From:	[redacted]
To:	Manston Airport
Cc:	[redacted]
Subject:	Re: SMAa representation Matter 2
Date:	30 June 2021 18:20:30
Attachments:	SMAa representation to the Secretary of State - Matter 2 - part 1.pdf

For the attention of the Manston Airport Case Team :

TR020002 – SMAa representation to the Secretary of State for Transport – Matter 2 Part 1

Re-determination of the Application by RiverOak Strategic Partners Limited ("the Applicant") for an Order granting Development Consent for the reopening and development of Manston Airport in Kent.

SMAa has over 3,700 members who are in full support of the Development Consent Order to reopen Manston Airport, many wanting jobs for themselves, their family or other Kentish people. Thus, we wish to make further representations to assist in the re-determination of the DCO.

Statement of Matters
In the Department for Transport's Statement of Matters letter dated 11th June 2021 it invited Interested Parties to make further representations on 4 matters. This representation will look at:
"whether the quantitative need for the Development has been affected by any changes since 9 July 2019, and if so, a description of any such changes and the impacts on the level of need from those changes (such as, but not limited to, changes in demand for air freight, changes of capacity at other airports, locational requirements for air freight and the effects of Brexit and/or Covid)"
Please see below web file :
SMAa representation to the Secretary of State for Transport - Matter 1.pdf
From the SMAa Committee on behalf of the 3,700 members
Dr Beau Webber (Chairman)
[redacted]

TR020002 – SMAa representation to the Secretary of State for Transport – Matter 2

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1.0 Changes in Capacity

1.1 Stansted Airport

Prior to the appeal decision, Stansted had a passenger cap of 35 million passengers per annum (mppa) and an ATM cap of 264,000 (Passenger ATM 243,500 & Cargo ATM 20,500)[1].

In 2019 there were approximately 28 mppa and 202,000 ATMs including nearly 12,000 cargo ATMs[2]. To reduce the likelihood of delays, it is desirable for an airport to operate at a demand/capacity ratio below 0.8[3]. Bearing this in mind the data indicates that, at present there is capacity at Stansted to accommodate some additional freighter traffic.

However, this limited capacity is predicted by MAG to be short-lived. According to their Planning Statement for application UTT/18/0460/FUL, they state that passenger ATMs:

"are forecast to increase from 152,000 in 2016 to just over 253,000 movements by 2028[4]".

This would leave even more limited slots for dedicated freighters and certainly not enough for the 17,000 freighter ATMs specified in the Manston DCO.

Following the appeal decision 26th May 2021, the Cargo ATM cap was reduced to 16,000 from 20,500 with passenger throughput rising from 35 million passengers per annum (mppa) to 43 mppa.

Using the 2019 passenger numbers (28,304,744) and passenger ATMs (174,657) there were, on average 162 passengers per ATM. Using this figure, 43 mppa would require 265,432 passenger ATMs.

[1] London Stansted W18/W19 capacity - page 2
[2] London Stansted 2018 & 2019 data - table 1
[3] UK CAA runway resilience study – page 101
[4] MAG Stansted Airport Planning Application – Planning Statement paragraph 2.80 on page 18

Even using the projected MAG figure of 170 passengers per flight[5] (it was 160 in 2016)[6], 43 mppa would require 252,941 passenger ATMs. It should be noted that this increase to 170 passengers per flight is dependent on a number of factors including a change of fleet to larger aircraft. All the necessary changes are likely to be phased over a number of years and Stansted may not achieve the 170 figure. This will result in a higher passenger ATM being required

Since the overall ATM cap (including other ATMs) will remain at 274,000 ATMs per year, this increase in passenger ATMs can only happen with a reduction in cargo ATMs and other ATMs (there were 15,175 other ATMs in 2019).

This inevitably will result in slots for dedicated freighters becoming increasingly limited particularly at the peak times for passenger flights in the morning and evening. The situation will be made even worse because of the current focus on increasing restrictions on night flights.

These restrictions and resulting lack of available slots imposed on Air Cargo Airlines indicate that Stansted is not the *"most appropriate means of meeting that need"*[7].

The evidence demonstrates that for the maximum Cargo ATMs availability is shrinking and must continue to fall because of the clear intention of MAG to increase passenger numbers. Depending on three scenarios the % reduction in the maximum Cargo ATMs available (currently 20,500) range from a Minimum 22% reduction (to 16,000) to a maximum of 71% reduction (to 6,000)[8].

In summary, because of the appeal decision to grant the planning application, Stansted will not have sufficient Cargo ATMs in the very near future to meet the cargo need as it increases its passenger ATMs closer and closer to the total ATMs available at Stansted. In our view this change increases the quantitative need for Manston Airport.

1.2 Heathrow

In our opinion, recent legal challenges involving both Heathrow and Stansted have revealed new evidence that increases the quantitative need for Manston Airport.

Heathrow has, at present an ATM cap of 480,000. In 2018 there were 475,624 ATMs and in 2019 slightly more with 476,133 movements[9]. Both these figures indicate that Heathrow is operating at 99% of its ATM limit. It is clear that Heathrow, pre-covid, had no spare capacity to accommodate additional freighter traffic and it could be argued that it was operating way above its optimal level to reduce delays. (< 0.8 demand/capacity ratio).

However, as is well known, Heathrow are planning on having a third runway (R3) which was originally intended to be open in 2026. According to the review into the Heathrow Preferred Masterplan conducted by Arcadis for the CAA, the aim is to increase cargo to 3 million tons per year[10]. It is assumed that, as now, most of this freight will be carried in the belly hold of aircraft rather than dedicated freighters. This is confirmed in the review[11]:

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[5] MAG Stansted Airport Planning Application – Planning Statement paragraph 2.79 on page 18
[6] MAG Stansted Airport Planning Application – Planning Statement paragraph 2.78 on page 18
[7] ANPS – paragraph 1.41
[8] Reduction in air cargo ATMS at Stansted
[9] Heathrow Freight ATM data – page 1
[10] Heathrow CAA review of plans – page 17
[11] Heathrow CAA review of plans – page 22

"The opening of the 3rd Runway will see an increase in ATMs and will result in an increase in the availability of air freight capacity at the airport. This will mainly be in the availability of more 'belly hold' capacity rather than through a significant growth in dedicated air cargo flights".

In 2018 Heathrow handled 93,231 tonnes of freight in dedicated freighters and in 2019, 83,757 tonnes which represent 5.5% in 2018 and 5.3% in 2019 of the total freight tonnages handled by Heathrow[12].

This is less than the tonnes of freight predicted for Manston in year 2 of operation. [APP – 085]

Table 4 Forecast job creation

	Freight tonnage	Passenger numbers	Direct jobs	Indirect/ induced jobs	Catalytic jobs	Total job creation
Y1	0	0	116	0	0	**116**
Y2	96,553	0	856	1,542	0	**2,398**
Y3	108,553	662,768	1,551	2,791	6,203	**10,545**
Y4	167,092	679,868	2,085	3,753	8,341	**14,179**
Y5	173,741	686,672	2,150	3,870	8,601	**14,621**
Y6	181,436	965,295	2,466	4,438	9,862	**16,766**
Y7	192,908	975,591	2,576	4,638	10,306	**17,520**
Y8	200,673	975,591	2,645	4,762	10,581	**17,988**
Y9	203,245	975,591	2,668	4,803	10,673	**18,143**
Y10	212,351	975,591	2,749	4,948	10,996	**18,693**
Y11	222,377	1,011,587	2,812	5,062	11,249	**19,124**
Y12	234,508	1,049,022	2,890	5,202	11,561	**19,653**
Y13	244,690	1,087,954	2,947	5,305	11,789	**20,042**
Y14	256,989	1,128,444	3,018	5,432	12,072	**20,522**
Y15	270,579	1,170,553	3,094	5,570	12,378	**21,042**
Y16	283,904	1,214,347	3,164	5,695	12,656	**21,515**
Y17	296,594	1,259,892	3,224	5,802	12,894	**21,920**
Y18	312,344	1,307,259	3,301	5,942	13,205	**22,448**
Y19	324,838	1,356,521	3,349	6,029	13,397	**22,775**
Y20	340,758	1,407,753	3,417	6,151	13,668	**23,235**

As has already been stated, the original opening of R3 was 2026 but due to legal challenges, CAA rulings on funding, COVID etc. this date has been pushed back considerably.

In the Arcadis report for the CAA it highlighted a number of factors that could delay the opening date for R3.

"Much of this work is outside of the airport's existing boundary and will be reliant on gaining the appropriate consents, acquiring land and working with other agencies or organisations. This could create a level of risk to the programme that HAL may not be able to mitigate". [13] P3

One key area identified is the assumption by Heathrow Airport Limited (HAL) that the DCO process will be completed in 17 months. The report casts doubt on this timescale on page 34 (P34) and this is also borne out by the Manston DCO, which has taken far longer than that timescale. It was accepted for examination on 14th August 2018 and is still ongoing nearly 35 months later. This is particularly relevant because a) it is an airport DCO and b) the Manston DCO is far less complex in comparison.

The report points out the risks to the timescale for R3 because of:

- The possibility that the submission is disputed during the pre-examination and examination process.[16] P34

[12] Heathrow Freight tonnage – page 1

[13] Heathrow CAA review of plans (relevant page numbers indicated in text)

- Delays caused by disputes over land acquisition through Compulsory Purchase Orders, [Compulsory Acquisition within the DCO?] and the need for Vacant possession. [16] P35.
- Problems if utility companies responsible for assets do not agree to the necessary works under local Town and Country Planning Acts (TCPA). [16] P36
- Problems could arise from the resighting of the Energy from Waste Facility requiring a local TCPA. [16] P32
- Problems could arise from the resighting of a Primary School requiring a local TCPA.[16] P37
- Problems could arise from the resighting of the Colnbrook Immigration Facility requiring a local TCPA. [16]P37
- The project requires river diversions and the consent granting bodies associated with these water courses has significant interest and powers over the scheme, which could lead to tensions in the approval process. [16] P38
- The project involves considerable earthworks which are dependent on Vacant possession and the clearing of existing assets referred to above. [16] P35
- Works on the M25 near to the A4 are dependent on the demolition of a bridge which cannot be done until the alternative A4 is completed. [16] P39
- Arcadis considers the time allowance between DCO approval and start of works (date redacted) is ambitious with little or no contingency. It will rely on a period of effective and swift discharging of the planning conditions imposed on HAL after the DCO date. [16] P48
- The Heathrow scheme has attracted a lot of public scrutiny over the years and there would be no reason to suggest that it will not be subject to intense scrutiny during the Development Consent Order process.[16] P36
- Any delays will have a negative impact on the costs estimates of the project.[16] P5

It is difficult to accurately predict when Heathrow will open with dates now ranging from 2028 to 2034. With the numerous risks to the timescale outlined above, it is fair to assume that the opening date will be closer to 2034 than the 2028 date. Indeed, in the Stansted Airport Public Inquiry held recently the possible opening date for Heathrow was referred to and it was stated that 2034 was a more realistic opening date for Heathrow[14].

Manston will have been operational for at least 5 years and nearer to 10 years by the time R3 opens and will be well established by then. It is predicted that Manston will be achieving between about 174,000 (Yr5) and 200,000 tonnes[15] by the time R3 opens. Even when Heathrow does open, the Preferred Masterplan indicates that work at Heathrow will be phased and the eventual increase to 3 million tons of cargo is not predicted to occur until 14 years after opening.

When the 3rd runway (R3) is opened there will be some capacity for dedicated freighters but, with the emphasis on passengers and belly freight at Heathrow, it is not going to be sufficient to meet the predicted need. A reopened Manston, with its state-of-the-art facilities and available capacity, will provide resilience to the supply network in the UK that LHR cannot, for at least several decades. The predicted delay to Heathrow increases the quantitative need for Manston Airport.

2.0 Changes in demand

2.1 As a result of the Covid Pandemic

One effect of the Covid pandemic was the huge reduction in passenger flights which highlighted the problem of an over reliance on belly hold freight in the UK. At the very time when the UK urgently

[14] Stansted Public Inquiry Day 11 am at 0.32.06 on recording Stansted Inquiry recording
[15] [APP – 085] table 5

needed supplies including PPE, due to the lack of dedicated freighters in the UK, some airlines took to loading freight on the seats of passenger aircraft to try and make up the shortfall.[16]

In January 2021, Alexandre de Juniac, IATA's Director General and CEO stated:

"Air cargo traffic is back to pre-crisis levels and that is some much-needed good news for the global economy. But while there is a strong demand to ship goods, our ability is capped by the shortage of belly capacity normally provided by passenger aircraft. That should be a sign to governments that they need to share their plans for restart so that the industry has clarity in terms of how soon more capacity can be brought online. In normal times, a third of world trade by value moves by air. This high value commerce is vital to helping restore COVID damaged economies—not to mention the critical role air cargo is playing in distributing lifesaving vaccines that must continue for the foreseeable future"[17].

The World Trade Organisation (WTO) has forecast that the "volume of world merchandise trade is expected to increase by 8.0% in 2021"[18]. However, the shortage of belly hold capacity has resulted in some airlines chartering dedicated freighters whilst others have begun converting passenger aircraft to freight aircraft (P2F). The demand for freighters is illustrated by Qatar Airlines who are "hungry for new freighters" and chief executive Akbar Al Baker said that "the company was considering an order for 30 or more freighters from Airbus or Boeing as part of a fleet renewal programme"[19].

Although it is predicted that passenger flight numbers are likely to return to pre-pandemic levels within two years,[20] the case for dedicated freighters has been strengthened and there are many situations where it is necessary to carry cargo in dedicated freighters. For example:

- Loads that need accurate climate control for sensitive loads like flowers, fresh fish, livestock.
- To move cargo to and from places not served by passenger flights.
- Time Sensitive goods.
- Transporting livestock of all kinds, farm animals such as chickens, animals for zoos or safari parks, whales, dolphins etc and bloodstock (which are very high value) and any animals requiring specialist in-flight care.
- Dangerous goods, munitions, industrial explosives etc: toxic substances.
- Vehicles, either civilian or military.
- Large, awkward, or outsize loads such as mining or oil drilling equipment, wind turbine components, generators, ships drive shafts, aeroplane engines etc:
- Any load that would exceed the floor loading limit of a passenger aeroplane, which is much lower than a cargo aeroplane, or would not fit into the lower cargo holds.

Many loads are time sensitive and must be delivered within a specified time slot and at a specific location.

Passenger aeroplanes will only take what they still have weight or space for and will only fly to their scheduled destination at the scheduled time and date.

They will only know what spare capacity they have shortly before departure and may

[16] Forbes – Cargo into passenger seats
[17] IATA January Air Cargo Demands
[18] WTO growth forecasts
[19] Qatar Airlines
[20] Airline industry forecasts

discover at that point, that they cannot take all or any of the freight. The freight then sits around either at the airport or back on lorries, not good if it is urgent or perishable.

A passenger aeroplane with the seats removed is of limited use. The lack of cargo doors will limit the size of items dramatically and will increase turnaround times plus the lack of suitable air conditioning limits the loads that can be accommodated.

It is clear from the examples and reasons given above there is a need for dedicated air cargo freighters in addition to belly hold freight.

However, the situation in the UK pre-covid seemed to be at odds with what was going on elsewhere.

"*Several stakeholders have noted that capacity constraints are a significant hinderance to the operation of UK air freight – one stated that it has caused volume growth to fall behind other European countries, and another stated it is one of the main reasons why so much freight is flown to mainland Europe and trucked to the UK – in turn causing more road and port congestion*"[21].

The report goes on to say:

"*At Heathrow in 2017, 6% of total freight volumes were carried by freighter aircraft compared to between 40% and 60% at Amsterdam, Frankfurt and Paris. Although Heathrow and Amsterdam carried very similar levels of freight in 2017, there were around 3,000 freighter air traffic movements at Heathrow compared to just under 17,800 at Amsterdam*"[22].

The evidence suggests that if there were no capacity constraints in the South East pre-covid then more freighters would land directly in the UK rather than flying to mainland Europe and then the goods being trucked.

Unlike Stansted and Heathrow, there appears to be no cap on ATMs at East Midlands although there are Night Noise restrictions which may get tougher. For that reason, unless regulations change, East Midlands has the capacity for cargo freighters both now and in the future although there will be pinch points at peak times when passenger flights take priority over slot allocation.

However, this should not be seen as an either East Midlands or Manston Airport situation. Instead, it should be seen as a vital opportunity to build significant resilience to the air freight market by having both airports available for dedicated freighters, one serving the Midlands / North and the other the South of England. In reference to e-commerce, the applicant stated that:

"*E-commerce is the fastest growing retail market in Europe and North America with online sales forecast to grow strongly year on year. The UK is second only to Norway for online purchases*."[23]

According to ONS data total e-commerce sales in the UK have risen from £375 billion in 2009 to £669 billion in 2019[24]. In 2020 the growth was even greater because of the pandemic:

[21] Steer 2018 report – 2.34 page 8
[22] Steer 2018 report – 3.24 page 21
[23] [APP - 085] Volume 1 page 31
[24] ONS e-commerce data - table 1

"The proportion of online retail increased to a record level in January 2021 reaching 35.2% up from 29.6% in December 2020 and was far higher than the 19.5% in January 2020, reflecting the impact the pandemic has had on consumer behaviours"[25].

Globally it is predicted that e-commerce sales will continue to grow and reach a forecasted global sales value of USD $4,800,000,000 (USD 4.8 trillion) in 2021.[26]

The Covid pandemic has forced people to look for online alternatives and it is likely that, having discovered how easy such purchases are, they will continue to use e-commerce rather than traditional retail.

"*One year after the beginning of the pandemic, the consumers' behavioural change towards online retail is established, with shoppers choosing more often the convenience (and often necessity) of online purchases*".[27]

With this increase in demand, IATA have indicated that it is essential the air cargo airlines invest in additional freighters:

"The COVID-19 pandemic has demonstrated air cargo's value, showing that the industry is essential for global and local economies and helps industries and populations worldwide. Airlines should consider new ways to address the risks related to crisis and capacity shortage by investing in their air cargo products"[28].

As can be seen e-commerce is a huge market and will continue to grow and would certainly support the use of both East Midlands and Manston Airports.

One of the major drivers of this increase in e-commerce is Amazon and it is significant to note that Amazon are in the process of building a "Mega Shed" in Dartford. This will be one of their largest warehouses in Europe and its four floors will encompass 2.3 million square feet.

Amazon have decided to make this huge investment in the South East rather than in the Midlands which is very telling. As has already been stated, neither Stansted nor Heathrow will have sufficient capacity to meet the need for e-commerce dedicated freighters in the next 5 to 10 years. In contrast, Manston Airport will have the necessary capacity and the location of this facility is much closer to Manston than East Midlands by road (58.5 miles as compared with 141.2 miles)[29]. Since the warehouse is adjacent to the Thames, it opens up the possibility of using greener methods of transporting goods from Manston, via Ramsgate Port, to Dartford.

Consumers increasingly expect rapid / next day delivery of their e-commerce items. The extra delay from landing their goods at East Midlands and then having to truck them down to Kent and the South East adds a significant extra delay compared to landing e-commerce items at Manston.

In summary, for the reasons outlined in above, the air freight industry needs dedicated freighters in addition to belly hold to satisfy the demand. With the huge increase in e-commerce and just-in-time goods this demand for freighters will only increase. East Midlands alone will not be able to meet this demand and with Stansted not having the capacity and Heathrow not able to meet that

[25] ONS 2021 retail data - section 5 online retail
[26] IATA Air Cargo and e-commerce – page 2
[27] IATA e-commerce. Strategies for Air Cargo Airlines - page 1
[28] IATA e-commerce. Strategies for Air Cargo Airlines - page 2
[29] AA route finder

need for years to come as explained above, Manston Airport is the "most appropriate means of meeting that need"[30]. The changes to freight demand brought about by the Covid Pandemic have increased the quantitative need for Manston Airport.

2.2 Post Brexit

In February the Airport Industrial Property Unit Trust (AIPUT) and Logistics UK held a policy roundtable, with representatives across the airline industry, to discuss the future of air freight to bring about sustainable growth post Brexit and Covid. Following that event, a detailed report was produced, and it stated that:

"*It is vital that the Government and industry commit to a long-term partnership to support both investment and green growth. This paper outlines the steps that need to be taken to ensure the future of air freight in a post-Brexit world"*.[31]

The report made 11 recommendations, many if not that all apply to the Manston Airport situation. Some key points are:

- The Government needs to give a clearer signal that it is supportive of and values air freight as a sector of national strategic importance.
- The UK needs to facilitate the timely delivery of the highest quality transport and real estate infrastructure serving its leading airports in order to underpin the future growth of a vibrant, sustainable and globally competitive aviation and air freight sector able to make its fullest contribution to the success of UK plc.
- Just-in-time and next day deliveries are no longer an ambition but an expectation. We must continue to innovate, supporting flexible freight movements throughout the day and, where possible, at night* to support this vital sector and growing market. (N.B. *night movements not applicable at Manston. However, a morning cargo movement can result in delivery in Kent on the same time scale as a night movement in the Midlands).
- The new generation of cargo warehouses, aircraft and equipment need to be fit for purpose, promoting safety and security, and designed to be as carbon neutral as possible, as well as future-proofed through the enabling of automation and digitisation.
- Planning regulations are significant when planning for ambitious supply chains and connectivity. Appropriate planning flexibility at ports, for warehousing and connectivity infrastructure, will allow for continued investment and reactive supply chains in air freight. Specifically, we call for support for sustainable expansion at Heathrow and other regional airports where required.
- Carbon is the enemy, not flying.
- We call for a commitment from Government to support research and development in aviation, leading to new technologies for electric and hydrogen aircraft that are fit for the future and cargo handling.
- Air freight is a growing industry and will recover from the impacts of COVID-19 and Brexit, contributing millions to the UK economy and its position as a trading nation. However, the industry needs to know now more than ever that the Government is fully behind the sustainable growth of UK air freight.

A decision by the Secretary of State to grant the DCO will go a long way to addressing the points raised above. Not only would it send a strong signal to the industry that the government values and supports the sustainable growth of air cargo but would also recognise that Manston, being a state-of-the-art green airport, with a long existing runway, will:

- Contribute significantly to UK PLC.
- Cater for the just-in-time / ecommerce market during the day.

[30] ANPS – paragraph 1.41
[31] Logistics UK Call to Action Report

- Deliver state of the art warehouses that involve automation and digitisation, and all buildings and equipment will be as carbon neutral as possible using sustainable materials and include solar panels, electric or hydrogen powered vehicles etc.
- When available Manston will welcome electric and /or hydrogen powered aircraft and will encourage the use of biofuels in the interim.
- Be in line with government policy to make best use of existing runways[32].

The recommendations from AIPUT and Logistics UK strengthen the quantitative need case for Manston Airport.

By leaving the EU, the UK is now free to make trade deals with countries outside the UK and recently they have done trade deals with Japan[33] and Australia[34].

Clearly trade flowing to and from these countries outside the EU will require an increase in air freight capacity, both belly hold and dedicated freighters, and as such increases the quantitative need for Manston.

The UK will continue to trade with the EU and the free movement of goods is vital to all parties. Dover Port has seen many closures, with the most recent one being due to Covid[35], but many in the past have been due to industrial action. This is particularly problematical for perishable goods and time critical goods. Taking perishable and time critical goods by air to Manston would alleviate this problem.

3.0 Conclusion

It is our firm belief that the Quantitative need for Manston has been strengthened by changes to capacity at Stansted; the likely long delay in the opening of the third runway at Heathrow; the problem of an over reliance on belly hold; the continued growth of the just-in-time/e-commerce sector; the requirement to deliver new air cargo facilities that are as carbon neutral as possible; the need to embrace new technologies; new trade deals outside of the EU and the potential disruption to freight through Dover and other ports. For these reasons we urge the Secretary of State to grant the DCO for Manston Airport.

From the SMAa Committee on behalf of the 3,700 members

Dr Beau Webber (Chairman)
Liam Coyle (Vice-Chairman & Chief Moderator)
David Stevens (Vice-Chairman)
Margaret Sole (Treasurer)
Gregory Nocentini (Treasurer)
Angela Stevens (Secretary)
Ex-officio members:
Bryan Girdler
Garry Dumigan

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32 ANPS – page 11 section 1.39
33 UK and Japan free trade agreement
34 UK trade deal with Australia
35 Port of Dover Closed

References for SMAa representation to the Secretary of State for Transport - Matter 2

London Stansted Airport: Winter 2018/19 Scheduling Capacities

(all times in GMT)

Runway:

Hours (GMT)	Max Number Operations (Deps or Arrs)	Max Number Operations (two way)	Max Number Operations (Deps or Arrs)	Max Number Operations (two way)
0000-0059*	24	36	7 >> 9	11 >> 13
0100-0159*	24	36	7 >> 9	11 >> 13
0200-0259*	24	36	7 >> 9	11 >> 13
0300-0359*	24	36	7 >> 9	11 >> 13
0400-0449*	24	36	7 >> 9	11 >> 13
0500-0559*	24	36	7 >> 9	11 >> 13
0600-0614	33 Dep or 24 Arr.	44	9	13
0615-0629			9	13
0630-0644			9	13
0645-0659			9	13
0700-0714	33 Dep or 28 Arr.	48	9	13
0715-0729			9	13
0730-0744			9	13
0745-0759			9	13
0800-0859	27	44 >> 46	9	13
0900-0959	24 >> 27	38 >> 42	9	13
1000-1014	25 >> 27	40 >> 42	9	13
1014-1029			9	13
1030-1044			9	13
1045-1059			9	13
1100-1114	28	50	9	13
1115-1129			9	13
1130-1144			9	13
1145-1159			9	13
1200-1259	28	44	9	13
1300-1359	24 >> 27	38 >> 42	9	13
1400-1459	24 >> 27	38 >> 42	9	13
1500-1559	28	44	9	13
1600-1614	28	42	9	13
1615-1629			9	13
1630-1644			9	13
1645-1659			9	13
1700-1759	28	44	9	13
1800-1859	28	50	9	13
1900-1959	28	48	9	13
2000-2059	24 >> 27	38 >> 42	9	13
2100-2159	27	38 >> 42	9	13
2200-2214	31 Dep or 24 arr >> 24	39 >> 42	9	13
2215-2229			9	13
2230-2244			9	13
2245-2259			9	13
2300-2314	27 Dep or 24 arr >> 24	36	7 >> 9	11 >> 13
2315-2329			7 >> 9	11 >> 13
2330-2344*			7 >> 9	11 >> 13
2345-2359*			7 >> 9	11 >> 13

London Stansted Airport: Winter 2018/19 Scheduling Capacities

NOTES:

1 DETR Night Quota restrictions apply during the hours marked *.

2 Planning restrictions limit the total number of annual passenger and cargo air transport movements in a year to 264,000.(PATM 243,500 Catm 20,500) The Coordinator will ensure this limit is not breached.

3 The peak hour runway limits have been agreed on the understanding that during those busy periods departing aircraft may be subject to an average wait at the holding point of about ten minutes.

4 The coordinator shall ensure that the "Seat cap" introduced by the adoption of Local rule 4 be applied. The seat cap for Winter 2016 will be 14.8 million Seats. The application of local rule 4 shall ensure that in a 12 month period. London Stansted Airport does not exceed a passenger throughput of 35 million passengers

5 The Antonov 124 cannot depart during the period 23:00-06:00 and requires 4 consecutive departure slots. The Antonov is not restricted on arrivals

Load Factors (%):

	Scheduled services	Charter services	UK	CTA Arrivals
Mondays	92	100	92	92
Tuesdays	92	100	92	92
Wednesdays	92	100	92	92
Thursdays	92	100	92	92
Fridays	92	100	92	92
Saturdays	92	100	92	92
Sundays	92	100	92	92

London Stansted Airport: Winter 2018/19 Scheduling Capacities

Terminal:

Hours	Departures[1]	Arrivals International[2]	Arrivals Domestic[2]	Arrivals CTA[3]
0000-0059	4750	4100	750	700
0100-0159	4750	4100	750	700
0200-0259	4750	4100	750	700
0300-0359	4750	4100	750	700
0400-0459	4750	4100	750	700
0500-0559	4750	4100	750	700
0600-0659	4750	4100	750	700
0700-0759	4750	4100	750	700
0800-0859	4750	4100	750	700
0900-0959	4750	4100	750	700
1000-1059	4750	4100	750	700
1100-1159	4750	4100	750	700
1200-1259	4750	4100	750	700
1300-1359	4750	4100	750	700
1400-1459	4750	4100	750	700
1500-1600	4750	4100	750	700
1600-1659	4750	4100	750	700
1700-1759	4750	4100	750	700
1800-1859	4750	4100	750	700
1900-1959	4750	4100	750	700
2000-2059	4750	4100	750	700
2100-2159	4750	4100	750	700
2200-2259	4750	4100	750	700
2300-2359	4750	4100	750	700

NOTES:

1 Departures limits are the maximum number of passengers that can be scheduled to depart in any 60 minute period on any type of flight - inclusive of scheduled/charter, International/UK.

2 For international arrivals and UK flight arrivals, the maxima are independent.

3 CTA arrivals are also modelled at a 15 minute and 30 minute level. Capacity is 380 passengers per 15 minutes and 579 passengers per 30 minutes. Hourly limits are displayed in the above table.

4 The Terminal limits set out above are 60 minute capacities. To avoid "bunching" effects the Coordinator will cross check capacities over each hour starting at 15 minutes past the hour as well as over each hour.

5 A rolling 2 hour passenger limit of 8500 departing passengers will be applied.

6 An additional check in desk constraint will be applied for W18 as follows:-

Area	No of Desks	Declaration
Zone A	15	13
Zone B	15	13
Zone C	15	13
Zone D	14	8 desks 10:30 to 14:30, after 19:00 STD
Zone E	15	12
Zone F	15	12
501+	12	

Additional check-in desks will be delivered through W18 ahead of S19. Any temporary reductions in capacity to facilitate the construction of additional desks will be factored into coordination through the check-in referral process already in place.

Cargo:
Only 3 aircraft stands are available at any one time for B747-800 or 2 A380 series aircraft on the main cargo apron.
Total cargo parking demand will also be assessed. Where stand availability causes a constraint, a referral process will be implemented by ACL for the Airport to review and revert.

Business Aviation:
Stansted is designated as fully coordinated airport and therefore each business and general aviation movement requires the prior allocation of a slot.

Night quota:
Night quota limits apply at Stansted. The night quota period is defined as 2330 - 0600 (GMT) during which DfT have determined that for the Winter 2018 season, the number of movements will be restricted to 5600, and the maximum number of night quota points permitted to be 3310.
An assessment of remaining night allocations will be made at slot return deadline.

Stansted Airport
Summary of Traffic Results
Sep-19

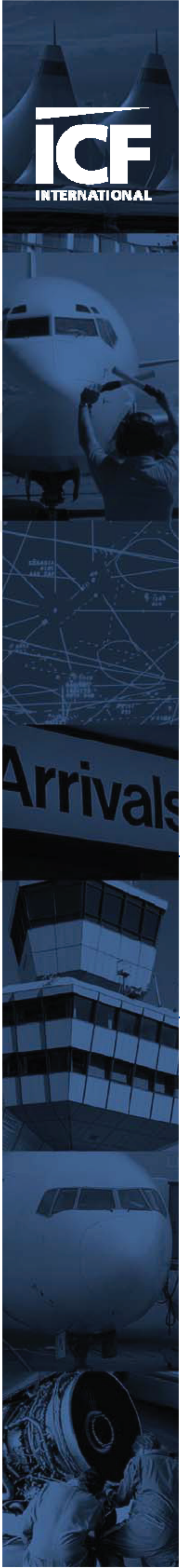
		Monthly figures			Year to date figures			Moving Annual Totals		
		Sep-18	Sep-19	% Dif	Sep-18	Sep-19	% Dif	Sep-18	Sep-19	% Dif
PASSENGERS										
Terminal		2,683,052	2,610,786	-2.7	15,944,798	15,853,377	-0.6	27,448,541	28,304,744	3.1
Split	Domestic	163,018	106,540	-34.6	1,095,489	751,493	-31.4	1,743,353	1,741,966	-0.1
	International	2,520,034	2,504,246	-0.6	14,849,309	15,101,884	1.7	25,705,188	26,562,778	3.3
Total Passengers		2,683,052	2,610,786	-2.7	15,944,798	15,853,377	-0.6	27,448,541	28,304,744	3.1
LOAD FACTORS										
(Pax ATMs only)										
Available seats		3,021,506	2,905,734	-3.8	17,732,559	17,569,466	-0.9	31,239,958	32,149,046	2.9
Split	Domestic	196,584	122,027	-37.9	1,274,882	867,052	-32.0	2,053,855	2,096,371	2.1
	International	2,824,922	2,783,707	-1.5	16,457,677	16,702,414	1.5	29,186,103	30,052,675	3.0
% Load Factors		88.8	89.8	na	89.9	90.2	na	87.9	88.0	na
Split	Domestic	82.9	87.3	na	85.9	86.7	na	84.9	83.1	na
	International	89.2	90.0	na	90.2	90.4	na	88.1	88.4	na
AIR TRANSPORT MOVEMENTS										
Passenger ATMs		16,431	15,699	-4.5	96,466	95,076	-1.4	170,766	174,657	2.3
Split	Domestic	1,275	875	-31.4	8,289	6,007	-27.5	13,812	13,977	1.2
	International	15,156	14,824	-2.2	88,177	89,069	1.0	156,954	160,680	2.4
Cargo ATMs		966	935	-3.2	5,945	5,745	-3.4	12,402	11,701	-5.7
ATM Total		17,397	16,634	-4.4	102,411	100,821	-1.6	183,168	186,358	1.7
Other Movements		1,450	1,592	9.8	9,037	8,766	-3.0	16,143	15,175	-6.0
Total Movements		18,847	18,226	-3.3	111,448	109,587	-1.7	199,311	201,533	1.1
FREIGHT TONNAGE										
Freight		20,189	18,167	-10.0	119,600	103,056	-13.8	242,712	214,719	-11.5
Mail		1,343	1,579	17.6	8,297	8,771	5.7	17,513	17,759	1.4
Total Cargo		21,532	19,746	-8.3	127,897	111,828	-12.6	260,224	232,478	-10.7
NIGHT NOISE										
QC Point Used		720	670		3,877	3,801		7,076	6,617	
Total Movements		1,383	1,306		7,642	7,519		13,022	12,607	

Stansted Airport
Summary of Traffic Results
Aug-19

		Monthly figures			Year to date figures			Moving Annual Totals		
		Aug-18	Aug-19	% Dif	Aug-18	Aug-19	% Dif	Aug-18	Aug-19	% Dif
PASSENGERS										
Terminal		2,975,568	2,865,863	-3.7	13,261,746	13,242,591	-0.1	27,223,584	28,377,010	4.2
Split	Domestic	198,803	107,927	-45.7	932,471	644,953	-30.8	1,729,254	1,798,444	4.0
	International	2,776,765	2,757,936	-0.7	12,329,275	12,597,638	2.2	25,494,330	26,578,566	4.3
Total Passengers		2,975,568	2,865,863	-3.7	13,261,746	13,242,591	-0.1	27,223,584	28,377,010	4.2
LOAD FACTORS (Pax ATMs only)										
Available seats		3,188,574	3,052,917	-4.3	14,711,053	14,663,732	-0.3	30,978,854	32,264,818	4.2
Split	Domestic	218,602	120,191	-45.0	1,078,298	745,025	-30.9	2,035,371	2,170,928	6.7
	International	2,969,972	2,932,726	-1.3	13,632,755	13,918,707	2.1	28,943,483	30,093,890	4.0
% Load Factors		93.3	93.9	na	90.1	90.3	na	87.9	88.0	na
Split	Domestic	90.9	89.8	na	86.5	86.6	na	85.0	82.8	na
	International	93.5	94.0	na	90.4	90.5	na	88.1	88.3	na
AIR TRANSPORT MOVEMENTS										
Passenger ATMs		17,260	16,486	-4.5	80,035	79,377	-0.8	169,444	175,389	3.5
Split	Domestic	1,431	876	-38.8	7,014	5,132	-26.8	13,727	14,377	4.7
	International	15,829	15,610	-1.4	73,021	74,245	1.7	155,717	161,012	3.4
Cargo ATMs		1,023	910	-11.0	4,979	4,810	-3.4	12,432	11,732	-5.6
ATM Total		18,283	17,396	-4.9	85,014	84,187	-1.0	181,876	187,121	2.9
Other Movements		1,467	1,506	2.7	7,587	7,174	-5.4	16,291	15,033	-7.7
Total Movements		19,750	18,902	-4.3	92,601	91,361	-1.3	198,167	202,154	2.0
FREIGHT TONNAGE										
Freight		20,646	16,103	-22.0	99,411	84,889	-14.6	243,116	216,741	-10.8
Mail		1,457	1,567	7.5	6,954	7,192	3.4	17,684	17,523	-0.9
Total Cargo		22,103	17,670	-20.1	106,365	92,082	-13.4	260,800	234,264	-10.2
NIGHT NOISE										
QC Point Used		775	695		3,157	3,131		7,059	6,667	
Total Movements		1,536	1,384		6,259	6,213		12,902	12,684	

Stansted Airport
Summary of Traffic Results
Jul-19

		Monthly figures			Year to date figures			Moving Annual Totals		
		Jul-18	Jul-19	% Dif	Jul-18	Jul-19	% Dif	Jul-18	Jul-19	% Dif
PASSENGERS										
Terminal		2,772,044	2,759,222	-0.5	10,286,178	10,376,728	0.9	26,990,062	28,486,715	5.5
Split	Domestic	193,303	109,005	-43.6	733,668	537,026	-26.8	1,697,090	1,889,320	11.3
	International	2,578,741	2,650,217	2.8	9,552,510	9,839,702	3.0	25,292,972	26,597,395	5.2
Total Passengers		2,772,044	2,759,222	-0.5	10,286,178	10,376,728	0.9	26,990,062	28,486,715	5.5
LOAD FACTORS (Pax ATMs only)										
Available seats		3,033,226	3,020,679	-0.4	11,522,479	11,610,815	0.8	30,717,809	32,400,475	5.5
Split	Domestic	209,440	121,023	-42.2	859,696	624,834	-27.3	2,003,238	2,269,339	13.3
	International	2,823,786	2,899,656	2.7	10,662,783	10,985,981	3.0	28,714,571	30,131,136	4.9
% Load Factors		91.4	91.3	na	89.3	89.4	na	87.9	87.9	na
Split	Domestic	92.3	90.1	na	85.3	85.9	na	84.7	83.3	na
	International	91.3	91.4	na	89.6	89.6	na	88.1	88.3	na
AIR TRANSPORT MOVEMENTS										
Passenger ATMs		16,480	16,302	-1.1	62,775	62,891	0.2	168,096	176,163	4.8
Split	Domestic	1,415	881	-37.7	5,583	4,256	-23.8	13,548	14,932	10.2
	International	15,065	15,421	2.4	57,192	58,635	2.5	154,548	161,231	4.3
Cargo ATMs		1,029	1,010	-1.8	3,956	3,900	-1.4	12,423	11,845	-4.7
ATM Total		17,509	17,312	-1.1	66,731	66,791	0.1	180,519	188,008	4.1
Other Movements		1,899	1,547	-18.5	6,120	5,668	-7.4	16,121	14,994	-7.0
Total Movements		19,408	18,859	-2.8	72,851	72,459	-0.5	196,640	203,002	3.2
FREIGHT TONNAGE										
Freight		20,752	16,131	-22.3	78,765	68,786	-12.7	241,519	221,284	-8.4
Mail		1,389	1,494	7.6	5,497	5,626	2.3	17,686	17,413	-1.5
Total Cargo		22,141	17,625	-20.4	84,262	74,412	-11.7	259,205	238,697	-7.9
NIGHT NOISE										
QC Point Used		704	680		2,382	2,436		7,009	6,747	
Total Movements		1,406	1,386		4,723	4,829		12,641	12,836	



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UK CAA RUNWAY RESILIENCE STUDY – FINAL REPORT

Prepared for:

UK CAA

Prepared by:

HELIOS **XPX Consulting and SH&E Limited**

December 2008

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1 EXECUTIVE SUMMARY

INTRODUCTION

1.1 The Department for Transport (DfT) has requested advice from the CAA, under Section 16(1) of the Civil Aviation Act in three areas to aid its understanding and evaluation of the end-to-end journey experience for air passengers to support policy development. These areas are[1]:

- the through-airport passenger experience
- early review of the passenger experience in Heathrow Terminal 5
- runway resilience.

