			
SE Airports	Capacity (mppa)	199	199
	Forecast use (mppa)	145	154
Non SE Airports	Forecast use (mppa)	120	144
Passengers Lost to UK System	(mppa)	23	37
Package 3: Partial Mixed Mode at Heathrow			
SE Airports	Capacity (mppa)	204	204
	Forecast use (mppa)	148	155
Non SE Airports	Forecast use (mppa)	119	146
Passengers Lost to UK System	(mppa)	21	34
Package 4: Full Mixed Mode at Heathrow			
SE Airports	Capacity (mppa)	218	218
	Forecast use (mppa)	155	162
Non SE Airports	Forecast use (mppa)	116	148
Passengers Lost to UK System	(mppa)	17	24
Package 5a: New 2000m Runway and Mixed Mode at Heathrow			
SE Airports	Capacity (mppa)	241	241
	Forecast use (mppa)	170	198
Non SE Airports	Forecast use (mppa)	111	129
Passengers Lost to UK System	(mppa)	7	7
Package 5b: New 2000m Runway at Heathrow			
SE Airports	Capacity (mppa)	225	225
	Forecast use (mppa)	173	184
Non SE Airports	Forecast use (mppa)	109	132
Passengers Lost to UK System	(mppa)	6	18
Package 5c: New 4000m Runway at Heathrow			
SE Airports	Capacity (mppa)	234	234
	Forecast use (mppa)	169	181
Non SE Airports	Forecast use (mppa)	111	135
Passengers Lost to UK System	(mppa)	8	20
Package 6: New Runway at Gatwick			
SE Airports	Capacity (mppa)	214	214

		2011	2015
	Forecast use (mppa)	154	165
Non SE Airports	Forecast use (mppa)	117	145
Passengers Lost to UK System	(mppa)	18	25

Package 7: New Runway at Stansted			
SE Airports	Capacity (mppa)	246	246
	Forecast use (mppa)	162	182
Non SE Airports	Forecast use (mppa)	114	134
Passengers Lost to UK System	(mppa)	12	19
Package 8(1/2): Two New Runways at Cliffe Marshes			
SE Airports	Capacity (mppa)	276	276
	Forecast use (mppa)	168	195
Non SE Airports	Forecast use (mppa)	112	130
Passengers Lost to UK System	(mppa)	9	10

14.2.15 Table 14.5 indicates that the provision of a new runway at Heathrow in 2011 leads to a big reduction in the number of passengers lost to the UK airports system, from 23 mppa (8% of national air travel demand), with maximum use made of existing runways, to 6 mppa (2%). With all packages in 2011, the limited ATM capacities mean that passenger forecasts at each airport fall short of terminal capacities (Figure 14.5).

14.2.16 The provision of a new runway at Heathrow in 2011 allows all but 6 to 8 mppa (3 to 4%) of unconstrained passenger demand for South East airports to be met. Additional runways in other locations leave more unmet. The additional close-parallel runway at Gatwick (Package 6) leaves 24 mppa (13%) unmet; the Stansted runway (Package 7) leaves 16 mppa (9%) unmet; and two runways at Cliffe Marshes leave 10 mppa (6%) unmet.

14.2.17 By 2015, it is Package 5A that comes closest to satisfying unconstrained demand for South East airports, followed by the Cliffe Marshes runways (Package 8 has the highest runway capacity), then an additional runway at Stansted and the other Heathrow runway options.

14.2.18 Figure 14.7 illustrates that with the new runways at Heathrow in packages 5A and 5B, terminal capacity as well as runway capacity is fully utilised. Elsewhere, there is spare terminal capacity.

2016 to 2030 Packages

14.2.19 The packages appraised for the period to 2030 are all those with one or more new runways, Packages 5 to 21. These can be grouped according to the number of new runways introduced, In the tables that follow they are grouped into 1-runway packages, 5 to 7, and into 2 or 3-runway packages, 8 to 21. Figures 14.8a-c show ATMs at each airport in each package in

2021: Figures 14.9a-c show passengers at each airport in each package. Figures 14.10a-c and 14.11a-c present the same information for 2025, and Figures 14.12 a-c and 14.13a-c present the same information for 2030.

Table 14.6a: ATM Forecasts for One Runway Packages - 2016 to 2030

		2016	2020	2025	2030
Package 5a					
SE Airports	Capacity ('000)	1513	1513	1513	1513
	Forecast use ('000)	1319	1320	1331	1356
Package 5b					
SE Airports	Capacity ('000)	1414	1414	1414	1414
	Forecast use ('000)	1266	1279	1329	1339
Package 5c					
SE Airports	Capacity ('000)	1397	1397	1397	1397
	Forecast use ('000)	1250	1286	1341	1383
Package 6					
SE Airports	Capacity ('000)	1357	1357	1357	1357
	Forecast use ('000)	1234	1308	1333	1306
Package 7					
SE Airports	Capacity ('000)	1493	1493	1493	1493
	Forecast use ('000)	1346	1391	1432	1458

14.2.20 Table 14.6a indicates that the addition of just one new runway will not provide adequate runway capacity much beyond 2015. With Package 5A, 87% of runway capacity is used in 2020 and, in all other cases, 90% and more of runway capacity is used. Figure 14.8a demonstrates that by 2021, the only runway capacity available in these scenarios is at Luton.

Table 14.6b: ATM Forecasts for Two and Three Runway Packages - 2016 to 2030

		2016	2020	2025	2030
Package 8(1/2)					
SE Airports	Capacity ('000)	1769	1769	1769	1769
	Forecast use ('000)	1518	1595	1622	1626
Package 9					
SE Airports	Capacity ('000)	1465	1465	1654	1654
	Forecast use ('000)	1324	1358	1554	1572
Package 10					
SE Airports	Capacity ('000)	1493	1493	1617	1617
	Forecast use ('000)	1351	1381	1531	1564
Package 11					
SE Airports	Capacity ('000)	1513	1513	1631	1631
	Forecast use ('000)	1319	1320	1423	1430
Package 12					
SE Airports	Capacity ('000)	1513	1513	1767	1767
	Forecast use ('000)	1319	1320	1559	1594
Package 13					
SE Airports	Capacity ('000)	1357	1357	1611	1611

		2016	2020	2025	2030
	Forecast use ('000)	1234	1308	1556	1590
Package 14					
SE Airports	Capacity ('000)	1493	1617	1736	1736
	Forecast use ('000)	1348	1498	1582	1635
Package 15					
SE Airports	Capacity ('000)	1513	1631	1885	1885
	Forecast use ('000)	1319	1422	1577	1695
Package 16					
SE Airports	Capacity ('000)	1513	1767	1891	1891
	Forecast use ('000)	1319	1471	1572	1640
Package 17					
SE Airports	Capacity ('000)	1357	1611	1735	1735
	Forecast use ('000)	1234	1483	1616	1646
Package 18					
SE Airports	Capacity ('000)	1513	1739	1928	1928
	Forecast use ('000)	1319	1458	1608	1703
Package 19					
SE Airports	Capacity ('000)	1465	1654	1908	1908
	Forecast use ('000)	1324	1522	1664	1740
Package 20					
SE Airports	Capacity ('000)	1769	1769	1887	1887
	Forecast use ('000)	1518	1595	1713	1733
Package 21 (1/2)					
SE Airports	Capacity ('000)	1769	1769	2020	2020
	Forecast use ('000)	1518	1595	1764	1792

14.2.21 Table 14.6b indicates that with two new runways, Packages 8 to 13, by 2020, forecast runway use ranges between 87% and 96% of runway capacity. In the forecasting it has typically been assumed that third runways will be introduced in 2024. With the propensity for new runway capacity to be taken up very soon after its introduction, the new runways assumed do not provide significant amounts of spare capacity. By 2025, with three or more new runways in Packages 14 to 21, the proportion of runway capacity used ranges between 83% and 93%, indicating an airport system continuing to operate close to its physical capacity. Figure 14.10c indicates that, other than at Luton, there is very little spare runway capacity by 2025 with any package appraised.

Table 14.7a: Passenger Forecasts for One Runway Packages - 2016 to 2030

		2016	2020	2025	2030
Unconstrained Passenger Demand (mppa)	SE Airports	210	242	273	301
	all UK airports	347	402	454	501
Package 5a					
SE Airports	Capacity (mppa)	241	241	241	241
	Forecast use (mppa)	201	208	215	223

		2016	2020	2025	2030
Non SE Airports	Forecast use (mppa)	135	162	198	217
Passengers Lost to UK System	(mppa)	11	32	41	61
Package 5b					
SE Airports	Capacity (mppa)	225	225	225	225
	Forecast use (mppa)	187	195	208	215
Non SE Airports	Forecast use (mppa)	139	166	199	223
Passengers Lost to UK System	(mppa)	21	41	47	63
Package 5c					
SE Airports	Capacity (mppa)	234	234	234	234
	Forecast use (mppa)	184	197	211	224
Non SE Airports	Forecast use (mppa)	142	166	197	222
Passengers Lost to UK System	(mppa)	22	40	46	55
Package 6					
SE Airports	Capacity (mppa)	214	214	214	214
	Forecast use (mppa)	169	187	197	201
Non SE Airports	Forecast use (mppa)	146	170	204	234
Passengers Lost to UK System	(mppa)	32	45	52	66
Package 7					
SE Airports	Capacity (mppa)	246	246	246	246
	Forecast use (mppa)	185	201	214	225
Non SE Airports	Forecast use (mppa)	140	164	208	222
Passengers Lost to UK System	(mppa)	22	37	31	53

14.2.22 Table 14.7a indicates that, by 2020, the unconstrained demand for use of South East airports is 241 mppa, while the forecast use of all packages appraised lies in the range between 187 mppa and 208 mppa. This indicates that the addition of only one new runway by 2020 will leave a large part of the demand for South East airports unsatisfied. Between 32 and 45 mppa (8% to 11% of national air travel demand) will be lost to the airport system.

Table 14.7b: Passenger Forecasts for Two and Three Runway Packages – 2016 to 2030

		2016	2020	2025	2030
Package 8(1/2)					
SE Airports	Capacity (mppa)	276	276	276	276
	Forecast use (mppa)	202	222	237	245
Non SE Airports	Forecast use (mppa)	135	156	190	226
Passengers Lost to UK System	(mppa)	10	23	27	30
Package 9					
SE Airports	Capacity (mppa)	235	235	267	267
	Forecast use (mppa)	180	194	232	243
Non SE Airports	Forecast use (mppa)	144	167	195	229
Passengers Lost to UK System	(mppa)	23	41	26	29
Package 10					
SE Airports	Capacity (mppa)	246	246	266	266
	Forecast use (mppa)	185	200	231	243
Non SE Airports	Forecast use (mppa)	140	164	196	226
Passengers Lost to UK System	(mppa)	22	38	27	32
Package 11					
SE Airports	Capacity (mppa)	241	241	256	256
	Forecast use (mppa)	201	208	230	235
Non SE Airports	Forecast use (mppa)	135	162	197	212
Passengers Lost to UK System	(mppa)	11	32	26	53
Package 12					
SE Airports	Capacity (mppa)	241	241	288	288
	Forecast use (mppa)	201	208	253	264
Non SE Airports	Forecast use (mppa)	135	162	182	210
Passengers Lost to UK System	(mppa)	11	32	18	26
Package 13					
SE Airports	Capacity (mppa)	214	214	261	261
	Forecast use (mppa)	169	187	230	242
Non SE Airports	Forecast use (mppa)	146	170	196	228
Passengers Lost to UK System	(mppa)	32	45	28	31
Package 14					
SE Airports	Capacity (mppa)	246	266	293	293
	Forecast use (mppa)	185	217	242	257
Non SE Airports	Forecast use (mppa)	140	162	190	216
Passengers Lost to UK System	(mppa)	22	24	21	27
Package 15					
SE Airports	Capacity (mppa)	241	256	303	303
	Forecast use (mppa)	201	223	254	279
Non SE Airports	Forecast use (mppa)	135	158	182	202
Passengers Lost to UK System	(mppa)	11	21	18	20
Package 16					
SE Airports	Capacity (mppa)	241	288	308	308
	Forecast use (mppa)	201	232	256	274
Non SE Airports	Forecast use (mppa)	135	155	180	206
Passengers Lost to UK System	(mppa)	11	15	18	21

		2016	2020	2025	2030
Package 17					
SE Airports	Capacity (mppa)	214	261	281	281
	Forecast use (mppa)	169	214	244	255
Non SE Airports	Forecast use (mppa)	146	160	186	213
Passengers Lost to UK System	(mppa)	32	27	24	32
Package 18					
SE Airports	Capacity (mppa)	241	277	309	309
	Forecast use (mppa)	201	227	257	279
Non SE Airports	Forecast use (mppa)	135	158	182	205
Passengers Lost to UK System	(mppa)	11	17	15	16
Package 19					
SE Airports	Capacity (mppa)	235	267	314	314
	Forecast use (mppa)	180	218	251	273
Non SE Airports	Forecast use (mppa)	144	160	185	207
Passengers Lost to UK System	(mppa)	23	24	18	20
Package 20					
SE Airports	Capacity (mppa)	276	276	291	291
	Forecast use (mppa)	202	222	251	262
Non SE Airports	Forecast use (mppa)	135	156	182	211
Passengers Lost to UK System	(mppa)	10	23	21	28
Package 21 (1/2)					
SE Airports	Capacity (mppa)	276	276	312	312
	Forecast use (mppa)	202	222	260	271
Non SE Airports	Forecast use (mppa)	135	156	182	205
Passengers Lost to UK System	(mppa)	10	23	11	24

14.2.23 The addition of second and third new runways by 2021 and 2024, in Packages 14 to 21, allows between 242 mppa and 260 mppa out of the unconstrained demand of 272 mppa to be accommodated at South East airports. By 2030, the highest number of passengers accommodated at the major South East airports in any package appraised is 279 mppa, out of the unconstrained demand of 300 mppa, ie, 93% of demand is being accommodated. The number of passengers lost to the UK airports system is, in the best case, 16 mppa, out of national unconstrained demand of around 500 mppa.