1.2 Other areas that affect the overall resilience of the airport, including the availability and quality of the critical terminal infrastructure as well as the quality of the services delivered, are addressed in the regulatory regime for the designated airports through service quality standards, quality of service monitoring (QSM) and a system of rebates. These do not, however, cover the resilience of the runways themselves. Clearly, the airport has to be viewed as a single system and any gains made through regulatory initiatives could be negated through poor runway performance as the runway effectively delivers the passengers to and from the terminals.

1.3 The CAA has, therefore commissioned a study on runway resilience to investigate, in cooperation with the airlines and the airports, lessons learned from current runway operations at Heathrow and Gatwick airports. This document, prepared for the Economic Regulation Group (ERG) of the Civil Aviation Authority (CAA), by Helios, XPX and SH&E, is the final report of that study.

OPERATIONAL OVERVIEW

1.4 All departures from an airport are funnelled from their stands, via the taxiway system to take-off along a runway before dispersing along their departure air routes, usually standard instrument departures (SIDs). The situation is reversed for arrivals which are funnelled from their arrival air routes, often standard terminal arrival routes (STARs) to land on the runway and then dispersed via taxiways to their stands. The runway, therefore, represents a pinch point in the air traffic network. When demand is high it is a scarce resource

1 Letter from the Secretary of State for Transport to the Chairman of the CAA, dated 20 November 2007

utilisation of which must be managed carefully and optimised. This is the situation at both Heathrow and Gatwick airports.

1.5 As with all systems where demand is approaching capacity, queues to use the runway can build up. For arriving aircraft, the first mechanism used to manage these queues at Heathrow and Gatwick is the airborne holding stack. Generally, in holding stacks aircraft fly in a spiral racetrack pattern, entering at the top, descending through several levels and exiting at the bottom. Stacks are used to moderate the demand for the runway, as a buffer to allow air traffic controllers to sequence aircraft to optimise the throughput of the runway whilst maintaining separation between aircraft to ensure that the following aircraft is not affected by the preceding aircraft's wake vortex. This separation varies depending on the sequence of aircraft (heavy-heavy, heavy-light, light-heavy, etc). In simple terms the separation for a lighter aircraft following a heavier aircraft must be greater than if the sequence were the other way round. In this report, this process is called **stack holding** and the time that each aircraft spends in the stack is termed the **stack holding time**. Heathrow can use up to four stacks and Gatwick two.

1.6 Heathrow generally operates its two runways in segregated mode, meaning that one runway is used solely for arrivals and the other for departures. Thus to maximise throughput, arrivals are spaced as closely together as possible. Gatwick, as a single runway airport, uses its runway for both arrivals and departures. Arrivals and departures can be interspersed or bunched. The pressure for arrivals in this situation is less than for the single mode arrivals runway meaning that the separation between arriving aircraft is necessarily larger than the minimum imposed by wake vortex considerations to allow for a departure or bunch of departures to be slotted between successive arrivals or bunches of arrivals.

1.7 The holding stacks themselves have a limited capacity and two techniques can be used at Heathrow to deal with situations where the stack capacity looks as though it will be exceeded by the number of planned arrivals or when average stack holding time will become greater than twenty minutes:

- in certain circumstances, a procedure know as TEAM (Tactically Enhanced Arrivals Measures) can be applied temporarily to boost arrivals capacity by allowing a proportion of the arriving aircraft to use the departure runway. Typically, this is applied to match the early morning peak of demand, or when predicted delays within the next two hours are becoming excessive and reach defined trigger points. This does not, however, raise the capacity to that expected from a full mixed mode operation. TEAM is most valuable in mitigating short-term arrivals peaks.

- if the constraint is expected to be persistent, aircraft that plan to arrive during the period of congestion are held upstream on the ground at their departure airport until the downstream capacity constraint is alleviated. This technique of air traffic flow management (ATFM) is generally restricted to aircraft departing from a point in Europe and is administered centrally by the Eurocontrol Central Flow Management Unit (CFMU). In this report, the process of holding aircraft at their departure airport is called **ATFM regulation** or **restriction**. The ATFM regulation imposes an **ATFM delay** on the affected aircraft by imposing a calculated take-off time (CTOT) on the flight to ensure its passage to its destination is not impeded by capacity constraints along the way. The ATFM delay is the difference between the CTOT and the take off time estimated in the aircraft's flight plan.

1.8 As Gatwick's runway operates for both arrivals and departures, it cannot apply TEAM but its traffic can be moderated by ATFM regulation.

1.9 It is important to draw a distinction between mixed mode operations and TEAM because:

- TEAM allows a small proportion of arrivals to use the departure runway for a limited amount of time. Mixed mode would be a continuous operation over a more extended period.
- TEAM does not allow for departures to use the arrivals runway whereas mixed mode would utilise both runways for both arrivals and departures.
- approaches on the two runways during periods when TEAM is applied interact with each other and are dependent whereas full mixed mode would use support systems and associated procedures and practices required to enable independent parallel approach operations.
- if there is high demand for departures, TEAM will have a negative effect on departure queues as it allocates a proportion of the departure capacity to arrivals whereas mixed mode allows sharing of the capacity of both runways for both arrivals and departures.

1.10 The departure flow is moderated by managing the queue to optimise the throughput of the departure runway. Departures are sequenced by managing the time that the aircraft is pushed back and by managing its passage from its stand to the runway after it has pushed back to provide the optimum sequence of aircraft at the departure runway. In this report, this process is termed **ground holding** and the period that the aircraft spends in this process is called the **ground holding time**.

1.11 The ground holding process is further complicated because it needs to take account of:

- potential capacity constraints down the aircraft's flight path which might be manifested as ATFM regulations that cause the aircraft to be held at Heathrow or Gatwick
- short-term sequencing of aircraft departing the London terminal area through standard instrument departure (SID) routes shared between Heathrow, Gatwick, Stansted, Luton and London City airports. This sequencing, that takes into account all traffic departing London, not just Heathrow and Gatwick, is managed through the application of minimum departure intervals (MDIs) whereby short holding delays are imposed on the affected aircraft by local air traffic control.

1.12 The operational analysis undertaken in this report focuses on the three main areas impacted by the runway:

- stack holding for arrivals
- upstream ATFM regulation due to the capacity of the arrivals airport
- ground holding for departures.

1.13 In each case, section 4 describes the current situation and section 5 assesses the impact several potential future scenarios.

1.14 The root causes of the current runway performance and potential improvement opportunities are explored in section 8.

Current situation at Heathrow and Gatwick

Capacity

1.15 The capacity of both Heathrow and Gatwick airports is determined through the scheduling process (see part 3 of this report for a full description). The scheduling process results in a scheduling limit (the maximum number of movements per hour and effectively the planned capacity of the runways) on a hourly basis for departures, arrivals and total movements based on estimates of the capacity of various elements of the airport, including the runways, terminal buildings, stands and so on, balanced against acceptable stack and ground holding times. This scheduling process is performed for summer and winter seasons separately and, hence, it is expected that there will be a different relationship between demand, delay and capacity for summer and winter. The summer season runs from the end of March to the end of October (approximately 7 months), corresponding to British Summer Time (BST) whereas the winter season runs from the end of October to the end of March (approximately 5 months) corresponding to Greenwich Mean Time (GMT). For this reason and the fact that the weather usually varies from summer to winter, the two seasons have been analysed separately.

1.16 Analysis based on the two most recent complete scheduling seasons, namely summer 2007 and winter 2007/2008 for Heathrow and Gatwick indicates that the operational demand levels for the runways were such that:

- there was little difference in demand at Heathrow between summer and winter and from month-to-month within the seasons. Across each season, on average, the airport is consistently operating at an actual flow rate of approximately between 97 to 98% of its runway capacity, as defined by the scheduling limit, with peak utilisation reaching 98.5% at times. The underlying rate of cancellations is around 2% indicating that overall the demand for the runways is 100% of capacity.
- runway demand at Gatwick is much lower than at Heathrow. Gatwick's runway demand, accounting for the underlying cancellation rate, is highest in the peak part of the summer season (roughly May to September), with average utilisation levels, compared to the scheduling limits, at around 95% and up to 99% in July and August. In the winter the seasonal average runway demand is around 88%.

Holding in stacks

1.17 At Heathrow, the time spent holding in stacks was approximately 565000 minutes in total for the summer season and 602000 minutes in total for the winter season. The holding patterns are broken down as:

- summer: an average hold per inbound flight of around 7 minutes in the peak periods and 3½ minutes in the off peak periods. The average stack holding time per inbound flight is around 4 minutes over the summer season. Peak (95th percentile) stack holding reaches approximately 15 minutes at times during the summer season
- winter: an average hold per inbound flight of around 7 minutes in the peak periods and 6 minutes in the off peak periods. The average stack holding time per inbound flight is around 6 minutes over the winter season. Peak (95th percentile) stack holding times reach 18 to 19 minutes at times during the winter season.

1.18 Tactically Enhanced Arrivals Measures (TEAM) is applied virtually every day around 06:00 to 07:00 local time to manage the early morning peak. In addition, it is applied on other occasions to manage traffic as appropriate when it appears that stack holding times will become excessive.

1.19 At Gatwick, summer stack holding is, at a total of approximately 28,000 minutes, around a factor of three times greater than the delay attributable to ATFM restrictions but, at a total of approximately 44,000 minutes in total, around the same magnitude as ATFM restrictions in winter. Average stack hold per flight is considerably lower than that experienced at Heathrow and is broken down as follows:

- summer: in the early morning peak, the average hold per flight is around 3½ minutes and is around 1 minute per flight the rest of the time. The overall average stack holding time per inbound flight is around 0.4 minutes
- winter: in the winter morning peak the average stack hold per flight is around 3 minutes per flight and is less than 1 minute per flight the rest of the time. The overall average stack holding time per inbound flight is around 0.9 minutes

ATFM restrictions

1.20 Upstream at the origin airport, arrivals at Heathrow and Gatwick from within Europe and some other places may be subject to air traffic flow management (ATFM) restrictions imposed as regulations by the Eurocontrol Central Flow Management Unit (CFMU) at the request of the London Flow Management Position (FMP), based at Swanwick. The purpose of these restrictions is to balance demand with available capacity throughout the air traffic management (ATM) network. If a regulation applies, a flight is held on the ground at its origin airport until a time that the CFMU system has calculated that it can be handled within the capacity limits declared along the entire route of flight. These regulations may be applied because of capacity constraints at the destination airport or because of capacity restrictions en route. In the case of Heathrow just over half of the inbound ATFM restrictions are due to Heathrow itself and approximately one quarter of the arriving flights that have delays of greater than 15 minutes are caused by a Heathrow restriction. It is important to stress that, particularly in the early morning arrivals peak, a high proportion of the arriving traffic, especially at Heathrow, originates outside of Europe and is, therefore, not subject to ATFM restrictions. The whole of the demand during this period is, therefore, moderated by restricting only part of the traffic.

1.21 Examination of data collected from the CFMU that describes airport ATFM restrictions at Heathrow and Gatwick indicate that;

- capacity restrictions of varying severity are applied virtually every day at Heathrow in both summer and winter seasons, although the restrictions applied during the summer are usually less severe than those applied during the winter
- Gatwick is subject to many fewer restrictions than Heathrow

1.22 The overall performance of the two airports during 2007 was as follows:

- Heathrow: during the summer season there were approximately 390000 minutes of ATFM delay imposed due to Heathrow airport ATFM regulations . During the winter season this rose to approximately 625000 minutes despite the fact that the winter season (5 months) is shorter than the summer season (7 months). These totals equate to approximate average airport ATFM delays of:
  - 6 minutes on average per inbound flight[2] during the peak times in the summer season with an average over the season of around 3 minutes per flight. Peak airport ATFM delays, quantified by the 95th percentile, reached around 25 minutes at Heathrow in the summer
  - up to 8 minutes on average per inbound flight during the peak times during the winter season. The average over the season was around 6 minutes per inbound flight. Peak (95th percentile) airport ATFM delays in the winter were around 40 to 45 minutes
- Gatwick: during the summer season there were approximately 28000 minutes of ATFM delay imposed due to Gatwick airport ATFM regulations whereas there were approximately 53,000 minutes of ATFM delay during the winter season. The average airport ATFM delay per inbound flight attributed to Gatwick never exceeded 1 minute in either the summer or winter seasons. The peak (95th percentile) Airport ATFM delays only occur at Gatwick during peak periods.

Heathrow ATFM performance compared to other hubs:

1.23 To account for scale effects the best parameter to compare the ATFM performance of different airports is the average airport-related ATFM delay per flight. Such comparison must be treated with some caution as different airports may allocate and report associated delays in different ways and have different infrastructure and associated operations – Charles de Gaulle has theoretical capacity of around twice that of Heathrow, Amsterdam’s capacity is around 75% higher than Heathrow’s and Frankfurt has comparable capacity to Heathrow. This simple comparison indicates that:

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2 The average is performed over every inbound flight including those from outside of the CFMU area. The ATFM per delay per delayed flight is therefore much higher than the overall average

- in summer, except in the early morning peak (where Charles de Gaulle is the worst performer, despite having the highest capacity) Heathrow's ATFM performance is worse than Amsterdam, Frankfurt and Paris Charles de Gaulle
- in winter Heathrow and Frankfurt perform much worse than Paris Charles de Gaulle in terms of average airport ATFM delays (there is no data available for Amsterdam with which to make a comparison).

1.24 Weather is the biggest single cause of airport ATFM restriction at Heathrow, Gatwick and the other major European hub airports and, unsurprisingly, the proportion of weather related restrictions increases in the winter season compared to the summer season. Comparison of Heathrow's robustness against poor weather has been gauged by comparing the ratio of weather regulated capacity to peak capacity for the major European hubs using data available from the Eurocontrol Performance Review Commission. The results of this analysis indicate that:

- in the most extreme cases experienced in 2004 (which is the latest year for which the data is available), Heathrow outperformed the other three main hubs, Amsterdam, Frankfurt and Paris Charles de Gaulle
- averaged over 2004, Heathrow performance was more robust than Amsterdam and Paris Charles de Gaulle but was slightly outperformed by Frankfurt.

Knock-on effects

1.25 Airport ATFM restrictions imposed at the destination airport have a knock-on effect upstream throughout the network as they cause congestion at departure airports as aircraft must be held on the ground. Similarly, they might be expected to have knock-on effects downstream as inbound punctuality will have an impact on the reliability of the airlines ability to provide connecting services beyond the destination airport – specifically Heathrow.

1.26 In the case of the upstream, origin airports, the effect of ATFM restrictions is limited to those within the CFMU system: UK domestic, European and a few others. This is due to the limitation of the mandate of the CFMU to impose flow restrictions, when so required, on aircraft that originate within its area of responsibility, which in broad terms encompasses Europe to the west of the Ural Mountains and the immediately adjacent flight information regions (FIRs). Effectively, therefore, aircraft inbound to Heathrow from domestic and European destinations are disproportionately affected by ATFM as they are the only flights that can be restricted to manage demand – long haul flights are generally unaffected.

1.27 Examination of the airport ATFM restrictions imposed on arrivals from domestic and European origins show that the average delay per flight in the early morning peak (when a large proportion of flights are long haul and unaffected by ATFM) is around 8 to 12 minutes per flight whereas the equivalent delays in the evening peak are approximately 6 to 8 minutes per flight. Airport ATFM delays during the off peak period are of the order of 2 to 4 minutes. The patterns of delays from a sample of specific origin airports - the major European hubs and main domestic origins - show a similar pattern. Heathrow appears to be causing significant knock-on disruption during its peak periods.

Relation between AFTM delays and arrival punctuality

1.28 Correlating the airport ATFM delay with on time arrival punctuality performance (OTAP) on a flight by flight basis shows that:

- for airport ATFM delays of longer than approximately 30 minutes there is a direct 1-to-1 relationship between punctuality and the ATFM delay
- for shorter airport ATFM delays the very many other potential sources of delay mask any correlation that might exist.

Ground holding by ATC

1.29 Ground holding is a complex situation where runway effects are intermingled with factors other than the runway that affect the aircraft's take-off time and hence ground holding. These factors include ATFM restrictions, imposed by the CFMU in the form of a calculated take-off time (CTOT); the application of minimum departure intervals (MDIs) imposed tactically by London flow management position (FMP) to manage congestion in terminal manoeuvring area (TMA) and en-route airspace; and the requirement for air traffic controllers (ATCOs) to apply standard departure separations.

1.30 Ground holding times have been derived for both Heathrow and Gatwick using data available from the electronic flight processing system (EFPS) which allows the taxi time from stand to departure runway to be calculated. The excess taxi time beyond the unimpeded taxi time[3] is defined as the ground holding time.

1.31 Ground holding times at Heathrow are similar for both summer and winter and are typically around 10 to 12 minutes per departure during most of the day but are reduced to around 6 minutes per departure in the early morning. At Heathrow the average ground holding time per flight is:

- just over 9 minutes per departure in the summer season

[3] Note – variable taxi times are available for most stand-runway combinations for Heathrow from work performed by Eurocontrol. Variable taxi times have been calculated for Gatwick assuming the same statistical definition as applied at Heathrow

- just under 9 minutes per departure in the winter season.

1.32 Peak ground holding times, as defined by the 95th percentile, are around 20 to 22 minutes across the day for both summer and winter seasons.

1.33 In contrast to both stack holding and airport ATFM delays, ground holding is of the same order of magnitude at Gatwick as it is at Heathrow. The average ground holding time per flight is around 10 minutes in the early morning, that is between 05:00 and 08:00 local time. At this time there is high demand for both arrivals and departures. Subsequently, the average ground holding time per flight reduces gradually throughout the day to a value of around 4 minutes per flight in the late evening.

1.34 At Gatwick, the average ground holding time per flight is:

- just over 8 minutes per departure in the summer season
- just under 8 minutes per departure in the winter season.

1.35 At Gatwick, peak (95th percentile) ground holding times are around 18 minutes in the early morning, gradually reducing to around 12 minutes by the late evening.

1.36 The large mismatch between average ground holding times and average stack holding times at Gatwick (a ratio of up to 20 for the summer averages), when compared to those for Heathrow (a ratio of 2.25 for the summer averages) suggests that arrivals are prioritised, i.e. held less, than departures on the shared Gatwick runway.

1.37 The final dimension of holding on the ground is the delay between the pilot requesting start-up and that request being approved. Here there is little difference between the summer and winter seasons. The average time difference is around 4.5 minutes at Heathrow and 2.2 minutes at Gatwick.

Summary of holding and delays

1.38 The following table summarises the various types of holding and ATFM delays at Heathrow and Gatwick over the last two complete seasons.

Exhibit 1-1: Summary of different delay types at Heathrow and Gatwick

		Heathrow				Gatwick			
		Stack	ATFM	Ground	Pre-start-up	Stack	ATFM	Ground	Pre-start-up
Summer	Total (000s mins)	565	389	1404	537	93	28	603	167
	Average (mins)	5.3	2 8	10.0	4.6	1.2	0.4	7.8	2.2
	95th %ile	10-15	15-25	14-22	19	0	0	12-18	12
Winter	Total (000s mins)	602	625	942	409	44	53	381	108
	Average (mins)	6.0	5 3	9.2	4.4	0.8	1.0	6.9	2.2
	95th %ile	15-20	35-45	14-22	18	0	0-12	12-18	12

Major disruptions

1.39 During the periods April 2007 to March 2008, Heathrow suffered 13 days when arrivals capacity was restricted to less than 90% of the norm averaged across the operating day. The main cause of these restrictions was the weather and in addition there was the BA038 accident.

1.40 Collectively, in addition to the associated ATFM delays, these 13 days resulted in approximately 2000 cancelled flights. There were, of course, additional days when large numbers of flights were cancelled for a cause other than runway restrictions. Over the period Heathrow suffered 8 days when over 10% of flights were cancelled. In total there were 47 more days when the flow of both or either of arrivals and departures was severely restricted to less than 90% of the norm or there were more than 20 cancellations. Heathrow appears to suffer around 8 to 13 days per year when operations are disastrously disrupted and a further 47 to 52 days when there is significant but recoverable disruption.

1.41 Examination of runway utilisation figures indicates that NATS uses TEAM to the maximum extent possible to provide the maximum capacity to minimise the impact of disruption and to facilitate recovery afterwards. The use of TEAM is enabled by the drop of demand for the use of the departure runway as a knock-on effect from delayed and cancelled arrivals.

1.42 In contrast, Gatwick suffered no days (despite similar weather) where the capacity was restricted to below 90% (or indeed, 95%) of the monthly average flow. Levels of cancellation were also much lower at Gatwick. Over the period, Gatwick did not suffer a single day when 10% or more of flights were cancelled. Gatwick's resilience is due to: 1) the spare buffer capacity that it has to absorb disruptions by, for example, having the freedom to accommodate delayed flights into spare slots; and 2) the natural robustness that its runway operations bring against wind and low visibility conditions primarily because of the reduced pressure and increased flexibility to sequence arriving and departing aircraft compared to heavily utilised segregated mode runways.

POSSIBLE FUTURE SCENARIOS AT HEATHROW

Normal operations

1.43 The impact of a number of scenarios on stack holding, airport ATFM delays and ground holding of potential future developments at Heathrow has been investigated. These scenarios, which are linked to potential future developments reported in part 4, are summarised in the following table.

Exhibit 1-2 Scenarios Investigated

	Sensitivity testing	Additional TEAM	Mixed mode	Theoretical reduction in demand
Additional flights added	1) Flight added in each hour separately, no capacity added			
Number of flights reduced	2) Flight removed from each hour separately, capacity held at current levels			7) 5% of flights removed each hour across the day, current capacity
Capacity added, current movement levels retained		3) application of TEAM extended across the delay peaks, demand held at current levels	4) maximum capacity mixed mode, giving 15% capacity increase 5) TWASS[4] mixed mode with amended SID[5] structure, giving 10% capacity increase 6) TWASS mixed mode with current SID structure, giving 5% capacity increase	

1.44 The objective of the scenario analysis was to test the impact on runway resilience alone in terms of operational and economic factors as one element of the policy-making process. It is well understood that many additional impact assessments, not least environmental – noise and emissions – would have to be performed should these scenarios be developed further as proposals in any way. It should also be noted that none of the scenarios, with the exception of scenario 1, add any demand and even scenario 1 adds only 1 flight per day. The scenarios are based on the current ground infrastructure and operations and primarily focused

4 TWASS - TWin Arrival Streams maintaining Standard Separation
5 SID- Standard Instrument Departure

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on the addition of capacity with demand held at current levels or, indeed, reduced. The impact of ongoing and potential future developments is assessed, and correlated to these scenarios in Part 4 of this document. Finally, the scenarios, with the exception of scenario 4, are based on the current traffic mix and compared to the current situation. The analysis gives a measure, therefore, of the each scenario's impact against a stable baseline. Scenario 4 is based on a 2015 traffic mix, based on a best estimate by NATS and BAA of what this is likely to be.

1.45 The impact of each scenario on airport ATFM delays, stack holding and ground holding was tested using a statistical model that describes the relationship between holding times/ATFM delays, demand and capacity. In each case the familiar exponential or power law relationship, expected from queuing theory, was derived. For most scenarios, the model was derived and validated using operational data covering the summer season 2007 and the winter season 2007/2008. The validation shows that the model predicts total airport ATFM delays to an accuracy of better than 30%. This discrepancy between the model and the actual observations for ATFM delays is caused by the broad spread of ATFM delays around the exponential relationship, reflecting, presumably, the influence of the many other factors present in the complex ATFM situation. However, the accuracy is adequate to determine the directional impact of the various scenarios in airport ATFM delays.

1.46 The statistical models predict total both stack and ground holding times to an accuracy of better than 10%. This accuracy is more than sufficient to assess the impact of the scenarios.

1.47 For the full capacity mixed mode scenario the holding time/ATFM delay, demand, capacity relationship was derived and validated using the results of the NATS HERMES simulation tool as no operational data exists. The statistical approach gives a total stack holding time that agrees with the HERMES output to around 10% which again is very adequate to assess the impact of the scenarios.

1.48 The results of the analysis of each of the scenarios in terms of the change in total ATFM delays stack holding times and ground holding times are given in the following table.

Exhibit 1-3 Impact on holding times at Heathrow by scenario

	ATFM delays (000s minutes)		Stack holding (000s minutes)		Ground holding (000s minutes)	
Scenario	Summer	Winter	Summer	Winter	Summer	Winter
Model baseline (excludes severely disrupted days which are treated separately)	352	396	565	602	1404	942
	Change due to each scenario					
Additional flight (worst case)	+29	+42	+93	+21	+24	+3
Flight removed (best case)	-12	-12	-19	-17	-10	-3
Additional TEAM	-85	-92	-185	-159	193	39
TWASS MM, current SIDs (+5%) capacity, current movement limits	-109	-122	-261	-264	-181	-46
TWASS MM, enhanced SIDS (+10%) capacity, , current movement limits	-159	-241	-382	-373	-327	-86
Full capacity MM +15% capacity, , current movement limits	-196	-265	-486	-548	-1214	-730
5% fewer flights per hour	-129	-166	-264	-284	-255	-95

Source: Helios Analysis

1.49 The same data normalised to the number of flights operating in each season is presented in the following table.

Exhibit 1-4 Impact expressed as average minutes per flight

	ATFM delays (minutes per flight)		Stack holding (minutes per flight)		Ground holding (minutes per flight)	
Scenario	Summer	Winter	Summer	Winter	Summer	Winter
Baseline (excludes severely disrupted days which are treated separately)	2 49	3 98	4 00	6 05	10 02	9 20
	Change due to each scenario					
Additional flight (worst case)	+0 20	+0 42	+0 66	+0 21	+0 17	+0 03
Flight removed (best case)	-0 09	-0 12	-0 13	-0 17	-0 07	-0 03
Additional TEAM	-0 60	-0 92	-1 31	-1 60	1 38	0 39
TWASS MM, current SIDs (+5%) capacity, current movement limits	-0 77	-1 23	-1 85	-2 65	-1 28	-0 46
TWASS MM, enhanced SIDS (+10%) capacity, , current movement limits	-1 13	-2 42	-2 71	-3 75	-2 32	-0 86
Full capacity MM +15% capacity, , current movement limits	-1 39	-2 66	-3 44	-5 50	-8 60	-7 33
5% fewer flights per hour	-0 96	-1 75	-1 97	-3 00	-1 90	-1 00

Source: Helios Analysis

1.50 The qualitative impact of the scenarios can be summarised as:

- in terms of sensitivity, adding a flight, especially at an inappropriate time has significantly more negative impact than removing a flight, that is the addition or subtraction of flights is asymmetric. The increase in delays and holding time caused by adding a single flight can be very large indeed and in the worst case approaches the total holding time experienced at Gatwick
- additional TEAM can deliver benefits in terms of reduced airport ATFM delays and stack holding times for arrivals but there is an associated cost in increased ground holding especially if TEAM is applied at times when

- the demand for departures is high. When TEAM is extended across the morning peak and applied consistently during the evening peak, the losses due to increases in departure holding are around half of the gains from reductions in ATFM delays and stack holding

- in terms of the pure operational benefit of reducing holding times, discounting economic effects, the scenarios in order of increasing preference would be: i) TWASS mixed mode, current SIDs adding 5% capacity; ii) TWASS mixed mode, with enhanced SIDS adding 10%; iii) full capacity mixed mode. The illustrative scenario of reducing demand by 5% indicates the degree to which the balance has tipped in favour of enabling flights in preference to resilience.

MAJOR DISRUPTIONS

1.51 At Heathrow, disruption associated with the runway is principally caused by reduction in the runway flow rate because of either low visibility conditions or adverse wind conditions. As Heathrow operates in segregated mode, the spacing between arriving aircraft must be minimised to maximise the flow rate. Both adverse wind conditions and low visibility cause the spacing between (principally) arriving aircraft to be extended beyond the minimum separation applied on normal operating days.

1.52 Analysis of two case studies, one based on 23 December 2007 when severe disruption due to fog persisted throughout the day (a disaster day) and one based on 5 November 2007 where there was disruption in the early morning peak, again due to fog, that cleared by around 09:00 shows that:

- the application of TEAM on both disaster and recoverable days brings benefits to the situation compared to that in which TEAM is not applied. Without TEAM on disaster days, the shortfall in arrivals would have been up to around 40% greater than that achieved and around 50% greater than that achieved on the recoverable day. TEAM does not allow recovery on the disaster days though

- reducing or capping demand facilitates recovery by both reducing the impact of the disruption when it occurs and by ensuring that there is spare capacity available after resumption of normal operations

- it is not possible to recover from the disaster days that occur on between 8 and 13 days per year. However, use of mixed mode operations on these days would ease the situation and could result in a reduction in shortfall of flights (and cancellations depending on particular airline policy) by around 40%. This benefit arises from the natural robustness of mixed mode operations against the requirement to impose increased separation for arriving aircraft in adverse wind and visibility conditions. Simple addition of capacity would not ease the situation on disaster days in segregated mode operations as the operational capacity is already reduced well below that available on normal days

- use of mixed mode on recoverable days at Heathrow would likely allow full recovery similar to that achieved at Gatwick on similar types of day. There is a dual benefit on the recoverable day in that mixed mode reduces the impact of the disruption (wind or fog) as well as speeding up the recovery by providing additional capacity.

Economic Results

1.53 Stack and ground holding and airport ATFM delays have an economic impact, primarily on airlines and their passengers, and also an impact on the environment. Stack and ground holding result in extra flying or extended taxi times which use additional fuel so generating CO2 and damaging the environment. To compensate for time spent holding, airlines plan their schedules around an expectation that aircraft will be queuing on a daily basis to take-off or land. This incurs additional cost for the airlines as they need to operate with more crews and aircraft.

1.54 Because holding times and airport ATFM delays vary with weather conditions and traffic intensity, despite the extended sector times reflected in airlines' schedules, runway related holding and delay also has an impact on departure and arrival punctuality. Around 20% of passenger delay minutes at Heathrow are directly attributed to runway congestion; with rotational delays the figure will be higher.

1.55 The scope of this study focusses on the airlines and airports, their passengers and the environment, and excludes wider economic effects such as employment and the contribution of flying to the UK economy. The study has not looked in detail at the competitiveness of Heathrow compared to other European hubs, and how changing levels of Heathrow performance would change traffic patterns. In assessing the net benefits we have adopted the DfT's methodology used in their 2007 paper, "UK Air Passenger Demand and CO2", and which is detailed in Appendix H of that report.

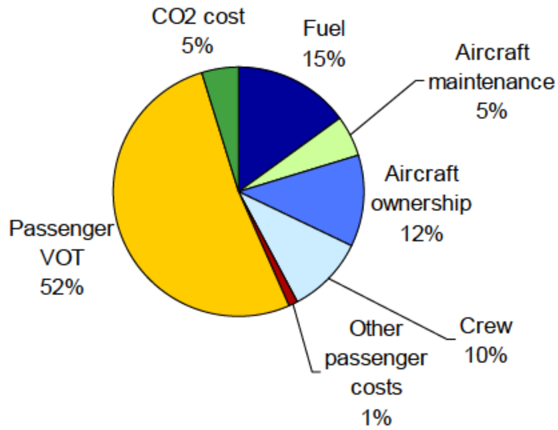
1.56 From discussions with the BAA we have concluded that at least at the margin, changes in aircraft holding times have no measurable cost or benefit to the airport operator so the impact on them is not considered. However, the economic benefits from incremental passengers are considered in line with the

DfT approach referred to above which recognises the additional profit they bring to airports.

Current Situation

1.57 The total cost of stack and ground holding, and airport ATFM delays based on analysis of the summer 2007 and winter 2007/2008 seasons for Heathrow is around £433 M. This is broken down as follows:

Exhibit 1-5 Costs of Holding in Summer 2007 and Winter 2007/2008



Source: SH&E Analysis

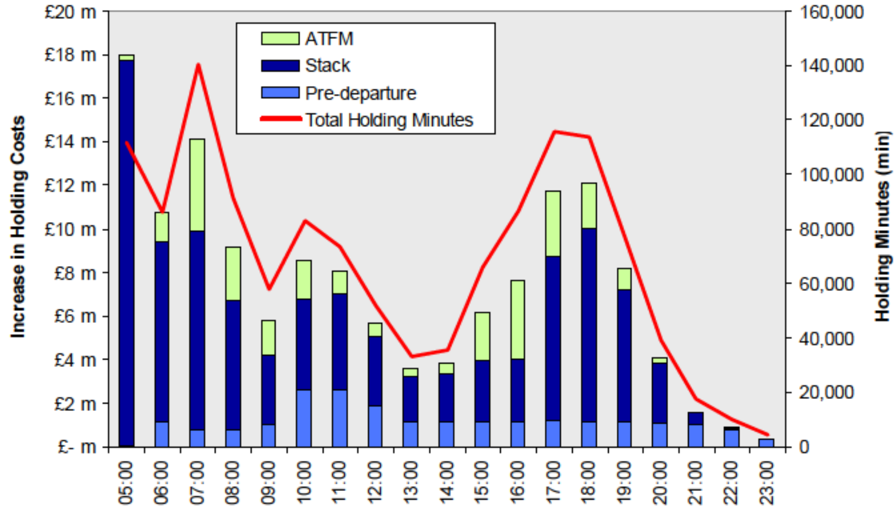
1.58 To these costs should also be added a further £3 million to £5 million share of the standby resources (aircraft, crew and ground staff) that airlines allocate to improve resilience to arrival and departure delays when they occur: a 20% share of these delays are related to runway congestion.

Changing the balance of demand and capacity

1.59 The impact of adding extra flights at Heathrow would be to increase holding times, airport ATFM delays and costs associated with runway congestion. These costs would be incurred by all airlines operating around the time of the additional flights, not just by the extra flight itself. These costs need to be considered against the benefits of the extra flights which largely accrue to the airlines and airports, their passengers and their passengers' employers.

1.60 Looking first at the increased holding costs which include airline costs, the value of passengers' time and the cost of the carbon emissions, we can see that the impact varies considerably with the time of day.

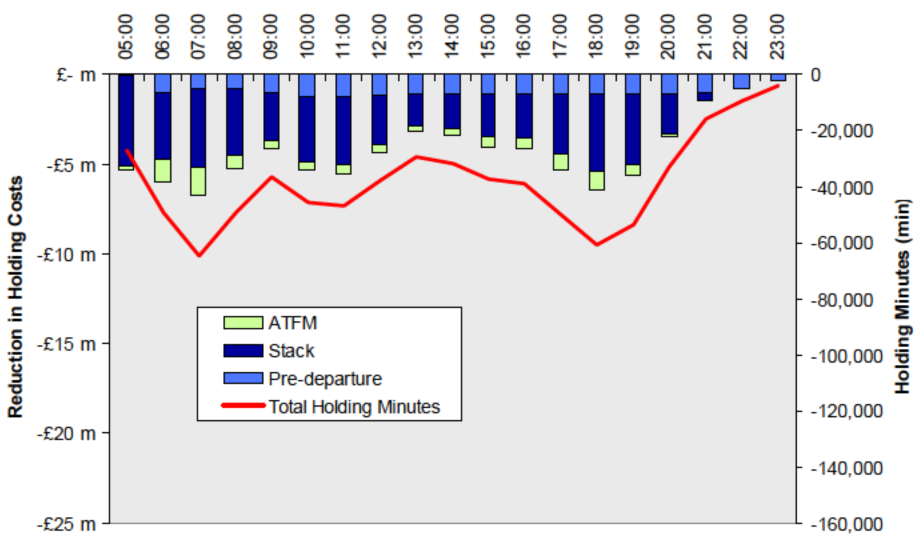
Exhibit 1-6 Effect of Adding Extra Flights on Holding Costs (assuming one arriving and one departing flight is added in any hour)



Source: SH&E Analysis

1.61 Exhibit 1-6 shows the increased costs are highest for the stack holding and particularly in the early morning arrivals peak when there is a high proportion of wide-bodied aircraft. There is another peak in the evening. The potential from reducing the demand by removing a flight in each hour has a lower and opposite impact, as shown below in Exhibit 1-7. The costs are proportional to the total holding minutes which are more sensitive to increased demand than reduced demand.

Exhibit 1-7: Reduction in Holding Costs when flights are removed is lower



Source: SH&E Analysis

1.62 The increase in holding costs from an extra daily flight pair, averaged across the day is £7.5 million a year (in 2007 costs). The decrease if a flight pair is removed is -£4.3 million.

1.63 The benefits of the extra flight are made up of several elements

- The benefits new passengers gain from the additional flights (Generated User Benefits)
- The value of time saved by existing passengers who benefit from more convenient schedules (Existing User Benefits)
- Additional profits airports make from additional passengers (Producer Benefits)
- Increased Air Passenger Duty (APD Revenue)

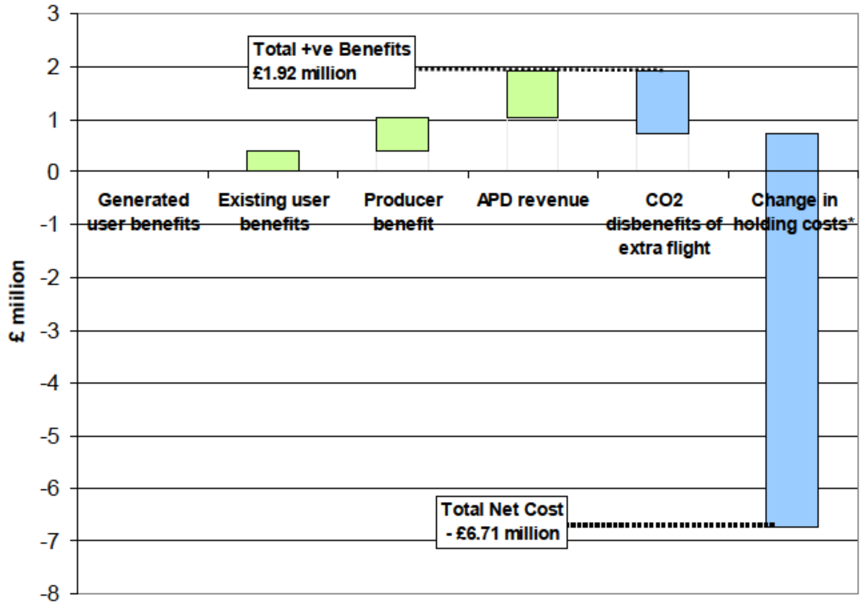
Less the offsetting incurred costs

- The environmental costs of extra flights
- The increased costs of holding, as summarised in Exhibit 1-6 above.