14.3 Economic Appraisal of Core Packages

14.3.1 The results of the economic appraisal of all the core packages are set out in Table 14.8. Appraisals have been made against Package 2 (Maximum use of existing runways). Benefits are broken down into categories of beneficiary: user benefits (generated and existing passengers, UK and foreign residents, freight), producer surpluses (effectively to airport operators) and additional Government revenue from Air Passenger Duty. Total benefits are set against the sum of the capital costs and additional refurbishment costs associated with each package. All costs and benefits are in £ million at 2000 values discounted back to 2000 using the Government's current test discount rate of 6% per annum in real terms. Two measures of Net Benefit (discounted benefits minus discounted costs) are given: Net Benefits which includes all benefits, and Net Benefits Only Counting Benefits to UK Users, which excludes benefits to foreign passengers. Two other indicators are given: Benefit:Cost ratio and Net Benefit per mppa of additional capacity.

Table 14.8: Core Economic Appraisal Results

(2000-2060, £m, 2000 values, discounted @ 6% p.a.)			Benefits to Users												
			Generated		Existing										
Package	Description	MPPA of Additional Capacity	UK	Foreign	UK	Foreign	Benefits to Freight Users	Benefits to Producers	Government Revenue	Total Benefits	Costs	Net Benefits	Net Benefits: Benefits to UK Users Only	Benefit: Cost Ratio	NPV per mppa of additional capacity
3	LHR partial mixed mode	5	£224	£29	£140	£18	-£6	£238	£139	£783	-£858	-£75	-£123	0.91	-£15.05
4	LHR full mixed mode	19	£577	£323	£347	£227	£15	£722	£325	£2,536	-£833	£1,703	£1,153	3.04	£89.62
5A	LHR 2000m r/w, all in mixed mode	42	£3,607	£1,532	£641	£519	£128	£1,832	£349	£8,609	-£3,168	£5,442	£3,390	2.72	£129.56
5B	LHR 2000m r/w in mixed mode	26	£2,112	£764	£530	£414	£128	£1,156	£218	£5,321	-£2,406	£2,916	£1,738	2.21	£112.14
5C	LHR 4000m r/w, one in mixed mode	35	£2,131	£1,152	£614	£445	£78	£1,429	£406	£6,254	-£3,101	£3,154	£1,557	2.02	£90.11
6	LGW close parallel r/w	15.5	£376	£148	£395	£318	£26	£501	£151	£1,915	-£982	£933	£467	1.95	£60.18
7	STN wide spaced r/w	47	£1,732	£889	£417	£134	£26	£677	£431	£4,307	-£2,149	£2,158	£1,135	2.00	£45.91
8 (i)	Cliffe, 2 new r/ws	77	£2,524	£328	£88	-£216	£151	£3,577	£459	£6,912	-£5,916	£996	£884	1.17	£12.93
8 (ii)	Cliffe, 2 new r/ws plus crosswind	77	£2,524	£328	£88	-£216	£151	£3,577	£459	£6,912	-£6,128	£784	£672	1.13	£10.18
9	LGW 2 new r/ws	68.5	£3,775	£1,814	£1,066	£549	£62	£1,652	£460	£9,377	-£2,775	£6,602	£4,239	3.38	£96.38
10	STN 2 new r/ws	67	£3,244	£2,014	£478	£142	£2	£1,025	£435	£7,340	-£2,791	£4,549	£2,393	2.63	£67.89
11	LHR & LGW, 1 new r/w each	57.5	£4,861	£1,952	£1,046	£789	£158	£2,096	£463	£11,364	-£3,837	£7,527	£4,786	2.96	£130.91
12	LHR & STN, 1 new r/w each	89	£7,040	£3,447	£1,072	£671	£125	£2,406	£567	£15,327	-£4,415	£10,912	£6,794	3.47	£122.61
13	LGW & STN, 1 new r/w each	62.5	£2,652	£1,421	£920	£571	£7	£1,093	£338	£7,003	-£2,153	£4,850	£2,858	3.25	£77.61
14	STN, 3 new r/ws	94	£5,412	£2,961	£620	£138	£34	£1,279	£660	£11,104	-£3,437	£7,667	£4,568	3.23	£81.56
15	LHR, LGW, STN, 1 new r/w each	104.5	£7,926	£3,616	£1,542	£954	£127	£2,601	£661	£17,428	-£4,966	£12,463	£7,893	3.51	£119.26
16	LHR, 1 new r/w, STN, 2 new r/ws	109	£7,876	£4,007	£1,205	£732	£345	£2,635	£728	£17,528	-£5,103	£12,425	£7,687	3.44	£113.99
17	LGW, 1 new r/w, STN, 2 new r/ws	82.5	£4,438	£2,323	£944	£543	£15	£1,264	£606	£10,133	-£2,998	£7,134	£4,268	3.38	£86.48
18	LHR, 1 new r/w, LGW, 2 new r/ws	110.5	£8,458	£3,706	£1,614	£1,022	£214	£2,952	£572	£18,537	-£5,155	£13,382	£8,655	3.60	£121.11
19	LGW, 2 new r/ws, STN, 1 new r/w	115.5	£6,950	£3,444	£1,567	£791	£276	£2,078	£778	£15,884	-£3,980	£11,904	£7,669	3.99	£103.06
20	Cliffe, 2 new r/ws, LGW, 1 new r/w	92.5	£4,265	£1,203	£416	-£10	£226	£3,845	£551	£10,495	-£6,579	£3,917	£2,724	1.60	£42.34
21 (i)	Cliffe, 4 new r/ws	113	£4,344	£1,082	£12	-£359	£307	£4,492	£718	£10,595	-£7,059	£3,537	£2,814	1.50	£31.30
21 (ii)	Cliffe, 4 new r/ws, plus crosswind r/w	113	£4,344	£1,082	£12	-£359	£307	£4,492	£718	£10,595	-£7,270	£3,325	£2,602	1.46	£29.43

14.3.2 The economic benefits associated with the change from Package 1, the capacity currently envisaged in the land-use planning system, to Package 2, maximum use of existing runways, have been separately estimated. The changes are additional use of the runways at Stansted and Luton, in particular, and some additional capacity at Gatwick. The net benefits of Package 2 compared to Package 1 are £4.9bn. This comprises total benefits of £6.7bn against total costs of £1.8bn, a Benefit:Cost ratio of 3.8:1 and NPV per mppa of additional capacity of £104m.

14.3.3 Benefit:Cost ratios of other packages measured against Package 2 generally exceed 1, with the highest ratios being up towards 4:1. Ranking packages by benefit:cost ratios gives the following highest-ranking packages.

Table 14.9: Highest Ranking Packages by Benefit:Cost Ratio

Package	Runways	B:C ratio
19	Gatwick (2) and Stansted	3.99
18	Heathrow and Gatwick (2)	3.60
15	Heathrow, Gatwick and Stansted	3.51
12	Heathrow and Stansted	3.47
16	Heathrow and Stansted (2)	3.44
17	Gatwick and Stansted (2)	3.38
9	Gatwick (2)	3.38
13	Gatwick and Stansted	3.25
14	Stansted (3)	3.23
4	Mixed mode at Heathrow	3.04

14.3.4 Larger packages feature strongly. All of the highest-ranked packages have two or three new runways. This suggests the possibilities that:

- the addition of further new runways does not substantially reduce the unit benefit per additional unit of capacity,
- there may be synergies, with additional capacity in one location generating benefits at other sites, and
- adding second and third new runways may incur a lower cost per mppa than adding just one runway, thereby helping to keep benefit:cost ratios high.

14.3.5 It is also notable that packages containing Gatwick and Stansted options feature strongly, in part reflecting the lower cost per mppa of new capacity in those locations.

14.3.6 The packages with the lowest benefit:cost ratios are Partial Mixed Mode at Heathrow, which deliberately only makes use of the additional capacity for five hours per day for environmental reasons, and the packages containing options at Cliffe Marshes, which incur relatively high site preparation costs. This is particularly true of Package 8 which includes some costs in preparation for future runways that only materialise in Package 21.

14.3.7 Ranking packages by their Net Benefit per mppa of additional capacity gives the following highest-ranked packages.

Table 14.10: Highest Ranking Packages by Net Benefit per mppa

Package	Runways	Net benefit per mppa, £ million
11	Heathrow and Gatwick	131
5A	Heathrow	130
12	Heathrow and Stansted	123
18	Heathrow and Gatwick (2)	121
15	Heathrow, Gatwick and Stansted	119
16	Heathrow and Stansted (2)	114
5B	Heathrow	112
19	Gatwick (2) and Stansted	103
9	Gatwick (2)	96

14.3.8 Heathrow features in all of the highest ranked packages, clearly pointing to the economic value of additional capacity at Heathrow. With all the packages appraised, there remain high shadow costs at Heathrow. In 2030 they are equivalent to £70 per passenger with package 2 and to £37 per passenger with Package 5A, which contains the largest capacity Heathrow option appraised. This indicates that there remain substantial economic benefits to be obtained from a fourth runway at Heathrow.

14.3.9 Again, multiple-runway packages feature strongly suggesting that the addition of second and third new runways does not substantially dilute net benefits. Of the five packages with net benefits in excess of £10 billion, four have three runways and one has two runways. Packages with more than three new runways would be likely to emerge if the objective were to maximise net benefits.

14.3.10 In the appraisal of packages it was assumed that a first runway would be implemented in 2011 and a second runway in 2021, or in 2018 if a third runway were to be implemented in 2024. There is sufficient evidence from the passenger and ATM forecasting, the persistent lack of runway capacity in many packages, and the take-up of new runway capacity as it emerges to suggest that, if the objective were to maximise economic returns, additional runways ought to be brought forward from these assumed implementation dates.

Delay

14.3.11 In the foregoing calculations, no account has been taken of the costs associated with delay at capacity-constrained airports, or the possible reduction in delay costs in those scenarios that provide sufficient capacity to allow higher level of service standards to be applied.

14.3.12 At runway-constrained airports in the UK, the delay standards currently applied are:

- 10 minutes average delay in all half hours in the operating day, and
- 20/25 minutes peak delay for arrivals and departures respectively.

14.3.13 These delays impose costs on airports, airlines and passengers, not just because they encompass a higher average delay than the industry norm of 5 minutes, but because the higher average delay is associated with greater variability in delay and general unreliability in airport and airline operations. The costs imposed include the following items: the values quoted are the costs estimated to be currently incurred annually at Heathrow and Gatwick from an average 10-minute rather than 5-minute delay:

- Passengers – average delay time cost (£120 million),
- Airlines – increased aircraft and crew time costs from increased block-time allowances for delay; fuel costs for air delays; larger aircraft fleets to allow for fewer rotations; schedule disruption and recovery associated with extreme delays; missed flight compensation (£220 million),
- Airports – extended gate times require additional terminal facilities and aircraft stands (estimated capital value of £250 million), and
- Economic and social costs – restricted slot availability restricts air services and competition between airlines.

14.3.14 Thus total costs to airlines are of the order of £220 million per year and to passengers £120 million. There are additional costs to airport operators too. It is not possible to predict how these delay costs will vary between packages. In those packages with less runway capacity, there will be a tendency for delay standards to be reduced still further at the expense of throughput. In larger capacity packages, with spare runway capacity, it is more likely that tighter delay standards could be imposed. It may be that the probability of tighter standards being imposed is higher with development at new sites – Cliffe Marshes and the large Stansted options – than at Heathrow and Gatwick where reduced standards already apply.

14.3.15 The sums involved can be considerable. Taking account of costs to passengers and airlines and making no allowance for growth in either the numbers affected or the values of the different costs, a current annual value of £340 million, assumed to be saved from 2011 (when new runway capacity might be available allowing higher standards to be imposed) onwards, has a Present Value of around £3 billion. If passenger time costs were omitted and only airline resource costs were allowed for, the Present Value is £1.9 billion. In the context of the larger capacity packages, with Present Values of Benefits up to a highest estimated value of £17 billion, an additional £3 billion would add approaching 20% to benefits and would increase the benefit:cost ratios of the three runway packages variously by 0.4 to 1.0.

14.4 Financial Appraisal of Core Packages

14.4.1 The principal results of the financial appraisal, IRRs and NPVs of different airport options in each core package, are given in Table 14.11. This table also gives some indication of the sensitivity of IRRs to additional revenues from other sources. IRRs and NPVs for each package are calculated from the incremental costs and revenues generated by the options in a package over a Base Case of making maximum use of existing runway capacity.

14.4.2 Scheme costs include the costs of necessary surface access schemes. Base Estimates of NPVs and IRRs take account only of the surpluses generated by the additional capacity of an option within a package. Also shown are the effects on IRR of additional revenues from two sources: from a levy on departing passengers, either just at the airport where additional capacity is provided or at the major airports in the South East airports system; or from a different value of *x* in an RPI - *x* regulatory formula. Since the base assumption is that *x* is zero, the alternative IRRs reported in Table 14.11 imply a formula of RPI + *x*. Again the impacts of applying a different regulatory formula, either just at the airport where capacity is increased or at the major South East airports, are shown. It is assumed these additional revenue sources are in place only from 2008 to 2030.

14.4.3 The financial IRRs vary much less from one option/package to another than the economic returns. This is largely attributable to the similarity of revenues and costs per passenger (and certainly the similarity of financial surpluses per passenger) in contrast to the variation in shadow costs from airport option to option, which is a major contributor to differences in economic benefits. However, the assumed financial surplus per passenger does differ between the cases. At existing airports, the financial surplus per passenger is extrapolated from recent historic data. In the financial results reported below, Cliffe is assumed to enjoy Heathrow's revenue per passenger but to incur lower operating costs than Heathrow. A multi-runway Stansted, however, is assumed to have the same financial surplus per passenger as at present.

14.4.4 None of the new runway options reaches the target IRR of 12.5% nominal, even when the additional runway and terminal capacity is effectively fully utilised from its introduction. The highest IRR of any option is the 10.1% generated by mixed mode operation (Package 4) at Heathrow, which gains from the additional capacity without the costs of a new runway. Of the new single runway options, Option 5A, which also includes mixed mode operation on the existing Heathrow runways, has the highest IRR at 7.1%, but all single-runway packages have IRRs in the range from 5.8% to 7.1%.

14.4.5 In the larger packages, IRRs for the first runway to be built tend to be little changed from the IRRs of the same runway built on its own, principally because the demand forecasting has indicated no significant effect of subsequent runways on the demand for the first runway to be built in a package. The IRRs of second or third runways to be built, however, are often lower.

14.4.6 Levies charged on departing passengers, either at the airport where capacity is enhanced, or at all of the major South East airports will raise IRRs. A £2 levy charged at all South East airports will bring the IRRs of most options/packages up to or over 10%, as would allowing aeronautical charges to rise by 1% per year in real terms.

Table 14.11: Principal Financial Appraisal Results

Package	Airport	Runway	BASE 60y	BASE 60y	Levy @ airport (IRR)		Levy @ all airports (IRR)		RPI + x% @ airport (IRR)		RPI + x% @ all airports (IRR)	
		Order	NPV	IRR	£2	£4	£1	£2	1%	2%	0.5%	1%
3	LHR	Terminal	-466	1.5	8.1	14.1	8.2	13.8	9.1	13.2	8.6	12.2
4	LHR	Terminal	-117	10.1	16.5	24.1	15.9	22.5	14.9	18.7	14.2	17.4
5A	LHR	1st	-1,080	7.1	9.2	11.1	8.9	10.5	9.5	11.5	9.0	10.5
5B	LHR	1st	-887	6.3	8.9	11.4	8.6	10.8	9.3	11.7	8.8	10.7
5C	LHR	1st	-1,304	5.9	7.9	9.7	7.6	9.3	8.4	10.5	7.9	9.6
6	LGW	1st	-392	6.1	9.1	11.8	11.0	15.7	9.2	11.5	10.7	13.7
7	STN	1st	-873	5.8	7.5	9.0	8.4	10.8	7.8	9.5	8.6	10.7
8(1)	Cliffe	1st & 2nd	-2,202	6.8	7.8	8.8	8.0	9.1	8.3	9.8	8.3	9.6
8(2)	Cliffe	1st, 2nd & 3rd	-2,350	6.6	7.6	8.5	7.7	8.8	8.1	9.5	8.1	9.3
9	LGW	1st & 2nd	-851	6.9	8.6	10.2	9.0	11.1	8.9	10.7	9.2	11.1
10	STN	1st	-873	5.8	7.5	9.0	8.4	10.8	7.8	9.5	8.6	10.7
10	STN	2nd	-200	4.5	9.6	14.2	10.9	16.9	9.2	12.3	10.2	13.6
11	LHR	1st	-1,086	7.1	9.1	11.1	8.9	10.5	9.5	11.5	9.0	10.6
11	LGW	2nd	-192	5.0	8.3	11.1	11.1	16.8	8.2	10.7	10.5	13.8
12	LHR	1st	-1,084	7.1	9.1	11.1	9.0	10.7	9.5	11.5	9.1	10.8
12	STN	2nd	-359	5.2	7.1	8.8	8.6	11.9	7.3	9.2	8.7	11.2
13	LGW	1st	-333	6.6	9.8	12.7	12.3	17.6	9.7	12.1	11.7	14.9
13	STN	2nd	-363	5.3	7.2	9.0	8.5	11.5	7.4	9.2	8.5	10.8
14	STN	1st	-873	5.8	7.5	9.0	8.4	10.8	7.8	9.5	8.6	10.7
14	STN	2nd & 3rd	-405	5.3	8.5	11.6	9.0	12.7	8.6	11.3	9.0	11.7
15	LHR	1st	-1,085	7.1	9.1	11.1	9.0	10.7	9.5	11.5	9.2	10.9
15	LGW	2nd	-218	5.7	8.9	11.8	12.2	18.4	8.9	11.3	11.4	14.9
15	STN	3rd	-294	4.7	6.7	8.4	8.3	11.6	6.8	8.7	8.2	10.8
16	LHR	1st	-1,084	7.1	9.1	11.1	9.0	10.8	9.5	11.5	9.2	10.9
16	STN	2nd & 3rd	-629	4.6	6.2	7.7	7.3	10.0	6.6	8.5	7.6	10.0
17	LGW	1st	-353	6.4	9.5	12.4	12.1	17.3	9.5	11.9	11.7	14.9
17	STN	2nd & 3rd	-644	5.1	6.7	8.3	7.5	9.8	7.1	8.8	7.7	9.8
18	LHR	1st	-1,084	7.1	9.1	11.1	9.0	10.7	9.5	11.5	9.2	10.9
18	LGW	2nd & 3rd	-520	6.2	7.9	9.6	8.7	11.4	8.2	10.1	8.8	11.1
19	LGW	1st & 2nd	-932	6.8	8.4	10.0	8.9	11.0	8.7	10.5	9.1	11.1
19	STN	3rd	-283	4.7	6.7	8.4	8.6	12.2	6.9	8.8	8.4	11.1
20	Cliffe	1st & 2nd	-222	4.1	7.1	9.6	10.6	16.7	7.4	9.8	10.1	13.7
20	LGW	3rd	-2,218	6.7	7.8	8.7	8.0	9.1	8.3	9.7	8.3	9.6
21(1)	Cliffe	3rd & 4th	-223	8.3	13.3	18.7	12.8	17.7	12.8	16.4	12.2	15.1
21(1)	Cliffe	All	-2,435	7.0	8.1	9.0	8.1	9.1	8.7	10.2	8.4	9.7

14.5 Wider Economic Impacts

Introduction

14.5.1 The estimation of the economic costs and benefits of packages described above incorporates the principal direct economic benefits from additional airport capacity. Benefits to air passengers, both business and leisure travellers, and air freight users from the greater range of services available, increased surpluses to airport operators arising from increased passenger and freight volumes, and additional Government revenues from Air Passenger Duty have been included alongside any offsetting costs.

14.5.2 In addition to these direct benefits, increased airport capacity is expected to have wider, indirect economic impacts for the economy as a whole, or for those parts of the economy most closely linked to aviation and air transport. Recent investigations of the potential wider economic impacts of aviation have identified the following as the principal potential impacts.

- Increased airport capacity and improved air services may contribute to productivity growth across the economy as a whole;
- Foreign direct investment and trade may be enhanced by increased airport capacity and improved air services; and
- There may be benefits to or costs imposed on individual industries, tourism, for example, closely associated with aviation.

14.5.3 The focus in this study has been on the estimation of the direct impacts of increased airport capacity, as being the most tangible, most certain and most measurable indicators of the economic benefits of increased airport capacity and the enhanced air services thereby made possible. In addressing the wider economic impacts, the intention has been to explore the issues and to present an order of magnitude estimate of their potential. It is important to avoid double counting benefits: the value of improved services to business travellers themselves, for example, is already recognised in the direct user benefits. Any wider benefits have to be additional to those already estimated.

14.5.4 The starting point in the estimation of wider economic impacts is a recognition of the importance of air transport as a necessary factor of production in a modern economy, and, that if air transport is made less convenient or more costly, if passengers and freight cannot get in and out of the country easily, there will be wider economic ramifications. Among the effects of less convenient and more costly travel are passengers having to use airports other than their preferred airports or not travelling by air at all. Table 14.12 indicates for a number of packages wiith different capacities, and for an unconstrained passenger allocation, the numbers of foreign and UK business and leisure passengers in 2030 at South East airports (Heathrow, Gatwick, Stansted, Luton and London City Airport).

Table 14.12: Effects of Capacity Constraints on Trips through SE Airports

Package	Foreign Business Trips via SE Airports (millions)	UK Business Trips via SE Airports (millions)	Foreign Leisure Trips via SE Airports (millions)	UK Leisure Trips via SE Airports (millions)
2000	11.4	12.5	22.0	39.0
2030 packages				
2	33.8	32.5	37.3	41.3
5A	36.3	36.7	47.4	52.5
5B	35.6	35.8	45.5	51.2
6	34.8	33.9	43.1	46.6
7	35.7	35.7	47.4	53.2
11	36.9	37.7	50.3	56.2
12	38.5	41.0	56.9	64.1
15	39.0	40.8	58.4	66.9
Unconstrained	38.8	40.6	59.9	67.6

South East airports are Heathrow, Gatwick, Stansted, Luton and London City airports.

14.5.5 Domestic flights and international to international interliners are not included in the figures above as they are less relevant in that they will make less contribution to the national economy in terms of productivity, investment or consumer expenditure.

14.5.6 In the case of no new runways - Package 2 - 20% of UK business trips are lost from these airports compared to package 15, a less constrained scenario, and 38% of UK leisure trips are lost. 13% of foreign business trips and 36% of foreign leisure trips are lost.

Productivity Growth Across the Economy as a Whole

14.5.7 The potential effect of increased airport investment and air services on productivity across the economy can be gauged from the additional business travel facilitated, which may lead to wider productivity gains.

14.5.8 Business travel through South East airports grows at an average rate of about 4% per year for most packages, slightly more for those packages adding more capacity, with less growth in the constrained package 2. The business travel through South East airports lost with different constrained packages is summarised in Table 14.13. In the worst case, some 16% of business travel through South East airports are lost.

Table 14.13: Business Travel at Constrained South East Airports

Package	Number of Additional Runways	Business Trips through SE Airports (millions in 2030)	% of Unconstrained Business Demand Through SE Airports in 2030
2 (Base)	0	66.3	84%
5A	1	73.0	92%
5B	1	71.4	90%
6	1	68.7	87%
7	1	71.4	90%
11	2	74.6	94%
12	2	79.5	100%
15	3	79.8	100%
Unconstrained		79.4	100%

South East airports are Heathrow, Gatwick, Stansted, Luton and London City airports.

Foreign Direct Investment

14.5.9 The appropriate proxy for the effects of constrained airport capacity on foreign direct investment is the effect on the number of business trips by foreign residents through South East airports. Table 14.14 indicates the loss of these trips for the same range of packages. In the worst case, 13% of business trips by foreign residents are lost.

Table 14.14: Foreign Business Travel at Constrained South East Airports

Package	Number of Additional Runways	Foreign Business Trips through SE Airports (millions in 2030)	% of Unconstrained Foreign Business Demand Through the SE Airports in 2030
2 (Base)	0	33.8	87%
5A	1	36.3	94%
5B	1	35.6	92%
6	1	34.8	90%
7	1	35.7	92%
11	2	36.9	95%
12	2	38.5	99%
15	3	39.0	100%
Unconstrained		38.8	100%

South East airports are Heathrow, Gatwick, Stansted, Luton and London City airports

14.5.10 Foreign direct investment in 1999 has been estimated to be almost 50% of total investment, although this is a higher proportion than in previous years. Thus, there is the potential for a reasonably significant loss of investment if business travel is suppressed by a lack of runway capacity.

Impacts on Individual Industries

14.5.11 The tourism industry, both in the UK and abroad is a particular industry that would be affected by increased airport capacity. There are two elements to be considered: changes in the numbers of trips made overseas by UK residents and by overseas visitors to the UK, and their relative tourism expenditure levels.

14.5.12 The nature of leisure travel and tourism by air is changing:

- there are more short breaks,
- the average number of nights stayed per trip is coming down;
- visiting friends/relatives is becoming a larger share of the total;
- tourism is taking a smaller share; and
- there are more repeat visits.

14.5.13 These factors mean that tourism trips, and pressure on tourist facilities, will grow less quickly than leisure trips. Leisure trips by both UK and foreign residents are quite heavily suppressed (approaching 40% of trips being lost to South East airports) in capacity-constrained airport scenarios.

14.5.14 Table 14.15 shows the increase in foreign leisure travel into the South East Airports and UK leisure travel out of the South East Airports compared to the base case (package 2) in 2030 for a representative selection of packages. Note that the totals are airport terminal movements, rather than trips.

Table 14.15: Leisure Travel at Constrained South East Airports

Package	**Foreign Leisure Trips**			**UK Leisure Trips**		
	2030 trips mppa	**Reduction from unconstrained**		**2030 trips mppa**	**Reduction from unconstrained**	
		Mppa	**%**		**Mppa**	**%**
2 (base)	37.3	22.6	38	41.3	26.3	39
5A	47.4	12.5	21	52.5	15.1	22
5B	45.5	14.4	24	51.2	16.4	24
6	43.1	16,8	28	46.6	21.0	31
7	47.4	12.5	21	53.2	14.4	21
11	50.3	9.6	16	56.2	11.4	17
12	56.9	3.0	5	64.1	3.5	5
15	58.4	1.5	3	66.9	0.7	1
Unconstrained	59.9			67.6		

South East airports are Heathrow, Gatwick, Stansted, Luton and London City airports

14.5.15 Table 14.16 shows the average amount UK tourists spend abroad and the average amount foreign tourists spend in the UK, enabling a comparison to be made of the relative expenditure effects of the differences in trip making by UK and foreign leisure travellers.

Table 14.16: Expenditure Levels of UK and Foreign Tourists

Expenditure per Overseas Tourist in the UK (1999 prices)	Expenditure per UK Tourist Abroad (1999 prices)
£492.16	£408.68

Source: British Tourist Authority, Digest of Tourist Statistics no 24, Jan 2001

14.5.16 Combining the numbers of leisure trips by UK and foreign residents with 1999 expenditure levels gives an indication of how much foreign visitors to the UK would spend and the amount UK tourists abroad would spend in 2030, assuming they spend the amount in the table above and this amount does not grow in real terms. Table 14.17 indicates the additional tourist expenditure associated with each package relative to the base (package 2). The 'lost' expenditures of foreign and UK tourists are broadly similar. The current tourist expenditure imbalance is forecast to be reduced by faster growth in demand for foreign tourist trips to the UK between now and 2030 than for UK tourist trips abroad. The two markets are assumed to be equally susceptible to the higher costs and inconvenience associated woth a lack of airport capacity.

Table 14.17: Additional Tourist Expenditure with Different South East Airport Packages

Package	**Increase in Foreign Tourism Expenditure in the UK in 2030 (£m 1999 prices)**	**Increase in UK Tourism Expenditure Abroad in 2030 (£m 1999 prices)**	**Net Change: Foreign minus UK Tourism Expenditure (£m 1999 prices)**
5A	2,492	2,288	204
5B	2,039	2,021	17
6	1,435	1,081	354
7	2,486	2,439	47
11	3,216	3,042	174
12	4,827	4,654	172
15	5,211	5,230	-20

South East airports are Heathrow, Gatwick, Stansted, Luton and London City airports

14.5.17 The packages with addirtional capacity could lead to additional expenditure in the UK tourism industry. Tourism Expenditure in the UK in 1999 was £12.5bn (Source: British Tourist Authority, Digest of Tourist Statistics no 24, Jan 2001). Thus, considering solely the addition to tourism expenditure in the UK, package 15 increases this amount by around 40% by 2030. This could be at risk if additional airport capacity is not provided. Some compensation would come from the additional tourist expenditure within the UK by UK residents making fewer trips overseas.