While the actual benefits from any additional flights may vary by time of day and also depend on the flight destination, the aircraft size and so on, the methodology of benefit estimation works at a more aggregate level and does not allow that level of differentiation.

1.64 The total average annual benefit from adding an extra flight is £0.74 million. This gives a net result per flight pair added of a loss of -£6.71 million when the increased holding costs are considered. The elements that make this up are shown in the following Exhibit 1-8.

Exhibit 1-8: The average net loss from adding a daily pair of flights at LHR



Source: SH&E Analysis

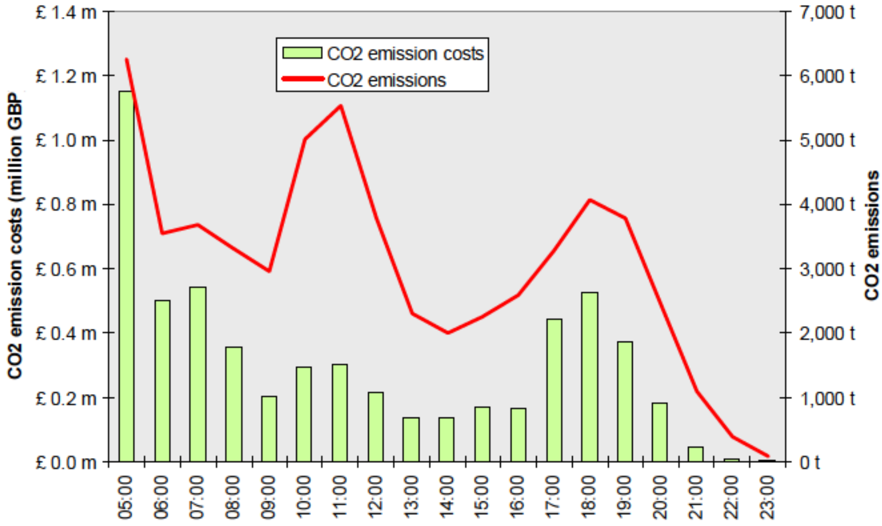
1.65 The main conclusion from this analysis is that the benefits of additional flights are, on average, heavily outweighed by increased holding costs from the resulting worsened congestion at Heathrow.

1.66 A similar picture was found when the scenario of reduced flying was analysed. In this case the magnitude of the improvement in net benefit was less - £3.52 million per flight pair compared to £6.71 million when flights are added. This difference reflects the increasingly damaging effect of adding demand to a system which is very close to its capacity.

1.67 The main environmental impacts for holding are from additional flying in the stack which burns fuel and increases emissions of C02 and NOx. The costs of carbon emissions in the stack and from additional flights include a 1.9 escalation factor for Radiative Forcing as recommended by the DfT: this reflects the additional environmental harm caused by CO2 released at altitude.

1.68 The annualised emission of CO2 and the costs of emission would increase as shown below. The average increased holding cost of carbon is around £0.3 million a year; this is in addition to annual cost of carbon for the additional flight itself of £1.2M.

Exhibit 1-9. CO2 Effect of Adding Extra Flights



Source: SH&E Analysis

Allocating more airline resources to reduce holding delay impacts

1.69 When holding delays increase airlines in theory can choose whether to plan on the increased sector times this implies, or ignore it and accept worse on-time punctuality. In simple terms this is a trade off between expenditure, lower levels of delivered customer service, and some associated costs from compensation, lost baggage and mis-connecting passengers.

1.70 A simple analysis shows that in terms of easily measurable costs it is more expensive for airlines to increase their scheduled sector times than it is to pay for the costs of worse on-time performance by a factor of ten-to-one. The fact that they do not pursue a "lowest cost" policy suggests that they put a high value on customer service and passengers' time.

ROOT CAUSE ANALYSIS

1.71 The are four main strands of root cause issues:

- Pressure on the Capacity Declaration procedures to create additional capacity – but with a process which does not have, nor is asked to have, a full set of planning parameters, metrics, and targets to make it sufficiently operationally realistic. An example is in-bound pre-departure ATFM delays which, although often caused by factors beyond the airport's control, happen on a daily basis - it would therefore seem prudent to have a collective stakeholder response in addition to the schedule buffering introduced by airlines (using their own internal assumptions). The process also lacks any real power to drive any difficult changes – particularly reductions in capacity/demand. This is exacerbated by the current lack of economic trade-off metrics.

- Pressure on tactical ATC management to correct the imbalances created by weaknesses in the plan, airline adherence to plan and factors outside their control. Over time, tactical reserve positions have been eroded and effectively incorporated into the assumed operation e.g. TEAM in the early morning. Small but measurable increases in demand and adverse trends in aircraft mix are adding to the problems and potentially further weakening resilience.
- Bunching of runway demand, caused in part by peaks within the schedule but also by airline processes and performance which do not consistently deliver aircraft on plan (although again recognising network factors which may be beyond their control).
- Gaps in the governance structure and processes which result in limited incentives and sanctions around adherence to plan and responses to endemic issues. While there are many planning and performance committees and improvement initiatives, there are few system-wide key performance indicators (KPIs) – resulting in gaps e.g. again relating to the ATFM delay problem described above and, until recent community effort, a fully co-ordinated response to days of serious disruption. This can be exacerbated by funding debates where benefits and costs accumulate in different organisations.

1.72 It should be stressed that the airport and its community of airline users have a set of planning, governance and performance review structures which are fully compliant with EU slot regulations, safety and DfT regulations, and IATA scheduling guidelines, and which are highly respected in the aviation industry. However, the problems of congestion, environment and disruption specific to Heathrow appear now to demand a new and higher order of targeting, planning and managing at the airport. We have assumed for the purposes of this study that the legislative and regulatory frameworks mentioned above will remain in place as the context for Heathrow operational planning, albeit that some of the parameters affecting demand and/or capacity may be modified.

Conclusions

Operational aspects

1.73 Heathrow's runways are currently operating at or very near their capacity giving very limited buffer against the normal perturbations in the air traffic network or to cope with or recover from disruptions to operations. The very high utilisation at Heathrow is also reflected in its low robustness to and limited ability to recover from major disruption when compared to Gatwick.

1.74 This fragility appears to be exacerbated by the use of the runways in segregated mode with the minimum spacing between arriving aircraft when compared to the additional, buffer spacing that naturally occurs when runways are shared for both arrivals and departures.

1.75 As a consequence of operating very near to capacity, Heathrow's current performance is significantly worse than that at Gatwick in terms of stack holding and airport ATFM delays. The performance of the two airports is comparable for ground holding for departures. Gatwick's poor performance in ground holding, relative to stack holding and ATFM delays, is probably due to priority being given to arrivals for access to the runway.

1.76 In addition, Heathrow's performance in terms of airport ATFM delays is worse than two of its main European hub competitors (Amsterdam Schiphol and Paris Charles de Gaulle with the caveat that both of these airports have considerably greater runway infrastructure than is available at Heathrow) and on a par with Frankfurt. Heathrow does, however, show better resilience against adverse weather conditions than both Amsterdam Schiphol and Paris Charles de Gaulle.

1.77 Heathrow's own ATFM delays, stack and ground holding can be very sensitive to the addition of even a single flight at an inappropriate time and can increase very significantly. This is because at times the runway is operating at its very limits of capacity and small increases in demand can therefore cause large increases in delay which propagate through to subsequent hours until a fire-break is reached where sufficient spare capacity is available to stop the knock-on effects. However, the sensitivity to the removal of a single flight at a given time is much lower than for the addition of a flight at the same time as the holding time reduces more slowly as demand reduces than it increases when demand increases because (1) the relationship between queue length and demand is exponential meaning that increases result in a much greater relative change than decreases. Furthermore, the knock-on effect of reducing demand is much less than the knock-on effect of increasing demand. There is more to lose in terms of increased delays by adding a flight than there is to gain by removing a flight.

1.78 In terms of improving performance, various scenarios could be considered for increasing capacity whilst holding demand at its current levels. These options include the extension of TEAM and implementation of various manifestations of mixed mode. Although TEAM brings operational benefits in terms of reduced airport ATFM delays and stack holding, it can also have a negative effect on ground holding for departures if it applied when departure demand is high.

1.79 Clearly the greater the capacity delivered by mixed mode operations, the greater the benefit in terms of reduced airport ATFM delays, stack and ground holding as well as improved scope for recovery from disruptions. Mixed mode runway operation can also ameliorate the impact of persistent major disruptions but it will not completely overcome the effect of the disruption.

Costs and benefits of changing the balance between demand and capacity

1.80 The current level of runway utilisation at Heathrow is beyond the economic balance point throughout the day and throughout the year. Adding more flights without any change in capacity or the way existing demand is managed will have an economically adverse effect.

1.81 Should it be possible to reduce the number of flights the savings in reduced holding costs would still outweigh the benefits lost from those flights at the current balance of demand and capacity.

1.82 Airlines' policy of fully reflecting increased holding times in their scheduled sector times is beneficial to passengers even though it appears to be a more expensive option for the airlines. The apparent anomaly can be explained by the implied high value airlines must put on the competitive value of punctuality, which is consistent with previous studies and figures quoted by individual airlines consulted during this project.

Root causes

1.83 Clearly, there are no simple solutions to the root cause issues at Heathrow – different levels of mixed mode have been modelled in the main exercise (and in other studies) and operationally it has the advantage of potentially allowing increased demand and/or restoring tactical capacity (and increased arrival separations) to improve resilience.

1.84 Short of mixed mode, or alongside it, there are a number of options which could be developed – some of which are already on the continuous improvement agenda and some of which could be addressed through a co-ordinated effort if the relevant targets, objectives and amended governance structures could be agreed. Examples include:

- Changes to the shape of the schedule and incorporation of more extensive and realistic planning parameters to smooth patterns of capacity and demand. Subject to technical feasibility and further detailed modelling (beyond the scope of this study), holds should be reduced by levelling flows over the day. It is possible that technical constraints associated with such a move could lead to a marginal reduction in capacity – which may carry economic penalties to airlines as a result of losing some commercially valuable slots in the peaks.

- Targeted reductions in capacity to induce a reduction in demand. Some modelling has been reported in the main report on general reductions – in practice there would be a range of options, the most valuable in terms of operational performance concentrating on "firebreaks" – short gaps or reductions in the airport's daily schedule - to relieve the impact of the peaks. The resultant loss in aircraft traffic movements would be off-set, in terms of passengers, through demand shifting to other services either side of the change in the schedule (leading to higher load factor and/or reinforcing trends to larger aircraft).

- Resilience and operational control improvements to help restore tactical resilience. These measures are unlikely to allow increases in demand but would assist resilience and facilitate punctuality improvement. Examples include:

  – Improved control and process discipline from implementation of wider Collaborative Decision Making – this is in development at Heathrow.

  – Time-based separation – this would be a significant development requiring substantial work on the safety case for moving from current distance-based separation.

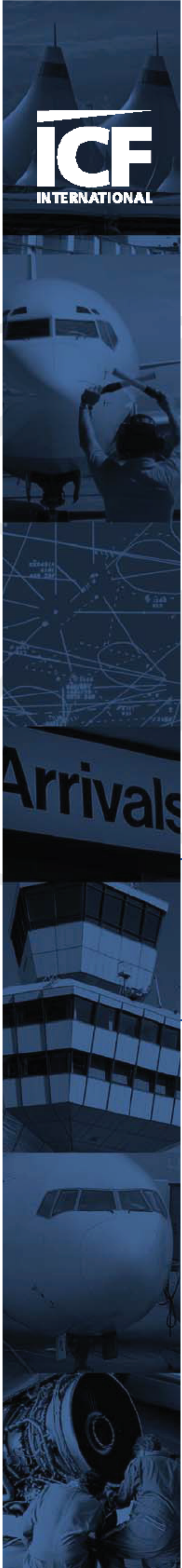
  – Extended application of TEAM – there are detailed options which are more specific than those modelled in the main project. This may require Government policy approval, given the noise implications, depending on the level of change required to the guidelines.

- A fuller package of targets, planning parameters and KPIs within a strengthened governance structure could tighten control of the operation and introduce more sanctions and incentives. Steps might include changes to the "first come, first served" procedures, new measurement points in the processes and trade-off decision support.

- Achieving change of this kind would also tighten the distribution curves to improve predictability - other drivers of poor punctuality at the airport could then be addressed with greater confidence and less interaction with runway performance.

1.85 These approaches address the identified root causes, but in terms of measured impact, most would be reflected in specific elements of performance (e.g. ATFM holds or cancellations) - rather than the fundamentals of the relationship between capacity and demand which was the focus of the main study. Therefore, rather than talk about overall improvement, it is necessary either to construct a package of changes or to specify more granular targets (e.g. reduced number of disrupted days) and to prioritise relevant initiatives.

1.86 In any event, a more holistic view of targets and governance is likely to be required to balance the historic pressures to increase the level of demand with acceptable operational integrity.



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Part I:
INTRODUCTION

2 INTRODUCTION

OPERATIONAL OVERVIEW

2.1 All departures from an airport are funnelled from their stands, via the taxiway system to take-off along a runway before dispersing along their departure air routes, usually standard instrument departures (SIDs). The situation is reversed for arrivals which are funnelled from their arrival air routes, often standard terminal arrival routes (STARs) to land on the runway and then dispersed via taxiways to their stands. The runway, therefore, represents a pinch point in the air traffic network and, as such, when demand is high, is a scarce resource whose utilisation must be managed carefully and optimised. This is the situation at both Heathrow and Gatwick airports.

2.2 As with all systems where demand is approaching capacity, queues to use the runway can build up. For arriving aircraft, the first mechanism used to manage these queues at Heathrow and Gatwick is the airborne holding stack. Generally in holding stacks, aircraft fly in a spiral racetrack pattern, entering at the top, descending through several levels and exiting at the bottom. Stacks are used to moderate the demand for the runway, as a buffer to allow air traffic controllers to sequence aircraft to optimise the throughput of the runway whilst maintaining separation between aircraft to ensure that the following aircraft is not affected by the preceding aircraft's wake vortex. This separation varies depending on the sequence of aircraft (heavy-heavy, heavy-light, light-heavy, etc). In simple terms the separation for a lighter aircraft following a heavier aircraft must be greater than if the sequence were the other way round. In this report, this process is called **stack holding** and the time that each aircraft spends in the stack is termed the **stack holding time**. Heathrow can use up to four stacks and Gatwick two.

2.3 Heathrow generally operates its runways in segregated mode, meaning that one runway is used solely for arrivals and the other for departures. Thus to maximise throughput, arrivals are spaced as closely together as possible. Gatwick, as a single runway airport, operates its runway in mixed mode, that is the same runway is used for arrivals and departures. In this case, arrivals and departures are often interspersed meaning that the separation between arriving aircraft is necessarily larger than the minimum imposed by wake vortex considerations to allow for a departure to be slotted between successive arrivals.

2.4 The holding stacks themselves have a limited capacity and two techniques can be used at Heathrow to deal with situations where the stack capacity looks as though it will be exceeded by the number of planned arrivals or average stack holding time will become greater than twenty minutes:

- if the constraint is caused by a short-term peak in demand, that is it is expected to be persist for less than around an hour, air traffic control applies a procedure know as TEAM (Tactically Enhanced Arrivals Measures). TEAM temporarily boosts arrivals capacity by allowing a proportion of the arriving aircraft to use the departure runway. This does not, however, raise the capacity to that expected from a full mixed mode operation because, for example, it does not allow full, independent use of the runways and only addresses arrivals. Its use is restricted to times when holding time in the stacks is predicted to become excessive
- if the constraint is expected to be persistent, aircraft that plan to arrive during the period of congestion are held upstream on the ground at their departure airport until the downstream capacity constraint is alleviated. This technique, called air traffic flow management (ATFM), is generally restricted to aircraft departing from a point in Europe and is administered centrally by the Eurocontrol Central Flow Management Unit (CFMU). In this report, the process of holding aircraft at their departure airport is called **ATFM regulation** or **restriction**. The ATFM regulation imposes an **ATFM delay** on the affected aircraft.

2.5 As Gatwick's runway operates for both arrivals and departures, it cannot apply TEAM but its traffic can be moderated by ATFM regulation.

2.6 The departure flow is moderated by managing the queue to optimise the throughput of the departure runway. Departures are sequenced by managing the time that the aircraft is pushed back and by managing its passage from its stand to the runway after it has pushed back to provide the optimum sequence of aircraft at the departure runway. In this report, this process is termed **ground holding** and the period that the aircraft spends in this process is called the **ground holding time**.

2.7 The ground holding process is further complicated because it needs to take account of:

- potential capacity constraints down the aircraft's flight path which might be manifested as ATFM regulations that cause the aircraft to be held at Heathrow or Gatwick
- short-term sequencing of aircraft departing the London terminal area through standard instrument departure (SID) routes shared between Heathrow, Gatwick, Stansted, Luton and London City airports. This sequencing, that takes into account all traffic departing London, not just

Heathrow and Gatwick, is managed through the application of minimum departure intervals (MDIs) whereby short holding delays are imposed on the affected aircraft by local air traffic control.

2.8 The operational analysis undertaken in this report focuses on the three main areas impacted by the runway:

- stack holding for arrivals
- upstream ATFM regulation due to the capacity of the arrivals airport
- ground holding for departures.

2.9 In each case, In Part 2 of the report, section 4 describes the current situation, section 5 assesses the impact of several potential future scenarios from the operational perspective. Part 3 of the report assesses the economic impact of both the current situation and potential future scenarios.

2.10 The root causes of the current runway performance and potential improvement opportunities have been explored by XPX Consulting and are reported in Part 4 of this document.

2.11 Part 5 of the report introduces work that was done additional to the original remit of the study to help understand how best to balance resilience and additional flights in the situation that additional capacity might be made available.

BACKGROUND TO THE STUDY

2.12 In November 2007 the Department for Transport (DfT) published a report "*Improving the air passenger experience*" with particular focus on Heathrow airport. This report considers all elements of the passenger's end-to-end journey, including:

- getting to and from the airport
- getting through the airport, including check-in, security screening, transit through the terminal, embarkation, immigration, baggage handling and reclaim, and customs
- take-off and landing, including push-back, taxiing, and disembarkation
- flying to and from the desired destination/origin.

2.13 The Department for Transport (DfT) has requested advice from the CAA, under Section 16(1) of the Civil Aviation Act in three areas to aid its understanding and evaluation of the end-to-end journey experience for air passengers to support policy development. These areas are[6]:

- the through-airport passenger experience
- early review of the passenger experience in Heathrow Terminal 5
- runway resilience.

2.14 Other areas that affect the overall resilience of the airport, including the availability and quality of the critical terminal infrastructure as well as the quality of the services delivered, are addressed in the regulatory regime for the designated airports through service quality standards, quality of service monitoring (QSM) and a system of rebates. These do not, however, cover the resilience of the runways themselves. Clearly, the airport has to be viewed as a single system and any gains made through regulatory initiatives could be negated through poor runway performance as the runway effectively delivers the passengers to and from the terminals.

2.15 The CAA has therefore commissioned a study on runway resilience to investigate, in cooperation with the airlines and the airports, lessons learned from current runway operations at Heathrow and Gatwick airports.

2.16 In simple terms, the study objectives are to make an assessment of the relative values (cost and benefits), to all stakeholders including the environment, of using capacity to: either enable additional flights; or to provide higher quality of service in terms of reduced delays, improved predictability and better recovery from significant operational disruption events. Effectively, the eventual trade-off will be to balance demand and quality of service.

2.17 Further to the evaluation of this trade-off, opportunities for achieving performance improvement, through the better planning and operation of the runway, slots and associated ATC resources, have been investigated in parallel.

2.18 This document, prepared for the Economic Regulation Group (ERG) of the Civil Aviation Authority (CAA), by Helios, SH&E and XPX Consulting, is the final report of that study.

2.19 Best use has been made of existing operational and modelling data. Gaps identified in the available data have been supplemented by focused modelling and analysis as necessary. Data gathered for the study includes National Air Traffic Services (NATS) operational records, Eurocontrol Central Flow Management Unit (CFMU) data, and simulation data produced by NATS under the

6 Letter from the Secretary of State for Transport to the Chairman of the CAA, dated 20 November 2007

commission of BAA as part of the recent Heathrow consultation, data held by Airport Coordination Limited (ACL) and the BAA airport super-logs required to support the regulation of quality of service standards at Heathrow and Gatwick airports.

2.20 This has been supplemented by detailed discussions with airlines which have provided specific data to help complete and calibrate the overall results, and support the economic evaluation.

2.21 During the course of the study we have benefited from the contribution of the main stakeholders, particularly the airlines, airports and NATS as the air navigation services provider, both through provision of a deeper understanding of the technical and economic aspects and also by providing access to the relevant data.

2.22 The Terms of Reference for the study are contained in Appendix A.

3

Measuring Delays and Runway Performance, Definitions

Introduction

3.1 This study is concerned with assessing the resilience of runway operations at Heathrow and Gatwick airports and to learn lessons from current operations. Runway resilience, from its dictionary definition (*the abilities to withstand or recover quickly from difficult conditions*), is interpreted as having two main components:

- **Withstanding:** how robust are current runway operations against normal day-to-day perturbations to the operating environment?
- **Recovering:** how well can current runway operations recover from large-scale disruptions to the current operating environment?

3.2 Loss of resilience in runway operations manifests itself in holding, delays and cancellations.

Optimising the Use of Available Capacity Using Holding

3.3 Management of runway operations is set up to optimise the utilisation of runways as a scarce and critical resource at both Heathrow and Gatwick. This is achieved through the use of three sets of queue:

- airborne holding or stacking for arrivals where air traffic control (ATC) manages the inbound queue and sequences aircraft to maximise runway throughput by establishing a buffer in the air – stacks – in the London terminal area
- air traffic flow management (ATFM) regulation and associated delays for arrivals, which is administered by the Central Flow Management Unit (CFMU) and holds inbound flights on the ground at the departure airport by slot regulation. ATFM regulations, imposed by the CFMU, and hence ATFM-related delays, occur when traffic demand exceeds ATM capacity en-route (en-route ATFM delay) or at departure/arrival airports (airport ATFM delay). ATFM regulation may be imposed because of over delivery of aircraft from the network or a structural lack of capacity due to technical failures, industrial action, staff shortages or adverse weather. This project is concerned only with ATFM regulations due to the imbalance of demand and capacity at Heathrow and Gatwick as arrival

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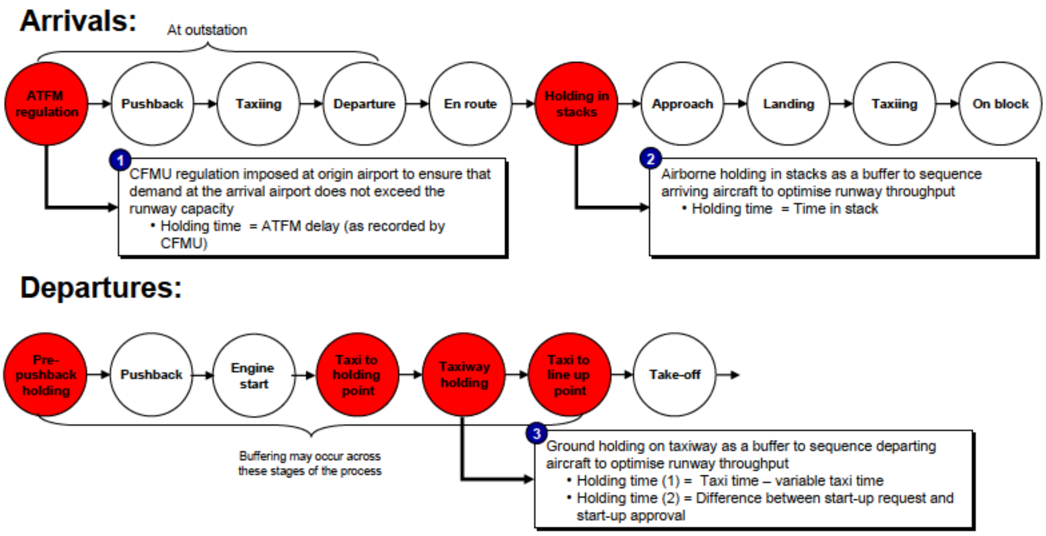
airports. Arrivals at Heathrow and Gatwick from origins within the CFMU system, which in broad terms encompasses Europe to the west of the Ural mountains and the immediately adjacent FIRs, and some other places may be subject to air traffic flow management (ATFM) restrictions imposed as regulations by the CFMU at the request of the London Flow Management Position (FMP), based at Swanwick. The purpose of these restrictions is to balance demand with available capacity throughout the air traffic management (ATM) network. If a regulation applies, a flight is held on the ground at its origin airport until a time that the CFMU system has calculated that it will be contained within the capacity limits declared along the route of flight

- ground holding for departures to manage the outbound queue and sequence aircraft, within the constraint of CFMU regulations and minimum departure intervals (MDIs), to maximise runway throughput by using the aircraft taxiing from the stand to the runway as a buffer. This may be achieved by managing the aircraft's progression from stand to departure runway after it has pushed back as well as managing the time that approval for start-up is granted.

3.4 The outcome of each of these three queue management techniques is often termed "a delay" although it is important to be aware that they might or might not impact on punctuality depending on other circumstances, including the amount of buffer built into airline schedules. The total delay comprises these three elements and other components, including en route delays, delays due to airline processes and rotational or knock-on delays. Each element of the total delay, however, has an impact on the passenger's perception of the quality of the service being delivered.

3.5 In terms of the end-to-end processes for arrivals and departures, the elements investigated in this study are highlighted in Exhibit 3-1 , together with definitions of the delays that are measured.

Exhibit 3-1: Discrete elements of the arrivals and departures processes being investigated



DEFINITIONS AND DATA SOURCES

3.6 The operational analysis part of the project has determined the relationship between delay[7], demand and capacity using statistical techniques based on a sample of data describing individual arrivals and departures to/from Heathrow and Gatwick over a 12 month period from 1 April 2007 to 31 March 2008 spanning the last two complete airline scheduling seasons, that is summer 2007 and winter 2007/2008.

3.7 The following definitions have been used:

- **demand** is defined as the number of aircraft wishing to use the runway within a given hour prior to holding (ATFM, stacking or ground holding) restrictions being applied. The demand profiles:
  - reflect actual observations and are not simply based on the schedule
  - are derived before ATFM regulations are applied to manage the demand for the runway.
- **capacity** is defined as the number of aircraft that the runway can throughput within a given hour for a given level of delay in normal operations
- **holding** and **holding time** is used to describe the time spent waiting on the ground or in the stack.
- **delays** occurs when demand approaches or exceeds capacity:

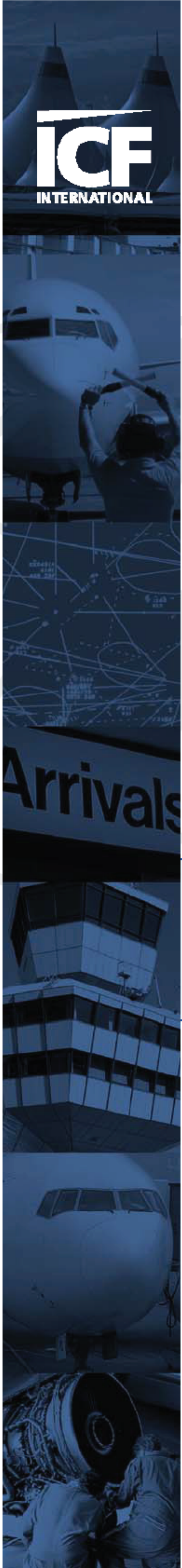
7 Here the term "delay" is taken to mean ATFM delay, stack holding time or ground holding time

- when the schedule, modified by network fluctuations, exceeds the normal operating capacity of the runway
- when capacity is reduced below its normal value by some event, such as weather.

3.8 Note that delays are also used to mean flights that arrive or depart later than their scheduled time. It should be clear from the context within the report which delay is referred to.

3.9 Historical operational data have been used as the basis of the analysis. The main sources of these data were:

- NATS, describing:
  - the use of stacks by arrivals at Heathrow and Gatwick. This data has been derived from the UK Flight Database
  - ground holding for departures from Heathrow, derived from the NATS electronic flight processing system (EFPS)
  - the output of the HERMES model used, *inter alia*, to investigate the potential of mixed mode operations at Heathrow as part of the recent consultation process
- the Eurocontrol Central Flow Management Unit, providing a complete catalogue of arrivals and departures at Heathrow and Gatwick including ATFM delays caused by regulations at those airports (note similar data was collected for Amsterdam, Frankfurt and Paris Charles de Gaulle airports to enable comparison of ATFM performance)
- airlines, describing particular operators' stack holding, ground holding and on time arrival punctuality performance as well as runway utilisation
- Airport Coordination Limited (ACL) providing information on disruption to operations and the causes of those disruptions.



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Part II:
OPERATIONAL ANALYSIS

4 CURRENT SITUATION AT LHR AND LGW

INTRODUCTION

Overview of runway operations

4.1 Heathrow operates with two parallel runways (27L/09R & 27R/09L) oriented east-west with a lateral separation of 4640ft. Heathrow operates in segregated mode with one runway for arrivals and one runway for departures. In segregated mode the runways operate independently. The preferred runway direction is Westerly (27L and 27R). Easterly operations are employed when the tail wind approaching the runway threshold exceeds 10kts. In order to meet noise restrictions, for easterly operations the northern runway (09L) is always used for arrivals and the southern runway (09R) is always used for departures as the Cranford Agreement prohibits easterly departures from the northern runway (09L). For westerly operations runway alternation is employed where the runways change over at 15:00 and where the active duty runway in the morning period (06:00 to 15:00) and in the evening period (15:00 to 23:30) changes on a rotational basis.

4.2 Gatwick is a single runway airport (08/26) and as such the runway operates both arrivals and departures interspersed or in bunches depending on the prevailing traffic situation.

4.3 As with all systems where demand is approaching capacity, queues to use the runway can build up. For arriving aircraft, the first mechanism used to manage these queues at Heathrow and Gatwick is the airborne holding stack. This approach enables air traffic controllers (ATCOs) to sequence aircraft in the optimum manner to maximise the flow rate – the penalty being that the pool of available aircraft must be held in order for the sequence to be optimised.

4.4 Generally, aircraft in holding stacks fly in a spiral racetrack pattern, entering at the top, descending through several levels and exiting at the bottom. Stacks are used to moderate the demand for the runway, as a buffer to allow air traffic controllers to sequence aircraft to optimise the throughput of the runway whilst maintaining separation between aircraft to ensure that the following aircraft is not affected by the preceding aircraft's wake vortex. This separation varies depending on the sequence of aircraft (heavy-heavy, heavy-light, light-heavy, etc). In simple terms, the separation for a lighter aircraft following a heavier aircraft must be greater than if the sequence were the other way round. In this report, this process is called **stack holding** and the time that each aircraft spends in the stack is termed the **stack holding time**. Heathrow can use up to four stacks and Gatwick two. The current agreed average stack holding time is set at ten minutes through an agreement between the airlines, airports and NATS.

4.5 There are number of uncontrollable (from the perspective of air traffic control) factors that impact on the holding time:

- Aircraft mix: As described above is necessary for air traffic controllers to maintain wake vortex separations which vary depending on the sequence of aircraft. The mixture of aircraft in the mix influences the efficiency with which this spacing can be optimised
- Airline schedules: Holding times will vary according to the schedules of the airlines operating to the airport. Holding is likely to increase where, for example, there is concentration of demand at a specific time. Smoothing of schedules is a technique that could bring benefits in terms of reduced holding times
- Wind conditions: variability in wind conditions can impact on the separation of aircraft on approach and, when adverse conditions are experienced and separations are greater than normal, runway throughput is decreased and holding times are expected to increase.

4.6 The holding stacks themselves have a limited capacity and two techniques can be used at Heathrow to deal with situations where the stack capacity looks as though it will be exceeded by the number of planned arrivals or average stack holding time will become greater than twenty minutes:

- in certain circumstances, a procedure know as TEAM (Tactically Enhanced Arrivals Measures) can be applied temporarily to boost arrivals capacity by allowing a proportion of the arriving aircraft to use the departure runway. Typically, this is applied to match the early morning peak of demand, or when predicted delays within the next two hours are becoming excessive and reach defined trigger points. This does not, however, raise the capacity to that expected from a full mixed mode operation. TEAM is most valuable in mitigating short-term arrivals peaks.
- if the constraint is expected to be persistent, aircraft that plan to arrive during the period of congestion are held upstream on the ground at their departure airport until the downstream capacity constraint is alleviated. This technique is called air traffic flow management (ATFM), is generally restricted to aircraft departing from a point in Europe (it does not, therefore, apply to long haul aircraft from intercontinental origins) and is administered centrally by the Eurocontrol Central Flow Management Unit (CFMU). In this report, the process of holding aircraft

at their departure airport is called **ATFM regulation** or **restriction**. The ATFM regulation imposes an **ATFM delay** on the affected aircraft by imposing a calculated take-off time (CTOT) on the flight to ensure its passage to its destination is not impeded by capacity constraints along the way. The ATFM delay is the difference between the CTOT and the take off time estimated in the aircraft's flight plan.

4.7 As Gatwick's runway operates for both arrivals and departures, it cannot apply TEAM but its traffic can be moderated by ATFM regulation.

4.8 It is important to draw a distinction between mixed mode operations and TEAM because:

- TEAM allows a small proportion of arrivals to use the departure runway for a limited amount of time. It is likely that mixed mode would be a continuous operation over a more extended period although it could also be applied for limited periods
- approaches on the two runways during periods when TEAM is applied interact with each other and are dependent whereas full mixed mode would use support systems and associated procedures and practices required to enable independent parallel approach operations
- TEAM does not allow for departures to use the arrivals runway whereas mixed mode would utilise both runways for both arrivals and departures
- if there is high demand for departures, TEAM will have a negative effect on departure queues as it allocates a proportion of the departure capacity to arrivals whereas mixed mode allows sharing of the capacity of both runways for both arrivals and departures.

4.9 The departure flow is moderated by managing the queue to optimise the throughput of the departure runway. Departures are sequenced by managing the time that the aircraft is pushed back and by managing its passage from its stand to the runway after it has pushed back to provide the optimum sequence of aircraft at the departure runway. In this report, this process is termed **ground holding** and the period that the aircraft spends in this process is called the **ground holding time**.

4.10 The ground holding process is further complicated because it needs to take account of:

- potential capacity constraints down the outbound aircraft's flight path which might be manifested as ATFM regulations that cause the aircraft to be held at Heathrow or Gatwick

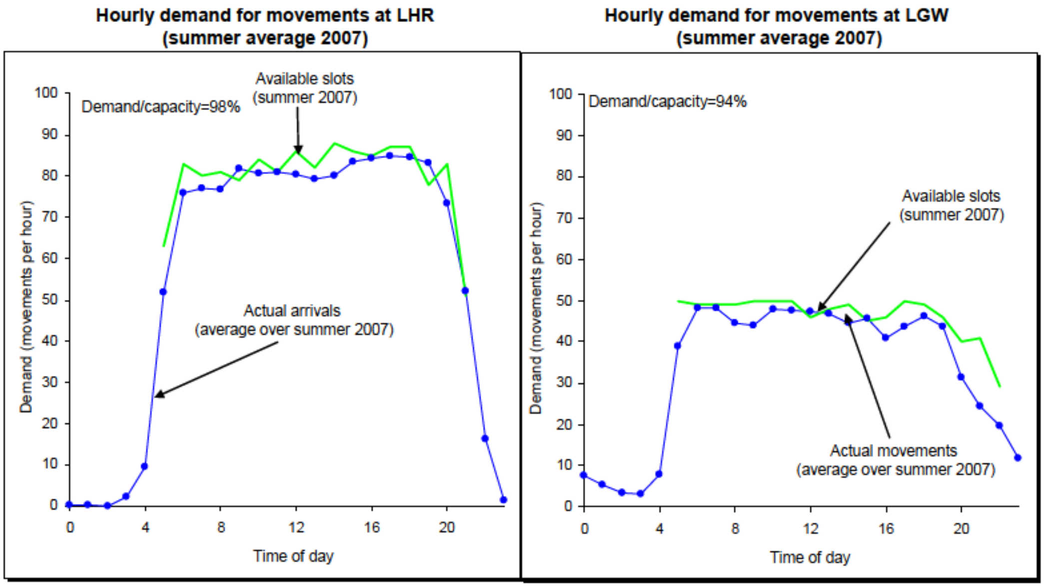
- short-term sequencing of aircraft departing the London terminal area through standard instrument departure (SID) routes shared between Heathrow, Gatwick, Stansted, Luton and London City airports. This sequencing, that takes into account all traffic departing London, not just Heathrow and Gatwick, is managed through the application of minimum departure intervals (MDIs) whereby short holding delays are imposed on the affected aircraft by local air traffic control.

Average traffic levels

4.11 The capacity of both Heathrow and Gatwick airports is determined through the scheduling process (see Part 4 of this report for a full description). The scheduling process results in a scheduling limit (the maximum number of movements per hour and effectively the planned capacity of the runways) on a hourly basis for departures, arrivals and total movements based on estimates of the capacity of various elements of the airport, including the runways, terminal buildings, stands and so on, balanced against acceptable stack and ground holding times. This scheduling process is performed for summer and winter seasons separately and, hence, it is expected that there will be a different relationship between demand, delay and capacity for summer and winter. The summer season runs from the end of March to the end of October (approximately 7 months), corresponding to British Summer Time (BST) whereas the winter season runs from the end of October to the end of March (approximately 5 months) corresponding to Greenwich Mean Time (GMT). For this reason and the fact that the weather usually varies from summer to winter, the two seasons have been analysed separately.

4.12 Heathrow is one of the world's busiest international airports and, along with Amsterdam, Frankfurt and Paris Charles de Gaulle, is one of Europe's four main hubs, serving intercontinental, European and domestic destinations. Gatwick is cited as the busiest single runway airport in the world. To set the context of current operations and the analysis of possible future scenarios, it is important to understand the level of demand for air traffic movements at Heathrow and Gatwick relative to the capacity of the airports. Exhibit 4-1 and Exhibit 4-2 show the actual runway capacity utilisation at Heathrow and Gatwick in the last two complete summer and winter seasons.

Exhibit 4-1: Comparison of actual utilisation and available slots at Heathrow and Gatwick in the summer season 2007

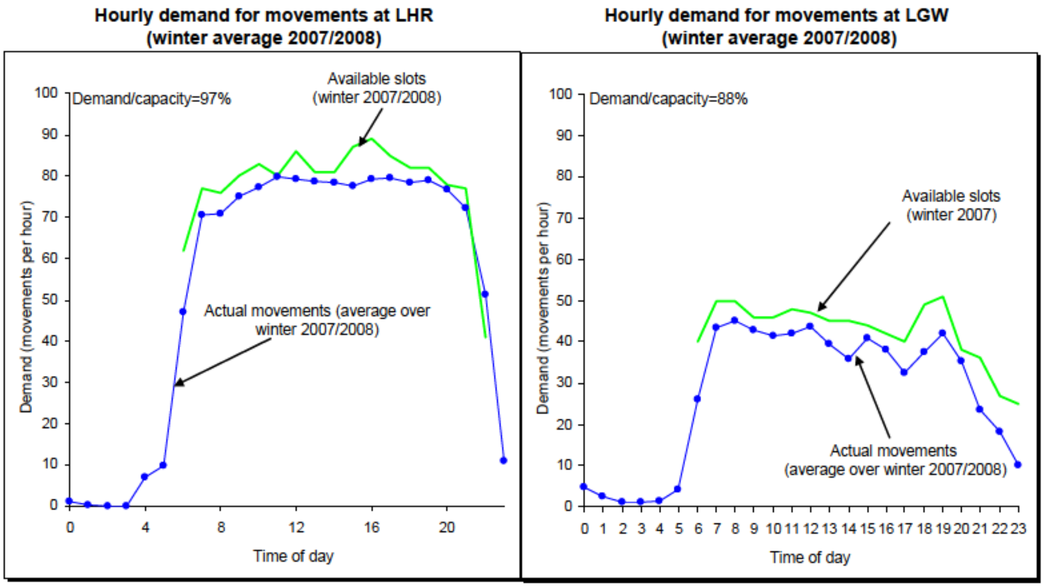


Source: ACL, CFMU

The exhibits show that:

- on average, in both summer and winter, Heathrow operates at around 97 to 98% of the available runway capacity, as defined by the number of slots made available through the scheduling process. There are peaks in specific weeks when utilisation reaches around 98.5%. There is an underlying rate of around 2% operational cancellations during both summer and winter indicating that the demand for the runway is 100% of its capacity
- similarly, on average Gatwick operates at around 94% of its available runway capacity in summer and around 88% of available capacity in winter. In August, Gatwick's demand for arrivals and departures together is 100% of the combined capacity although when taken individually the demand for arrivals and departures is around 94%. This situation occurs because the total capacity of the airport is lower than the sum of the capacity for arrivals and departures. Gatwick has a cancellation rate of between 1 and 2% indicating average demand levels compared to capacity of around 95% in summer and 89% in winter.

Exhibit 4-2: Comparison of the actual utilisation and available slots at Heathrow and Gatwick in the winter season 2007/2008

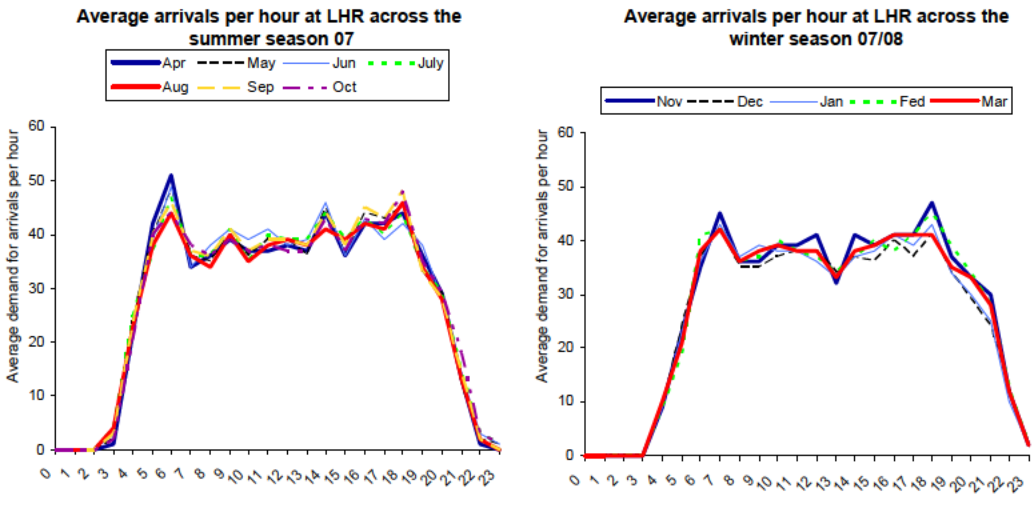


Source: ACL, CFMU

Seasonal and monthly variation

4.13 Exhibit 4-3 compares the average daily arrivals at Heathrow each day of the week across the summer 2007 and winter 2007/2008 seasons. The figure confirms that traffic is slightly higher during the summer season but only shows slight variation from month to month within each season.

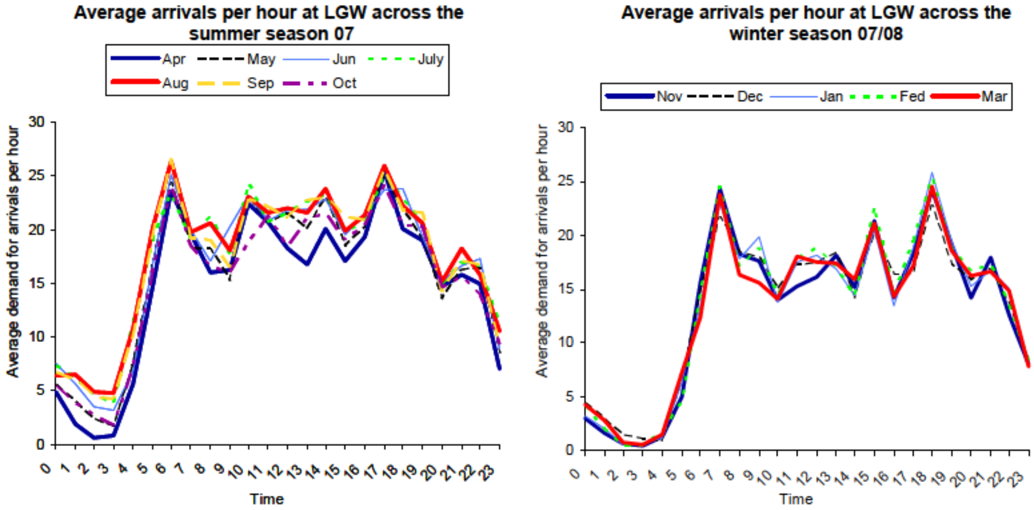
Exhibit 4-3: Comparison of the monthly variation in arrivals demand at Heathrow in the summer and winter seasons 2007 and 2007/2008



Source: CFMU

4.14 In contrast, and in addition to showing very different levels of demand in summer and winter, Gatwick shows in-season variation across the summer with July, August and September being considerably busier than April, May and October, as illustrated in the Exhibit 4-4and Exhibit 4-5 below.

Exhibit 4-4: Comparison of the monthly variation in arrivals demand at Gatwick in the summer and winter seasons 2007 and 2007/2008



Source: CFMU

Exhibit 4-5: Capacity utilisation for arrivals and departures at Gatwick during the summer months

Month						
April	May	June	July	August	September	October
85%	91%	96%	99%	100%	99%	91%

4.15 In summary, Heathrow operates at extremely high levels of runway utilisation throughout the year and across the day with a very limited buffer to ensure reliability/sustainability in operations or to recover from disruption. On the other hand, except in the peak summer months, Gatwick has spare buffer capacity.

The remainder of this section reports on the operational performance of the runways of both Heathrow and Gatwick over the last two full seasons in terms of:

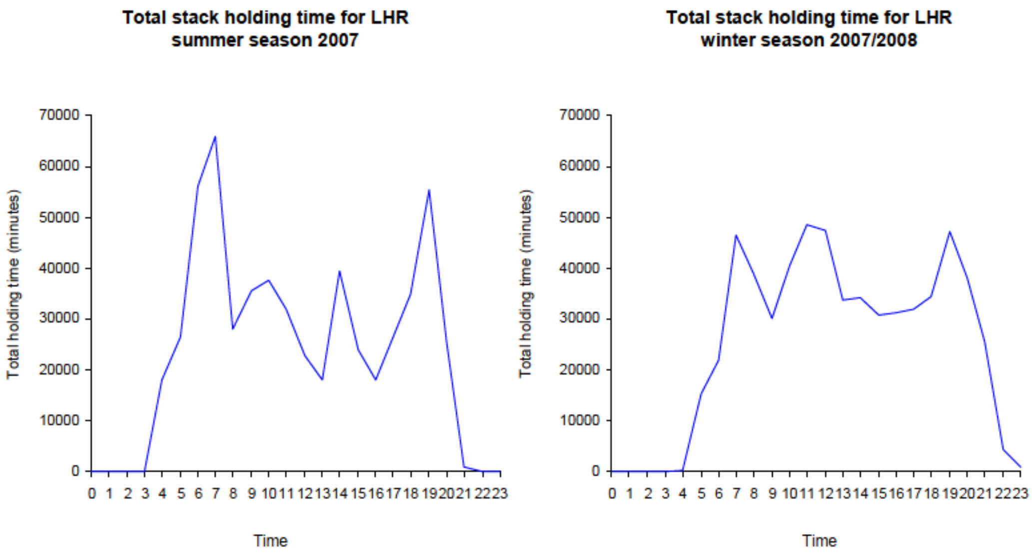
- holding in the stacks to enable optimal sequencing or arrivals
- air traffic flow management (ATFM) restrictions and associated delays due to the airports causing the most penalising regulation for their arrivals
- tactical, non-ATFM holding on the ground to enable optimal sequencing of departures.

Magnitude of stack holding at Heathrow

Total holding time

4.16 Exhibit 4-6 shows the total stack holding time distributed by time of day for Heathrow for the last two complete seasons. The total stack holding time over the summer season 2007 (seven months) was approximately 565000 minutes whereas the total holding time over the winter season (five months) was approximately 602000 minutes.

Exhibit 4-6: Total stack holding time at Heathrow in the summer and winter seasons 2007 and 2007/2008



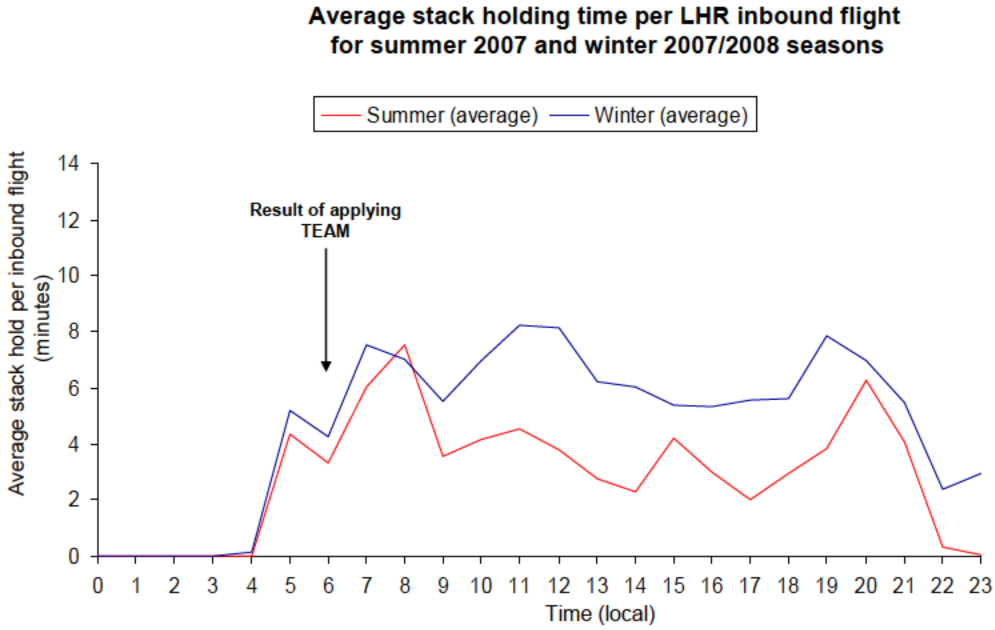
Source: Airline data, Helios analysis

Average holding times

Exhibit 4-7 shows the average stack holding time per inbound flight (that is all flights, not just those that are held in the stacks) at Heathrow for the summer and winter seasons. The average hold in winter is generally greater than that in summer except in the early morning peak where both holds are similar. In both cases, the average holding times across the day are well below the 10 minute average limit agreed between NATS, the airport and the airlines (noting that this limit does not include a contribution from ATFM holding).

There is a reduction in the average holding time during the hour starting 06:00 local time. This drop in holding time corresponds to the time in which tactically enhanced arrivals measures (TEAM) are applied virtually every day in both seasons. TEAM is applied at other times during the day but not consistently or at the same level as in the 06:00 hour.

Exhibit 4-7: Average stack holding time per inbound flight at Heathrow in the summer and winter seasons 2007 and 2007/2008



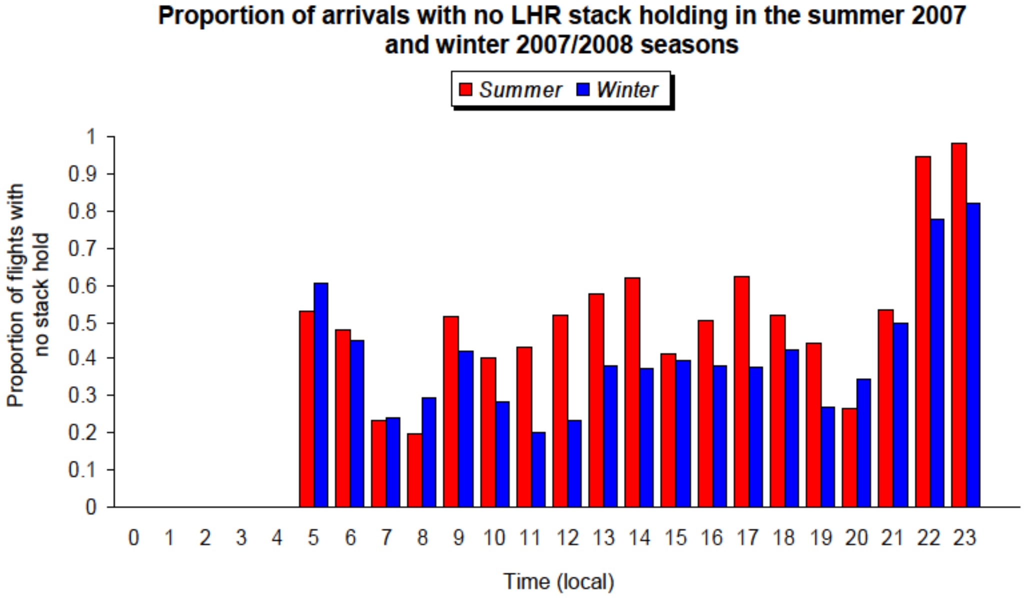
Source: Airline data, Helios analysis

Range of holding times

4.17 Stack holding at Heathrow is described by a set of statistical distributions, which is presented in full in Appendix D. The average holding times, described above, form one part of the description of those distributions. The following paragraphs highlight two other important elements of the distribution: the probability that a flight will be held and the peak holding times described by the 95th percentile of the distribution.

4.18 Exhibit 4-8 shows the proportion of aircraft arriving at Heathrow that were not subject to holding in the stacks during the summer 2007 and winter 2007/2008 seasons. A significant proportion of arrivals are held in stacks with around 80% being held in the early morning in both summer and winter and also during the middle of the day in winter. Only in the late evening does the proportion of aircraft being stacked fall significantly below 50%.

Exhibit 4-8: Proportion of inbound aircraft not subject to stacking at Heathrow in the summer and winter seasons 2007 and 2007/2008

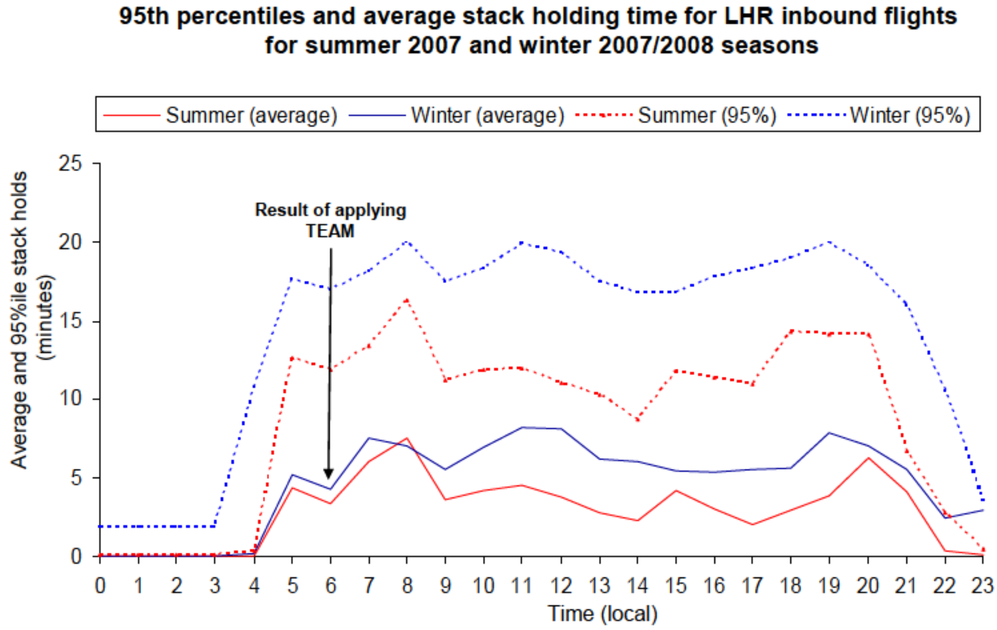


Source: NATS, Helios analysis

4.19 Exhibit 4-9 illustrates the peak holding times that might be expected in the Heathrow stacks using the 95th percentile of the holding distributions as an indicator of the peak. The shape of the 95th percentile curve generally follows that of the average holding time per flight but at a factor of between 2 and 3 greater being around 10 to 15 minutes in summer and 15 to 20 minutes in winter.

4.20 The impact of the application of TEAM at 06:00 local time can clearly be seen in the 95th percentile curves as well as the average holding times.

Exhibit 4-9: Average and peak stack holding times for arrivals at Heathrow over the last two seasons

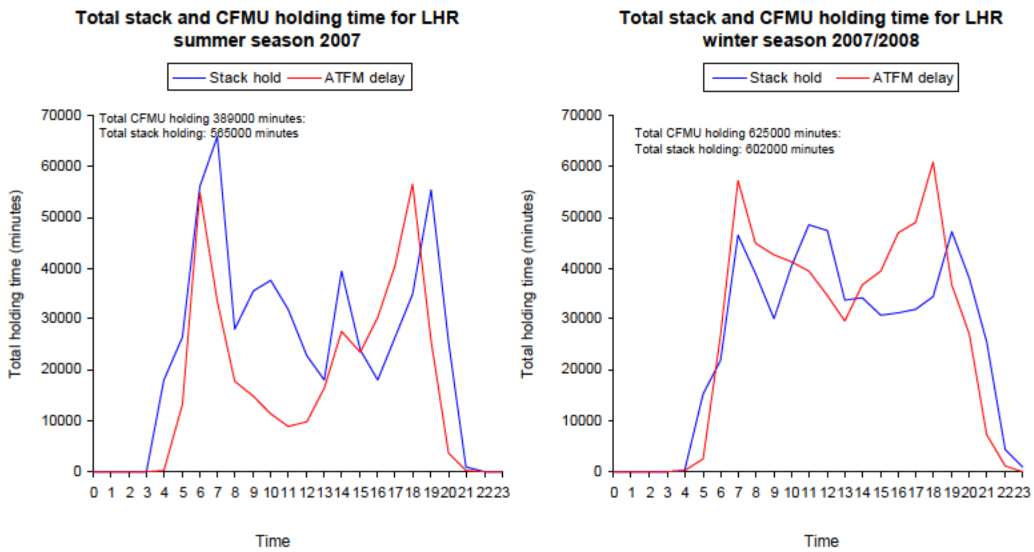


Source: NATS, Airline data, Helios analysis

Comparison of stack holding times and ATFM delays

4.21 Exhibit 4-10 compares the total stack holding times and the total airport ATFM delays (see the next section for a description of ATFM delays) at Heathrow both in terms of magnitude and distribution throughout the day.

Exhibit 4-10: Comparison of total airport ATFM delays and total stack holding times for arrivals at Heathrow over the last two seasons



Source: CFMU, NATS, Airline data, Helios analysis

The magnitude of ATFM delays and stack holding times are similar in both summer and winter seasons:

- in summer the total Heathrow generated airport ATFM delay is approximately 389000 minutes whereas the total stack holding time is approximately 565000 minutes
- in winter the total Heathrow generated airport ATFM delay is approximately 625000 minutes whereas the stack holding time is approximately 602000 minutes.

4.22 The main morning peaks in the curves are also of the same magnitude and occur at roughly the same time of day for both ATFM and stacks and correspond to periods where there is highest demand for arrivals, around 40 to 42 arrivals per hour and a high proportion of this demand is from outside Europe and cannot be moderated by ATFM (see 4.27 for an explanation). Between the peaks, when the demand for arrivals is around 38 to 40 per hour, there is an indication that the ATFM delays and stack holding are in anti-phase: that is as ATFM delays increase, stack holding decreases and vice versa. This is apparent between 08:00 and 13:00 in the summer and, to a lesser degree, between 15:00 and 18:00 in the winter and indicates that ATFM is being used to moderate stack holding.

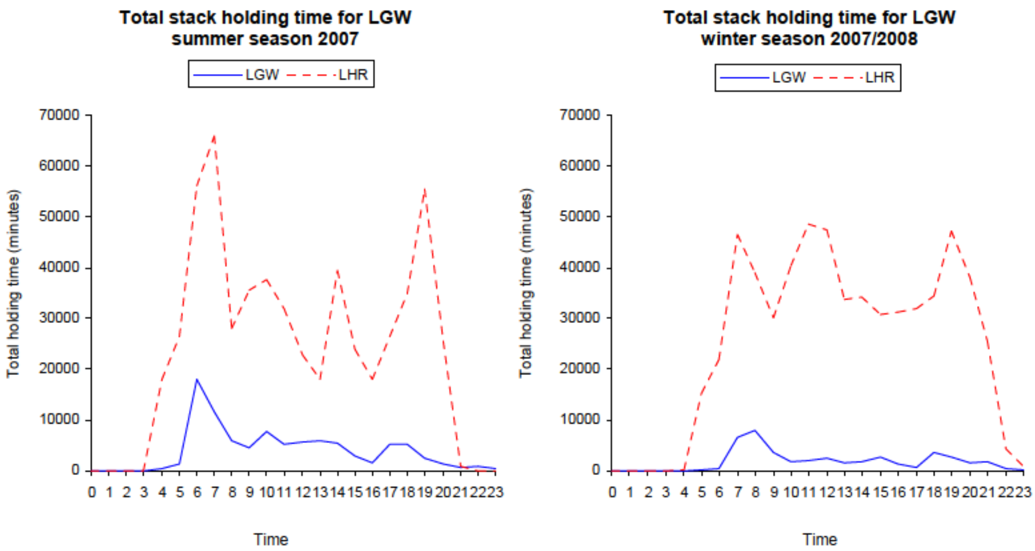
4.23 The wide variation in holding time and airport ATFM delays for relatively small fluctuations in demand, of around 3 per hour, emphasises the how near its absolute capacity the system is operating and illustrates its sensitivity to small increases in demand.

Magnitude of stack holding at Gatwick

Total holding time

4.24 The total holding in stacks at Gatwick was approximately 93000 minutes in the 2007 summer season (approximately 16% of that at Heathrow) and 44000 minutes in the 2007/2008 winter season (approximately 7% of that at Heathrow. The distribution of Gatwick's stack holding across the day is shown in Exhibit 4-11 where a comparison is also made with Heathrow for reference.

Exhibit 4-11: Total stack holding time at Gatwick in the summer and winter seasons 2007 and 2007/2008 with equivalent curves for Heathrow shown for comparison

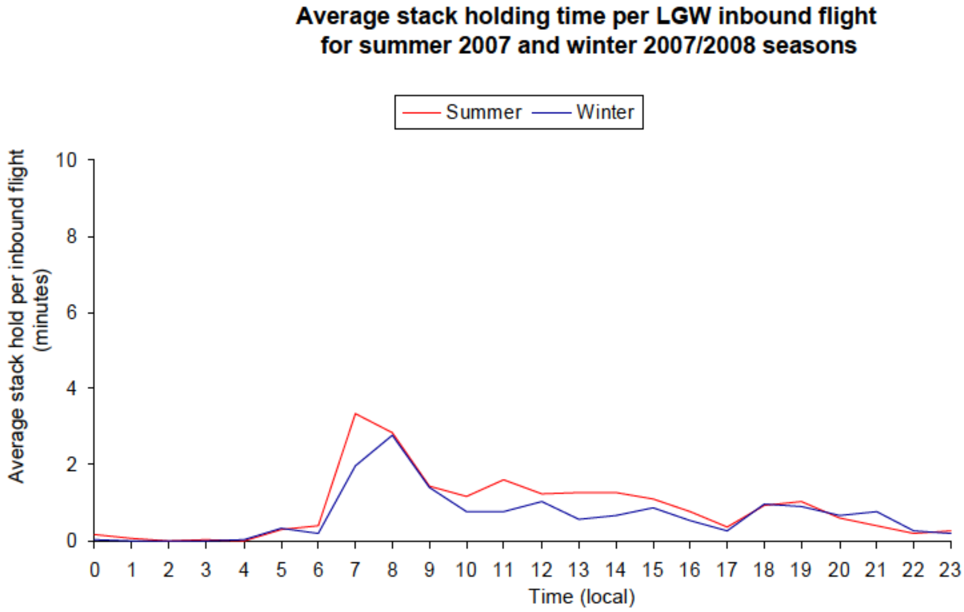


Source: Airline data, Helios analysis

Average holding times

4.25 Exhibit 4-12 shows the average stack holding times for Gatwick for the last two complete seasons using the same scale as the equivalent chart for Heathrow. There is little structure to the average hold throughout the day except in the early morning where there is a peak of 2 to 3 minutes in both seasons. This compares with the equivalent peak of 6 to 8 minutes experienced at Heathrow.

Exhibit 4-12: Average stack holding time per inbound flight at Gatwick in the summer and winter seasons 2007 and 2007/2008



Source: Airline data, Helios analysis

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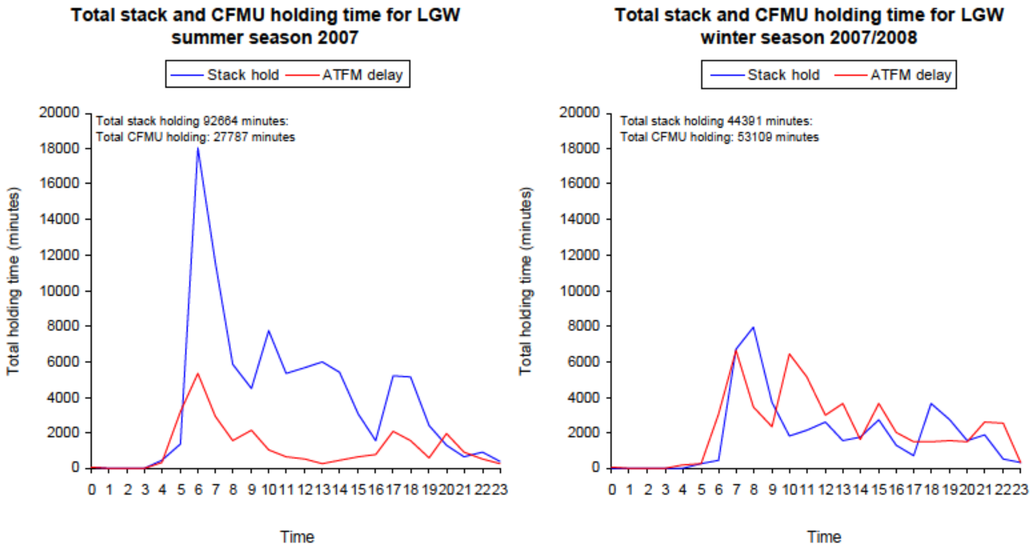
Comparison of stack holding times and ATFM delays

4.26 Exhibit 4-13 compares stack holding and airport ATFM delays at Gatwick. In summer 2007, stack holding was around a factor of 3 greater than Gatwick generated airport ATFM delays (93000 minutes compared to 27000 minutes respectively) whereas the two sets of delays were roughly similar in winter (44000 minutes compared to 53000 minutes). There is little to suggest any correlation between the two sets of delays.

Exhibit 4-13: Comparison of total ATFM delays and total stack holding times for arrivals at Heathrow over the last two seasons



Source: CFMU, Airline data, Helios analysis

AIR TRAFFIC FLOW MANAGEMENT RESTRICTIONS FOR ARRIVALS

Introduction

4.27 Airport ATFM restrictions are imposed when the capacity of the destination airport is exceeded by the predicted demand in the same way that they are applied to the other parts of the ATM network. Arrivals at Heathrow and Gatwick from origins within Europe and some other places are subject to these ATFM restrictions imposed as regulations by the Eurocontrol Central Flow Management Unit (CFMU) at the request of the London Flow Management Position (FMP), based at Swanwick. This situation may occur:

- when demand is higher than expected, for example, due to bunching of traffic caused by fluctuations elsewhere in the network
- when capacity is reduced below the norm, with a variety of causes including the weather, problems with air traffic control staffing or equipment and infrastructure.

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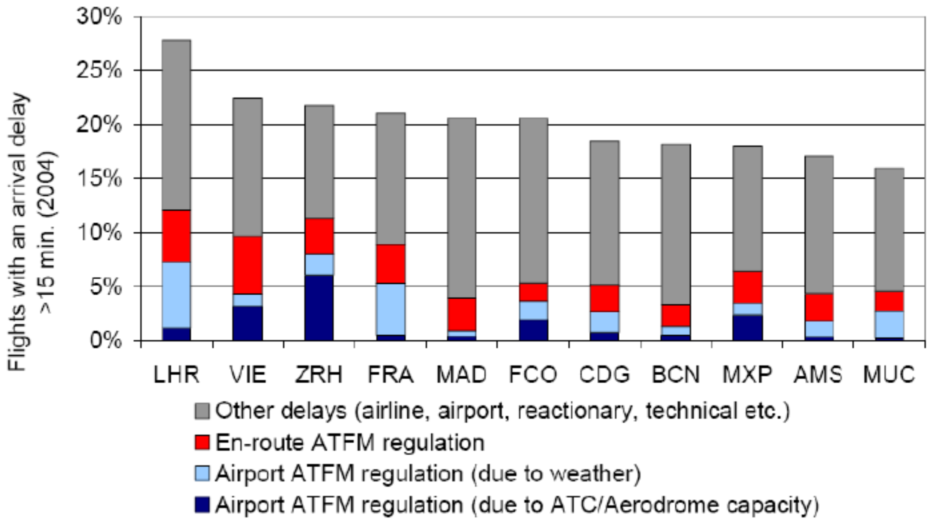
4.28 Airport ATFM restrictions cause a significant fraction (typically 25% to 35%) of the total delays experienced in the system, as illustrated in Exhibit 4-14 taken from the Eurocontrol Performance Review Commission.

Exhibit 4-14: Causes of delays at some major European airports



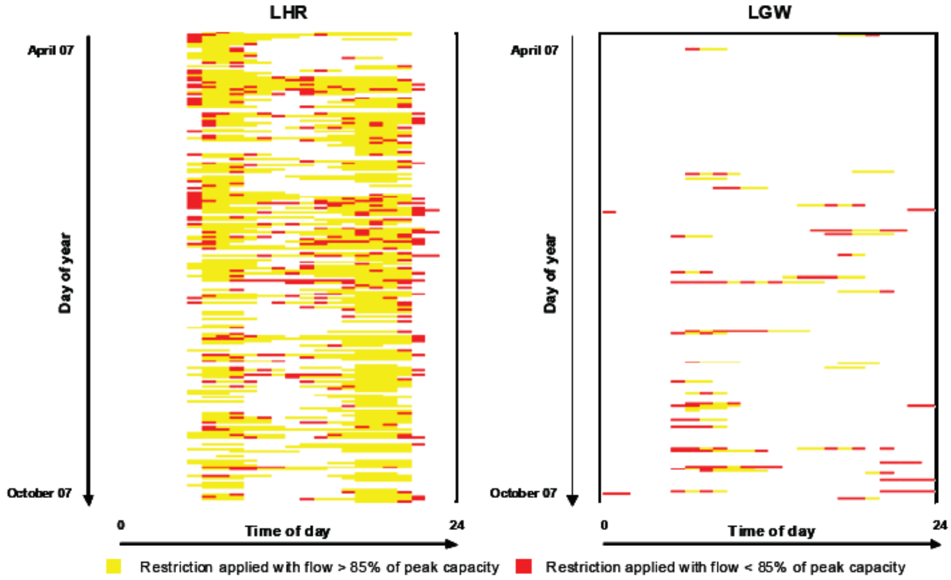
Source: Eurocontrol Performance Review Commission "Report on punctuality drivers at major European airports", May 2005

Frequency and severity of ATFM restrictions

4.29 Exhibit 4-15 and Exhibit 4-16 show the frequency and severity with which ATFM restrictions were applied at Heathrow and Gatwick over the past two complete seasons. The charts are shaded on a hourly basis indicating when:

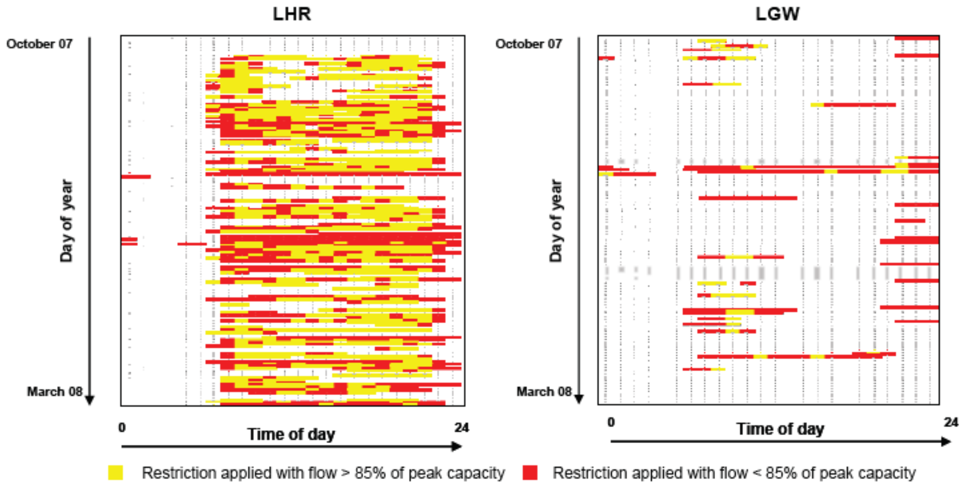
- no restriction was applied (unshaded)
- when a relatively mild restriction was applied (highlighted in yellow) where mild is understood to mean that the restriction allows traffic flows of above 85% of the normal hourly capacity. This corresponds to a flow rate of around 38 arrivals per hour at Heathrow which is understood to be the cut-off point that normal operations become unsustainable
- where the severe restriction was applied (highlighted in red) where the traffic flows were restricted to less than 85% of the normal capacity.

Exhibit 4-15: Comparison of the application of ATFM restrictions at Heathrow and Gatwick during the 2007 summer season



Source: CFMU, Helios analysis

Exhibit 4-16: Comparison of the application of ATFM restrictions at Heathrow and Gatwick during the 2007/2008 winter season



Source: CFMU, Helios analysis

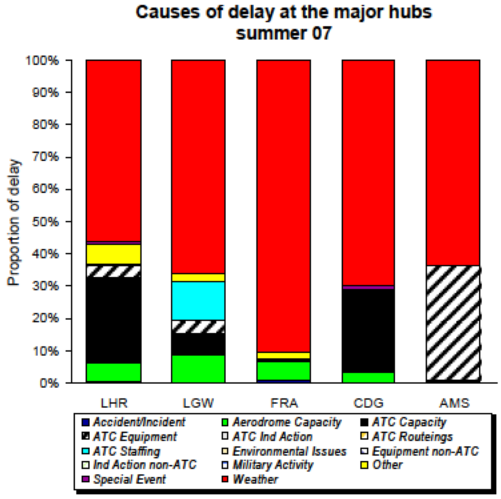
4.30 Exhibit 4-15 and Exhibit 4-16 show that ATFM restrictions were applied on most days at Heathrow during both seasons. Application of ATFM restrictions at Gatwick was much less frequent than at Heathrow, presumably due to the availability of a greater buffer between demand and capacity. The exhibits also show that:

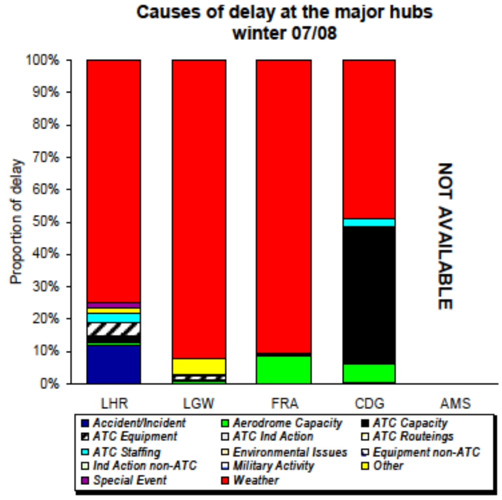
- the majority of the restrictions applied at Heathrow during the summer season were relatively mild whereas the majority of the restrictions applied in the winter were severe
- the ratio of severe to mild restrictions applied at Gatwick is much higher than at Heathrow.

Causes of Airport ATFM restrictions

4.31 When an ATFM restriction is imposed, the air navigation service provider (ANSP) that applies the restriction allocates a code to describe the cause of the restriction. Exhibit 4-17 presents data describing the main causes of and their proportion of the overall ATFM delay for Heathrow, Gatwick and the other main European hubs, with the exception of Amsterdam Schiphol for which data is not available for the 2007/2008 winter season.

Exhibit 4-17: Proportion of ATFM delay attributed by cause for the major European hubs





Source: CFMU, Helios analysis

4.32 Exhibit 4-17 shows that:

- weather is the predominant cause of ATFM related delay at all of the airports which, unsurprisingly, is more severe in winter than in summer
- the airport's ATC capacity (as allocated to the airport by the ANSP) is the second most significant contributor to ATFM related delay at Heathrow in the summer and at Paris Charles de Gaulle in both summer and winter
- the airport's ATC staffing (again as allocated by the ANSP) is the second most significant cause of ATFM related delay at Gatwick
- the airport's ATC equipment (as allocated by the ANSP) and aerodrome capacity make contributions to ATFM related delay in summer but less so in winter (presumably due to the increased influence of weather)
- the performance of Heathrow in winter 2007/2008 is masked by the consequences of the BA 038 accident.