14.6 CO_2 Impacts

14.6.1 Broad estimates of the CO_2 implications have been made for three SERAS packages chosen to represent a range of the capacity scenarios being appraised in SERAS. The approach used is outlined in chapter 6 It measures CO_2 at south east airports and for unsatisfied air travel demand which has its origin or destination in the south east.

14.6.2 Table 14.18 below illustrates the results of the CO_2 assessment. Results are provided by package as total CO_2 emissions (tonnes) and as relative changes over package 2 (taken as the base case). Results are also provided for aircraft and surface access separately, by movement type where feasible. Caution must be applied in using the separate data, as the methods used to estimate different movement types vary greatly. The uncertainties attached to the separate data also therefore vary greatly.

Table 14.18: Estimated Carbon Dioxide Emissions - 2030

CO_2 source type	**CO_2 emissions (tonnes per year)**			**Percentage change over Package 2**	
	Package 2	**Package 5c**	**Package 18**	**5c**	**18**
Surface Access Sources					
South East generated	1,870,260	1,760,303	1,560,130	-6%	-17%
Airport Sources ('UK ownership')					
International passenger traffic	27,949,902	33,601,034	45,118,754	+20%	+61%
Domestic passenger traffic	906,638	967,313	1,074,073	+7%	+18%
International freight traffic	762,546	781,079	790,403	+2%	+4%
Domestic freight traffic	163,741	168,163	170,388	+3%	+4%
Total CO_2					
Total surface access	1,870,260	1,760,303	1,560,130	-6%	-17%
Total aircraft	29,782,827	35,517,590	47,153,619	19%	58%
Grand total	**31,653,087**	**37,277,893**	**48,713,749**	**18%**	**54%**

14.6.3 Package 2 is the base case with maximum use of the existing runways, but no new runways. Package 5C adds a new runway at Heathrow and is a middle range capacity scenario. Package 18 is a large capacity scenario adding a new runway at Heathrow and two new runways at Gatwick.

14.6.4 Results show that as airport capacity increases, the overall CO_2 burden from SERAS increases. This effect is dominated by aircraft emissions (including ground-based emissions). For aircraft emissions freight remains a very small proportion of the total CO_2 emissions. For passenger aircraft, domestic and international-related CO_2 increases with capacity. Emissions from international passenger aircraft are larger (primarily because of cruise distance emissions), and also exhibit larger relative increases of 20% to over 60% compared to the base. Only 50% of total emissions from international flights from SERAS airports have been counted as being attributable to UK policy.

14.6.5 Overall, surface access impacts reduce as capacity increases. This is because surface access CO_2 is dominated by displaced movements. In capacity-constrained scenarios, more passengers would travel between the South East and regional airports rather than flying direct from the South East. CO_2 results for such displaced movements must be interpreted with caution given the limited data available to gauge displacement-related emissions. Leaving displaced movements aside, surface access emissions of CO_2 exhibit little change between packages.

14.7 Runway Size Sensitivity Tests

Options E4, E6 and E8 at Heathrow

14.7.1 Options E4, E6 and E8 each add an additional runway at Heathrow (modelled as single additional runways in packages 5B, 5A and 5C respectively). The new runways and the way in which new and existing runways are used differ between options, giving different capacities. The costs of the options differ. The key characteristics of the options are summarised in Table 14.19.

Table 14.19: Key Characteristics of Runway Options E4, E6 and E8 at Heathrow

	Option E4	Option E6	Option E8
ATM capacity	655,000	754,000	638,000
Passenger capacity, mppa	112	128	121
Capital cost, £ billion	4.0	5.1	5.1
Capital cost per mppa of additional capacity, £ million	153	123	146

14.7.2 Option E4 has the lowest capacity and is the cheapest to build. Option E6 has the lowest cost per unit of additional capacity since it maximises capacity through full mixed mode operation on the exisiting runways.

14.7.3 The principal demand forecasts associated with these options, in packages 5A, 5B and 5C, are summarised in Table 14.20.

Table 14.20: Demand Forecasts for Packages 5A, 5B and 5C, mppa

		2011	2015	2020	2025	2030
Option E6 (Package 5A)						
SE Airports	Heathrow	106	131	131	130	130
	Other SE airports [1]	69	72	85	94	105
Regional Airports		106	125	154	189	205
Passengers Lost to UK System		7	7	32	41	61
Option E4 (Package 5B)						
SE Airports	Heathrow	109	114	116	115	115
	Other SE airports [1]	69	75	88	105	112
Regional Airports		104	128	157	187	211
Passengers Lost to UK System		6	18	41	47	63
Option E8 (Package 5C)						
SE Airports	Heathrow	105	110	118	121	125
	Other SE airports [1]	69	77	89	101	113
Regional Airports		106	128	155	186	208
Passengers Lost to UK System		8	20	40	46	55

1 Other south east airports are Gatwick, Stansted, Luton, London City, Southampton and Norwich

14.7.4 Package 5A (Option E6) has the highest capacity at Heathrow and that capacity is fully utilised. There is more use made of other south east airports, principally Luton, with the lower capacity Heathrow options and more passengers are lost to the UK airport system. A little more use is made of regional airportsTowards the end of the forecasting period the differences between options are less clear-cut as unconstrained demand for south east airports exceeds the capacity provided in any package.

14.7.5 The economic performance of the three packages is summarised in Table 14.21.

Table 14.21: Economic Impacts of Packages 5A, 5B and 5C, £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
5A	3,168	8,609	5,442	2.72	130
5B	2,406	5,321	2,916	2.21	112

5C	3,101	6,254	3,154	2.02	90

14.7.6 Package 5A (Option E6) generates the highest net benefit, the highest benefit:cost ratio and the highest net benefit per mppa of additional capacity provided. It does this in part by maximising the use of the existing and new runways at little extra cost through mixed mode operation and by the provision of a lower-cost short runway.

14.7.7 The principal indicators of the financial performance of the three options are summarised in Table 14.22. Package 5A (Option E6) has the highest IRR, at 7.1% assuming no increase in real terms in charges at Heathrow.

Table 14.22: Principal Financial Indicators for Packages 5A, 5B and 5C

Package	NPV	IRR
5A	-1,080	7.1
5B	-887	6.3
5C	-1,304	5.9

Packages 15 and 16 with Options E4 and E6 at Heathrow

14.7.8 The core tests of packages 15 and 16 include Option E6 at Heathrow: tests have been run that substitute Option E4 for E6. The effects on demand met at south east airports is summarised in Table 14.23.

Table 14.23: Packages 15 and 16 with Option E4: Demand Forecasts

		2016	2020	2025	2030
Package 15 (Option E6)					
SE Airports	Heathrow	132	132	126	131
	Other SE airports [1]	74	96	134	156
Regional Airports		130	153	176	194
Passengers Lost to UK System		11	21	18	20
Package 15 (Option E4)					
SE Airports	Heathrow	116	115	116	116
	Other SE airports [1]	77	100	141	160
Regional Airports		134	154	177	199
Passengers Lost to UK System		20	33	20	26
Package 16 (Option E6)					
SE Airports	Heathrow	132	130	132	132
	Other SE airports [1]	74	106	129	149
Regional Airports		130	151	175	198
Passengers Lost to UK System		11	15	18	22
Package 16 (Option E4)					
SE Airports	Heathrow	116	116	116	116
	Other SE airports [1]	77	118	142	159

		2016	2020	2025	2030
Regional Airports		134	151	178	200
Passengers Lost to UK System		20	17	18	26

1 Other south east airports are Gatwick, Stansted, Luton, London City, Southampton and Norwich

14.7.9 The lower capacity available with Option E4 rather than Option E6 leads to more use of other south east airports, more use of regional airports and more passengers being lost to the UK airports system. By 2030, with Package 15, when additional runways are also provided at Gatwick and Stansted, these three responses are are similar: there are 4 mppa more using other south east airports, 5 mppa more using regional airports and 6 mppa more lost to the UK airports system. With Package 16, which adds more capacity at other south east airports than Package 15, 10 mppa more use other south east airports, only 2 mppa more use regional airports and 4 mppa more are lost to the UK airports system.

14.7.10 The economic results of these packages are summarised in Table 14.24.

Table 14.24: Economic Results of Packages with Options E4 and E6 at Heathrow , £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
15 (E6)	4,966	17,428	12,463	3.51	119
15 (E4)	4,302	14,305	10,004	3.33	113
16 (E6)	5,103	17,528	12,425	3.44	114
16 (E4)	4,432	14,177	9,745	3.20	105

14.7.11 Option E4 reduces costs by approaching £700 million compared to E6, but the lower capacity means that benefits are reduced substantially, by over £3,000 million. The versions with Option E4 therefore have lower benefit:cost ratios and lower benefits per unit of capacity provided than the E6 versions.

14.7.12 The principal financial indicators of incorporating Option E4 rather than E6 in packages are summarised in Table 14.25. Option E6 generates a higher IRR than Option E4. There is no clear, sigificant effect on the IRRs of subsequent runways of substituting one Heathrow runway for another.

Table 14.25: Financial Results of Packages with Options E4 and E6 at Heathrow, £ million

Package	Option E6			Option E4		
		NPV	IRR %		NPV	IRR %
15	LHR E6	-1,085	7.1	LHR E4	-891	6.3

	LGW	-218	5.7	LGW	-271	4.9
	STN	-294	4.7	STN	-291	4.8
16	LHR E6	-1,084	7.1	LHR E4	-887	6.3
	STN	-629	4.6	STN	-644	4.8

14.8 Opening Year Sensitivity Tests

14.8.1 The variants to the opening years of new runways in Packages 15, 16 and 18 are summarised in Table 14.26. They include:

- bringing forward runways and adding a second additional runway at Stansted to Package 15,
- advancing the Stansted runway over the Gatwick runway in package 15,
- advancing Stansted runways over the Heathrow runway in Package 16, and
- bringing forward the Gatwick runway in Package 18.

Table 14.26: Variants to Runway Opening Years

Core Package	/ersion	1st runway	2nd runway	3rd runway	4th runway
15	Core	LHR E6 2011	LGW 1 2018	STN 5 2024	
15	Extra Stansted	LHR E6 2011	LGW 1 2016	STN 5 2021	STN 11 2026
15	Core with E4 at Heathrow	LHR E4 2011	LGW 1 2018	STN 5 2024	
15	With Stansted before Gatwick (2026)	LHR E4 2011	STN 5 2018	LGW 1 2026	
15	With Stansted before Gatwick (2024)	LHR E4 2011	STN 5 2018	LGW 1 2024	
16	Core with E4 at Heathrow	LHR E4 2011	STN 5 2018	STN 11 2024	
16	With Stansted before Heathrow	STN 5 2011	STN 11 2021	LHR E4 2021	
18	Core	LHR E6 2011	LGW 2018	LGW 2024	
18	With Gatwick brought forward	LHR E6 2011	LGW 2016	LGW 2021	

14.8.3 The effects of these variations on the overall use of south east and regional airports in different years are summarised for the Package 15 variants in Table 14.27 and for the Package 16 and 18 variants in Table 14.30.

Table 14.27: Demand Forecasts for Package 15 Variants, mppa

		2011	2015	2020	2025	2030
Package 15 Core						
SE Airports	Heathrow	106	131	132	126	131
	Other SE airports [1]	69	71	96	134	156
Regional Airports		106	126	153	176	194
Passengers Lost to UK System		7	7	21	18	20
Package 15 Extra Stansted runway						
SE Airports	Heathrow	106	131	131	128	131
	Other SE airports [1]	69	71	97	135	156
Regional Airports		107	126	153	173	194
Passengers Lost to UK System		6	7	21	18	20
Package 15 E4 at Heathrow						
SE Airports	Heathrow	109	114	115	116	116
	Other SE airports [1]	68	76	100	141	160
Regional Airports		105	127	154	177	199
Passengers Lost to UK System		6	18	33	20	26
Package 15 with Stansted before Gatwick (2026)						
SE Airports	Heathrow	109	114	116	116	116
	Other SE airports [1]	68	76	118	133	157
Regional Airports		105	127	151	179	198
Passengers Lost to UK System		6	18	17	26	30
Package 15 with Stansted before Gatwick (2024)						
SE Airports	Heathrow	109	114	116	115	116
	Other SE airports [1]	68	76	118	145	156
Regional Airports		105	127	151	173	199
Passengers Lost to UK System		6	18	17	21	30

1 Other south east airports are Gatwick, Stansted, Luton, London City, Southampton and Norwich

14.8.4 The first Package 15 sensitivity test advances the Gatwick runway from 2018 to 2016 and adds two new runways at Stansted – in 2021 and 2026 – as opposed to just one in 2024. By 2030, the principal forecasts in Table 14.27 are the same as for the core run, but there are minor differences in 2020 and 2025. Some additional use is made of the additional capacity at Gatwick, brought forward from 2018 to 2016 (Gatwick serves 5 mppa more in 2016 and 10 mppa more in 2017, but only 2 mppa more by 2019). The extra capacity at Stansted between 2021 and 2024 serves around 20 mppa more each year, but after 2024 the two sets of Stansted forecasts are very similar. The second additional runway at Stansted is not obviously made use of in the period to 2030. By 2030, the three runway Stansted is serving 78.5 mppa and the two runway Stansted 76.8 mppa. But the two runway Stansted is almost at its ATM capacity by 2030.

14.8.5 The economic results are summarised in Table 14.28. Advancing runway capacity adds more to benefits than it does to costs. Costs increase by around £700 million and benefits by around £1,700 million, so net benefits increase by around £1,000 million.