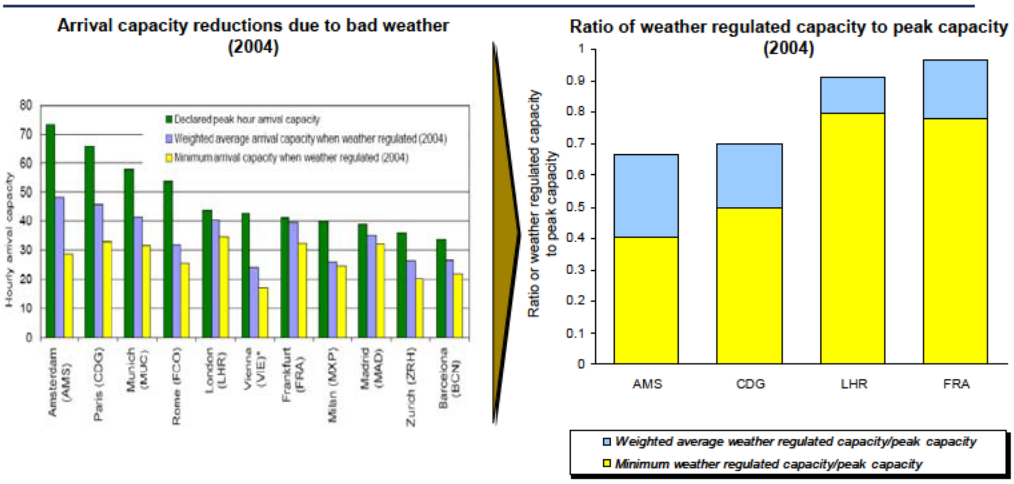
Resilience against weather effects

4.33 Given that the weather is the most significant cause of ATFM related delay, the Eurocontrol Performance Review Commission undertook an analysis of the resilience of major European airports to the impacts of bad weather. In addition to this work, it is possible to define supplementary indicators of resilience to weather as:

- the ratio of the average weather reduced capacity to the peak capacity
- the ratio of the minimum weather reduced capacity to the peak capacity.

4.34 These indicators are shown for the main European hubs in Exhibit 4-18 using 2004 data, which is the latest available.

Exhibit 4-18: Resilience of the main European hubs against weather-related ATFM restrictions



Source: Eurocontrol Performance Review Commission "Report on punctuality drivers at major European airports", May 2005, Helios analysis

4.35 Exhibit 4-18 shows that in the case of severe weather restrictions, Heathrow shows the highest resilience of the four main European hubs; however on average Frankfurt shows greater weather resilience than Heathrow.

Magnitude of Airport ATFM delays at Heathrow

Total delays

4.36 The airport ATFM delays due to Heathrow causing the most penalising ATFM regulation to inbound flights are significant. During the summer season 2007 (7 months), Heathrow was the cause of 389000 minutes of ATFM delay on the ground at the outstation airport. In the 2007/2008 winter season (5 months), Heathrow caused approximately 625000 minutes of ATFM delay. The distribution of these delays across the airport's operating day is shown in Exhibit 4-19.

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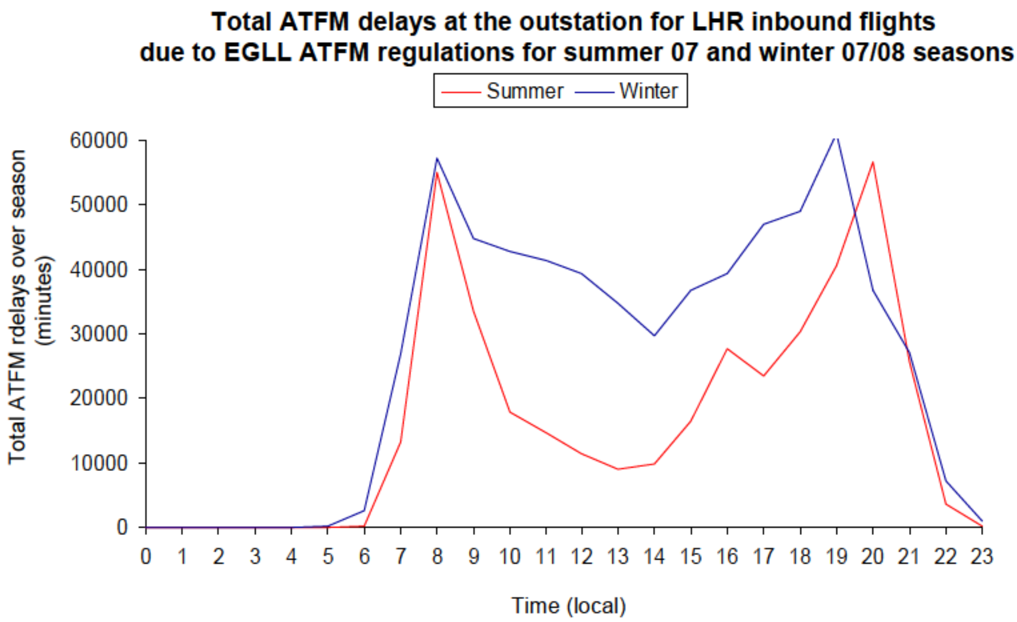
Exhibit 4-19: Total ATFM delays due to Heathrow regulations over the last two complete seasons

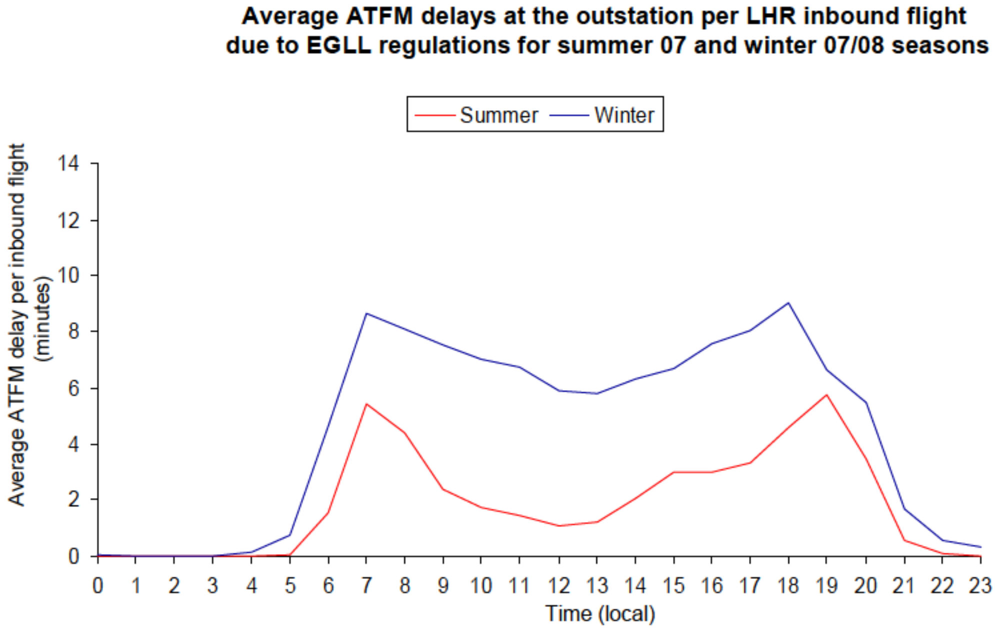


Source: CFMU, Helios analysis

Average ATFM delays

4.37 As the seasons are different lengths and airports have different levels of traffic, the average ATFM delay per flight is an important indicator that can be used to compare and contrast performance. However, when interpreting the results of such comparisons it is important to remember that only flights that originate within the CFMU area (essentially Europe) are subject to ATFM regulations so that ATFM delays are not distributed equitably across all arrivals (see discussion below). The average Heathrow ATFM delay per flight for the summer and winter seasons is illustrated in Exhibit 4-20. The time refers to the hour that the aircraft would have arrived at Heathrow in an unconstrained situation, that is before any ATFM restriction had been applied.

Exhibit 4-20: Average ATFM delay per inbound flight due to Heathrow ATFM regulations over the last two complete seasons



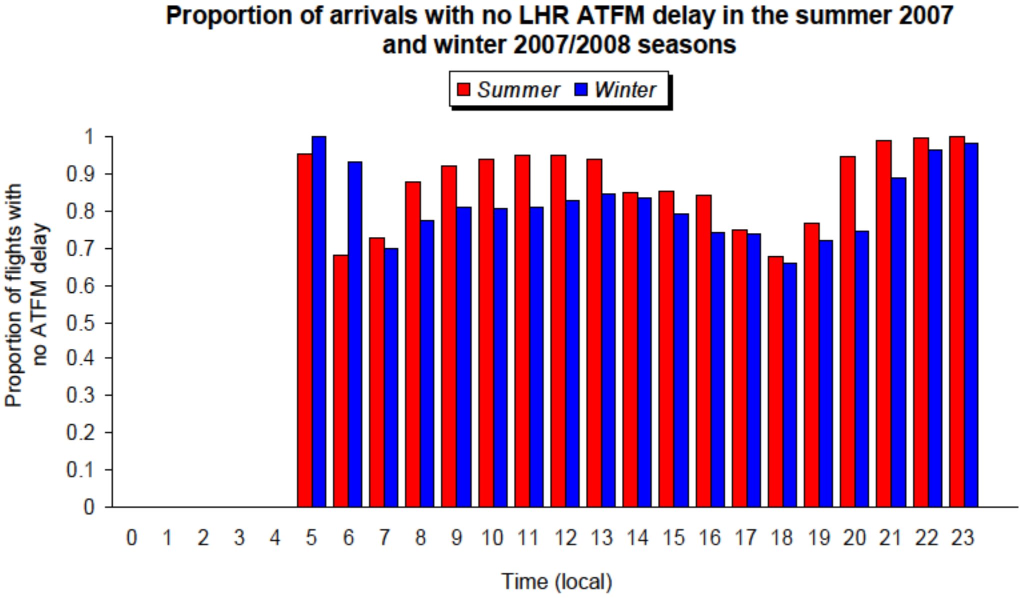
Source: CFMU, Helios analysis

4.38 Exhibit 4-20 shows that at the peaks (corresponding approximately to the peaks in demand – see Exhibit 4-1 and Exhibit 4-2), the average ATFM delay per flight is around 5½ minutes in summer and around 9 minutes in the winter season. In summer, the average ATFM restriction is reduced to a minimum of around 2 minutes per flight in summer but the reduction is less, remaining above 6 minutes (greater than the summer peak) throughout the day.

Range of ATFM delays

4.39 The previous section highlights the average ATFM delay per flight derived from the statistical distributions of ATFM delays. The full set of statistical distribution functions is provided in Appendix D. Flights to the airport experience a range of ATFM delays ranging from zero through to a maximum. Exhibit 4-21 shows the proportion of inbound flights to Heathrow that do not suffer any Heathrow generated airport ATFM delay (note that this includes inter-continental flights that by default are not within the CFMU system and cannot be subject to ATFM regulations).

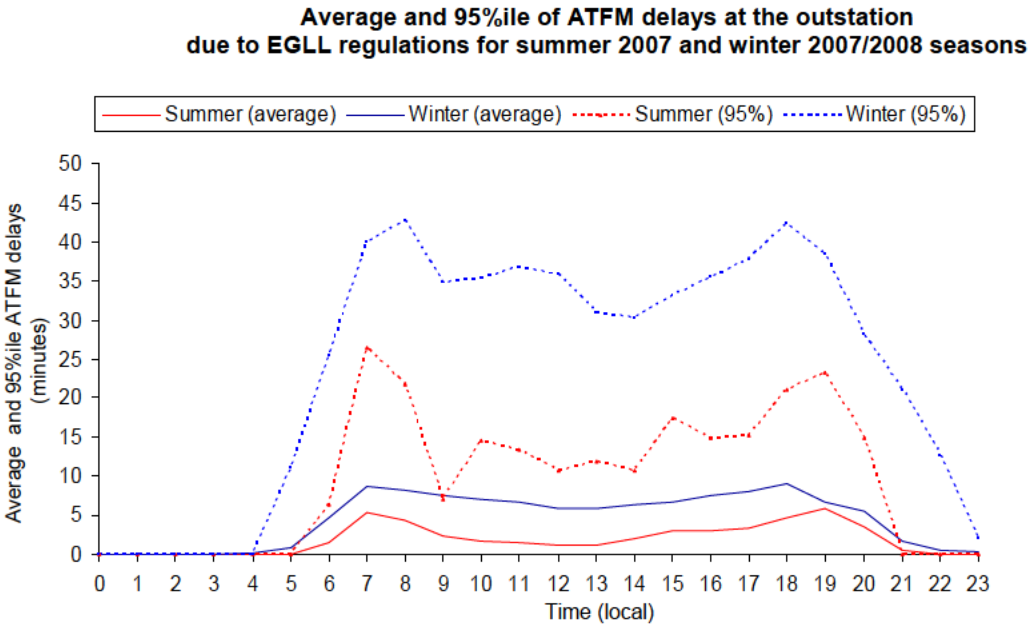
Exhibit 4-21: Proportion of flights arriving at Heathrow that have not been subject to a Heathrow related ATFM regulation



Source: CFMU, Helios analysis

4.40 At the other end of the scale, the 95th percentile of the ATFM delay (considering all flights, delayed or not) is a measure of the peak ATFM delay that might reasonably be expected. The 95th percentiles of Heathrow's ATFM delays for summer and winter are shown in Exhibit 4-22.

Exhibit 4-22: Peak and average airport ATFM delays due to Heathrow ATFM regulations over the last two complete seasons



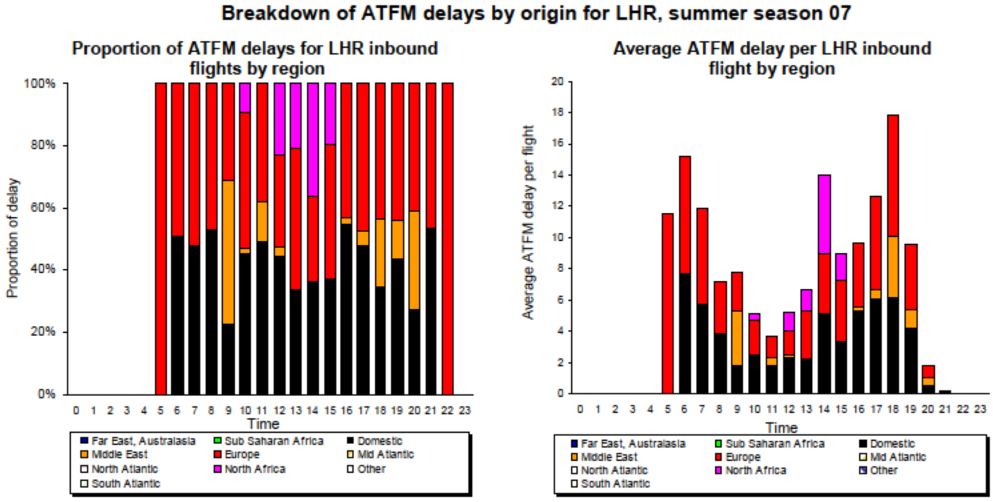
Source: CFMU, Helios analysis

4.41 Exhibit 4-22 shows that in summer Heathrow's peak airport ATFM delays were in the range 20 to 25 minutes whereas in the off-peak period, the peak airport ATFM delays were reduced to around 15 minutes. In the winter season, Heathrow's peak airport ATFM delays were between 40 and 45 minutes and the peak off-peak airport ATFM delays were around 35 minutes.

Distribution of Heathrow's ATFM delays by origin

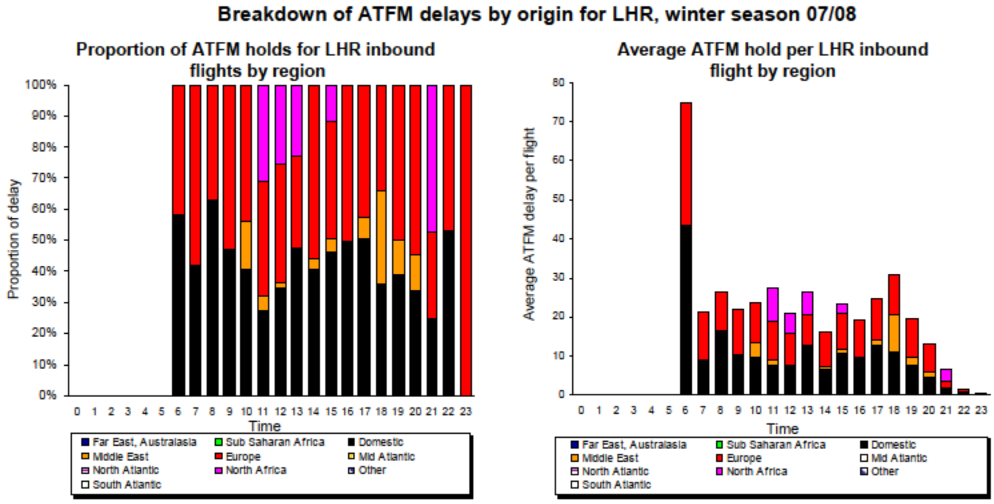
4.42 As introduced above, ATFM restrictions are only applied to aircraft that originate from within the CFMU area which comprises Europe and a few other origins including the Middle East and some parts of Africa. Exhibit 4-23 and Exhibit 4-24 show how Heathrow's arrivals ATFM delays are distributed around the regions from which its inbound flight originate.

Exhibit 4-23: Breakdown of Heathrow's ATFM delays by origin of the inbound flight for the summer season 2007



Source: CFMU, Helios analysis

Exhibit 4-24: Breakdown of Heathrow's ATFM delays by origin of the inbound flight for the winter season 2007/2008



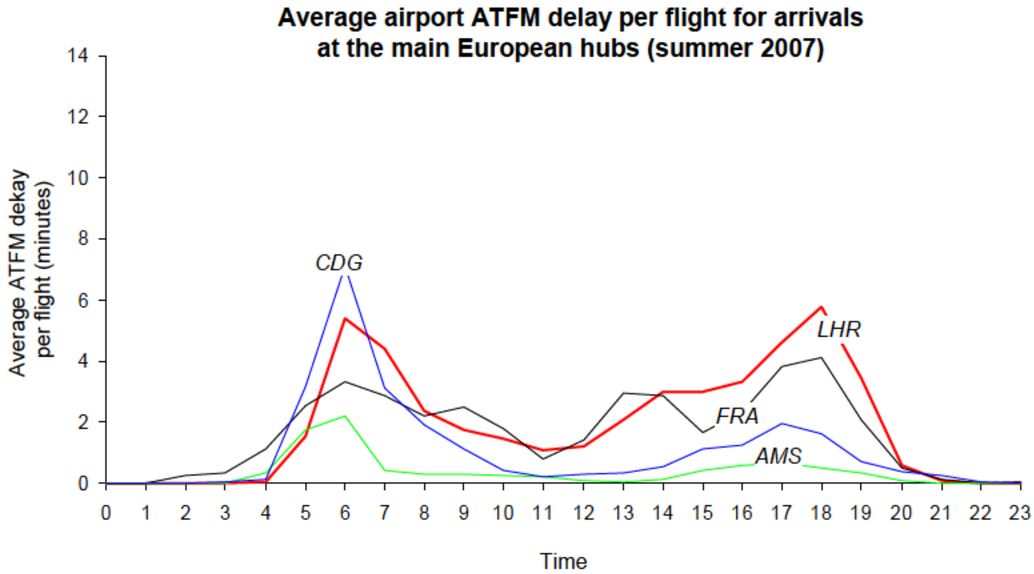
Source: CFMU, Helios analysis

4.43 The charts show, as expected, that flights from European and domestic origins suffer the bulk of the ATFM delays but with some ATFM restrictions imposed on flights from the Middle East and North Africa from the middle of the day onwards. The overall proportion of the airport ATFM delays incurred by flights from Europe is greater than that incurred by flights from domestic origins but this is due to the greater number of inbound flights from continental Europe than from the UK. The average airport ATFM delay per flight from domestic and European origins is broadly similar. Finally, the large peak in airport ATFM delays for flights scheduled to arrive in the 06:00 to 07:00 hour in the winter season is presumably due to large demand at the airport at that time from intercontinental flights.

Performance compared to other hubs

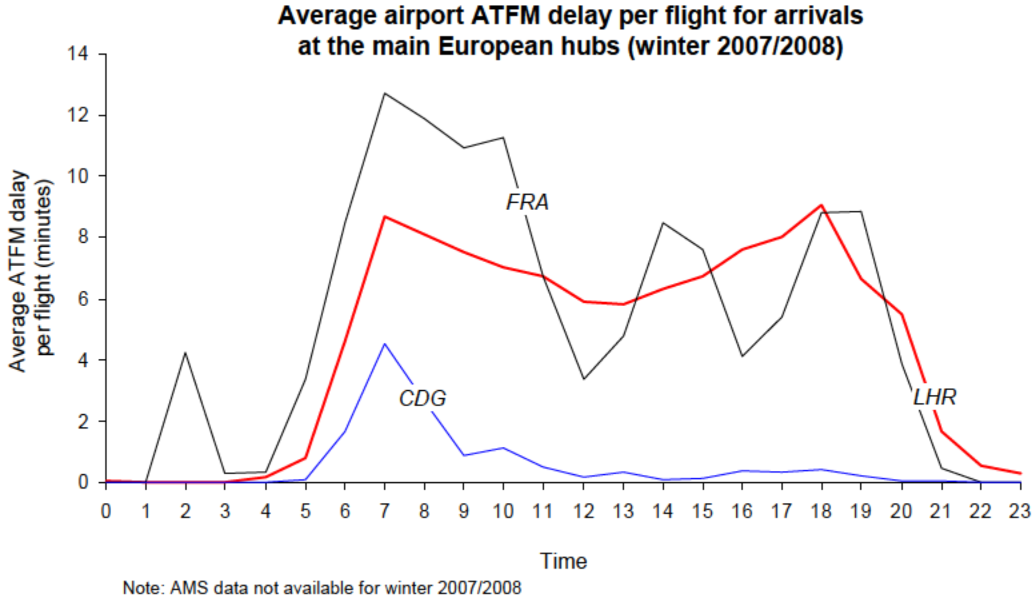
4.44 In comparison with the other main European hubs, Heathrow's ATFM performance is similar to that at Frankfurt, slightly worse than that at Paris Charles de Gaulle (except in the early morning peak in summer) and considerably worse that that at Amsterdam. Exhibit 4-25 and Exhibit 4-26 illustrate this performance in terms of the average ATFM delay per inbound flight attributed to the arrival airport. Note that data for Amsterdam in the winter season were not available for the analysis.

Exhibit 4-25: Comparison of Heathrow's ATFM performance with the other main European hubs for the summer season 2007



Source: CFMU, Helios analysis

Exhibit 4-26: Comparison of Heathrow's ATFM performance with the other main European hubs for the winter season 2007/2008



Source: CFMU, Helios analysis

4.45 The ATFM performance of the hub airports will be driven by, amongst other things, the availability of runway infrastructure. In this respect, Heathrow is rather poorly served in comparison to its competitors:

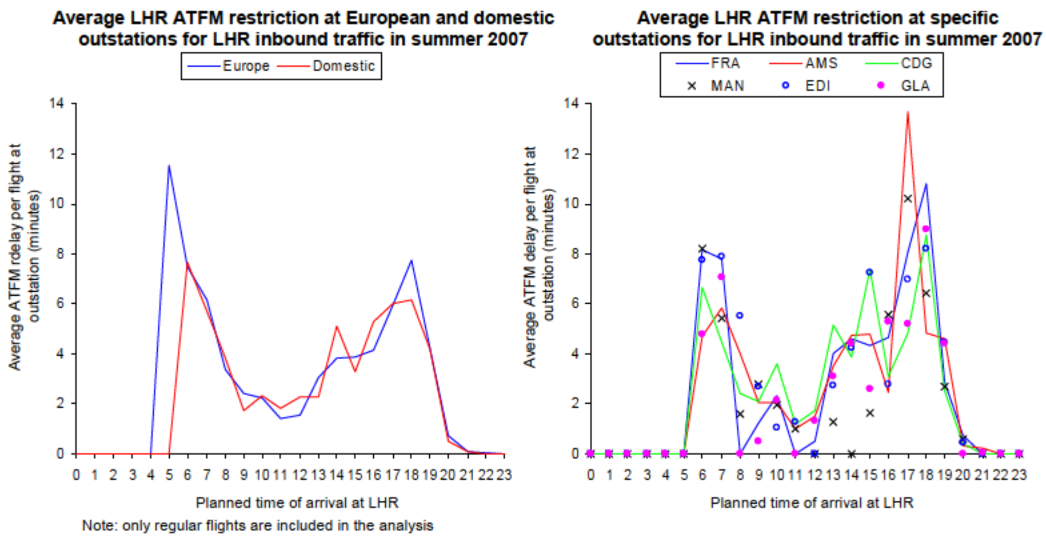
- Paris Charles de Gaulle (CDG) has four parallel runways that can be operated as two pairs of independent runways giving, in practice, around 1.5 times the capacity available at Heathrow
- Amsterdam Schiphol has multiple runways, five of which can be used for commercial air transport operations. However, because of noise and other restrictions, Schiphol is only allowed to operate three runways simultaneously: two for arrivals and one for departures in arrivals peaks and vice versa in departure peaks. With its traffic mix and operational restrictions, the capacity of the airport is approximately 70:35 with the higher figure alternating for arrivals or departures depending on the peak. Schiphol's peak capacity for arrivals is therefore around 75% higher than Heathrow's
- Frankfurt has three runways but only operates two simultaneously in semi-independent mixed mode configuration with a normal capacity similar to that at Heathrow.

4.46 The availability of buffer capacity, i.e. spare slots available to cope with disruptions, (available at Amsterdam and Paris CDG but not at Heathrow and Frankfurt) is likely to be one of the main drivers of the differences in ATFM performance between the hubs.

Heathrow's knock-on effects through the network

4.47 ATFM delays are executed as ground holding, usually on stand, at the origin airport. Airport ATFM restrictions due to the destination airport, therefore, can cause congestion at the origin airport. Exhibit 4-27 shows average Heathrow initiated ATFM delays per Heathrow arrival for all domestic and European origins as well as a few of Heathrow's main domestic and European origin airports.

Exhibit 4-27: ATFM delays at origin airports due to Heathrow ATFM restrictions



Source: CFMU, Helios analysis

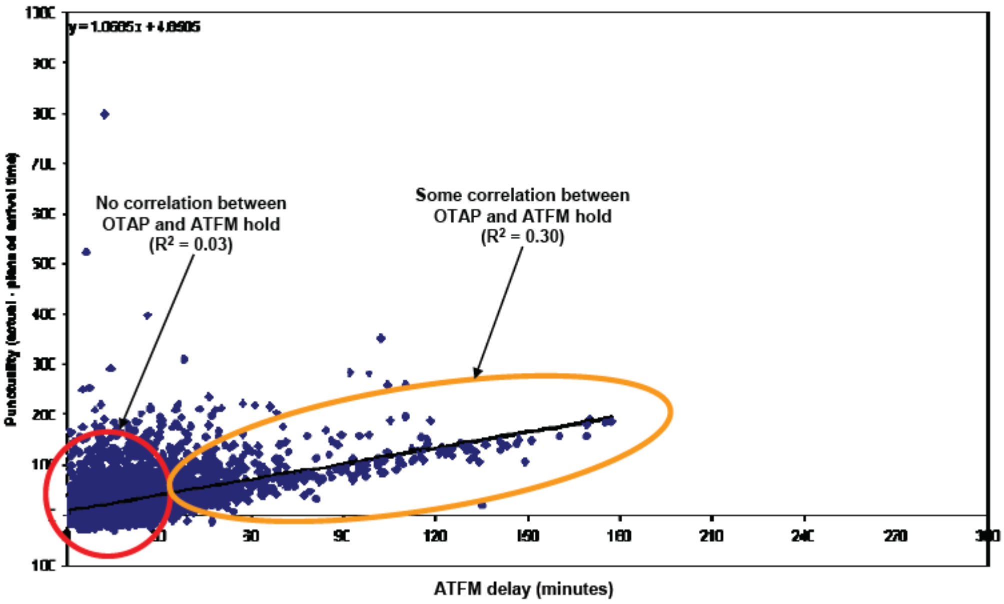
4.48 The ATFM delays at the origin airports are fairly evenly distributed (with the possible exception of arrivals from Amsterdam scheduled for arrival at around 17:00 universal time coordinated (UTC)) showing that the CFMU process is reasonably equitable. The consequences of these airport ATFM delays, especially in peak hours are:

- a large number of short haul inbound flights are delayed by the order of 10 to 12 minutes with a 95th percentile of 20 to 25 minutes (see exhibit 4-14) meaning that a buffer of this scale needs to be built into the schedule for connections at Heathrow. This might be expected to increase minimum connect times (MCTs) significantly depending on how airlines/alliance build uncertainty into their schedules
- the same large number of aircraft are held on the ground at their origin airports. For each airport with a relatively thick route to Heathrow this is likely to amount to three aircraft delayed simultaneously by the same amount of time.

The relationship between ATFM delays and punctuality

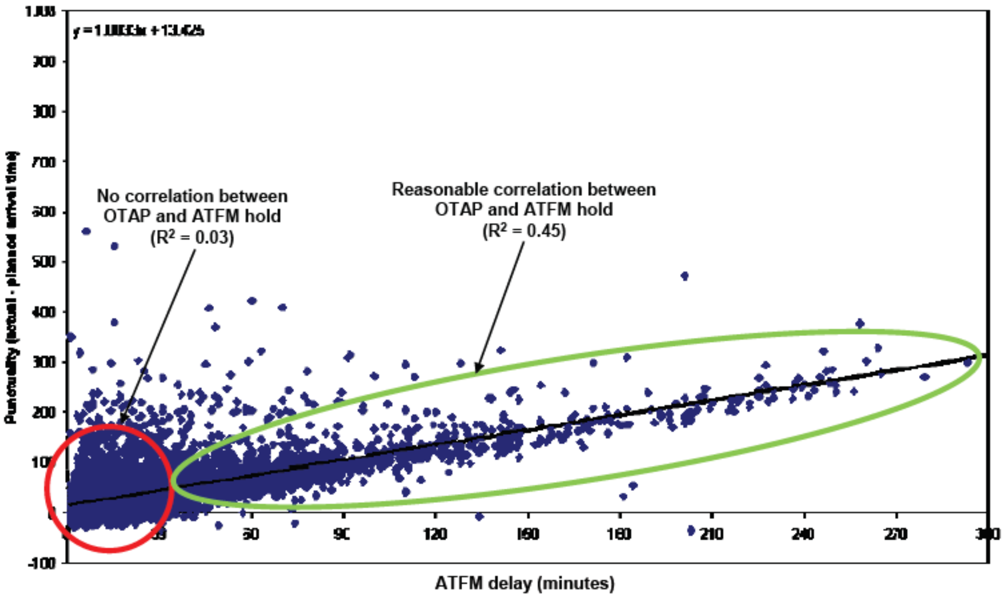
4.49 The imposition of an ATFM regulation does not necessarily mean that the regulated flight will necessarily arrive late compared to its timetable or schedule because there are buffers built into schedules and there are also many other potential causes of delay in addition to ATFM. Exhibit 4-28 and Exhibit 4-29 show the correlation between on time arrival performance (OTAP) and ATFM restrictions on a flight-by-flight basis for both the summer and winter seasons at Heathrow.

Exhibit 4-28: Correlation between ATFM delays and on time arrival performance at Heathrow, summer season 2007



Source: CFMU, airline data, Helios analysis

Exhibit 4-29: Correlation between ATFM delays and on time arrival performance at Heathrow, winter season 2007/2008



Source: CFMU, airline data, Helios analysis

4.50 The scatter on the points in Exhibit 4-28 and Exhibit 4-29 gives a good indication of the multiple causes of delay. Only for reasonably large airport ATFM delays (>30 minutes) is there reasonable correlation between the airport ATFM delay and punctuality performance. Where this correlation exists, there is a direct one-to-one relationship between airport ATFM delays and punctuality. At shorter ATFM delays any correlation is masked by the contribution of other delay causes, which may also include ATFM restrictions arising from sources other than the airport.

Magnitude of airport ATFM delays at Gatwick

Total airport ATFM delays

4.51 Total airport ATFM delays due to Gatwick are an order of magnitude lower than they are for Heathrow, as shown in Exhibit 4-30. During the summer season 2007 (7 months), Gatwick was the cause of 28,000 minutes of ATFM delay on the ground at the outstation airport. In the 2007/2008 winter season (5 months), Gatwick caused approximately 53,000 minutes of ATFM delay. These lower levels of airport ATFM delay are to be expected given both the lower traffic levels and the much lower frequency that ATFM regulations are applied at Gatwick than they are at Heathrow (see Exhibit 4-15 and Exhibit 4-16).

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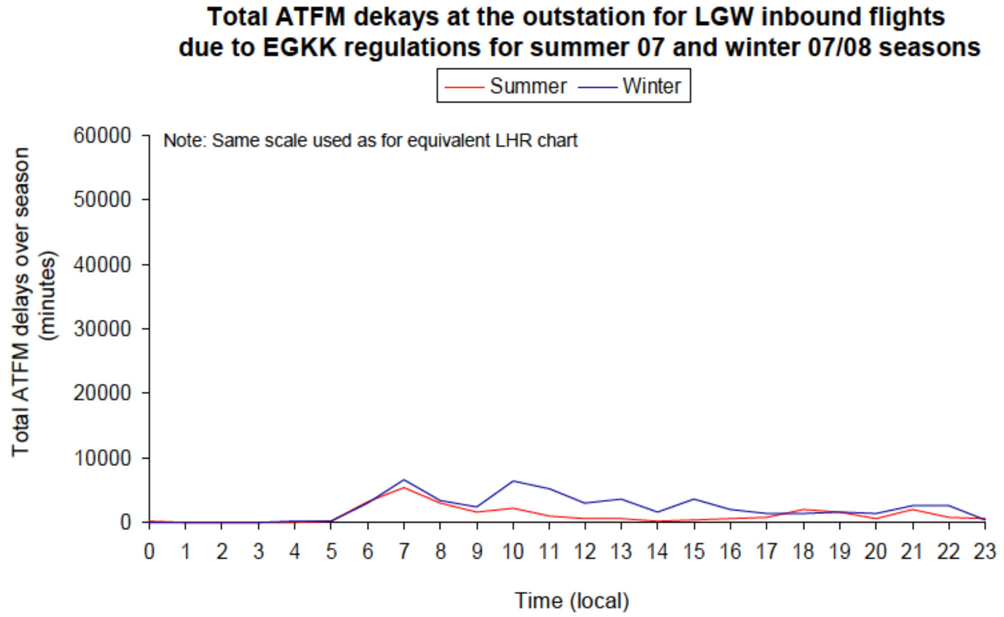
Exhibit 4-30: Total airport ATFM delays due to Gatwick ATFM regulations over the last two complete seasons

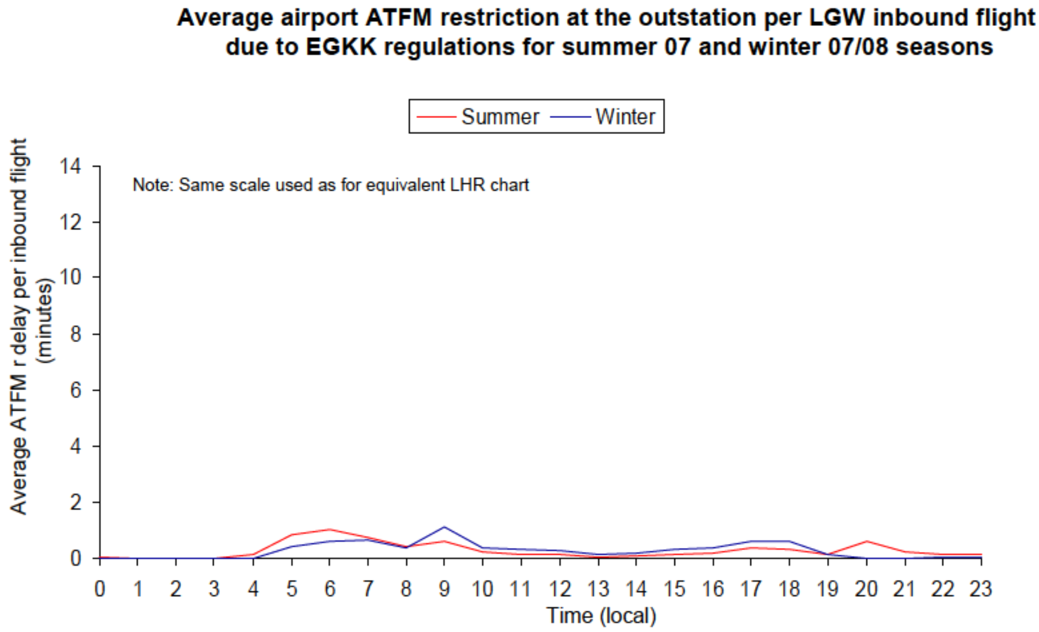


Source: CFMU, Helios analysis

Average airport ATFM delays

4.52 Taking into account lower traffic levels at Gatwick, the average ATFM delay per inbound flight is still much lower at Gatwick than at Heathrow as shown in Exhibit 4-31.

Exhibit 4-31: Average airport ATFM delay per inbound flight due to Gatwick ATFM regulations over the last two complete seasons

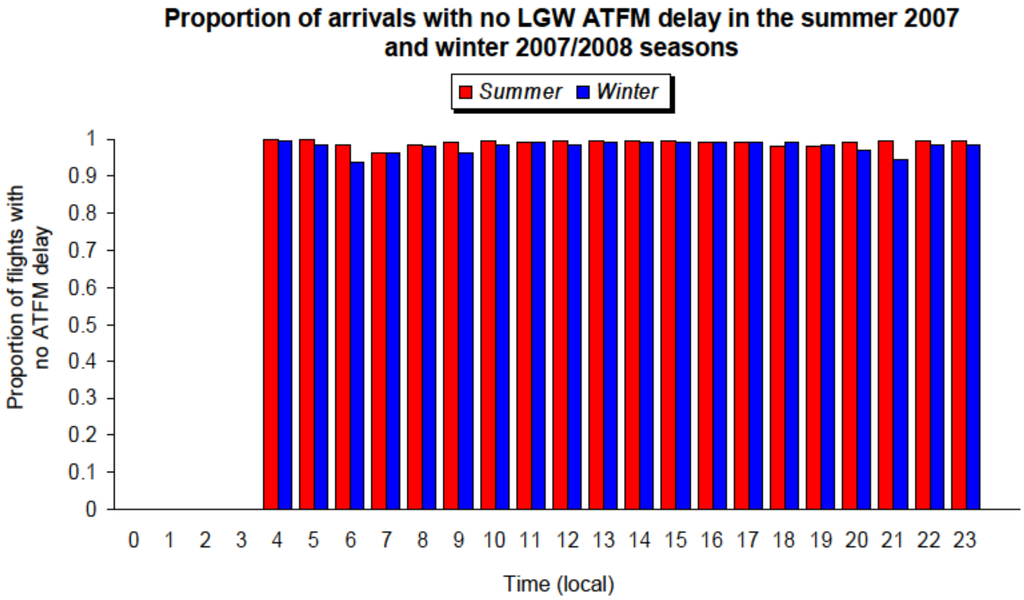


Source: CFMU, Helios analysis

Range of ATFM delays

4.53 The statistical distributions of Gatwick's ATFM delays show that the vast majority of flights to Gatwick suffer no Gatwick-related ATFM delay as shown in Exhibit 4-32.