Table 14.28: Economic Results of Package 15 with Additional Stansted Runway, £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
15	4,966	17,428	12,463	3.51	119
15 extra STN runway	5,682	19,106	13,424	3.36	108

14.8.6 The second Package 15 sensitivity test adds a runway at Stansted rather than Gatwick as the second runway in 2018 and defers the Gatwick runway to either 2026 or 2024. The same runways are included in each test but at different times. By 2030, the major forecasts are very similar, with 272 to 276 mppa using Heathrow and other south east airports and 198 to 199 mppa using regional airports. The second Stansted runway adds more capacity than the second Gatwick runway so that, in 2020, 234 mppa are using south east airports in the sensitivity test compared with 215 mppa in the core version.

14.8.7 The economic results are summarised in Table 14.29. Net benefits are highest with the Stansted runway brought forward to 2018 and the Gatwick runway introduced in 2024.

Table 14.29: Economic Results of Package 15 (Option E4 at Heathrow) with Stansted Runway Advanced, £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
Package 15 (E4)					
	4,302	14,305	10,004	3.33	113
Package 15 (E4) with STN runway advanced to 2018 and LGW runway in 2026					
	4,353	13,854	9,501	3.18	107
Package 15 (E4) with STN runway advanced to 2018 and LGW runway in 2024					
	4,409	14,574	10,165	3.31	115

14.8.8 The Package 16 variant brings forward the Stansted runways (from 2018 and 2024 to 2011 and 2021) and defers the Heathrow runway (Option E4) from 2011 to 2021, to allow airlines and the airport operator more time to achieve the noise and air quality measures that may be needed to support an additional runway at Heathrow. The Package 18 variant brings forward the two Gatwick runways, from 2018 and 2014 to 2016 and 2021. The forecasts are summarised in Table 14.30.

Table 14.30: Demand Forecasts for Package 16 and 18 Variants, mppa

		2011	2015	2020	2025	2030
Package 16 E4 at Heathrow						
SE Airports	Heathrow	109	114	116	116	116
	Other SE airports [1]	68	76	118	142	159
Regional Airports		105	127	151	178	200
Passengers Lost to UK System		6	18	17	18	26
Package 16 Stansted before Heathrow						
SE Airports	Heathrow	72	73	87	115	116
	Other SE airports [1]	95	115	129	152	163
Regional Airports		108	126	152	171	193
Passengers Lost to UK System		13	21	34	16	29
Package 18 Core						
SE Airports	Heathrow	106	131	128	131	131
	Other SE airports [1]	69	71	105	131	155
Regional Airports		106	126	152	177	199
Passengers Lost to UK System		7	7	17	15	16
Package 18 with Gatwick brought forward						
SE Airports	Heathrow	106	131	132	128	131
	Other SE airports [1]	69	71	105	134	155
Regional Airports		107	126	151	177	199
Passengers Lost to UK System		6	7	14	15	16

1 Other south east airports are Gatwick, Stansted, Luton, London City, Southampton and Norwich

14.8.9 Bringing forward the Stansted runway instead of the Heathrow runway in Package 16 leads to fewer passengers using south east airports 2011, 2015 and 2020. The numbers of passengers using regional airports does not increase, but more passengers are lost to the UK airports system. More use is made of the advanced Gatwick runways in Package 18, particularly between 2016 and 2018. In 2017, there are some 10 mppa more passengers at Gatwick, modt of whom would either use other south east airports or not travel by air without this extra capacity.

14.8.10 The economic results of these tests are summarised in Table 14.31. Deferring the Heathrow runway and advancing the Stansted runways in Package 16 reduces benefit but reduces costs by a greater amount, thereby increasing net benefit. Advancing the Gatwick runways in Package 18 also increases net benefit.

Table 14.31: Economic Results of Variants to Packages 16 and 18, £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
Package 16					
	4,432	14,177	9,745	3.20	105

Package 16 with Stansted runways advanced and Heathrow runway delayed					
	4,101	14,082	9,981	3.43	107
Package 18					
	5,155	18,537	13,382	3.60	121
Package 18 with Gatwick runways advanced					
	5,417	18,878	13,461	3.48	122

14.9 Additional Runway Sensitivity Tests

14.9.1 A variant of Package 15, the results of which were summarised in Tables 14.27 and 14.28 added a runway at Stansted to that package. Two further sensitivity tests which added runways to existing packages are described in Table 14.32. A runway at Heathrow has been added to Package 8 and a runway at Stansted to package 18.

Table 14.32: Additional Runway Sensitivity Tests

Core Package	/ersion	1st runway	2nd runway	3rd runway	4th runway
8	Core	Cliffe 2011	Cliffe 2011		
8	Core plus Heathrow	Cliffe 2011	Cliffe 2011	LHR E4 2021	
8	Heathrow first	LHR E4 2011	Cliffe 2021	Cliffe 2021	
18	Core	LHR E6 2011	LGW 2018	LGW 2024	
18	plus Stansted	LHR E6 2011	LGW 2016	LGW 2021	STN 5 2026

14.9.3 The demand forecasts for these sensitivity tests are summarised at the level of south east and regional airports in Table 14.33.

Table 14.33: Demand Forecasts for Additional Runway Variants, mppa

		2011	2015	2020	2025	2030
Package 8 Core						
SE Airports	Heathrow	72	76	81	86	87
	Cliffe Marshes	33	58	74	78	79
	Other SE airports [1]	67	65	72	79	89

		2011	2015	2020	2025	2030
Regional Airports		108	126	152	184	216
Passengers Lost to UK System		8	10	23	27	30
Package 8 core plus Heathrow E4 runway						
SE Airports	Heathrow	72	77	91	114	116
	Cliffe Marshes	33	56	76	77	78
	Other SE airports [1]	66	65	70	74	80
Regional Airports		107	125	151	175	198
Passengers Lost to UK System		10	12	14	14	29
Package 8 with Heathrow runway before Cliffe runways						
SE Airports	Heathrow	109	114	116	116	116
	Cliffe Marshes	0	0	0	68	75
	Other SE airports [1]	68	75	88	79	84
Regional Airports		105	127	155	175	198
Passengers Lost to UK System		6	19	43	16	28
Package 18 Core						
SE Airports	Heathrow	106	131	128	131	131
	Other SE airports [1]	69	71	105	131	155
Regional Airports		106	126	152	177	199
Passengers Lost to UK System		7	7	17	15	16
Package 18 with Stansted runway						
SE Airports	Heathrow	106	131	132	128	131
	Other SE airports [1]	69	71	105	134	163
Regional Airports		107	126	151	177	193
Passengers Lost to UK System		6	7	14	15	14

1 Other south east airports are Gatwick, Stansted, Luton, London City, Southampton and Norwich

14.9.4 The economic results for these tests are summarised in Table 14.34. The economic results of Package 8 are considerably enhanced by the addition of a Heathrow runway and further enhanced by bringing it forward in advance of the Cliffe runways. The addition of a Stansted runway to Package 18 adds to net benefits and the benefit:cost ratio.

Table 14.34: Economic Results of Additional Runway Variants, £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
Package 8 Core					
	5,916	6,912	996	1.17	13
Package 8 Core plus Heathrow E4 runway					
	7,232	13,238	6,006	1.83	58
Package 8 with Heathrow runway before Cliffe runways					
	5,780	14,443	8,662	2.50	84
Package 18 Core					
	5,417	18,878	13,461	3.48	122
Package 18 with Stansted runway					
	6,258	24,154	17,896	3.86	114

14.10 Seeding Sensitivity Tests

14.10.1 The core versions of the forecasting model runs for packages containing options at Cliffe or large developments at Stansted were seeded with air services as described in Chapter 6 and in the relevant airport chapters – 9 and 11. As indicated in Table 14.35, the practice of seeding encourages the build-up of forecast traffic at the seeded airport to be faster than it otherwise be. Unseeded Cliffe options reach around 72 mppa by 2030, but with seeding the forecast increases to 110 mppa. At Stansted, where the seeding was less, the effect of seeding the largest option in Package 14 is to increase use of the aiport from 115 mppa to 122 mppa.

Table 14.35: Comparison of Seeded and Unseeded Passenger Forecasts, mppa

Year	Stansted				Cliffe			
	Package 7		Package 14		Package 8		Package 21	
	Unseeded	Seeded	Unseeded	Seeded	Unseeded	Seeded	Unseeded	Seeded
2011	30.3	47.4	30.7	47.8	8.0	33.0	8.0	33.0
2015	45.7	64.3	46.0	64.2	31.0	58.4	31.1	58.4
2020	57.0	68.8	78.3	90.0	46.7	74.0	46.9	74.0
2025	60.8	71.7	99.6	115.4	58.7	78.1	60.5	104.2
2030	62.8	74.4	114.9	121.5	70.4	79.4	71.8	109.7

14.10.2 The wider effects of seeding forecasts, on forecast use of south east airports and regional airports is summarised in Table 14.36.

Table 14.36: Effects of Seeding on Demand Forecasts, mppa

	2011	2015	2020	2025	2030
Package 7 Unseeded					
SE Airports	157	179	206	221	235
Regional Airports	112	132	157	187	210
Passengers Lost to UK System	19	24	39	46	56
Package 7 Seeded					
SE Airports	168	189	210	225	240
Regional Airports	108	127	155	197	207
Passengers Lost to UK System	12	19	37	32	54
Package 8 Unseeded					

	2011	2015	2020	2025	2030
SE Airports	156	181	212	233	250
Regional Airports	112	135	155	188	204
Passengers Lost to UK System	20	19	35	33	47
Package 8 Seeded					
SE Airports	172	199	227	243	255
Regional Airports	108	126	152	184	216
Passengers Lost to UK System	8	10	23	27	30
Package 14 Unseeded					
SE Airports	157	179	220	246	265
Regional Airports	112	132	153	192	216
Passengers Lost to UK System	19	24	29	16	20
Package 14 Seeded					
SE Airports	168	189	225	251	268
Regional Airports	108	126	153	182	205
Passengers Lost to UK System	12	20	24	21	28
Package 21 Unseeded					
SE Airports	156	181	212	234	253
Regional Airports	112	135	155	188	203
Passengers Lost to UK System	20	19	35	32	45
Package 21 Seeded					
SE Airports	172	199	227	265	278
Regional Airports	108	126	152	177	199
Passengers Lost to UK System	8	10	23	12	24

South east airports are Heathrow, Gatwick, Stansted, Luton, London City, Southampton and Norwich, and Cliffe where relevant

14.11 Environmental Policy Sensitivity Tests

14.11.1 The environmental policy sensitivity tests are based on the principle that aviation should bear its full costs, including external costs. Analysis has confirmed that of the principal environmental costs associated with aviation – noise, local air quality, global warming – it is global warming that imposes the highest cost. Given the uncertainty in measuring and, particularly in valuing environmental impacts, alternative levels of environmental tax have been assumed. These are modelled as leading progressively to a reduction in overall air travel demand of 5% and 10% by 2016. The effects have been modelled for selected packages. Table 14.37 shows the effects in 2015 and 2030 on the overall allocation of demand to south east and regional airports for these packages with no taxes and with taxes generating 5% and 10% demand reductions.

Table 14.37: Effects of Environmental Policy Tests on Demand Forecasts, mppa

	2015			2030		
	0%	5%	10%	0%	5%	10%
Unconstrained demand						
SE Airports	206	196	186	306	291	276
Regional Airports	129	122	115	195	185	175
Total unconstrained demand	335	318	301	501	476	451
Package 2						
SE Airports	163	158	155	198	198	198
Regional Airports	134	128	126	230	211	195
Passengers Lost to UK System	38	32	20	73	67	58
Package 14						
SE Airports	189		178	268		257
Regional Airports	126		114	205		180
Passengers Lost to UK System	20		9	28		14
Package 15 (with Option E4 at Heathrow)						
SE Airports	190	186		276	267	
Regional Airports	127	120		199	185	
Passengers Lost to UK System	18	12		26	24	
Package 15 (with Option E6 at Heathrow)						
SE Airports	202	193		287	274	
Regional Airports	125	119		194	183	
Passengers Lost to UK System	7	6		20	19	
Package 15 (with Stansted in 2018)						
SE Airports	190		180	286		268
Regional Airports	127		114	192		171
Passengers Lost to UK System	18		7	23		12
Package 16 (with Option E4 at Heathrow)						
SE Airports	190	186	180	275	269	255
Regional Airports	127	120	114	200	189	178
Passengers Lost to UK System	18	12	7	26	18	18
Package 19						
SE Airports	183	181		282	272	
Regional Airports	131	122		198	186	
Passengers Lost to UK System	21	15		21	18	
Package 21						
SE Airports	199	189	178	278	275	256
Regional Airports	126	120	114	198	188	182
Passengers Lost to UK System	10	9	9	25	13	13

South east airports are Heathrow, Gatwick, Stansted, Luton, London City, Southampton and Norwich, and Cliffe where relevant

14.11.2 The results for the constrained Package 2 are that in 2030 south east airports are operating at capacity and serve 198 mppa whether there is no demand reduction, or 5% or 10% demand reduction. In this constrained south east scenario, the 10% demand reduction causes a reduction of 35 mppa (15%) in the use of regional airports, of which 13 mppa is accounted for by reduced overspill from London, the east and south east. There is also a reduction of 15 mppa (21%) in the number of passengers lost to the UK airport system.

14.11.3 In the higher capacity packages (Packages 14, 15, 16 and 21), the 10% demand reduction in 2030 causes a reduction of 11 – 22 mppa in the use of south east airports, a larger reduction of 16 – 25 mppa in the use of regional airports and a reduction of 8 – 14 mppa in the number of passengers lost to the UK airport system. In percentage terms, the reduction in use of south east airports in 2030 when overall demand is reduced by 10% ranges between 0% (Package 2), 4% (Package 14) and 8% (Package 21).

14.11.4 Economic appraisal results for a number of the environmental tests are summarised in Table 14.38. The reduction in demand associated with environmental taxes causes a reduction in benefits and typically a small reduction in costs, as the costs of terminal capacity are pushed further into the future. Benefit:cost ratios fall with environmental taxes, typically by 0.2 – 0.3 percentage points with a 5% reduction in demand and by 0.4 – 0.5 percentage points with a 10% reduction in demand.