Exhibit 4-32: Proportion of flights arriving at Gatwick that have not been subject to a Gatwick related ATFM regulation



Source: CFMU, Helios analysis

4.54 At all times except for the 06:00 to 07:00 and 21:00 to 22:00 hours during the winter season more than 95% of Gatwick's inbound flights are undelayed. The 95th percentile of Gatwick's ATFM restrictions is, therefore, zero, with the exception of:

- winter 06:00 to 07:00, where the 95th percentile ATFM delay is approximately 12 minutes
- winter 21:00 to 22:00, where the 95th percentile ATFM delay is approximately 6 minutes.

Distribution of Gatwick's airport ATFM delays by origin

4.55 Exhibit 4-33 and Exhibit 4-34 show the distribution of Gatwick ATFM delays by region of origin of the flight both as a proportion of the ATFM delays and as the average ATFM delay per flight for both summer and winter seasons.

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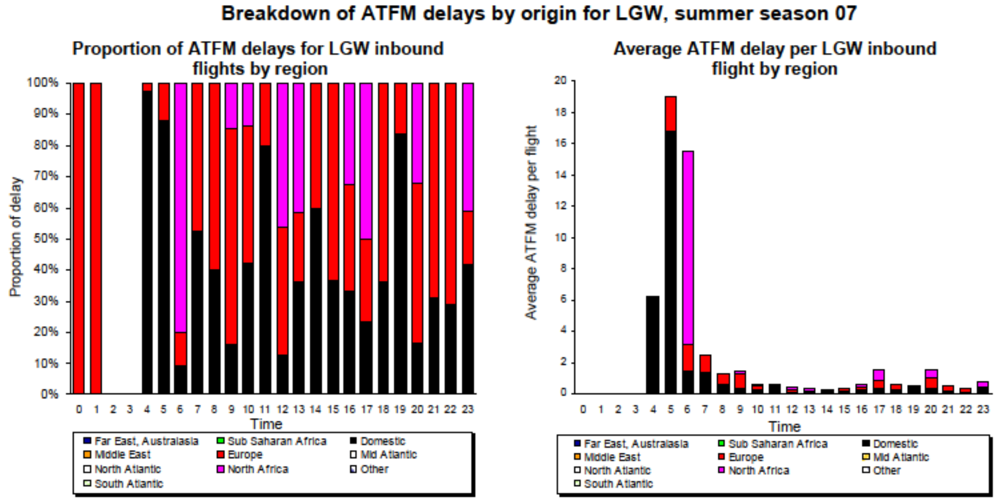
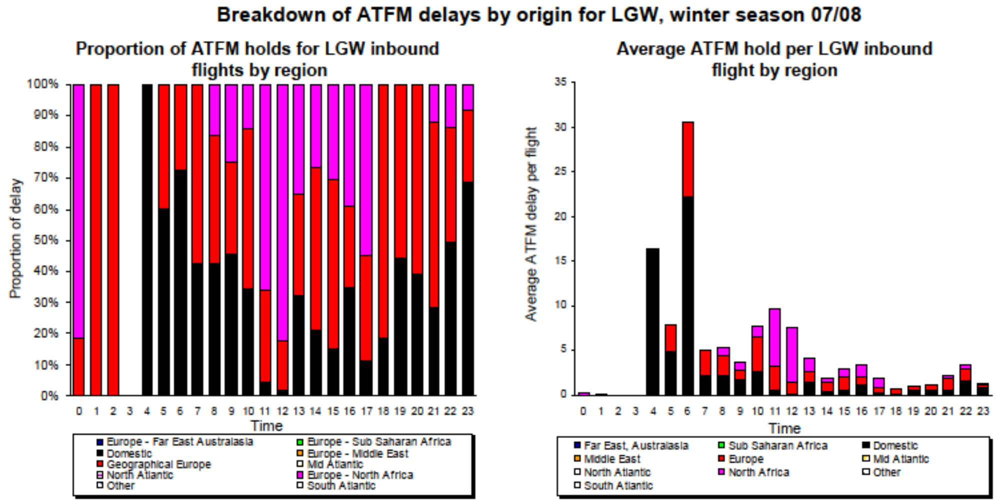
Exhibit 4-33: Breakdown of Gatwick's inbound airport ATFM delays by origin of the inbound flight for the summer season 2007



Source: CFMU, Helios analysis

Exhibit 4-34: Breakdown of Gatwick's inbound airport ATFM delays by origin of the inbound flight for the winter season 2007/2008



Source: CFMU, Helios analysis

4.56 As expected the highest proportion of airport ATFM delays inbound to Gatwick are borne by flights from domestic and European origins. However, in contrast to Heathrow where these ATFM delays are evenly distributed, those at Gatwick are borne to a much greater degree by domestic traffic in the morning peak both summer and winter. The early morning peak is the only time that ATFM delays are significant in the summer. In the winter, other than in the early morning, there is quite a high proportion of traffic from North Africa that suffers Gatwick airport ATFM delays.

Ground holding for departures

Introduction

4.57 Ground holding is a more complex situation to analyse than either airport ATFM delays or stack holding. Whereas the latter two processes are concerned with optimising demand for the runway to the available capacity, ground holding must take into account issues other than the runway. These issues include the need to impose minimum departure intervals (MDIs) to account for capacity restrictions on standard instrument departure (SID) routes, the need to account for ATFM restrictions placed on departing flights and their need to meet their calculated take-off time (CTOT) issued by the CFMU as well as the need to take account of taxiway restrictions and congestion. Furthermore, holding in the stacks and ATFM delays are well-defined and bounded whereas the air traffic controller can manage a ground hold in a number of ways, including holding the aircraft on the stand, managing the taxi speed, holding the aircraft at some point on the taxiway, etc. For these reasons the approach to the analysis of ground holding is focussed on and defined as the difference in the actual overall taxi time from a particular stand to a particular runway to the ideal time as defined by the so-called variable taxi time (VTT) defined as the unimpeded taxi time from stand to runway.

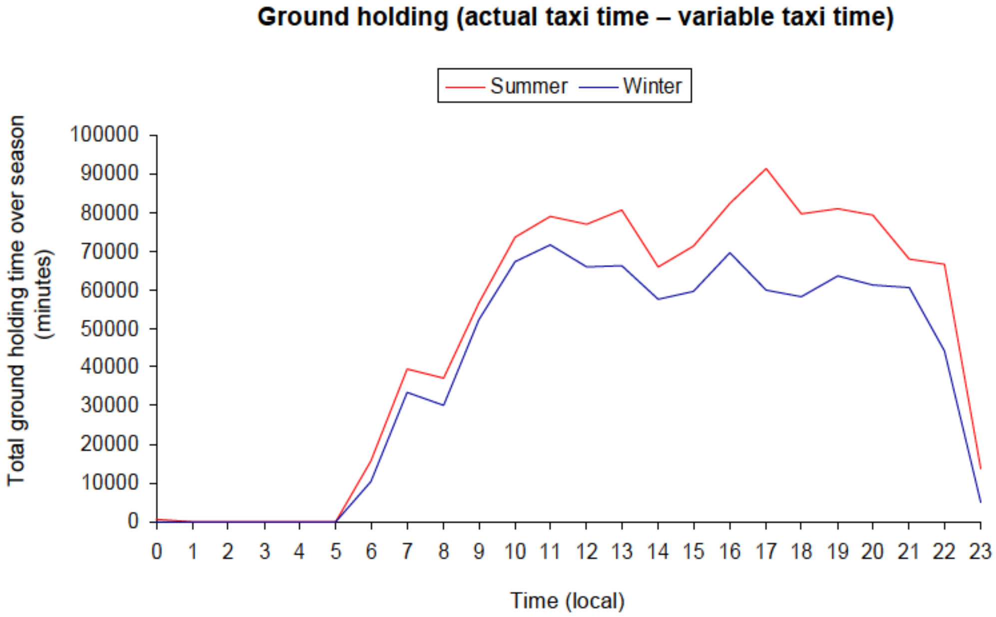
Heathrow

Overall results

4.58 Exhibit 4-35 shows the total ground holding time (actual taxi time minus the variable taxi time) over the last two complete seasons at Heathrow. In the summer season the total holding time was approximately 1404000 minutes whereas the figure for the summer season was approximately 942000 minutes. These figures are of a similar magnitude to the total stack holding and ATFM delays for arrivals combined.

4.59 Other than the factor accounting for the different length of the two seasons there appears to be little difference in the total ground holding times from summer to winter.

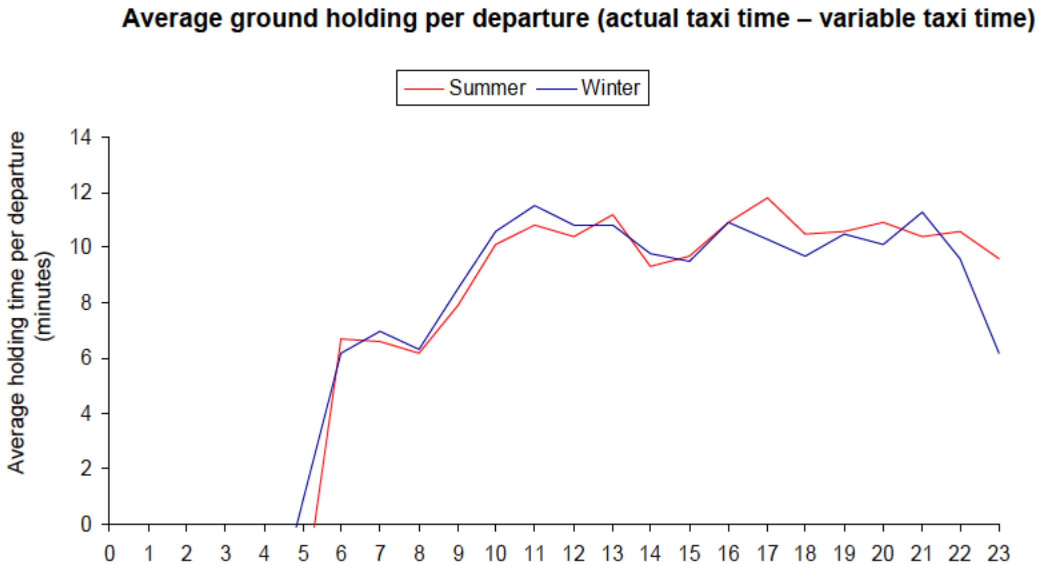
Exhibit 4-35: Total ground holding times for departures from Heathrow over the last two seasons



Source: NATS, Eurocontrol, Helios analysis

Exhibit 4-36 shows the average ground hold per departure from Heathrow over the last two seasons.

Exhibit 4-36: Average ground hold per departure from Heathrow over the last two seasons

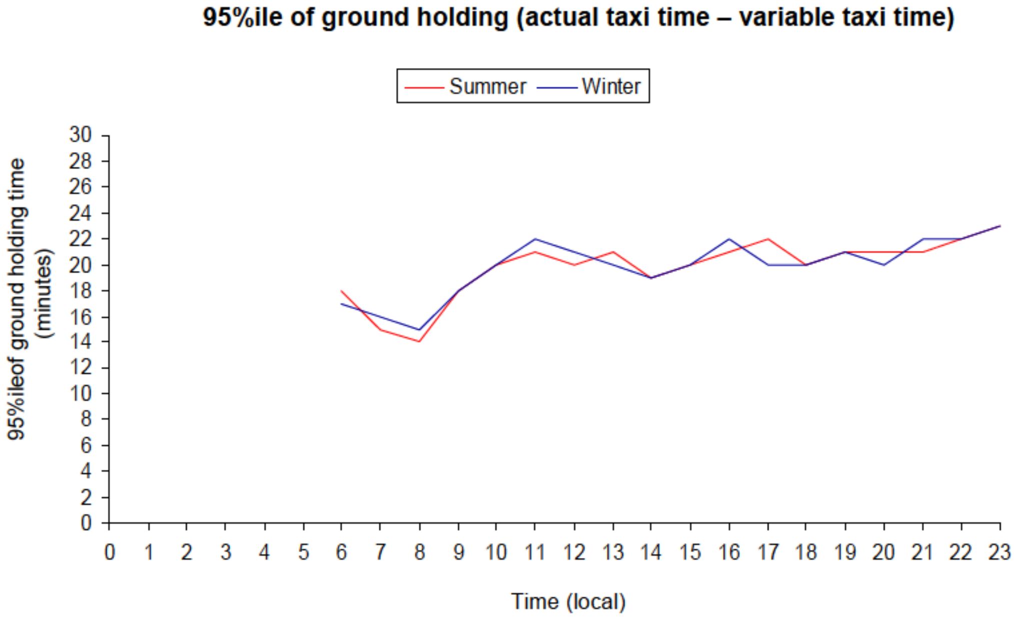


Source: NATS, Eurocontrol, Helios analysis

4.60 There is very little difference between the two curves shown in Exhibit 4-35 and Exhibit 4-36 indicating that the different conditions experienced in summer and winter have little effect on ground holding. For much of the day, the ground holding time lies between around 10 and 12 minutes per departure except for the early morning, where the departure rate is lower than during the rest of the day, when it is around 6 minutes per departure.

4.61 There is also very little difference between the 95th percentiles, a measure of the peak ground holding times, in the summer and winter seasons as shown in Exhibit 4-37. As with the average ground holding times, there is little variation in the 95th percentiles across the day except during the early morning where the range is between 14 to 18 minutes as compared to 20 to 22 minutes for the rest of the day. The higher ratio of 95th percentile to average early in the day (~3) compared to the rest of the day (~2) indicates that there is greater variability in ground holding during the morning.

Exhibit 4-37: 95th percentiles of the ground holding times observed at Heathrow in the last two complete seasons

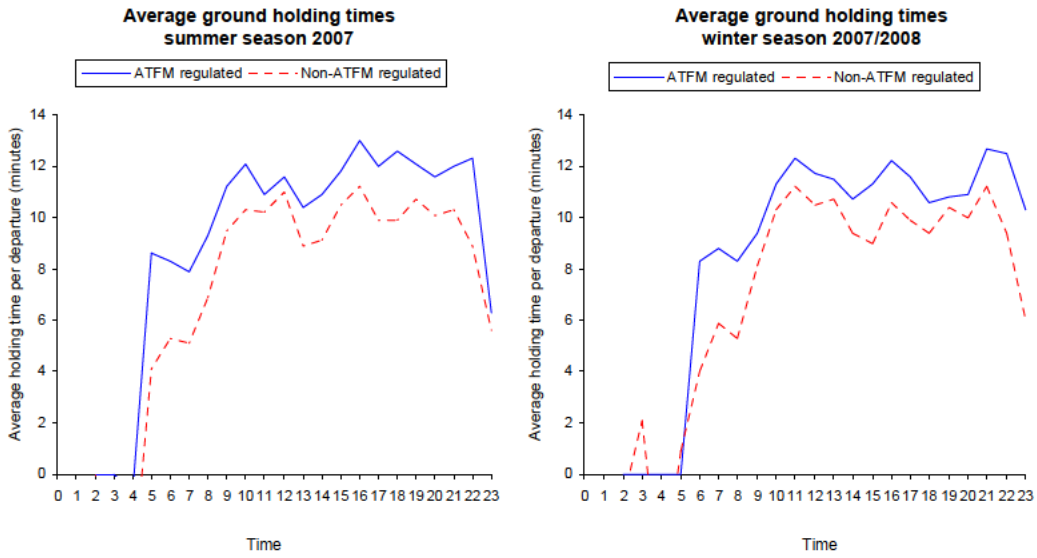


Source: NATS, Eurocontrol, Helios analysis

The impact of ATFM restrictions

4.62 When a departure is subject to an ATFM regulation, it is assigned a CTOT by the CFMU and must depart within a 15 minute window (-5 to +10 minutes) of the CTOT. Much of the ATFM delay is likely to be taken on-stand but some of the delay may be absorbed during taxiing. It is instructive to compare, therefore, the ground holding times for flights not subject to ATFM regulation with those flights that are regulated. This comparison is made in Exhibit 4-38 which shows that flights that are subject to ATFM regulations on average have longer taxi times than unregulated flights. This may indicate that the controller absorbs part of the ATFM delay in the taxi time.

Exhibit 4-38: Comparison of ground holding at Heathrow for flights with and without ATFM regulations



Source: NATS, Eurocontrol, Helios analysis

Pre-start-up holding

4.63 In addition to holding during the taxiing process as described above, an additional mechanism that can be used to hold aircraft on the ground is delaying the ATC approval to start. This is manifested in a delay between the pilot's requested start-up time and the start-up time approved by the air traffic controller.

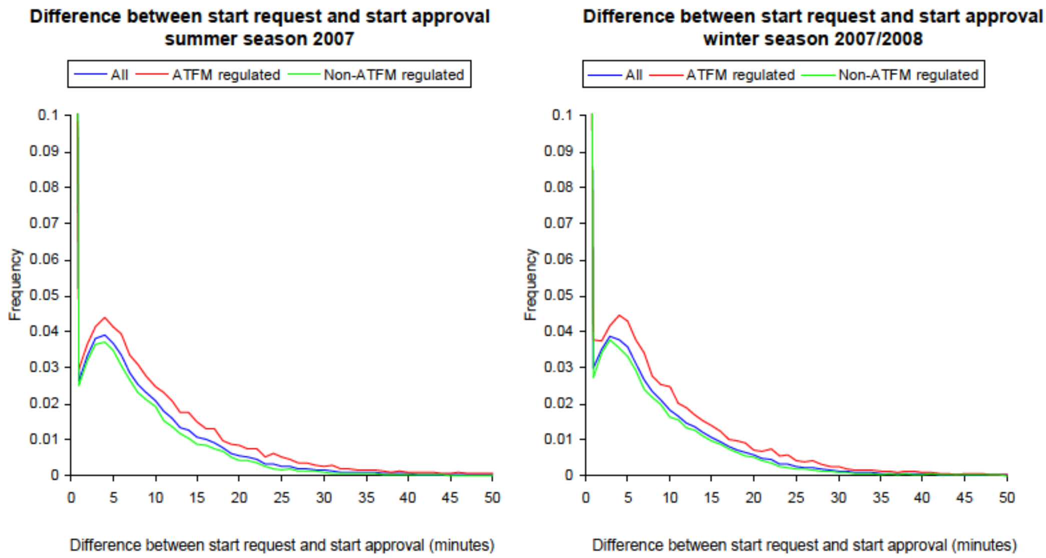
4.64 The distribution of this type of holding time at Heathrow is shown in Exhibit 4-39 for all flights, for flights subject to ATFM regulations and for flights that were not subject to ATFM regulations.

4.65 The key parameters of the distributions are summarised in Exhibit 4-40 and the following observations can be made:

- there is very little difference between the summer and winter seasons
- just over half of all departures are granted start-up approval with no delay with this figure dropping to just over 40% for ATFM regulated flights and rising to around 60% for non-ATFM regulated flights
- there is little qualitative difference between the distributions for aircraft that are subject to ATFM regulation and those that are not but the average difference rises from around 3.7 minutes for non-ATFM regulated flights to 6 to 7 minutes for ATFM regulated flights
- the 95^{th} percentile of the difference between start-up request and start-up approval is approximately 17 minutes for non-ATFM regulated flights and 25 minutes for ATFM regulated flights.

4.66 The lower performance of the ATFM-regulated flights compared to the non-ATFM-regulated flights is probably due to the pilot calling for start-up at the very start or shortly before the CTOT period[8] in anticipation of an early a start as possible. The controller will moderate the actual start-up to sequence the departing traffic more easily and hence, premature calls for start are likely to experience longer delays. Assuming that the pilot generally calls for start-up at the earliest time, taking taxiing into consideration, that would mean departure at the beginning of the CTOT window, then a delay in around 15 minutes for start-up approval would imperil that window being met. Exhibit 4-39 indicates that this is expected to occur for around 12 to 14% of departures.

Exhibit 4-39: Time lag between start-up request and start-up approval for flights departing Heathrow for the last two complete seasons



Source: NATS, Helios analysis

Exhibit 4-40: Key parameters of the distribution of time lags between start-up request and start-up approval for flights departing Heathrow

	Parameter	Total sample	ATFM regulated flights	Non-ATFM regulated flights
Summer season 2007	Proportion of flights that are not held	54%	41%	60%
	Average hold per flight	4.6 mins	7.0mins	3.6 mins
	95%ile of hold	19 mins	26 mins	16 mins
Winter season 2007/2008	Proportion of flights that are not held	55%	44%	59%
	Average hold per flight	4.4mins	6.1 mins	3.8 mins
	95%ile of hold	18 mins	24 mins	17 mins

Source: NATS, Helios analysis

8 For ATFM regulated traffic, departures are allowed within a 15 minute time window of 5 minutes before 10 minutes after the CTOT

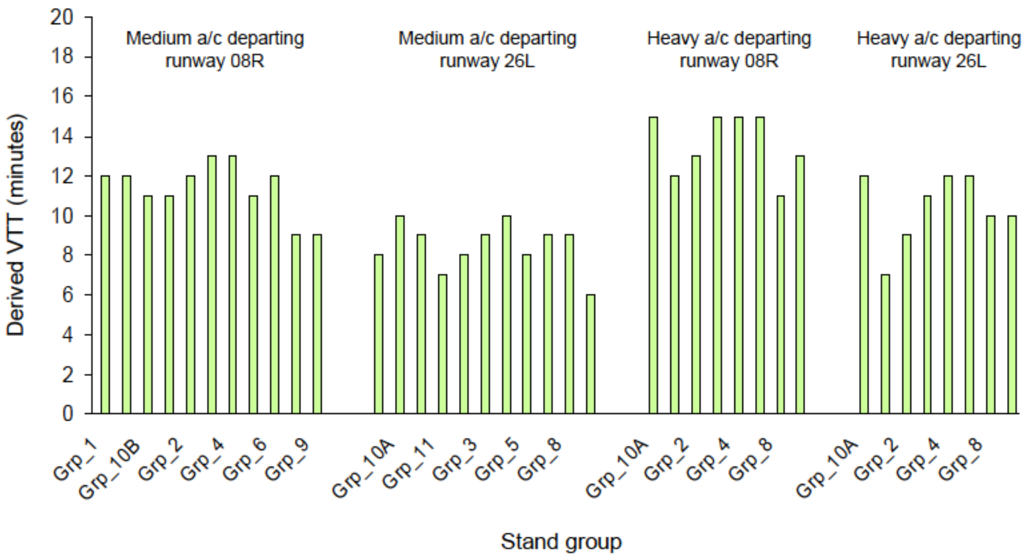
Gatwick

Derivation of variable taxi times

Variable (unimpeded) taxi times are not available for Gatwick so it was necessary to undertake an analysis to estimate the VTT for the various stand-runway configurations. This analysis was based on the observation that the VTTs for stand-runway combinations at Heathrow are consistently the 2nd percentile of the taxi time distribution for each combination. Based on the assumptions that there is unlikely to be a significant difference between Heathrow and Gatwick, the same criterion was applied to Gatwick enabling the VTTs to be estimated.

The results are shown in the following figure classified by stand group and departure runway for medium and heavy aircraft.

Exhibit 4-41: Derived VTTs used in the analysis of ground holding at Gatwick



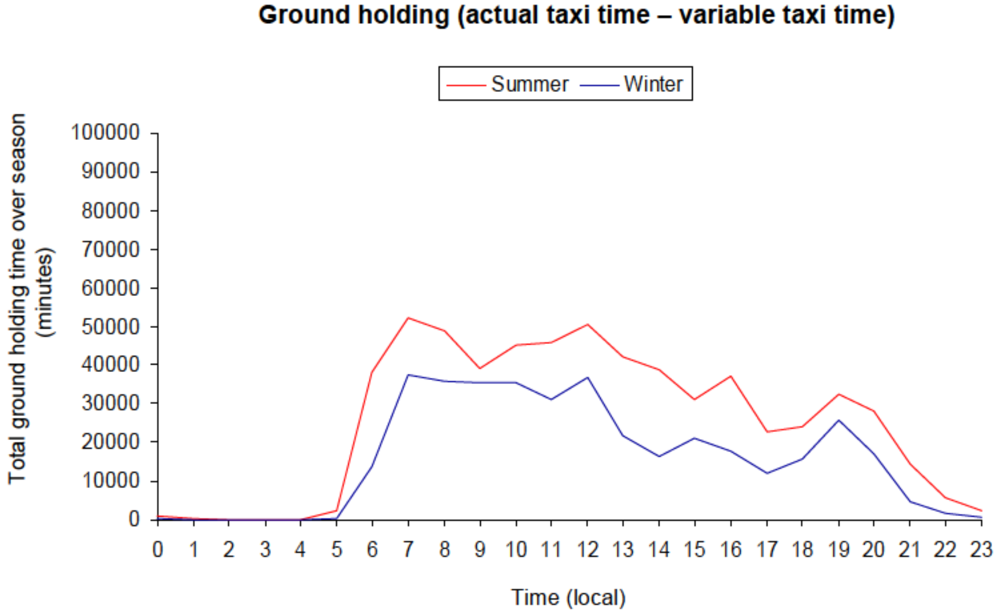
Source: NATS, Helios analysis

Overall results

4.67 Exhibit 4-42 shows the total ground holding time over the last two complete seasons at Gatwick. In the summer season the total holding time was approximately 603000 minutes whereas the figure for the summer season was approximately 381000 minutes. These figures are the same order of magnitude, allowing for differences in traffic volume, as those calculated for Heathrow and are an order of magnitude greater than the equivalent ATFM delays and stack holding times for arrivals.

4.68 Other than the factor accounting for the different length of the two seasons there appears to be little difference in the total ground holding times from summer to winter.

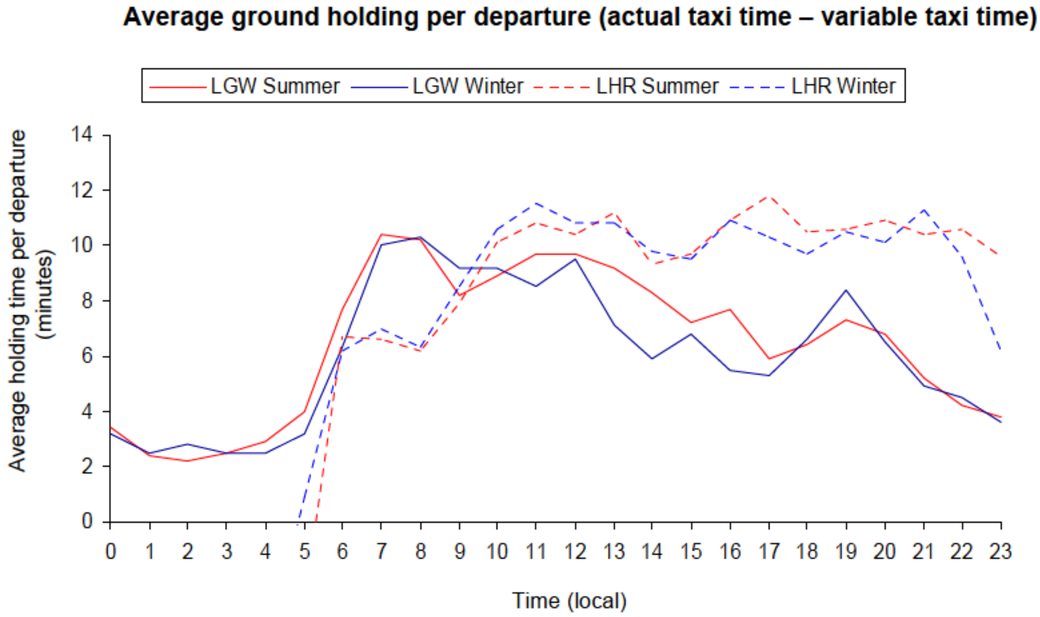
Exhibit 4-42: Total ground holding times for departures from Gatwick over the last two seasons



Source: NATS, Helios analysis

The following exhibit shows the average ground holding time per flight for departures from Gatwick.The equivalent data are also shown for Heathrow. In contrast to stack holding times and ATFM delays, whose averages are much greater for Heathrow and Gatwick, in this case the two sets of average are similar. In fact, in the early morning, average ground holding at Gatwick is worse than at Heathrow although the situation reverses as the day progresses.

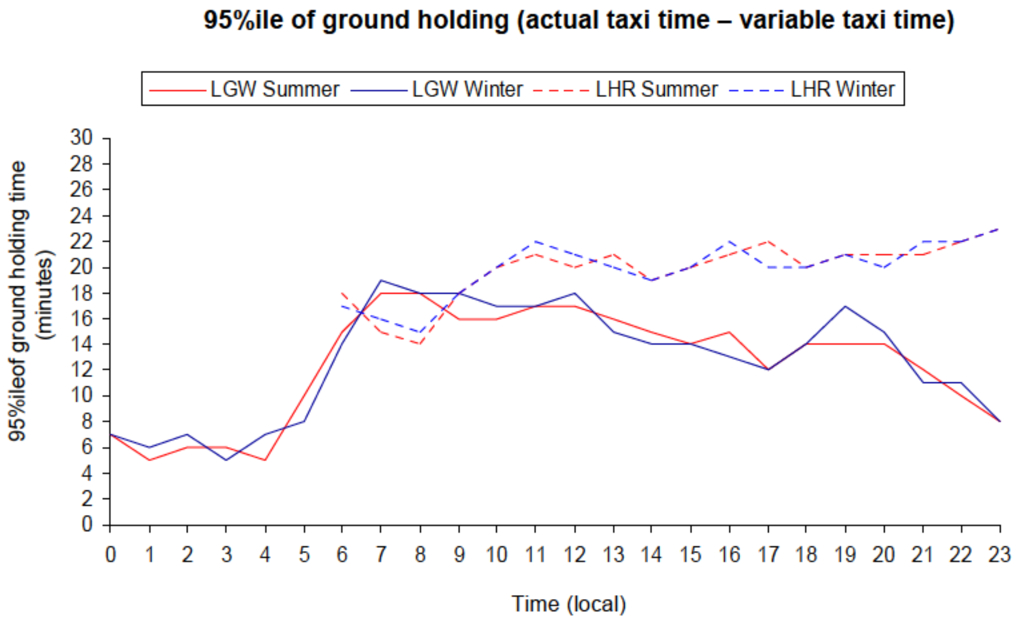
Exhibit 4-43: Average ground hold per departure from Gatwick compared to Heathrow over the last two seasons



Source: NATS, Eurocontrol, Helios analysis

4.69 The behaviour of the peak ground holding at Gatwick, as described by the 95th percentile of the ground holding time, is shown in the following figure and compared to the equivalent data for Heathrow. Again the magnitude of peak ground holding at Gatwick is similar to that at Heathrow with Gatwick's performance being slightly worse than Heathrow's in the early morning but improving in relative and absolute terms as the day progresses.

Exhibit 4-44: 95th percentiles of the ground holding times observed at Gatwick compared to Heathrow in the last two complete seasons



Source: NATS, Eurocontrol, Helios analysis

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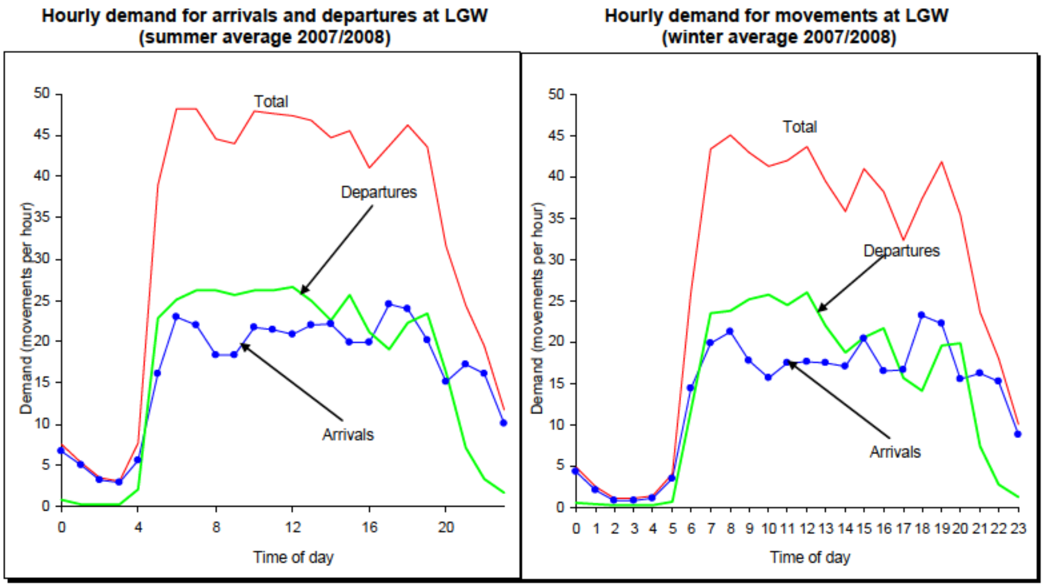
4.70 The poor performance of Gatwick at ground holding (compared to stack holding and ATFM delays) is probably exlained by priority being given to arrivals over departures for access to the single runway. The poor performance in the early morning is due to the high demand for both arrivals and departures at that time, as shown in the following figure. The improvement throughout the day is probably due to:

- periods of high demand for arrivals and departures mainly being in anti-phase
- the gradual decline in demand for arrivals as the day progresses.

Exhibit 4-45: Relationship between arrivals and departures demand at Gatwick

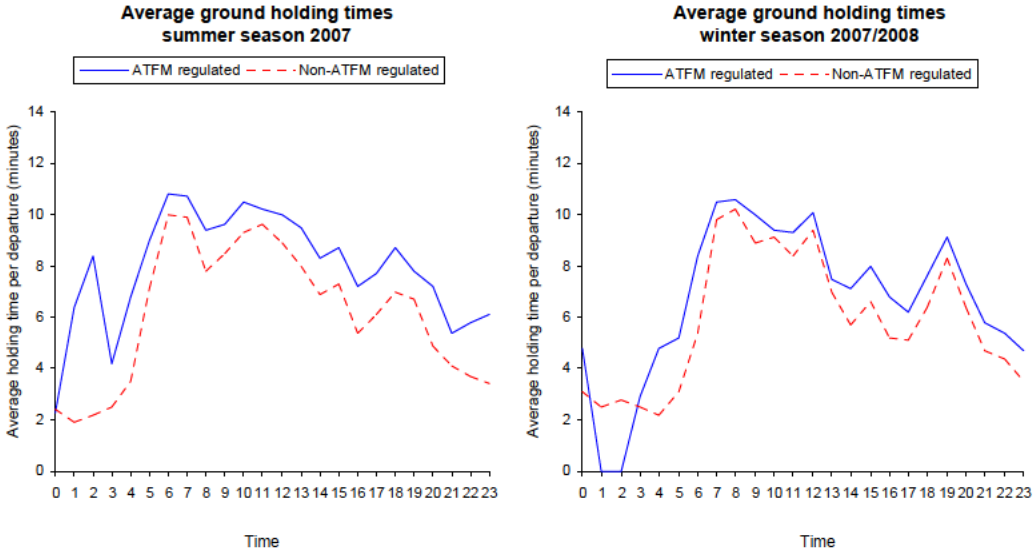


Source: CFMU

The impact of ATFM restrictions

4.71 The comparison of ground holding between departures from Gatwick that are ATFM-regulated and those that are not is made in Exhibit 4-38. As with Heathrow, this comparison shows that flights that are subject to ATFM regulations on average have longer taxi times than unregulated flights, again indicating that the controller absorbs part of the ATFM delay in the taxi time – at the penalty of the engines running for longer than is necessary increasing fuel costs and environmental impact. The difference between ATFM-regulated and non-ATFM-regulated departures is slightly smaller for Gatwick than for Heathrow.

Exhibit 4-46: Comparison of ground holding at Gatwick for flights with and without ATFM regulations



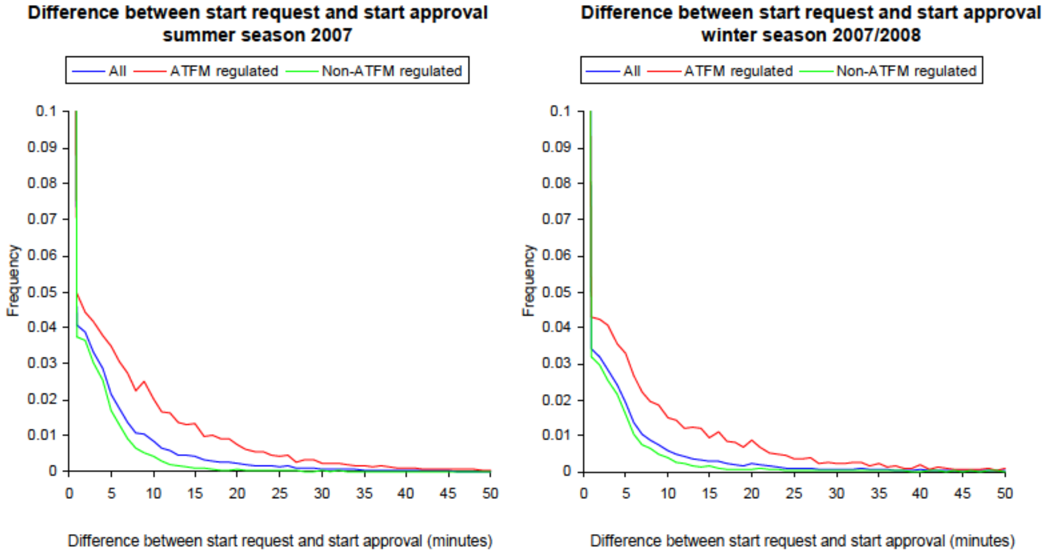
Pre-start-up holding

4.72 The distributions of this pre-start-up holding time at Gatwick are shown in Exhibit 4-39 for all flights, for flights subject to ATFM regulations and for flights that were not subject to ATFM regulations. The distributions are qualitatively different to those observed at Heathrow in that they decrease continuously and do not have side peaks, as is observed for Heathrow.

4.73 The key parameters of the distributions are summarised in Exhibit 4-47 and the following observations can be made:

- there is very little difference between the summer and winter seasons
- just over half of all departures are granted start-up approval with no delay, with this figure dropping to just over 40% for ATFM regulated flights and rising to around 60% for non-ATFM regulated flights
- there is little qualitative difference between the distributions for aircraft that are subject to ATFM regulation and those that are not but the average difference rises from around 3.7 minutes for non-ATFM regulated flights to 6 to 7 minutes for ATFM regulated flights
- the 95th percentile of the difference between start-up request and start-up approval is approximately 17 minutes for non-ATFM regulated flights and 25 minutes for ATFM regulated flights.

Exhibit 4-47: Time lag between start-up request and start-up approval for flights departing Gatwick for the last two complete seasons



Source: NATS, Helios analysis

4.74 Following the same premise as in paragraph 4.66, the proportion of ATFM-regulated flights that have a start-up delay of greater than 15 minutes (and hence may have difficulty in meeting their CTOT window) is around 12%.