Table 14.38: Economic Results of Environmental Tests, £ million

Package	PV costs	PV benefits	Net benefits	Benefit:cost ratio	Net benefit per mppa of additional capacity
Package 14					
	3,437	11,104	7,667	3.23	82
Package 14: 10% demand reduction					
	3,380	9,613	6,233	2.84	66
Package 15 (E4 at Heathrow)					
	4,302	14,305	10,004	3.33	113
Package 15 (E4 at Heathrow): 5% demand reduction					
	4,137	12,965	8,828	3.13	100
Package 15 (E6 at Heathrow)					
	4,966	17,428	12,463	3.51	119
Package 15 (E6 at Heathrow): 5% demand reduction					
	4,975	16,262	11,288	3.27	108
Package 16 (E4 at Heathrow)					
	4,432	14,177	9,745	3.20	105
Package 16 (E4 at Heathrow): 5% demand reduction					
	4,382	12,693	8,312	2.90	76
Package 16 (E4 at Heathrow): 10% demand reduction					
	4,212	11,479	7,267	2.73	78

Package 21					
	7,059	10,595	3,537	1.50	31
Package 21: 5% demand reduction					
	6,931	9,618	2,687	1.39	24
Package 21: 10% demand reduction					
	6,732	9,335	2,603	1.39	23

15 Air Freight

15.1 Introduction

15.1.1 The South East handled 80% of UK air freight in 2000, around 80% of which was carried in the hold of passenger aircraft. Heathrow is the UK's largest freight airport, with Gatwick the second largest. Together these two airports handled 70% of total UK tonnage in 2000. Over 90% of the freight throughput at Heathrow and Gatwick is carried on passenger aircraft. This proportion has increased over the last decade as dedicated freighters have been pushed out of Heathrow and Gatwick due to capacity constraints (freighters tend to be seen as secondary traffic at capacity-constrained airports as they generate less revenue per movement than passenger flights). The growth in bellyhold freight, freight carried in the hold of a passenger aircraft, has followed the growth in long haul passenger traffic, increasing by 85% over the last decade. Stansted and Luton have few long haul passenger services and so carry very little bellyhold traffic.

15.1.2 The growth in South East freighter traffic, freight carried on dedicated freighters, has been concentrated at Stansted, which has experienced a four-fold increase in traffic since 1990. This reflects the development of a hub for the rapidly developing express parcels market at the airport. Historic bellyhold and freighter traffic at the main South East airports is shown in Table 15.1.

15.1.3 The remainder of this chapter details the freight forecasts for the development options at each airport and draws some conclusions. The forecasts are taken from DTLR's Freight Forecasting Model. The base year for the freight forecasts is 1998. 2000 actual figures are included in the text for context. Forecasts are presented separately for bellyhold and freighter traffic and for 2015 and 2030. Further details on the forecasting approach are given in Chapter 6 The implications of the forecast growth in freight traffic for runway capacity and night-time movement restrictions in the South East are discussed at the end of the chapter.

Table 15.1: Freight Traffic at South East Airports 1990 to 2000

	1990	1995	2000	Average growth (%pa)
Bellyhold, '000 tonnes				
Heathrow	606	947	1209	7%
Gatwick	194	172	289	4%
Stansted	0	5	3	27%
Luton	2	1	1	-10%
Other South East	1	0	0	-2%
South East Total	**803**	**1124**	**1502**	**6%**
All UK	**868**	**1209**	**1607**	**6%**
South East as % of UK	**92%**	**93%**	**93%**	
Freighter, '000 tonnes				
Heathrow	89	85	98	1%
Gatwick	26	58	30	1%
Stansted	32	86	165	18%
Luton	20	13	35	6%
Other South East	13	10	33	10%
South East Total	**181**	**252**	**361**	**7%**
All UK	**325**	**509**	**719**	**8%**
South East as % of UK	**56%**	**49%**	**50%**	
Freighter ATM, '000 ATMs				
Heathrow	6.9	3.6	3.1	-8%
Gatwick	3.2	5.5	3.4	1%
Stansted	5.5	9.6	14.0	10%
Luton	9.8	3.5	6.1	-5%
Other South East	7.6	4.0	2.8	-10%
South East Total	**32.9**	**26.3**	**29.3**	**-1%**
All UK	**106.5**	**102.3**	**110.4**	**0%**
South East as % of UK	**31%**	**26%**	**27%**	

Source: CAA

15.2 Heathrow

15.2.1 Heathrow handled 1.2 million tonnes of freight in 1998, 1.1 million tonnes of which were bellyhold. The remaining 100,000 tonnes were carried by 3,300 freighters. By 2000 there has been a slight increase in total freight throughput to 1.3 million tonnes, but a decline in freighters to 3,100 movements.

15.2.2 A cap of 3,000 freighter movements has been placed on freighter ATM forecasts to reflect the increasing marginalisation of freighter traffic at Heathrow.

15.2.3 Under the maximum use of existing runways scenario, freight traffic growth is forecast to continue, with total freight traffic increasing in line with passenger volumes to 1.7 million tonnes in 2015 and 2.0 million tonnes in 2030. Freighter traffic is forecast to fall to 2,200 movements in 2015 and 900 movements in 2030 as runway constraints become tighter. A further small increase in freight traffic is forecast under both partial and full mixed mode operation.

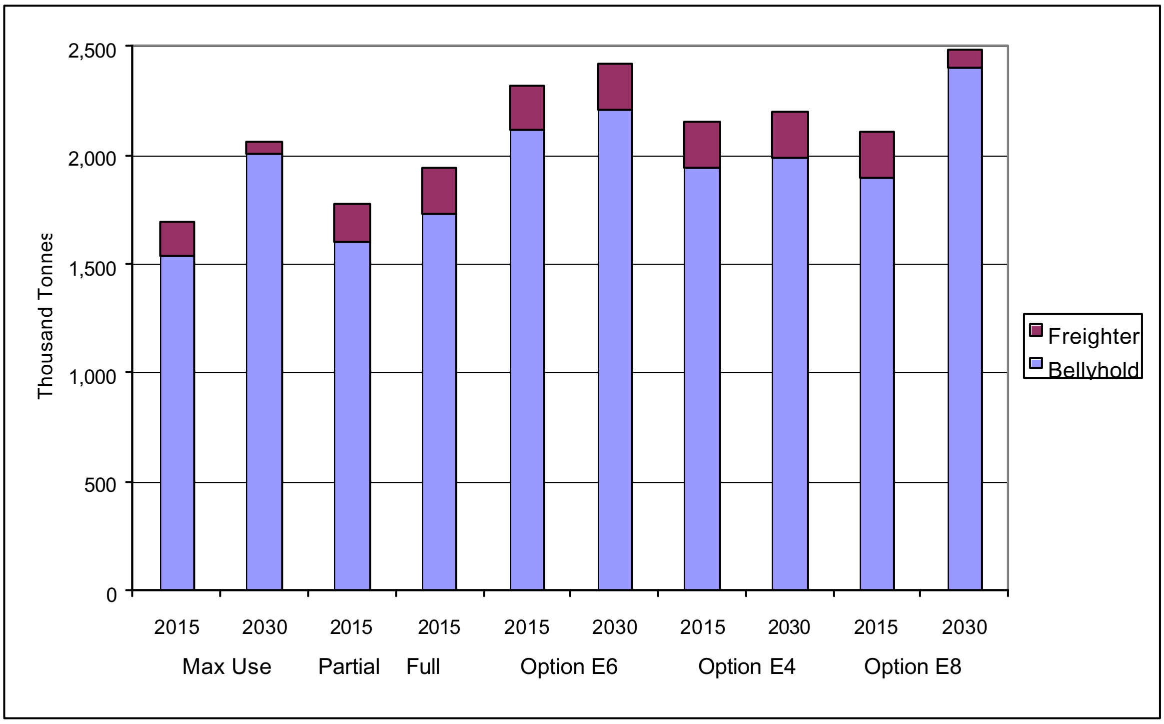
15.2.4 The introduction of a new runway at Heathrow would provide an increase in freight traffic to 2.2 million tonnes in 2015. The growth in freight traffic after 2015 would be less marked. Under Options E6 and E4 passenger traffic in 2030 would be constrained by terminal capacity, limiting the growth in bellyhold freight. Under Option E8, passenger traffic would not be terminal-constrained, allowing bellyhold traffic to increase to 2.4 million tonnes.

15.2.5 Freight forecasts for Heathrow are shown in Table 15.2 and Figure 15.1.

Table 15. 2: Heathrow Freight Traffic Forecasts ('000 tonnes) and Freighter ATMs (000)

Option	**Max Use**		**E1 (Partial mixed mode)**		**1 (Full mixed mode)**		**E6**		**E4**		**E8**	
	2015	**2030**	**2015**	**2030**	**2015**	**2030**	**2015**	**2030**	**2015**	**2030**	**2015**	**2030**
Bellyhold freight ('000 tonnes)	1541	2004	1602	2105	1729	2206	2111	2204	1941	1985	1894	2403
Freighter ('000 tonnes)	153	60	177	60	209	64	210	210	210	210	210	84
Total ('000 tonnes)	**1694**	**2064**	**1779**	**2165**	**1938**	**2270**	**2321**	**2414**	**2151**	**2195**	**2104**	**2487**
Freighter ATMs ('000)	2.2	0.9	2.5	0.9	3.0	0.9	3.0	3.0	3.0	3.0	3.0	1.2

Figure 15.1: Heathrow Freight Traffic Forecasts



15.3 Gatwick

15.3.1 Gatwick handled 320,000 tonnes of freight in 2000, 90% of which was bellyhold. The predominance of bellyhold traffic is expected to continue in the future with freight growing in line with passenger traffic. By 2015, under the maximum use of the existing runway scenario, freight traffic at Gatwick is forecast to grow to 380,000 tonnes, 340,000 tonnes of which would be bellyhold traffic.

15.3.2 Both the new runway options are forecast to increase freight traffic, again driven by growth in long haul passenger movements. Under Option 1, with close parallel runways, freight traffic is forecast to grow to 0.4 and 0.6 million tonnes in 2015 and 2030, respectively. The provision of two new runways under Option E1, is forecast to lead to a further increase in freight to 0.9 million tonnes in 2030, a threefold increase on existing volumes.

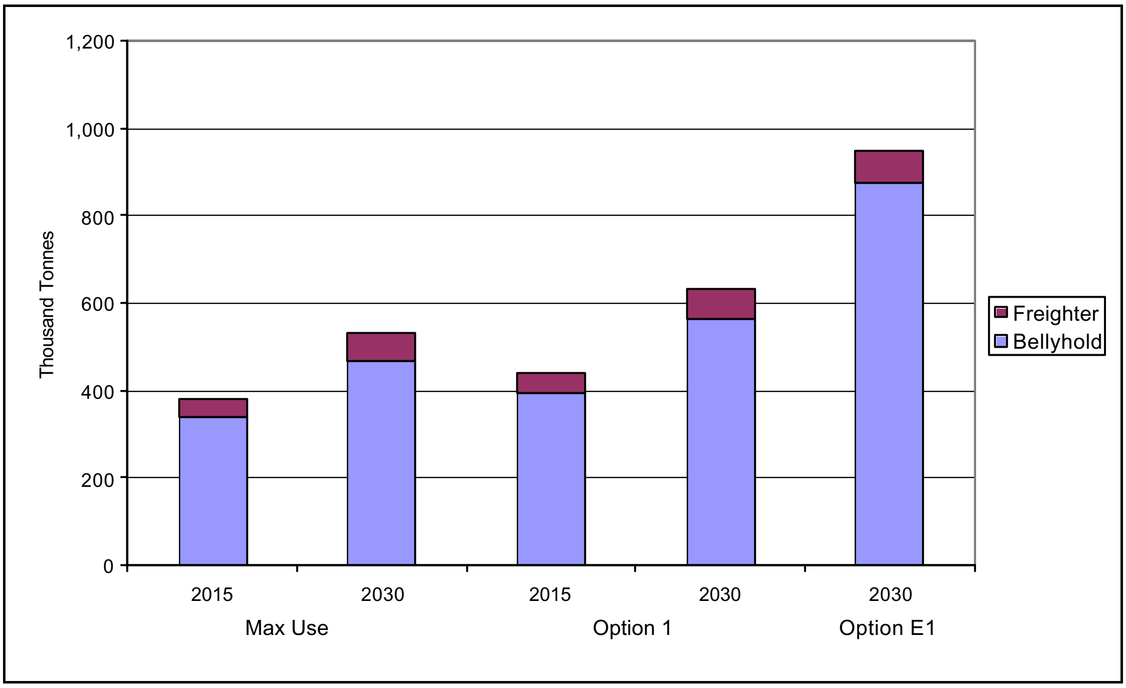
15.3.3 A cap of 3,500 ATMs has been assumed on freighter movements at Gatwick to reflect the impact of increasing passenger movements on available runway capacity. Freighter movements are not forecast to reach this cap under any of the development options.

15.3.4 Freight forecast for Gatwick are shown in Table 15.3 below. Figure 15.2 illustrates the freight data graphically.

Table 15.3: Gatwick Freight Traffic Forecasts ('000 Tonnes) and Freighter ATMs (000)

Option	Max Use		1		E1
	2015	**2030**	**2015**	**2030**	**2030**
Bellyhold freight ('000 tonnes)	339	468	393	564	876
Freighter ('000 tonnes)	41	62	47	70	70
Total ('000 tonnes)	**380**	**530**	**440**	**634**	**946**
Freighter ATMs ('000)	0.8	0.9	1.0	1.0	1.0

Figure 15.2: Gatwick Freight Traffic Forecasts



15.4 Stansted

15.4.1 Stansted is the third largest freight airport in the UK, after Heathrow and Gatwick. Unlike these two airports the majority of traffic at Stansted is carried on dedicated freighter aircraft. In 2000 Stansted handled 170,000 tonnes of freight, 98% of which was on freighter aircraft.

15.4.2 The freighter movement capacity of Stansted will be a combination of available day and night-time capacity. Available daytime capacity has been taken from SPASM. SPASM, however, does not explicitly include night-time movements, when freighter traffic is more prevalent. To reflect this, the current level of 12,000 night movements a year at Stansted has been added onto the daytime capacity to give an all day freighter capacity. This has been assumed to continue into the future.

15.4.3 With the maximum use of the existing runway, Stansted is forecast to handle 0.7 million tonnes in 2015, overtaking Gatwick as the 2nd largest freight airport in the UK. This growth is forecast to continue after 2015, with freight traffic reaching 2.2 million tonnes in 2030. The majority of the traffic growth at Stansted is expected to come from the express freight sector.