Exhibit 4-48: Key parameters of the distribution of time lags between start-up request and start-up approval for flights departing Gatwick

	Parameter	Total sample	ATFM regulated flights	Non-ATFM regulated flights
Summer season 2007	Proportion of flights that are not held	71%	48%	80%
	Average hold per flight	2.2	5.7	1.0
	95%ile of hold	12	24	5
Winter season 2007/2008	Proportion of flights that are not held	76%	52%	82%
	Average hold per flight	2.2	5.7	1.4
	95%ile of hold	11	26	6

Source: NATS, Helios analysis

SIGNIFICANT DISRUPTION

Frequency of major disruptions at Heathrow

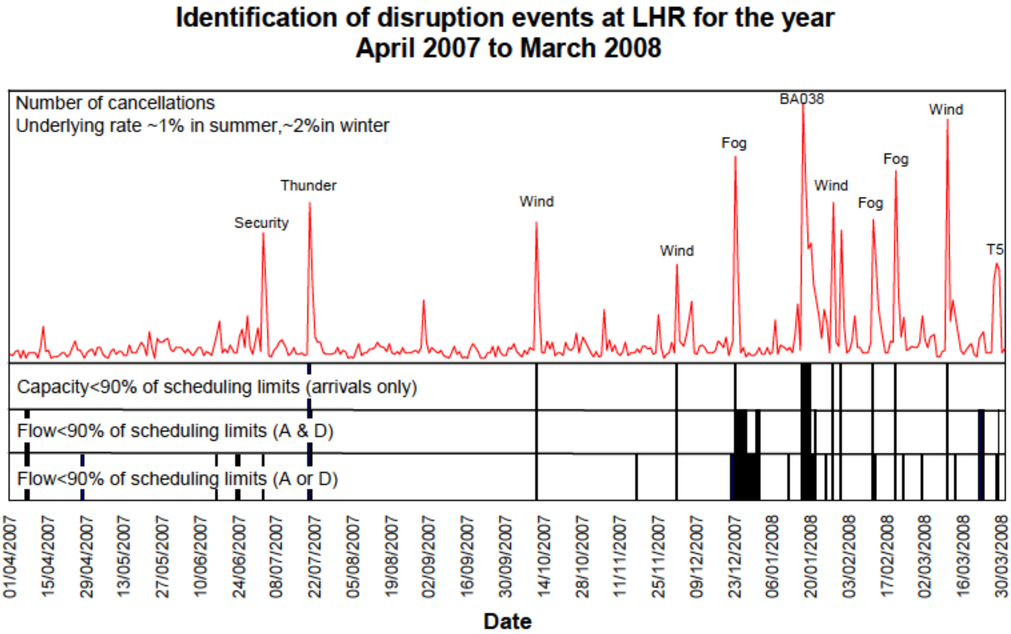
4.75 Significant disruption to the runway operations at an airport can be characterised by three main parameters:

- reduced flow rates for arrivals, departures or both
- significantly reduced runway capacity
- increased levels of operational (rather than economic – e.g. for flights with very low load factors) cancellations of flights.

4.76 Exhibit 4-49 illustrates these parameters for Heathrow over the year starting 1April 2007 and ending 31 March 2008. The top part of the chart shows the number of operational cancellations that occurred, with the cause of the disruption by day, when the level of cancellations reached about 10%. The three tramlines at the bottom of the chart show:

- the days on which the actual flow rate for arrivals was below 90% of the scheduling limits, that is very restricted arrivals (bottom tramline)
- the days on which the actual flow rate for both arrivals and departures was below 90% of the scheduling limits (middle tramline)
- the days on which the declared capacity was below 90% of the scheduling limits (top tramline).

Exhibit 4-49: Significant disruptions at Heathrow between April 2007 and March 2008 inclusive



Source: ACL, CFMU, Helios analysis

4.77 The figure shows that during the period investigated:

- there were 13 days when arrivals capacity was restricted to less than 90% of the norm taken over the normal operating day from 06:00 to 22:00. Together these days resulted in over 2000 cancellations and on 8 of the 13 days, more than 10% of Heathrow's flights were cancelled

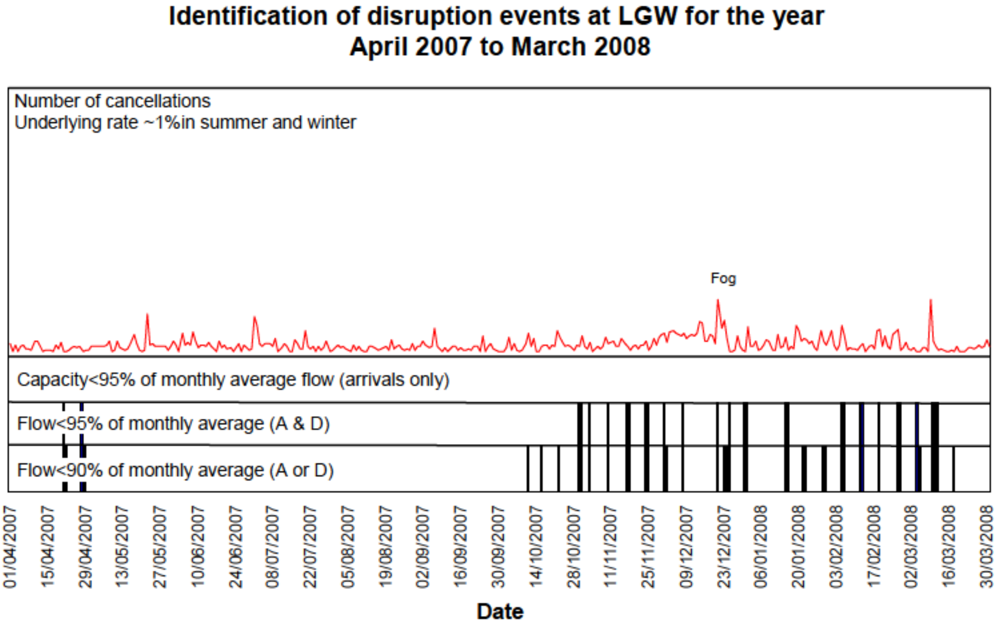
- weather was the principal cause of these disruptions, in addition to the BA038 accident
- there were 31 more days during the year when either arrivals or departures flow rates were lower than 90% of the scheduling limits
- there were 16 additional days over the year where there were more than 20 cancellations but less severe flow restrictions indicating that recovery from the disruption was possible or the disruption was not associated with the runway, for example the opening of terminal 5.

4.78 In summary, during the year April 2007 to March 2008 there were around 8 to 13 days when Heathrow's operations were disastrously disrupted and a further 47 to 52 days when there was major disruption.

Frequency of major disruptions at Gatwick

4.79 Exhibit 4-50 uses the same format as exhibit 4-38 to show the occurrence of major disruptions at Gatwick over the year April 2007 to March 2008. In this case there were no events where the flow rate was reduced to 90% of the norm, so in the Gatwick case the criteria for assessment has been set as the flow rate or capacity reduced to 95% of the scheduling limits. Despite this being a tighter threshold than that used for Heathrow, there were no events where the declared capacity was reduced to 95% of the norm. The number of cancellation events is also much lower than that experienced at Heathrow although the underlying rate of cancellations is around the same at the two airports in summer at around 1% but is lower at Gatwick in the winter at around 1% compared to 2% at Heathrow.

Exhibit 4-50: Significant disruptions at Gatwick between April 2007 and March 2008 inclusive



Source: ACL, CFMU, Helios analysis

4.80 The conclusion from Exhibit 4-49 and Exhibit 4-50 is that there were no major disruptions at Gatwick on the same scale as experienced at Heathrow during the period of analysis.

Recovery from disruption

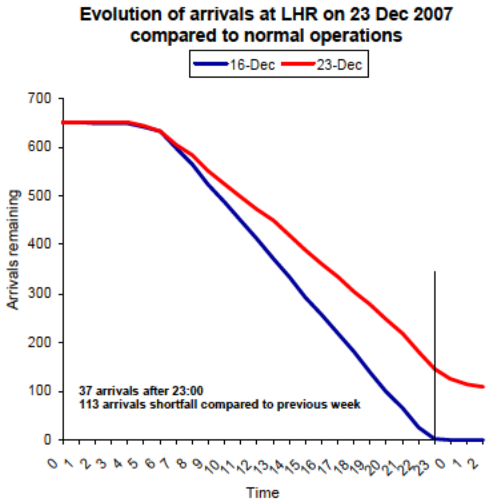
4.81 The following sections illustrate how Heathrow and Gatwick recover from events that disrupt their runway operations using three example disrupted days:

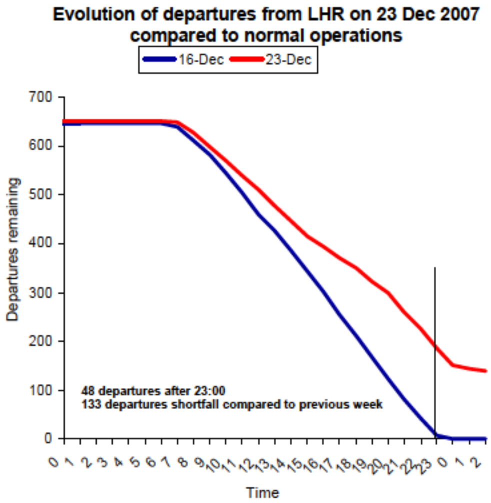
- 23 December 2007 where both airports were subject to severe fog that persisted for most of the day. As a baseline for normal operations at that time of year, the same weekday one week earlier – 16 December 2007 – which was not disrupted is used for comparison
- 5 November 2007 where both airports were subject to early morning fog that cleared during the day allowing scope for recovery. The day used for the normal baseline operations in this example is 12 November, one week later (the week earlier is not used as it is very close to the changeover between the summer and winter seasons)
- 2 December 2007 where both airports were subjected to high winds. Mean wind speeds at Heathrow and Gatwick were 34km/h and 22km/h with gusts of up to 78km/h and 50 km/h respectively.

Example – 23 December 2007

4.82 Exhibit 4-51 shows the evolution of Heathrow's arrivals and departures on 23 December compared to virtually the same schedule on 16 December.

Exhibit 4-51: Evolution of arrivals and departures at Heathrow throughout the day on 23 December compared to the baseline





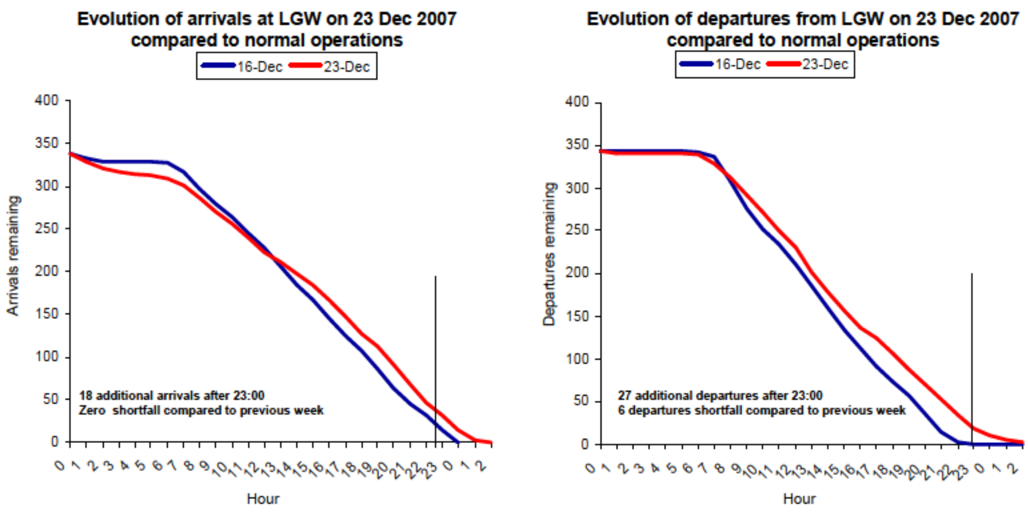
Source: ACL, CFMU, Helios analysis

The figure shows that the rate of both arrivals and departures is significantly reduced compared to the baseline resulting in:

- shortfalls in arrivals and departures of 113 and 133 respectively compared to the baseline
- overspill of normal operations into the night time, comprising 37 arrivals and 48 departures

4.83 Exhibit 4-52 shows the evolution of arrivals and departures at Gatwick on 23 December compared to the baseline of 16 December. The figure shows that disruption on the scale of that experienced at Heathrow was avoided at Gatwick with very few cancellations and a limited number of additional night time operations.

Exhibit 4-52: Evolution of arrivals and departures at Heathrow throughout the day on 23 December compared to the baseline



Source: ACL, CFMU, Helios analysis

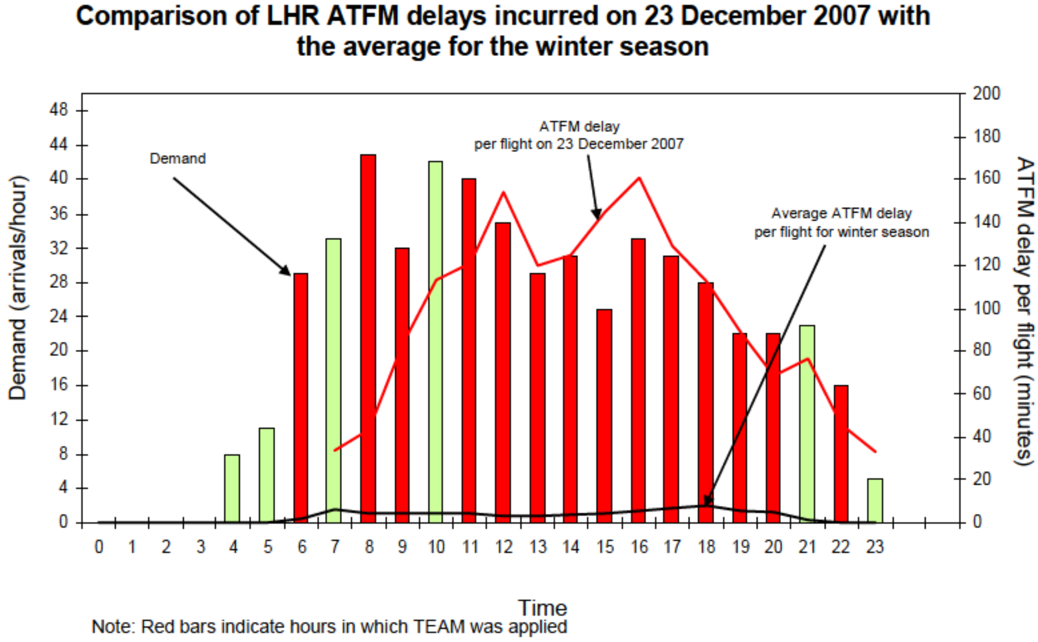
4.84 A second measure of disruption is the delays that are experienced by inbound flights due to ATFM regulations. Exhibit 4-53 and Exhibit 4-54 show the average airport ATFM delay per flight inbound to Heathrow and Gatwick on 23 December and compare these with the averages for the winter season. The figures also show the runway demand in terms of arrivals per hour, as derived from the CFMU data for the day.

4.85 The figures show:

- at their peak the airport ATFM delays per flight for each airport are very significant, at up to 3 hours per flight
- the airport ATFM delays ramp up more quickly to their peak at Heathrow than at Gatwick

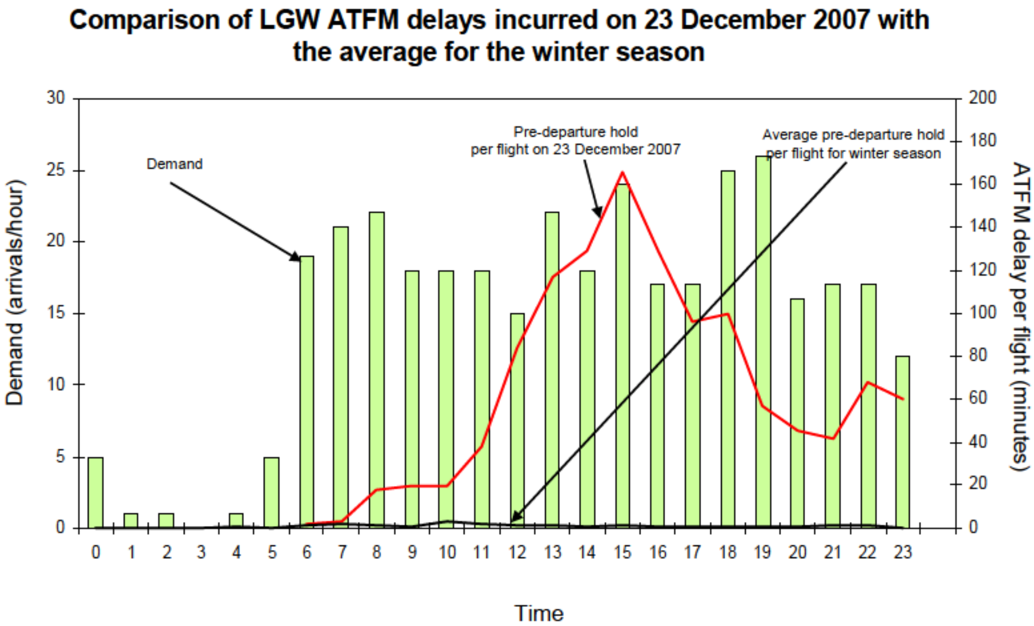
- by the end of the day, flights are still suffering serious airport ATFM delays of around 40 minutes at Heathrow and 60 minutes at Gatwick
- the arrivals demand at Heathrow drops off during the day from the norm at around 40 per hour to between 20 and 30 per hour reflecting the number of cancellations made.

Exhibit 4-53: Average airport ATFM delay per flight inbound to Heathrow and hourly arrivals demand on 23 December 2007



Source: CFMU, Airline data, Helios analysis

Exhibit 4-54: Average airport ATFM delay per flight inbound to Gatwick and hourly arrivals demand on 23 December 2007



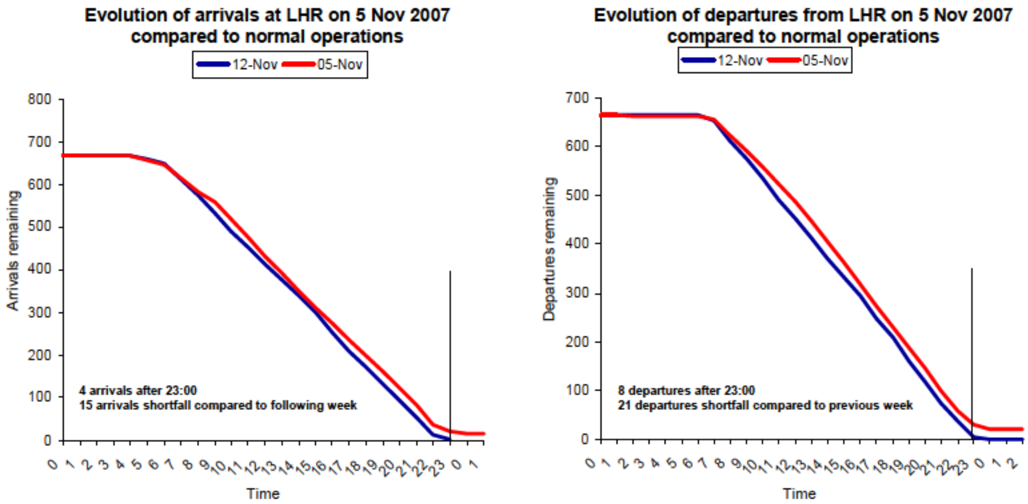
Source: CFMU, Helios analysis

4.86 Exhibit 4-53 shows that NATS uses TEAM to expedite arrival flows during the majority of the day. This application is made possible by the large number of cancellations reducing demand for the departures runway and allowing its use for arrivals which are more seriously affected by low visibility conditions than departures.

Example – 5 November 2007

4.87 Exhibit 4-55 shows the evolution of Heathrow's arrivals and departures on 5 November compared to the baseline of 12 November.

Exhibit 4-55: Evolution of arrivals and departures at Heathrow throughout the day on 5 November compared to the baseline

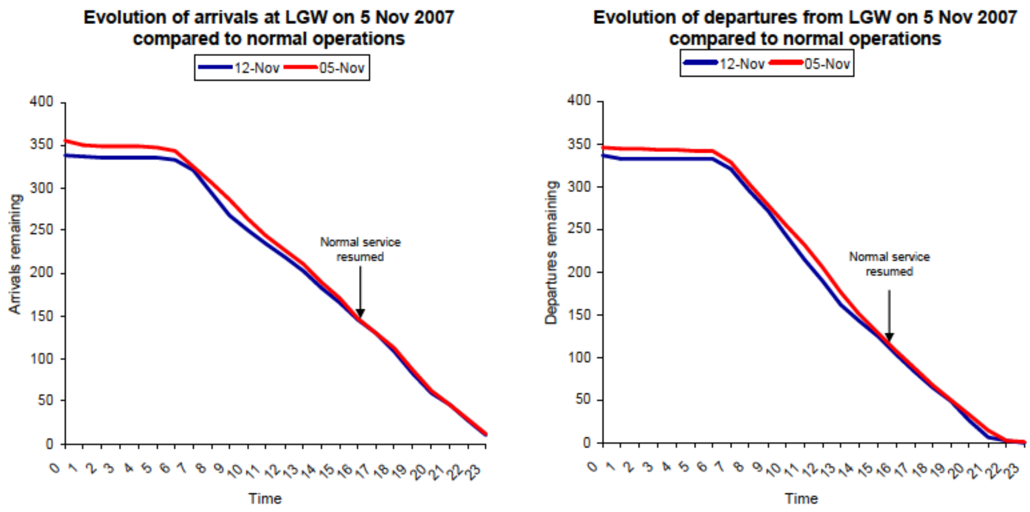


Source: CFMU, Helios analysis

4.88 The figure shows that there was significantly less disruption on 5 November than on 23 December. There were shortfalls in arrivals and departures of 15 and 21 respectively compared to the baseline, with a limited number of operations taking pace after 23:00. However, the evolution of the traffic remains behind the baseline throughout the day starting from the early morning.

4.89 Exhibit 4-56 shows the evolution of traffic at Gatwick on 5 November compared to the baseline of 12 November. This figure shows that there is a shortfall in movements compared to the baseline between approximately 08:00 and 15:00 but that after about 15:00 both the rate of and the cumulative number of movements has recovered completely.

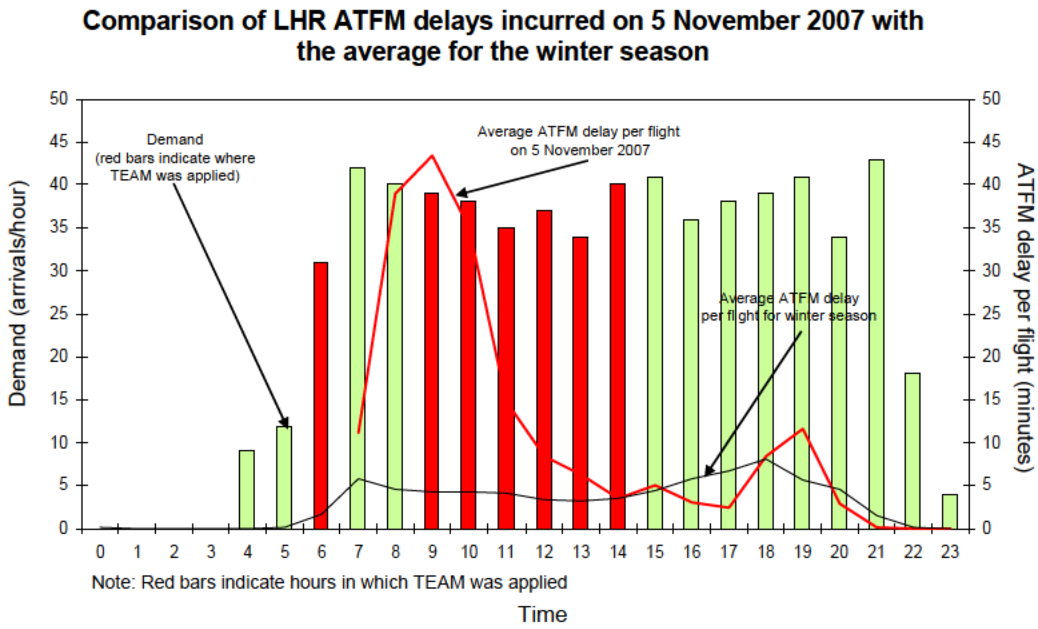
Exhibit 4-56: Evolution of arrivals and departures at Gatwick throughout the day on 5 November compared to the baseline



Source: CFMU, Helios analysis

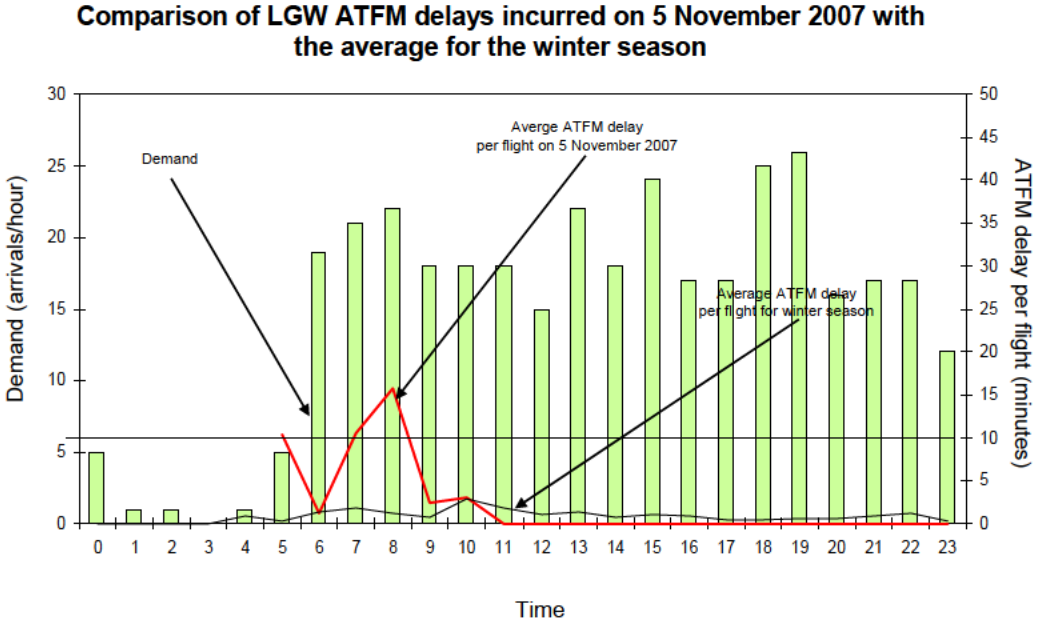
4.90 Exhibit 4-57 shows for arrivals the airport ATFM delays incurred at Heathrow on 5 November along with the hourly demand, derived from CFMU data. Exhibit 4-58 shows the same data for Gatwick.

Exhibit 4-57: Average airport ATFM delay per flight inbound to Heathrow and hourly arrivals demand on 5 November 2007



Source: CFMU, Airline data, Helios analysis

Exhibit 4-58: Average airport ATFM delay per flight inbound to Gatwick and hourly arrivals demand on 5 November 2007



Source: CFMU, Helios analysis

4.91 Comparison of Exhibit 4-57 and Exhibit 4-58 shows:

- airport ATFM delays due to Gatwick, at around 15 minutes in the peak at around 08:00, were considerably lower than those suffered due to Heathrow which were 45 minutes in the peak at around 09:00
- Gatwick had recovered to normal levels of airport ATFM delay by around 10:00 whereas Heathrow's recovery to normal delay levels took until around 14:00
- Gatwick did not suffer any real suppression of demand (i.e. cancellations) whereas Heathrow's demand was reduced to between 35 and 40 arrivals for parts of the day
- NATS applied TEAM to expedite arrivals from 09:00 to 14:00 in addition to its normal application at 06:00
- NATS can also apply mixed mode operations in some circumstances to alleviate severe disruption.

Example – 2 December 2007

4.92 Exhibit 4-59 and Exhibit 4-60 show the evolution of traffic at Heathrow and Gatwick on 2 December respectively compared to the evolution of traffic on the equivalent day one week earlier, when weather conditions were reasonably good.

4.93 The figures show that Gatwick was unaffected by wind conditions but that there was considerable disruption at Heathrow, albeit caused by winds that were stronger than experienced at Gatwick.

Exhibit 4-59: Evolution of arrivals and departures at Heathrow throughout the day on 2 December compared to the baseline

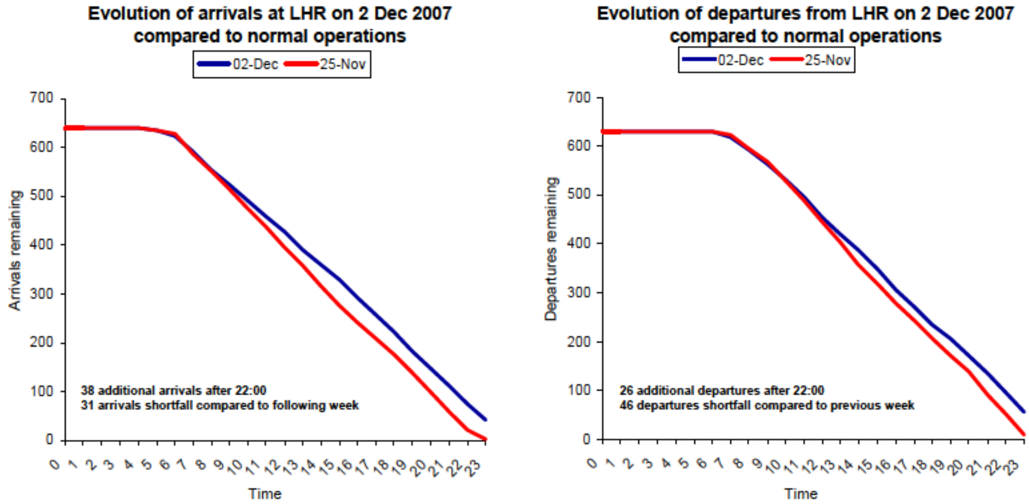
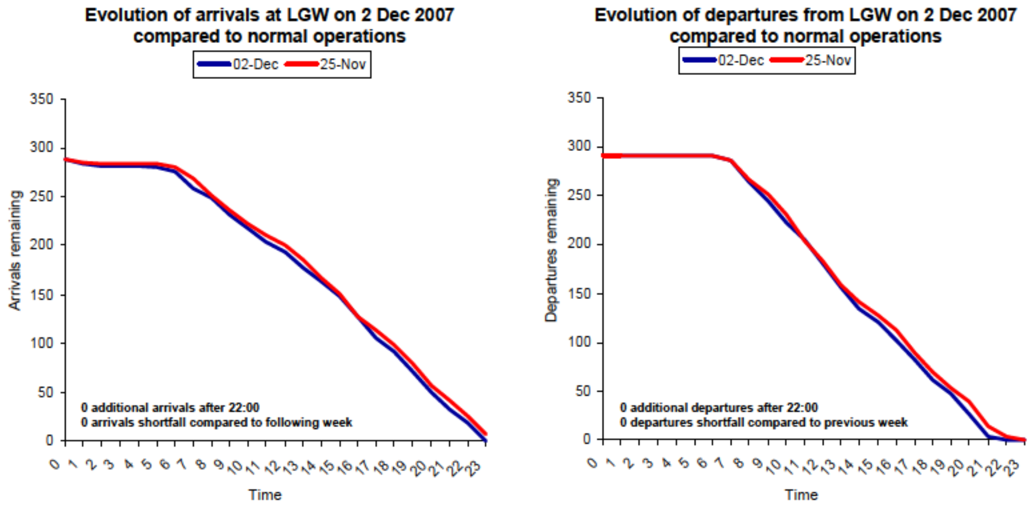


Exhibit 4-60: Evolution of arrivals and departures at Gatwick throughout the day on 2 December compared to the baseline



4.94 During the day at Heathrow, the arrival and departure rates were restricted to the low to mid 30s as opposed to high 30s and low 40s of the previous week. There was no extensive operation of TEAM in contrast to the low visibility days. At Gatwick the arrivals and departure rates were largely unaffected by the conditions, presumably due to the additional spacing needed to operate mixed mode.

CURRENT SITUATION - CONCLUSIONS

4.95 The performance of Heathrow and Gatwick airports in term of stack holding, airport ATFM delays and ground holding are summarised in the following table.

Exhibit 4-61: Summary of different delay types at Heathrow and Gatwick

		Heathrow				Gatwick			
		Stack	**ATFM**	**Ground**	**Pre-start-up**	**Stack**	**ATFM**	**Ground**	**Pre-start-up**
Summer	Total (000s mins)	565	389	1404	537	93	28	603	167
	Average (mins)	5.3	2 8	10.0	4.6	1.2	0.4	7.8	2.2
	95^{th} %ile	10-15	15-25	14-22	19	0	0	12-18	12
Winter	Total (000s mins)	602	625	942	409	44	53	381	108
	Average (mins)	6.0	5 3	9.2	4.4	0.8	1.0	6.9	2.2
	95^{th} %ile	15-20	35-45	14-22	18	0	0-12	12-18	12

4.96 Heathrow's runways are currently operating at or very near their capacity giving very limited scope to buffer against the normal perturbations in the air traffic network or to cope with or recover from disruptions to operations. The very high utilisation at Heathrow is also reflected in its low robustness to and limited ability to recover from major disruption when compared to Gatwick.

4.97 This fragility appears to be exacerbated by the use of the runways in segregated mode with the minimum spacing between arriving aircraft when compared to the additional, buffer spacing that naturally occurs when runways are operated for both arrivals and departures.

4.98 As a consequence of operating very near to capacity, Heathrow's current performance is significantly worse than that at Gatwick in terms of stack holding and inbound airport ATFM delays. The performance of the two airports is comparable for ground holding for departures. Gatwick's poor performance in ground holding, relative to stack holding and ATFM delays, is probably due to priority being given to arrivals for access to the mixed mode runway.

4.99 In addition, Heathrow's performance in terms of airport ATFM delays is worse than the two of its main European hub competitors that have greater capacity (Amsterdam Schiphol and Paris Charles de Gaulle) and on a par with Frankfurt with equivalent capacity. Heathrow does, however, show better resilience against adverse weather conditions than both Amsterdam Schiphol and Paris Charles de Gaulle.

5 Operational Analysis & Results

Scenarios

5.1 The remit for the study required examination of a range of different scenarios as described below. The analysis compares these to a Base Case scenario which is the seasons of Summer 2007 and Winter 2007/2008. The scenarios are considered under Normal Operations with recovery from Severe Disruption being assessed through a set of case studies.

Normal operations

5.2 These scenarios can be grouped under the following headings:

- **sensitivity testing** to determine the impact of adding or removing a flight from a given hour;
- **reducing the number of flights** to a level at around 5% below the current level (around 2 arrivals and 2 departures per hour) for example by restricting slots both broadly across the day and in the delay peaks. This scenario is consistent with London First's proposal[9] to reduce the number of air traffic movements (ATMs) at Heathrow below the current level and is included as an illustration of the degree to which the balance has tipped in favour of additional flights in preference to resilience;
- **increased application of TEAM** to better manage periods of peak arrivals holding acknowledging and investigating the negative impact that this might have on departures;
- **application of mixed mode** delivering 15%, 10% and 5% additional capacity respectively with no additional demand[10], corresponding to the scenarios investigated by NATS and BAA in the recent Heathrow consultation[11]:
  - maximum capacity mixed mode giving 15% additional capacity with a fully flexible arrival and departure system coupled with extended airspace facilitating fully continuous descent approach (CDA) compliant approaches. NATS has some reservations about the viability of this scenario;

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9 Imagine a world class Heathrow, London First, June 2008

10 In its report, "Imagine a world class Heathrow", London First highlights the short-term use of mixed mode operations with no corresponding increase in ATMs and this scenario was also considered as part of the recent Heathrow consultation process (http://www.dft.gov.uk/162259/165220/302152/completecondoc.pdf page 92)

11 Heathrow Mixed Mode Scenarios, Consultation Issue, prepared by NATS for BAA, October 2007

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– a scenario giving around 10% additional capacity using TWin Arrival Streams maintaining Standard Separation (TWASS) as the arrival regime, but retaining the maximum capacity mixed mode SID structure with a CDA compliant arrivals regime but with significant airspace changes required to the departure regime. NATS estimates that it would require around 4 years to make the necessary changes to support this scenario;

– a scenario, delivering around 5% capacity increase, based on TWASS but using the current SID structure. The scenario is again CDA compliant but requires smaller changes than either of the other two mixed mode scenarios and hence could be delivered more quickly within, in NATS opinion, 2 years.

The scenarios are summarised in Exhibit 5-1.

Exhibit 5-1: Summary of the scenarios investigated

	Sensitivity testing	Additional TEAM	Mixed mode	Indicative reduction of demand
Demand added	1) Flight added in each hour separately, no capacity added			
Number of flights reduced	2) Flight removed from each hour separately, demand held at current levels			7) 5% of flights removed each hour, current capacity
Capacity added, current movement levels retained		3) application of TEAM extended across the delay peaks, demand held at current levels	4) maximum capacity mixed mode, giving 15% capacity increase 5) TWASS mixed mode with amended SID structure, giving 10% capacity increase 6) TWASS mixed mode with current SID structure, giving 5% capacity increase	

Severe disruption

5.3 The impact of severe disruption is assessed separately to normal operations, investigating how the different capacity enhancements or a reduction in demand might aid recovery based on the two case study days, 23 December and 5 November. The scenarios are:

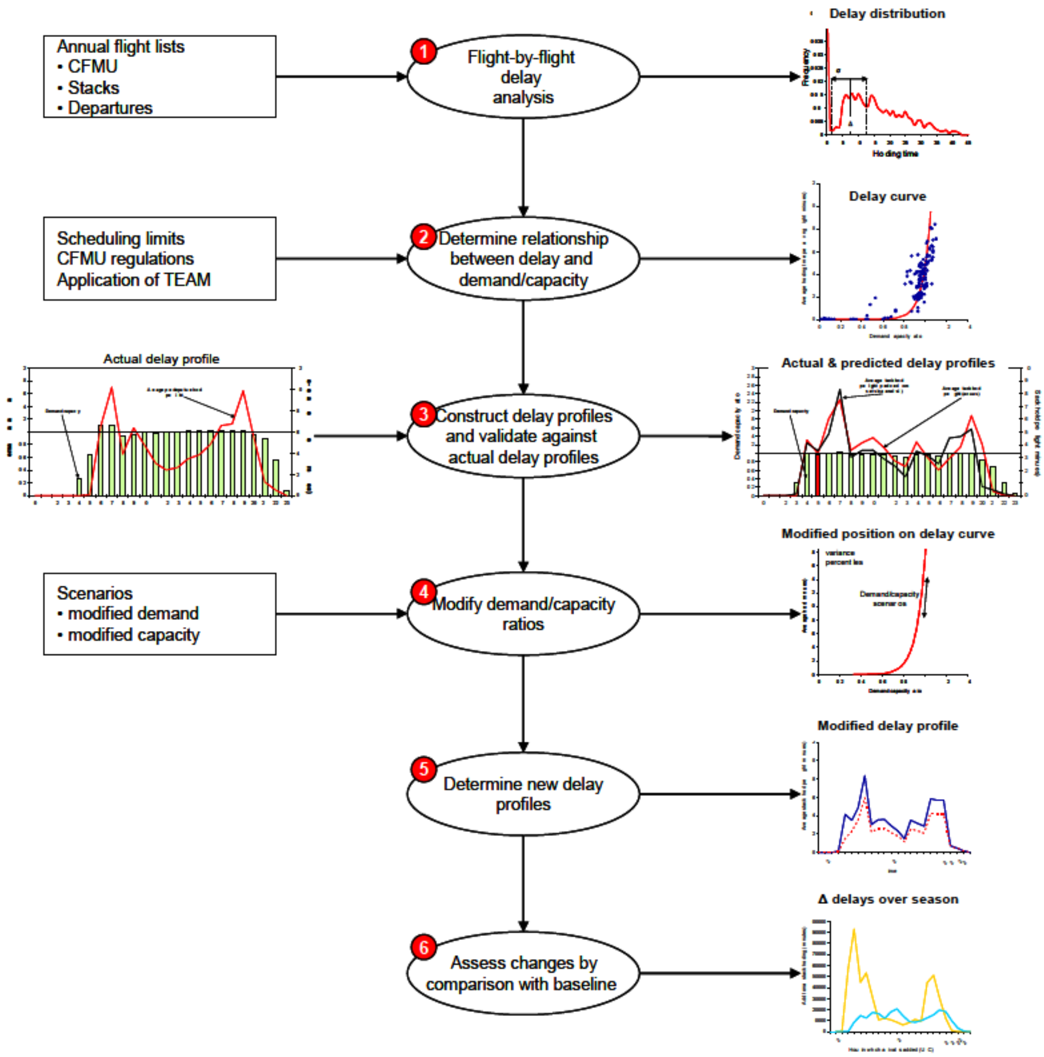
- assessment of the impact of TEAM (note that TEAM is applied currently to relieve disruption so the analysis has take the approach of determining the outcome were TEAM not to be applied);
- addition of 5% extra capacity through minimal mixed mode operations;
- reduction of 5% in demand; and
- operation of full capacity mixed mode, providing around an additional 15% of capacity.