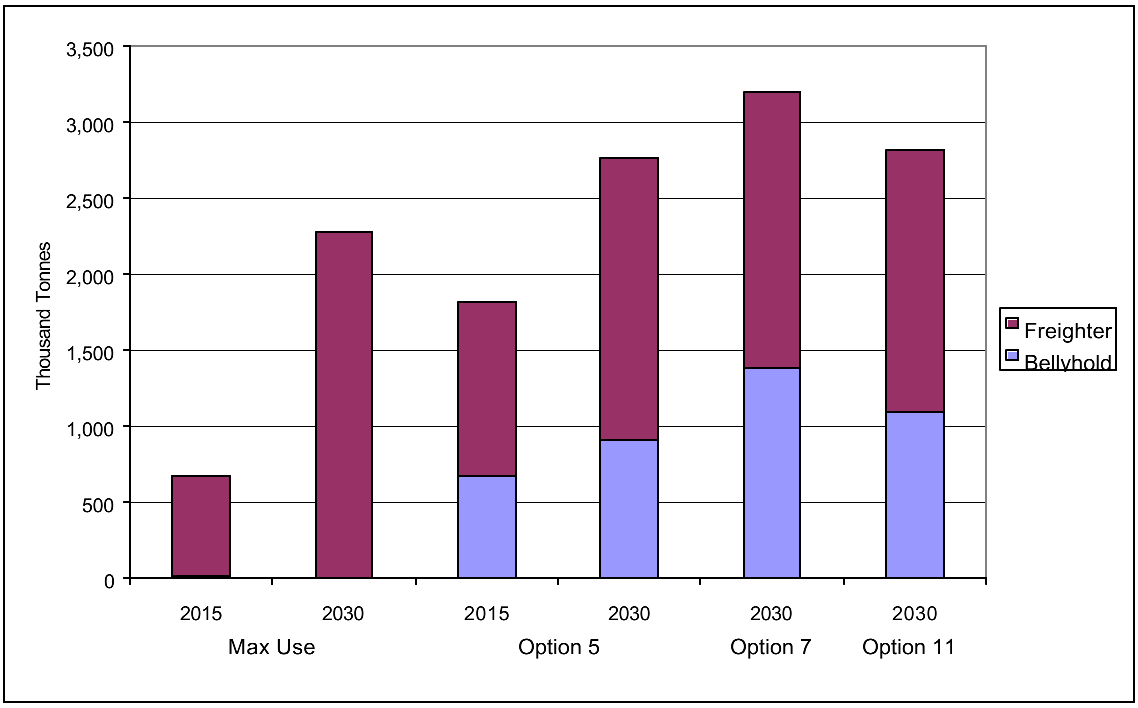
15.4.4 The construction of new runways at Stansted would not only provide additional space for freighters but is forecast to lead to the development of a number of scheduled long haul services. This would lead to a large increase in bellyhold traffic. Under Option 5, freight traffic is forecast to grow to 1.8 and 2.8 million tonnes in 2015 and 2030, around a third of which would be bellyhold. Bellyhold and total freight traffic is forecast to increase still further, to around 3 million tonnes under the 3 and 4 runway option scenarios.

15.4.5 Stansted freight forecasts are shown in Table 15.4 below. Figure 15.3 illustrates the forecasts graphically.

Table 15.4: Stansted Freight Traffic Forecasts ('000 Tonnes) and Freighter ATMs ('000)

Option	**Max Use**		**5**		**7**	**11**
	2015	**2030**	**2015**	**2030**	**2030**	**2030**
Bellyhold freight ('000 tonnes)	5	4	674	911	1377	1093
Freighter ('000 tonnes)	664	2274	1142	1848	1814	1718
Total ('000 tonnes)	**669**	**2278**	**1816**	**2759**	**3191**	**2811**
Freighter ATMs ('000)	18.2	40.0	31.3	32.5	31.9	30.2

Figure 15.3: Stansted Freight Traffic Forecasts



15.5 Luton

15.5.1 Luton airport handled 36,000 tonnes of freight in 2000, a 35% increase on the previous year. As the majority of passenger operations at Luton are either low cost or charter services there is very little bellyhold freight, with dedicated freighters handling 98% of total freight traffic in 2000.

15.5.2 There is very little spare capacity for increasing freighter traffic at the three main South East airports of Heathrow, Gatwick and Stansted. This traffic would therefore look to transfer to other airports, either within the UK or overseas. The Freight Forecasting Model predicts that Luton airport could be a major beneficiary of such traffic. In reality this would be dependent on the attitudes of airport management and freight operators, and whether additional capacity were provided elsewhere in the South East, such as Cliffe Marshes for example.

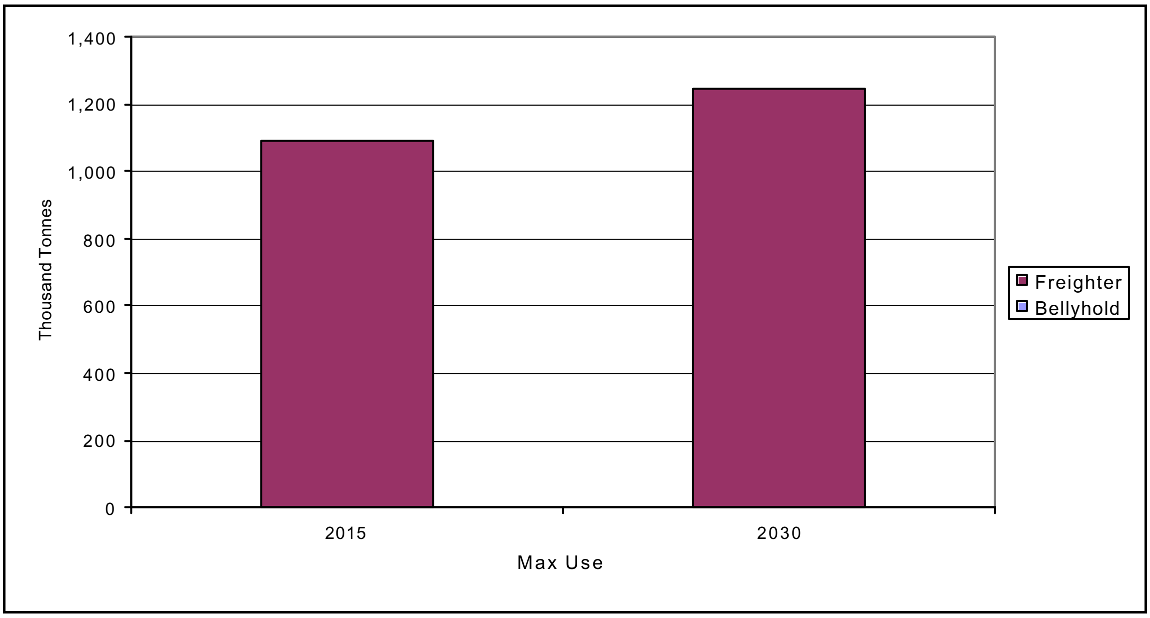
15.5.3 With the maximum use of facilities at Luton (either Option 2 or E3) and no additional runway capacity elsewhere in the south east, freight traffic is forecast to increase to 1.1 million tonnes in 2015, nearly all of which is freighter traffic spilt from other airports in the South East. Freight traffic at Luton has been capped at 1.2 million tonnes and 25,000 freighter movements to reflect likely constraints on the expansion of existing facilities. Under a heavily constrained scenario which makes maximum use of existing runways but does not provide any new runways, this will be required by 2020.

15.5.4 Freight forecasts for Luton are shown in Table 15.5 below. Figure 15.4 illustrates the forecasts graphically.

Table 15.5: Luton Freight Traffic Forecasts ('000 Tonnes) and Freighter ATMs ('000)

Option	Max Use	
	2015	2030
Bellyhold freight ('000 tonnes)	1	1
Freighter ('000 tonnes)	1090	1244
Total ('000 tonnes)	**1091**	**1245**
Freighter ATMs ('000)	21.8	24.9

Figure 15.4: Luton Freight Traffic Forecasts



15.6 Cliffe Marshes

15.6.1 The proposed airport at Cliffe Marshes has been designed so that 24 hour operation should be possible, with little impact on the surrounding population. Night-time operation is a particular requirement of the integrators and it is expected that Cliffe Marshes could capture a sizeable proportion of the dedicated freighter market. Based on an analysis of the distribution of freighter traffic, it is forecast that Cliffe airport could capture around a third of the freighter market in the South East. Cliffe would also have a sizeable bellyhold throughput from its network of long haul scheduled passenger services. By 2015 Cliffe is forecast to handle 1.2 million tonnes, 60% on freighters. By 2030, with four runways, this is forecast to increase to 2.8 million tonnes, two thirds of which would be freighter traffic.

15.7 Alconbury

15.7.1 The proposed airport at Alconbury would be designed to be a freight-friendly airport. Alconbury however, would not have a large natural catchment area and would reduce freight demand at other South East airports by less than 10%. Nevertheless, the airport is well positioned to receive traffic spilled over from capacity-constrained South East airports. By 2015, Alconbury is forecast to handle 0.2 million tonnes, nearly all of which would be freighter traffic. As constraints in the South East become tighter, more freight traffic would travel through Alconbury. By 2030 freight traffic at Alconbury could reach as much as 1.3 million tonnes.

15.8 Interpretation of Forecasts

Overall Growth

15.8.1 The overall forecast growth in air freight at South East airports to 2015 and 2030 is summarised in Table 15.6 for capacity-constrained scenarios and in Table 15.7 for selected larger capacity packages. These forecasts have been derived from an allocation to airports of a high forecast of national growth in air freight, from 2.1 million tonnes in 1998 and 2.5 million tonnes in 2000 to 13.6 million tonnes in 2030.

15.8.2 In the more constrained scenarios presented in Table 15.6, total tonnes at the major South East airports increase from 1.8 million in 2000 to around 4 million in 2015 and over 6 million in 2030. Some increase is forecast in bellyhold traffic (from 1.5 million tonnes in 2000 to around 2.5 million tonnes in 2030), but much more growth is forecast in freighter freight, from 0.3 million tonnes in 2030 to over 3 million tonnes in 2030. This growth in freighter traffic would be accommodated through an increase in freighter ATMs and a substantial increase in average tonnes carried per freighter ATM.

15.8.3 The forecast number of freighter ATMs at major South East airports increases from 26,600 in 2000 to 43,000 in 2015 and to 66,600 in 2030, with no new runway provision (Package 2). The assumption is that the growth in freighter ATMs will be accommodated at Stansted and Luton. Potential freighter ATMs at Heathrow and Gatwick are assumed to be limited to current totals of around 3,000 and 3,500 respectively. The introduction of additional runway capacity at Alconbury diverts some freighter ATMs away from Luton and Stansted and increases the total at South East airports.

15.8.4 The provision of additional runway capacity in the larger packages reported in Table 15.7 adds to forecast tonnes carried, to 4 – 4.5 million tonnes in 2015 and 6.2 – 7.6 million tonnes in 2030. In 2030, over 4 million tonnes are forecast at Stansted with packages 16 and 19 (2 additional runways in Package 16 and 1 in Package 19). Cliffe Marshes is forecast to handle 2.8 million tonnes in Package 21 in 2030, with Stansted handling a further 1.9 million tonnes as it is more accessible to the northern part of the SERAS region than Cliffe Marshes.. The number of freighter ATMs, allowing for further increases in tonnes per ATM, increases to almost 80,000, largely at Stansted and, in Package 21, Cliffe Marshes.

Table 15.6: SE Airports Air Freight Forecasts – Capacity-Constrained Scenarios

Airport	2000 actual	Package 2		Package 3	
		2015	2030	2015	2030
Heathrow					
Total freight, '000 tonnes	1307	1694	2064	1779	2165
Freighter freight, '000 tonnes	98	153	60	177	60
Bellyhold freight, '000 tonnes	1209	1541	2005	1601	2105
Freighter ATM's, '000	3.1	2.2	0.9	2.5	0.9
Gatwick					
Total freight, '000 tonnes	319	380	530	387	522
Freighter freight, '000 tonnes	30	41	62	48	59
Bellyhold freight, '000 tonnes	289	339	468	339	463
Freighter ATM's, '000	3.4	0.8	0.9	1.0	0.8
Stansted					
Total freight, '000 tonnes	168	669	2279	893	1582
Freighter freight, '000 tonnes	165	664	2274	887	1577
Bellyhold freight, '000 tonnes	3	5	5	6	5
Freighter ATM's, '000	14.0	18.2	40.0	24.3	27.7
Luton					
Total freight, '000 tonnes	36	1092	1245	751	1244
Freighter freight, '000 tonnes	35	1091	1244	750	1244
Bellyhold freight, '000 tonnes	1	1	1	1	0
Freighter ATM's, '000	6.1	21.8	24.9	15.0	24.9
Alconbury					
Total freight, '000 tonnes				236	1273
Freighter freight, '000 tonnes				235	1272
Bellyhold freight, '000 tonnes				1	1
Freighter ATM's, '000				10.8	31.4
All Major SE Airports					
Total freight, '000 tonnes	1830	3835	6118	4046	6786
Freighter freight, '000 tonnes	328	1949	3640	2097	4212
Bellyhold freight, '000 tonnes	1502	1886	2479	1948	2574
Freighter ATM's, '000	26.6	43.0	66.6	53.5	85.7

Table 15.7: SE Airports Air Freight Forecasts – Larger Packages

	2000 Actual	Package 15		Package 16		Package 19		Package 21	
		2015	2030	2015	2030	2015	2030	2015	2030
Heathrow									
Total freight, '000 tonnes	1307	2322	2260	2322	2188	1720	1894	1684	2085
Freighter freight, '000 tonnes	98	210	210	210	210	210	209	200	209
Bellyhold freight, '000 tonnes	1209	2112	2050	2112	1978	1510	1685	1484	1876
Freighter ATM's, '000	3.1	3.0	3.0	3.0	3.0	3.0	3.0	2.9	3.0
Gatwick									
Total freight, '000 tonnes	319	401	649	401	518	594	878	281	424
Freighter freight, '000 tonnes	30	111	187	111	144	43	107	53	110
Bellyhold freight, '000 tonnes	289	291	462	291	374	552	771	228	314
Freighter ATM's, '000	3.4	2.2	2.7	2.2	2.1	0.9	1.5	1.1	1.6
Stansted									
Total freight, '000 tonnes	168	1494	2838	1494	4401	1155	4114	1100	1914
Freighter freight, '000 tonnes	165	1487	1971	1487	3404	1149	3348	1095	1909
Bellyhold freight, '000 tonnes	3	7	867	7	996	6	765	6	5
Freighter ATM's, '000	14.0	40.7	34.6	40.7	59.8	31.5	58.8	30.0	33.5
Luton									
Total freight, '000 tonnes	36	313	494	313	422	594	723	262	386
Freighter freight, '000 tonnes	35	313	494	313	422	594	723	262	386
Bellyhold freight, '000 tonnes	1	0	0	0	0	0	0	0	0
Freighter ATM's, '000	6.1	6.3	9.9	6.3	8.4	11.9	14.5	5.2	7.7
Cliffe Marshes									
Total freight, '000 tonnes								1208	2787
Freighter freight, '000 tonnes								729	1887
Bellyhold freight, '000 tonnes								479	899
Freighter ATM's, '000								20.0	33.2
All Major SE Airports									
Total freight, '000 tonnes	1830	4530	6241	4530	7529	4063	7609	4535	7596
Freighter freight, '000 tonnes	328	2121	2862	2121	4180	1996	4387	2339	4501
Bellyhold freight, '000 tonnes	1502	2410	3379	2410	3348	2068	3221	2197	3094
Freighter ATM's, '000	26.6	52.2	50.2	52.2	73.3	47.2	77.8	59.1	79.0

Express Freight and Night-time ATMs

15.8.5 The forecasts of total air freight divide into forecasts of time-sensitive express freight and general cargo. While general cargo dominates current air freight in tonnage terms, by 2030 express freight is forecast to be 52% of the national air freight market. A consequence of the rapid growth in express freight is likely to be an increased demand for night-time freight ATMs to meet 'next day delivery' requirements. More than half of forecast freighter ATMs (ie, 40,000 plus) would prefer to be night-time movements.

15.8.6 In 2000, at Heathrow, Gatwick and Stansted, there were 9,600 night-time (between 2200 and 0600 UTC) cargo ATMs out of 64,000 total night-time ATMs. These night-time ATMs accounted for just under half of all cargo ATMs. 6,500 of them were at Stansted.

15.8.7 Although night-time flight policies are under review, it is unrealistic to expect any increase in night-time freight ATMs at Heathrow or Gatwick. In 2000, these two airports between them accounted for 3,100 night-time freight ATMs. The 6,500 at Stansted were at the night movement cap. At Luton, the airport is in discussions to introduce a new night noise regime which might allow for some increase in night-time ATMs, but currently around 55% of Luton's freighter ATMs (around 3,500) are at night. In total, therefore, these four airports accommodate around 13,000 night-time freighter ATMs.

Accommodating Forecast Demand

15.8.8 The conclusion, however, seems to be that, if the forecasts of air freight are realised, the demand for night-time freighter ATMs is likely to exceed substantially current capacity, ie, demand of 40,000 plus against current capacity of 13,000. Possible ways of meeting forecast demand might be:

- Relaxation of night-time movement caps at existing airports, notably Stansted and Luton,
- A new 24-hour runway to serve the South East, with Alconbury and Cliffe Marshes the possible locations,
- Additional use of existing or new 24-hour runways outside the South East, perhaps at East Midlands Airport, but this would be less well located in relation to the market, or
- A change in the way in which air freight markets, and particularly express air freight, operate, so they make more use of daytime runway capacity and fewer night-time movements.
- Substantial trip suppression, use of continental airports, or use of other, less preferred modes.

15.8.9 If additional night-time movements were contemplated, a key consideration would be the potential noise impact. Table 15.8 summarises numbers of people falling within 90dB SEL footprints based on 'average worst' (QC2) aircraft likely to operate at night at airports other than East Midlands, where the footprint is based on a B747-400.

Table 15.8: Populations Within 90dB SEL Footprints, '000

	Stansted: Appraised Runways	Luton: Appraised Runways	Cliffe Marshes: Appraised Runways	Alconbury: Appraised Runway	East Midlands: Existing Runway: B747-400
Westerly Operations					
Departures	0.3 – 2.0	0.4 – 3.7	<0.1 – 1.7	0.6	3.0
Arrivals	0.3 – 1.7	0.9 – 6.0	<0.1 – 1.2	10.6	1.3
Easterly Operations					
Departures	0.2 – 0.5	0.6 – 0.9	0.2 – 0.8	0.3	4.2
Arrivals	0.6 – 1.8	0.2 – 7.2	<0.1 – 2.3	0.3	2.2

15.8.10 Cliffe Marshes, followed by Stansted, offers the potential for minimising noise impacts, depending on which of the appraised runways were built in each location. At Cliffe Marshes, if only one east – west pair of runways were built, no more than 0.2 thousand (200) need be affected by arrivals or departures in either operating mode. Even if four runways were to be constructed at Cliffe, a maximum of 2,300 people would be under the arrival or departure footprint. At Alconbury, the 10,600 people under the arrivals footprint on westerly operations are largely in St Ives, some 8 km from the end of the runway (the single footprint scores all people within it equally, irrespective of their location in relation to the runway) though it is probable that there is scope for modifying arrival routes to avoid overflying St Ives.

16 Airspace

16.1 Airspace Modelling in SERAS

Capacity

16.1.1 The addition of runway capacity at any of the London area airports would have to be matched by capacity in the airspace system. In practice, airports and airspace have to be regarded as one system. Balanced capacity must be available at all stages (incoming airways, holding points, approach and departure routes, runways) if unacceptable levels of delay are to be avoided. It was therefore necessary to attempt to assess the likely capacity of South East airspace to handle the future traffic flows implied by the runway development options under consideration.

16.1.2 Experience from previous studies, such as RUCATSE, indicated that a precise definition of long-term airspace capacity would be an unrealistic target. Airspace structure and ATC operations are very complex and the technology that supports them is constantly evolving. Capacity is highly sensitive to traffic make-up, patterns of activity, runway location and other factors, so precise assessment of the effects of change requires precise and detailed inputs. The inevitable lack of such precision and detail when considering possible future scenarios means that any assessment should have clear objectives and that findings be interpreted with care.

Airspace Modelling

16.1.3 The assessment of airspace and airport system capacities requires the application of computer-based simulation modelling. Well established techniques are in regular use in the planning and implementation of changes to the structure and management of existing airspace. DTLR commissioned CAA-DAP (Directorate of Airspace Policy) and NATS to undertake the simulation of a number of future airport capacity development scenarios. The primary objective was to assess whether the system would be likely to have adequate capacity to accommodate runway capacities of the order envisaged by the development options.

16.1.4 The simulations were conducted by the CAA and NATS using the TAAM (Total Airport and Airspace Modeller) fast-time simulation software package. Given the time and resources necessary to set up and run different scenarios through TAAM, only four cases could be modelled. Also due to time constraints, those cases had to be defined before Ministerial decisions had been made, at the end of Stage One, on the packages to be taken forward to Stage Two, and before detailed demand forecasts were available. The development scenarios simulated do not, therefore, necessarily correspond to actual development packages subsequently explored in Stage Two.

16.1.5 The cases modelled were selected by DTLR as possible future scenarios that would provide reasonable tests of the adequacy of future airspace to accommodate additional runway throughputs in different locations. The four scenarios modelled were:

- Scenario 1: A new airport at Cliffe
- Scenario 2: Additional runways at both Gatwick and Stansted
- Scenario 3: An additional runway at Heathrow
- Scenario 4: An additional runway at Stansted plus the re-alignment of the runway at Luton in line with the Stansted runways (as in Luton Option E3).

16.1.6 The TAAM methodologies used by CAA and NATS differ in some respects, as they have been developed for various purposes. As the starting point for the SERAS work, both NATS and DAP simulated a common baseline scenario, to confirm that their models produced the same output. Each organisation then undertook modelling of two of the four future scenarios.

16.1.7 Scenarios were modelled using the then available forecast traffic profiles for 2010, 2020 and 2030. Simulation encompassed the whole of the London Terminal Control Area (LTMA), plus areas outside this to ensure proper boundary conditions. Airports included in the simulation were Heathrow, Gatwick, Stansted, Luton, London City and Cliffe. The daily number of flights in each sample reflected both forecast growth in demand and the effects of limited runway capacity. Because of the different numbers of runways and their differing capacities, the daily total number of flights varies between scenarios. In the baseline scenario, the number of flights per day barely exceeded 4,000 by 2030. For scenarios 1 and 2 there were around 6,000 daily movements in 2030, and for scenarios 3 and 4 just under 5,000.

16.1.8 The modelling was intended as a preliminary, high-level investigation of possible future scenarios. To reflect the continuing development of airspace management techniques, it was assumed that the following ATC tools and working practices would be in place by 2010;

- A combination of Arrivals Manager (AMAN) and Departures Manager (DMAN) tools, which assist controllers in optimally sequencing traffic
- Application of 'gate to gate' management of flights, and collaborative decision making, both optimising use of available capacity
- Area Navigation (RNAV) used on Standard Instrument Departure routes (SIDs), allowing more precise tracking and separation of aircraft
- Track keeping to improved tolerances through application of Requested Navigation Performance (RNP)
- Use of multiple close-track departure procedures, increasing capacity on a given departure routing.

16.1.9 Without the incorporation of multiple, close-track RNAV SIDs, it was doubtful whether the simulation would have been able to process the traffic volumes incorporated in some of the scenarios. Since it is expected that RNAV will be in use by 2010, t was considered appropriate to include them in all the simulations.

16.1.10 Apart from these technological changes, which are expected to be in place in the next 10 years, the modelling otherwise assumed that current air traffic management practices apply. By 2030, however, operating techniques can be expected to have evolved further. Tools to assist controllers in the decision making process will be available, dynamic information on an aircraft's position and intended route will provide advance data on traffic flows, and navigational equipment will allow control in time as well as position.

16.1.11 TAAM incorporates an automated conflict resolution system, which replicates controller intervention should conflicts be detected. In this high-level simulation, the models were run with conflict resolution switched off, so that aircraft flew the routes defined in the traffic samples. Any conflicts therefore remain uncorrected, so the reported number of conflicts is greater than it would be in real operations with controller intervention.

16.1.12 In order to achieve forecast movement totals, it was also necessary to adopt a 'free flow' methodology, in which the usual departure time intervals between consecutive departures on the same SID are not enforced. This, also, means that more conflicts are reported than would occur in actual operations.

16.1.13 In the main, only westerly operations were simulated (aircraft landing from the east and departing towards the west). These account for 70 to 80% of operations at South East airports over the past 20 years. Easterly operations (aircraft landing from the west and taking off towards the east) may lead to particular conflict between the potential new site at Cliffe and London City and Heathrow traffic. Scenario 1 was therefore also modelled under easterly operating conditions.

16.1.14 The modelling produced two standard graphical outputs for each scenario: a combined track and traffic density plot and a proximity plot. The track and density plot provides a graphical representation of the routes flown in the simulation in conjunction with traffic density. Areas with different traffic densities have different colour codes. The proximity plot provides a graphical representation of the airspace that would require controller intervention to resolve conflicts. Potential problem areas highlighted by the colour coding system, in terms of traffic density or proximity events, were addressed by CAA/NATS in formulating their conclusions on the potential for airspace to accommodate forecast traffic levels.

16.2 Principal Findings

16.2.1 The principal findings for each scenario modelled are set out below. Among the general conclusions reached it was stated that a detailed safety analysis of all proposed procedures and changes would be required at an early stage. Also, that contingency measures would need to be incorporated to cope with non-routine events, such as adverse weather or a blocked runway) when operating at or near airspace capacity.

16.2.2 Extensive re-alignments of all routes to all airports may be required together with associated reconfiguration of control sectors within the LTMA and its surrounds. The numbers of holding points or 'stacks' per airport and their positions may need to be modified. Such extensive changes would require substantial time and resources for design, simulation and phased implementation.

Scenario 1: New Airport at Cliffe Marshes

16.2.3 Airspace to the west of the site appears to be extremely congested, with potentially complex interactions between the new site, London City and Heathrow traffic. Operations to and from Southend, Biggin Hill and Manston airports could also be significantly affected.

16.2.4 Westerly operations appear to be workable, although vectoring of inbound traffic to Cliffe may position aircraft close to Belgian or Dutch airspace. The modelling of easterly operations identified the main area of interactions as the final vectoring area west of the new site. A large number of Cliffe arrivals would interact with London City and Biggin Hill traffic, and with Gatwick northerly departures. These in turn are constrained by Heathrow departures.

16.2.5 Consideration would need to be given to reducing Heathrow holds to two, and their possible repositioning.

Scenario 2: Additional Runways at Gatwick and Stansted

16.2.6 Additional controlled airspace would be required to the north of the LTMA. Dedicated holding points for Stansted (two points) and Luton (one) would probably be required. This represents one additional hold in comparison with the current situation. Adjustment of routes, possibly extensive, would be needed for both Gatwick and Stansted to cater for increased departing traffic.

Scenario 3: Additional Runway at Heathrow

16.2.7 The third runway was assumed to operate almost independently of the other runways. This would largely eliminate the difficulties of managing the ground movement of aircraft using three runways, which would otherwise constrain runway capacity. It is likely that operations into and out of Northolt would need to be severely restricted.

Scenario 4: Additional Runway at Stansted and Re-alignment of Luton Runway

16.2.8 Initial findings suggest that little additional airspace capacity was to be gained by realigning the Luton runway. A realigned Luton on easterly operations could cause conflict with flights inbound to Heathrow via the Bovingdon hold. The additional Stansted runway would require additional airspace to the north, plus inbound holding facilities.

Overall Conclusion

16.2.9 In conclusion, and with regard for the assumptions made in the simulation work, it was considered that the additional ATMs in all scenarios could be accommodated, with the changes envisaged to the structure and management of airspace within the LTMA. Other than the particular need identified for a thorough review of routes and procedures in the final vectoring areas of an airport at Cliffe, no serious impediments to implementation were anticipated as a result of these studies.