Overview of Operational Modelling

Normal operations

5.4 The approach taken to the operational modelling is statistical and is based on and validated against a large sample of operational data. Statistical techniques are very good for the rapid investigation of the large-scale properties of large systems where the mode detailed interactions are very complex and not necessarily fully understood. The same modelling process, based on a standard queuing approach, has been applied to all three elements of delay/holding: ATFM delays, stack holding for arrivals and ground holding for departures. The general approach consists of six main steps, is summarised below with an overview being given in Exhibit 5-2.

Exhibit 5-2: Overview of the analysis process



- Step 1 in the analysis process comprises analysis of flight-by-flight data to determine so-called delay distributions for each of the three types of delay or holding time. These delay distributions were calculated for each hour of operation over the two seasons and characterised by the average, the 95th percentile and the proportion of flights that were not delayed
- Step 2 in the analysis process used the delay distributions, hourly demand derived from the flight-by-flight data and capacity derived from the scheduling limits or CFMU regulations when these were in place, to determine the relationship between delay (average and 95th percentile) and the ratio of demand to capacity for each type of delay and each season independently. As all three delay types are essentially forms of queue, the relationships followed the expected exponential or power law
- Step 3 of the process used the delay, demand/capacity relationship to reconstruct the hourly delay profile for each season and to compare this

predicted profile with the one actually observed for each season as a means of validating the approach

- Step 4 modified the demand/capacity ratios based on the scenarios being assessed by addition or subtraction of flights or capacity in the specific hour or hours being assessed. The new delay was predicted from the position on the delay curve of the modified demand/capacity ratio
- in Step 5, the new hourly delay profiles were constructed from the new delays derived in Step 4. Rollover effects from hour to hour were incorporated by adding an additional flight to the subsequent hour if the modified demand/capacity ratio was greater than unity
- Step 6 compared the new delay profile with the baseline and calculated the new total delays over the season accounting for changes in traffic caused by the addition or subtraction of demand.

5.5 The majority of the scenarios were based on existing or only slightly changed operational procedures and relatively marginal changes in demand or capacity. These scenarios were, therefore, based on statistical analysis using distributions derived from operational observations. As most of the analysis involved interpolation along the delay, demand/capacity curve (increased capacity or reduced demand), the curve is valid for all scenarios. This is also the case for small additions of demand.

5.6 However, in the case of the more extreme mixed mode scenarios (10 and 15% capacity increases) the delay, demand/capacity curves will be shifted because of the major operational change, that is the full mixed mode scenario is so different to the current situation that the current statistics will no longer be valid. Therefore, a specific delay, demand/capacity curve was derived to assess the mixed mode scenario using output from the NATS' HERMES model used in the recent Heathrow consultation process.

5.7 The approach used for the modelling is based on the current traffic mix, as it is derived from current operational data. It is expected, however, that the traffic mix at Heathrow will evolve (there is evidence that this is already happening) to include a higher proportion of heavy, wide body aircraft. The overall result of that will be an increase in aircraft separation caused by wake vortex consideration and a corresponding decrease in runway capacity. Ongoing operational and technological improvements such as time-based separation (TBS), improved wake vortex separation techniques, the advanced arrival manager (AMAN) and improved collaborative decision making (CDM) will address the effects of this change in traffic mix, amongst other things. These developments are investigated in Part 4 of this report.

Recovery from severe disruption

5.8 Various scenarios have been assessed for their potential for recovery from two case studies:

- 23 December 2007, when there was disruption caused by low visibility that persisted throughout the day, severely constraining the runway flow rate throughout the day and allowing no scope for recovery
- 5 December 2007, when there was a significant disruption caused by low visibility that was dissipated a few hours into the day allowing scope for recovery.

5.9 The method used to assess the scope for recovery under the scenarios is to adjust either the demand or the capacity to determine the degree to which the scenario can approach normal operations.

Presentation of results

5.10 The results of the analysis are presented here under the headings of each of the four sets of scenarios:

- sensitivity testing
- additional application of TEAM
- application of mixed mode operations
- reduction of demand.

5.11 For completeness the derived relationships between delay, demand and capacity are also illustrated as is the validation of the predictions of the statistical analysis against the observed behaviour over the last year.

Delay curves

5.12 Establishing the relationship between (holding) delay demand and capacity is the key and initial part of the analysis. This was achieved by determining the hourly demand, the hourly capacity and the average delay/hold per flight in each hour over the summer and winter seasons, as follows:

- for the stack and ground holding analysis, demand was determined from the number of aircraft exiting the stack or pushing back from the stand in a given hour
- for the airport ATFM analysis, the hourly demand was determined as the number of aircraft that would use the runway after all non-airport related ATFM restrictions had been taken into account but prior to the airport restrictions being applied, that is the number of aircraft that would have

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arrived in a given hour had there been no airport related ATFM restrictions

- capacity was defined as the hourly scheduling limit when no airport related ATFM restrictions had been applied or the ATFM regulated hourly flow rate when ATFM restrictions were in place
- delay or holding was defined as: 1) the time spent in the stack for arrivals holding; 2) the ATFM delay attributed to the airport when the airport was the cause of the most penalising regulation for the flight; and 3) the difference between the variable taxi time (VTT) (defined as the unimpeded taxi time from the departure stand to the departure runway) and the actual taxi time between the departure stand and the departure runway for ground holding
- mixed mode relationships were derived from the output of the NATS HERMES model scenario describing the maximum capacity mixed mode situation using 2015 traffic schedules. To perform this analysis it was necessary to combine the results of HERMES simulations for use of the Easterly and Westerly runways. This was done using a weighted average with the ratio of 30% easterlies to 70% westerlies[12] as is observed in current operations
- the relationship was determined for the average delay per flight in the hour as well as the 95th percentile of the delay in the hour.

5.13 As each of the delays takes the form of a queue, the relationship was investigated in terms of assessing the average delay or holding time as a function of the ratio of demand to capacity. The relationship was defined by taking the best curve fit to the observed data using either standard power law curve or exponential relationships[13], whichever gave the best fit, in line with queuing theory. The relationships between average delay and demand/capacity are therefore empirical in nature but are consistent with queuing theory.

5.14 The derived relationships for average ATFM, stack holding and ground holding are shown in the following three sections for ATFM delays, stack holding and ground holding derived from the current operations and for mixed mode operations derived from the NATS HERMES mode in the fourth section.

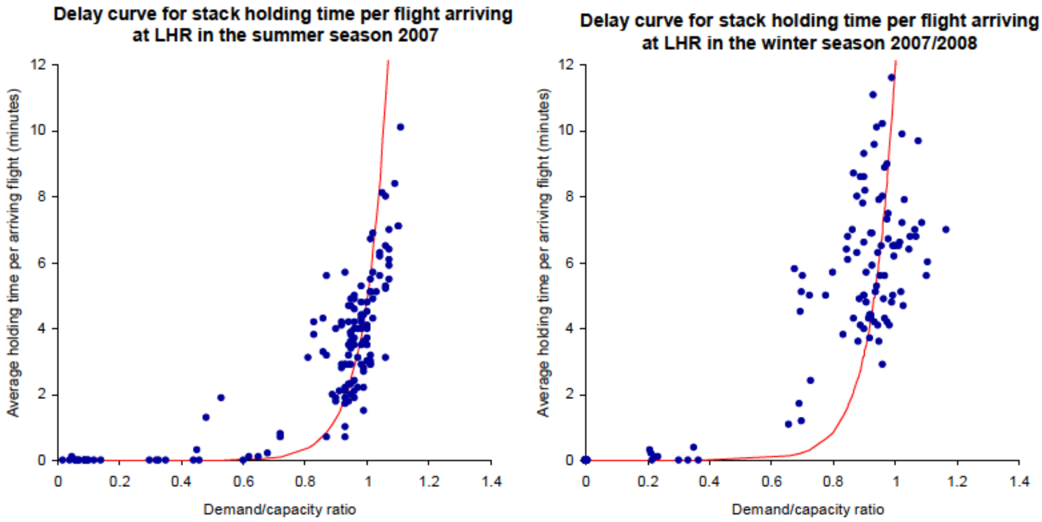
12 http://www.heathrowairport.com/portal/page/HeathrowNoise%5ENoise+explained%5EFAQs/925ee8dae5709010VgnVCM10000036821c0a____/448c6a4c7f1b0010VgnVCM200000357e120a____/)

13 Different queuing relationships are best described by exponential relationships of the form $Aexp^{(bx)}$ or power law relationship of the form Ax^b depending whether the inputs and outputs of the queue are ordered or random in nature

Stack holding

5.15 The relationship between the average stack holding time and the demand/capacity ratio is shown in Exhibit 5-1 for both the summer and winter seasons.

Exhibit 5-3: The relationship between the average stack holding time per flight and the demand/capacity ratio at Heathrow



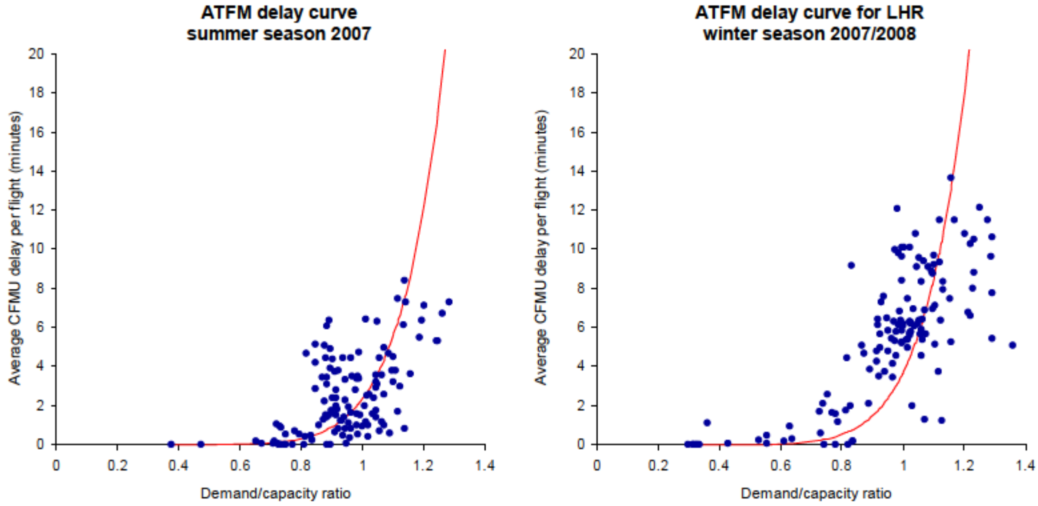
Source: NATS, Helios analysis

5.16 There is less scatter on the observed data points for stack holding than there is for ATFM delays, probably reflecting the higher complexity network effects that are likely to influence the ATFM situation. There is a strong visible relationship between the holding times and the demand/capacity ratio that is best described by an exponential relationship below a demand/capacity ratio of around 0.8 and a power law relationship above this value. Correlation coefficients are around 0.8 for both summer and winter seasons confirming the strong relationship.

ATFM delays

5.17 Exhibit 5-4 shows the observed average ATFM delays per flight on an hourly basis averaged as a function of the demand/capacity ratio as points. The solid curves show the best curve fits to the observed data (from which the severely disrupted days were excluded as they were treated separately) using a power law relationship for both summer and winter curves. Power law curves gave a better fit in this case than the alternative exponential function.

Exhibit 5-4: The relationship between average ATFM delay per flight and the demand/capacity ratio at Heathrow



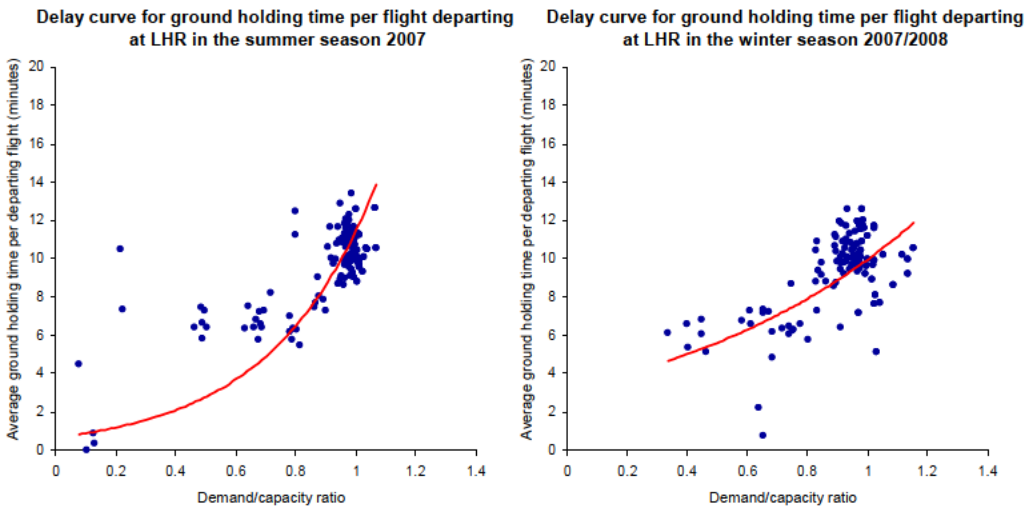
Source: CFMU, Helios analysis

5.18 Although there is a clear relationship between the ATFM delay and the demand/capacity relationship, the observed points show considerable scatter about the best fit curves indicating that the relationship is weak, with a correlation coefficient of approximately 0.3 in summer and 0.6 in winter, and may be masked by other effects. The implication of the relatively loose fit of the curve to the data is that there will be a greater error in results derived from the curve than in the case where the fit is better, as above.

Ground holding

5.19 Exhibit 5-5 shows the relationship between average ground holding time per flight (defined as the difference between the actual and perfect taxi time) and the demand/capacity ratio.

Exhibit 5-5: The relationship between the average ground holding time per flight and the demand/capacity ratio at Heathrow



Source: NATS, Helios analysis

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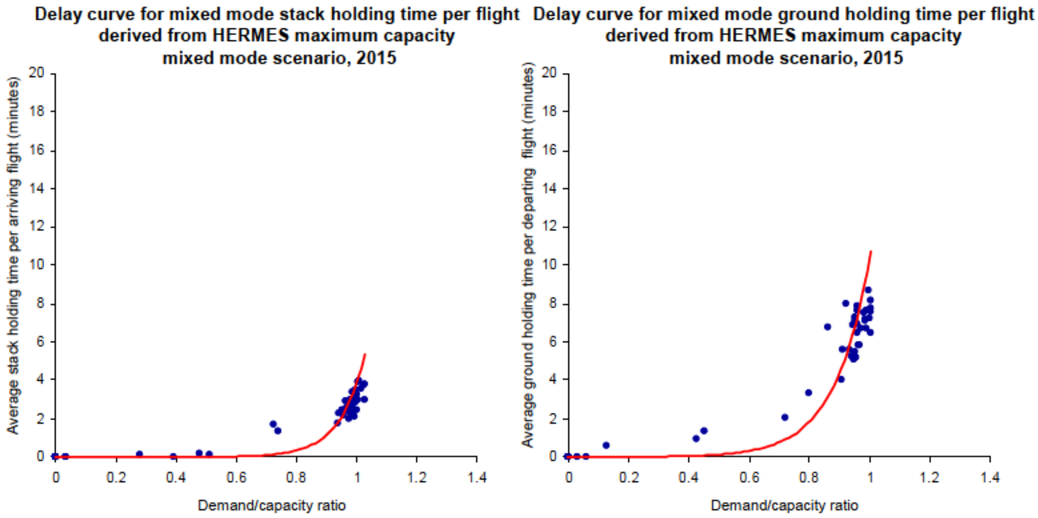
5.20 For ground holding there is a high degree of scatter of the observed points around the best fit curves, which in this case are exponential with correlation coefficients of around 0.3. This again indicates the complexity of the situation and the presence of other interactions which may be masking the situation. Another indication of the presence of other influences is provided by the observation that the intercept on the y-axis does not occur at zero – it occurs at around 0.6 for the summer curve and around 3.1 for the winter curve. This suggests that when demand approaches zero (and the taxi time would be expected to approach its perfect value) that there is 0.6 and 3.1 minutes additional taxi time in summer and winter respectively. If these differences were solely due to errors in the variable taxi time (the measure of the perfect taxi time) then they might be expected to be approximately the same value in summer and winter. However, the difference between the summer and winter intercept values indicates that there is some other, as yet not understood, systematic influence in addition to the variable taxi time, which may be associated, for example, with slower taxi speeds in winter due to adverse weather.

Mixed mode

5.21 Exhibit 5-6 shows the relationship between the average stack holding and ground holding times and the demand/capacity ratio derived from the results of the NATS HERMES simulation of the maximum capacity mixed mode scenario with 2015 traffic. In performing the analysis it was necessary to combine the HERMES results, which are derived for easterly and westerly runway operations separately, into a weighted average. The accepted ratio of 70% westerly to 30% easterly operations was used.

Exhibit 5-6: The relationship between the average stack and ground holding times per flight and the demand/capacity ratio predicted by HERMES for the maximum capacity mixed mode scenario with 2015 traffic



Source: NATS, Helios analysis

5.22 The scatter of the points generated by HERMES around the best fit curves is considerably less than that observed in any of the other cases where the operational data were derived from real observations and not a simulation. This is to be expected as HERMES cannot capture the true complexity of the situation and, in fact, does not address the ATFM component at all. The correlation coefficients in this case are greater than 0.9 for both arrivals and departures.

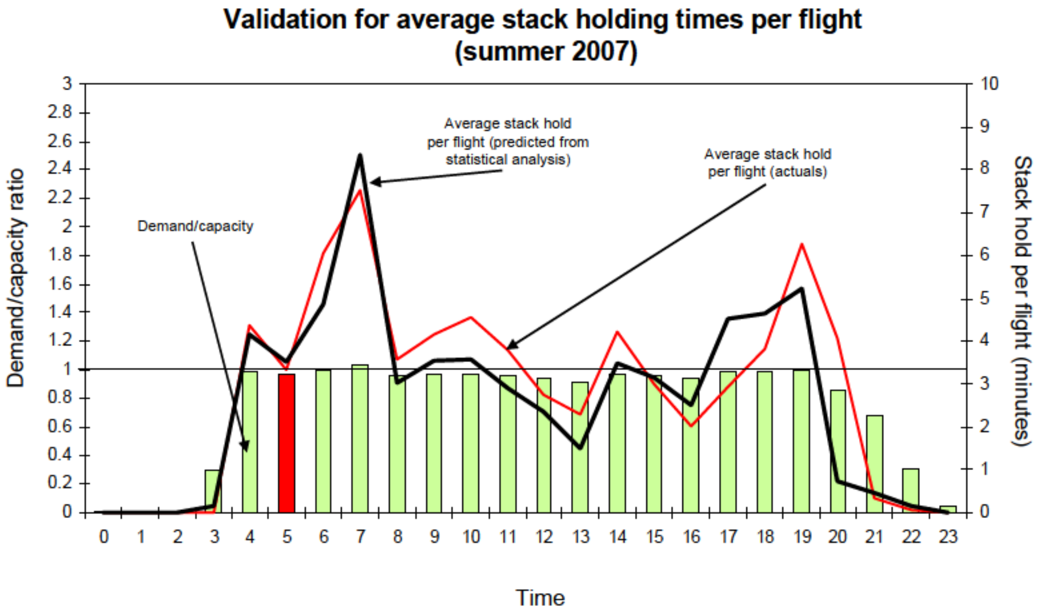
Validation

5.23 This section shows the results of comparing predicted delay profiles generated from the delay curves described above with the actual observed delay profiles as a means of validating the modelling approach.

Stack holding

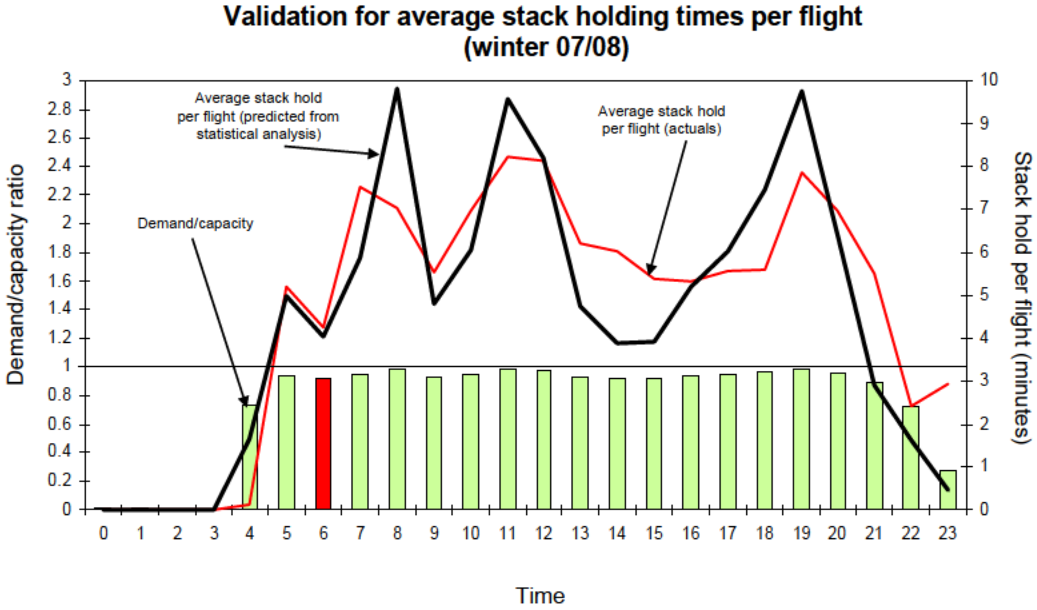
5.24 Exhibits 5-7 and 5-8 show the comparisons between the average stack holding times per flight observed and predicted from the curves in Exhibit 5-3. The bars show the demand/capacity ratio and the red bar shows the hour in which TEAM is applied.

Exhibit 5-7: Comparison of predicted and actual average stack holding times per flight for the summer season 2007



Source: NATS, Helios analysis

Exhibit 5-8: Comparison of predicted and actual average stack holding times per flight for the winter season 2007/2008



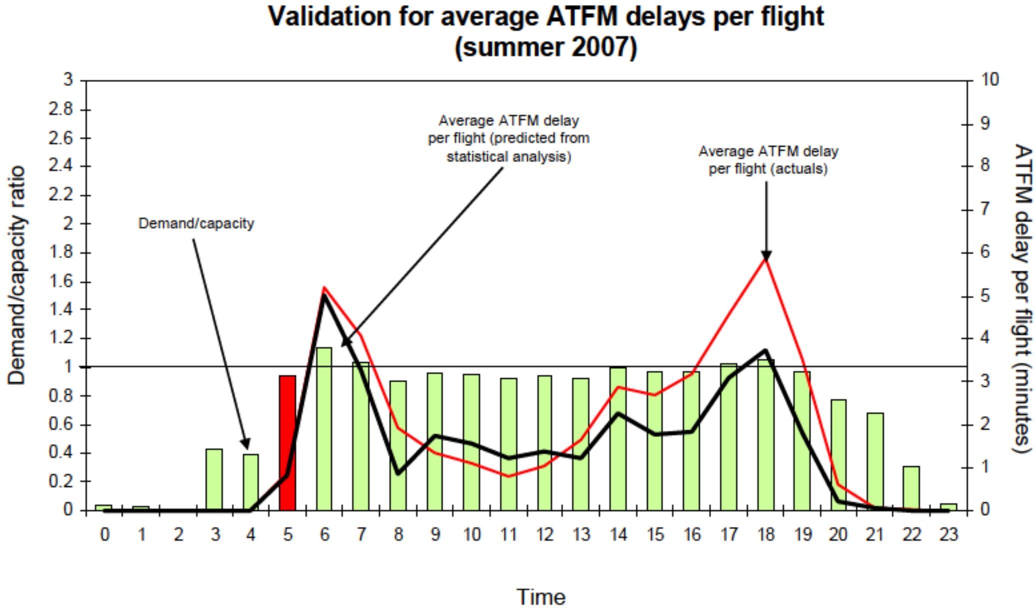
Source: NATS, Helios analysis

5.25 The match between the shape of the observed and predicted curves is good for both summer and winter seasons. The difference between the total observed delays and the total predicted delays is an underestimate of around 8% for the summer season and around 3% for the winter season.

Airport ATFM delays

5.26 Exhibit 5-9 compares, as lines, the observed average ATFM delays per flight for each hour over the summer season with those predicted using the summer delay curve shown in Exhibit 5-4 with the average hourly demand/capacity ratios observed over the season. The bars on the chart show the demand/capacity ratio for each hour with the red bar indicating that TEAM is applied in the 05:00 UTC hour and that the capacity has been adjusted accordingly.

Exhibit 5-9: Comparison of predicted and actual average ATFM delays per flight for the summer season 2007



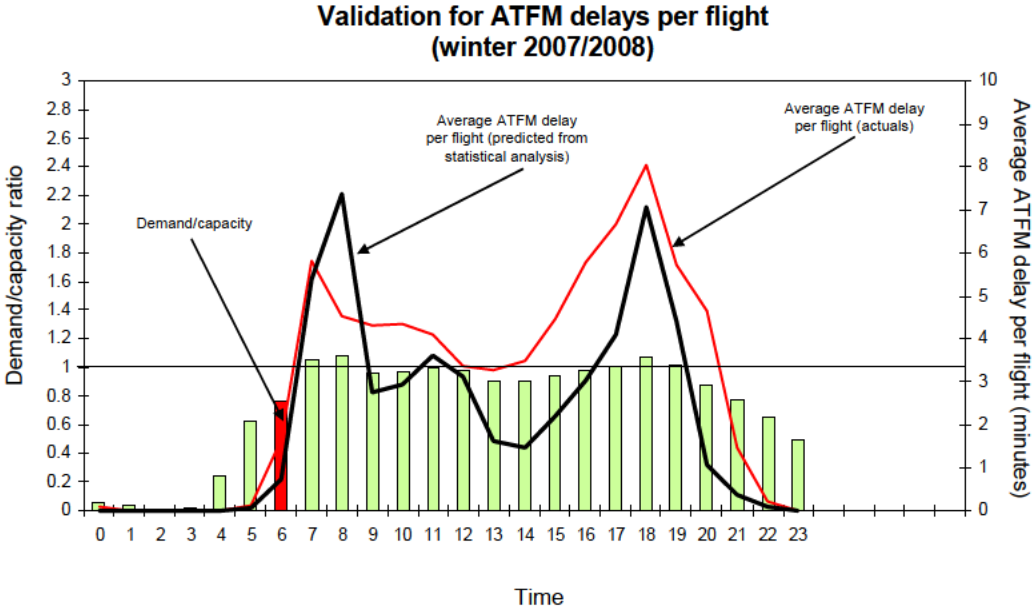
Source: CFMU, Helios analysis

5.27 The match of the general shapes of the observed and predicted ATFM delay profiles shown in Exhibit 5-9 is good but the predicted curve underestimates the total delay over the season by approximately 22%. Given the scatter of the points around the best fit line in Exhibit 5-4, this error range is surprisingly good.

5.28 Exhibit 5-10 makes the same comparison between the predicted and observed average ATFM hourly profiles for the winter season. The demand/capacity ratios are shown as bars and the delays are shown as lines. The red bar indicates the hour in which TEAM is applied and the appropriate adjustment has been made to the capacity. Again the match of the general shapes of the two curves is reasonable and in this case the prediction underestimates the actual total delays by around 28%.

5.29 The relatively large errors in the predictions of ATFM delays are primarily caused by the large scatter of points around the derived delay curve, which is probably caused by the complex network interactions associated with the ATFM system. This will cause a large uncertainty in the cost modelling but as costs are being compared to the baseline also derived from the modelling results, systematic errors will be minimised in the subtraction process.

Exhibit 5-10: Comparison of predicted and actual average ATFM delays per flight for the winter season 2007/2008



Source: CFMU, Helios analysis

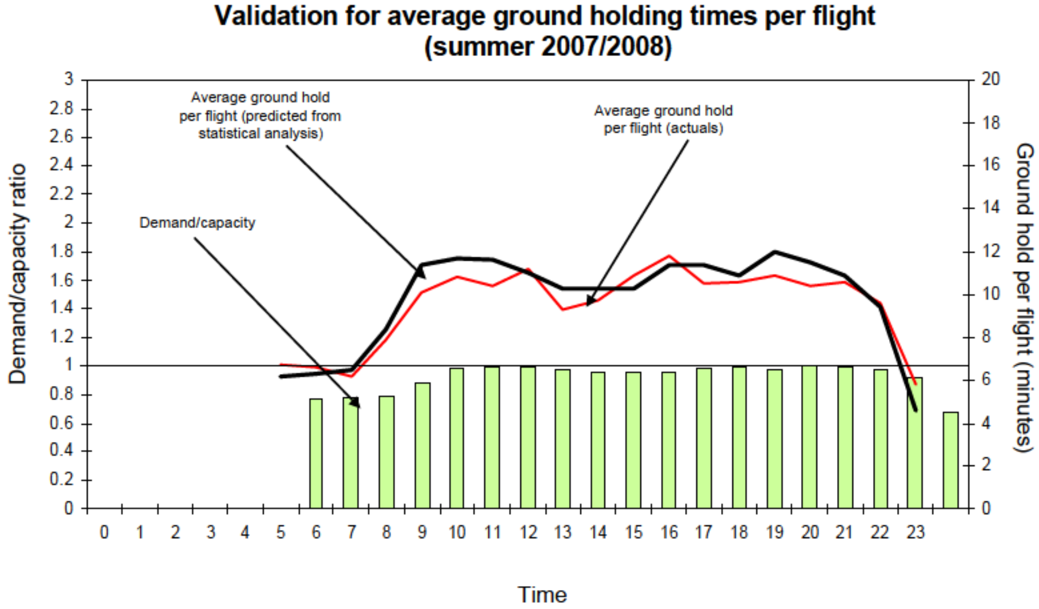
Ground holding

5.30 Exhibits 5-11 and 5-12 show the comparisons between the observed average ground holding delays and those predicted using the curves shown in Exhibit 5-5 combined with the demand/capacity ratios shown as bars in Exhibits 5-11 and 5-12. Both sets of delay profiles are generally featureless and the statistical model predicts the magnitude of the delays reasonably well in both summer and winter with an overestimate of approximately 5% and an underestimate of approximately 7% respectively.

5.31 It is interesting to note the relatively low demand/capacity ratios in the departure profiles in the early morning, indicating that the use of the departures runway for arrivals in TEAM would not have any great effect on departures capacity at that time. At other times in the day, however, the demand/capacity ratio for departures approaches 1 so there would likely be a negative impact of applying TEAM.

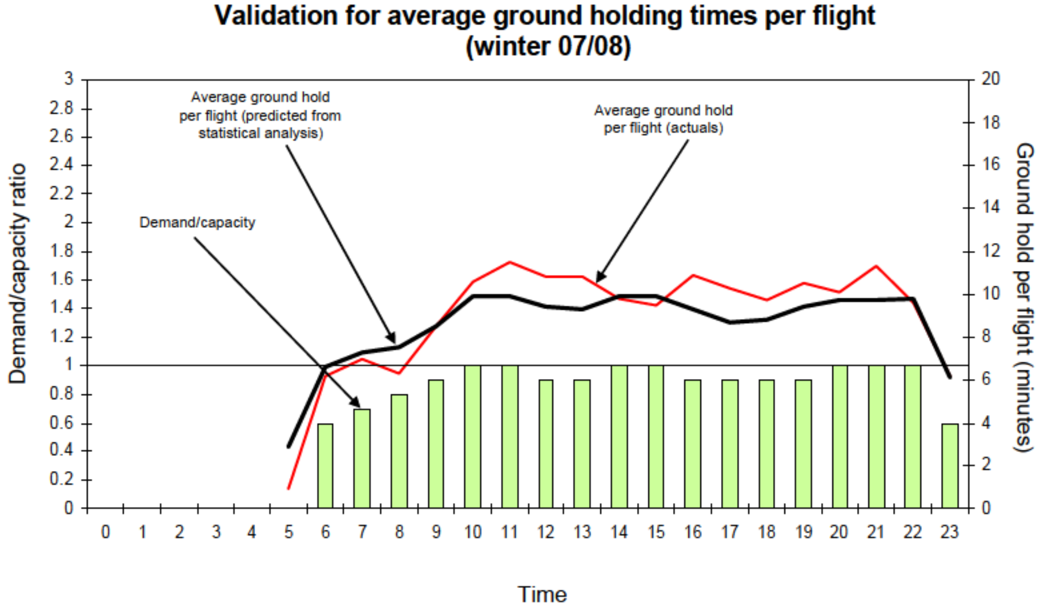
5.32 It is also interesting to note that the demand/capacity ratio for departures never exceeds 1, which it does for arrivals (see Exhibits 5-5 and 5-6), indicating that arrivals demand is managed better than arrivals demand.

Exhibit 5-11: Comparison of predicted and actual average ground holding times per flight for the summer season 2007



Source: NATS, Helios analysis

Exhibit 5-12: Comparison of predicted and actual average ground holding times per flight for the winter season 2007/2008

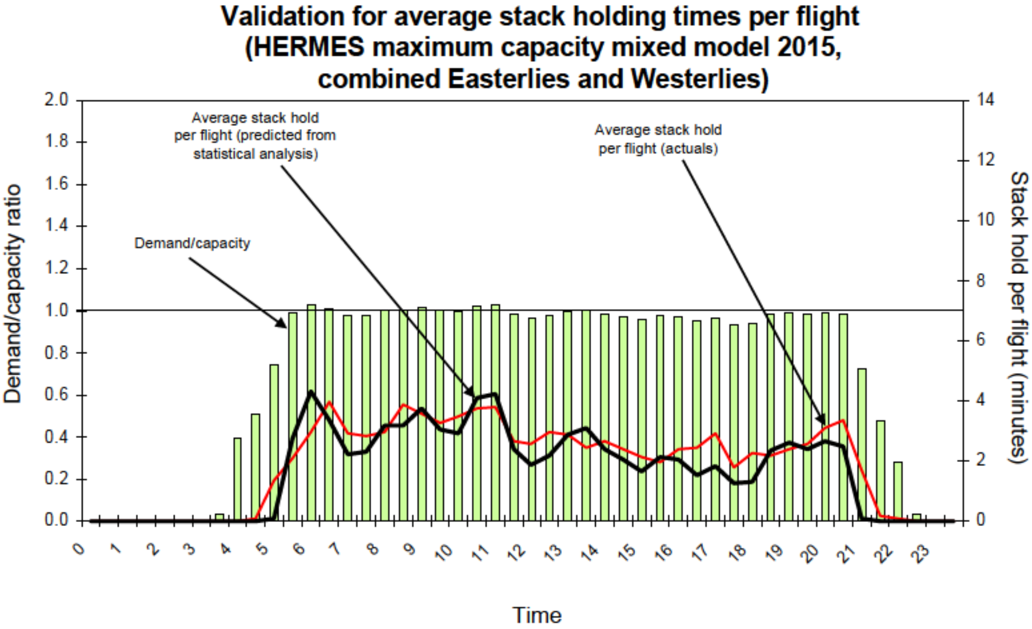


Source: NATS, Helios analysis

Mixed mode

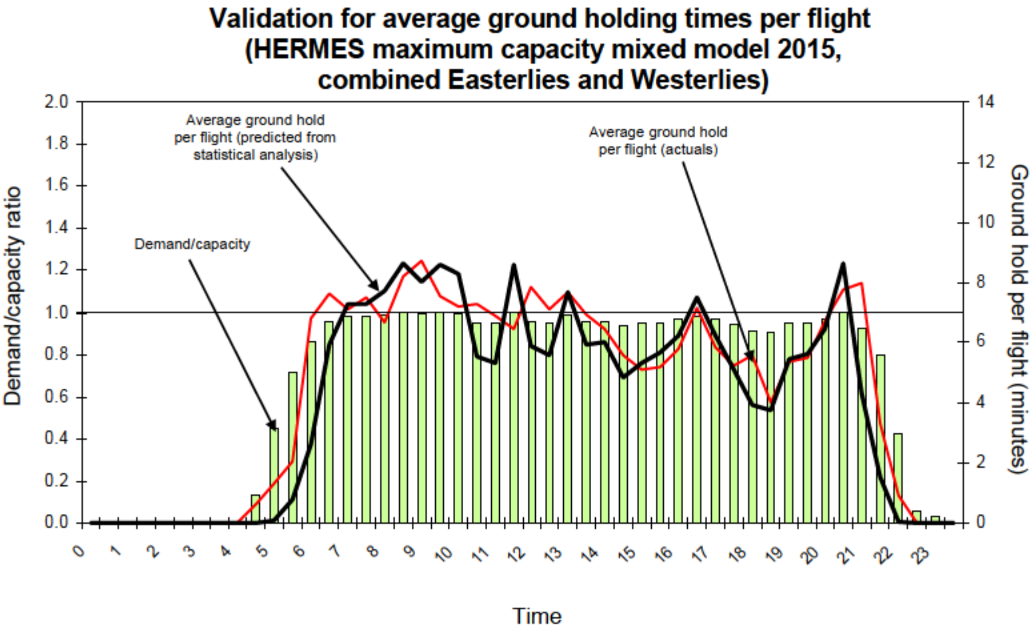
5.33 The comparison of the HERMES results for the full capacity mixed mode scenario and those predicted from the statistical model is made in Exhibits 5-13 and 5-14 for stack and ground holding traffic profiles. The data available for this validation for HERMES only covers the summer season.

Exhibit 5-13: Comparison of predicted and HERMES generated average stack holding times per flight for 2015



Source: NATS, Helios analysis

Exhibit 5-14: Comparison of predicted and HERMES generated average ground holding times per flight for 2015



Source: NATS, Helios analysis

The statistical model underestimates the total delay predicted by HERMES by around 11% for arrivals and 9% for departures.

Sensitivity testing

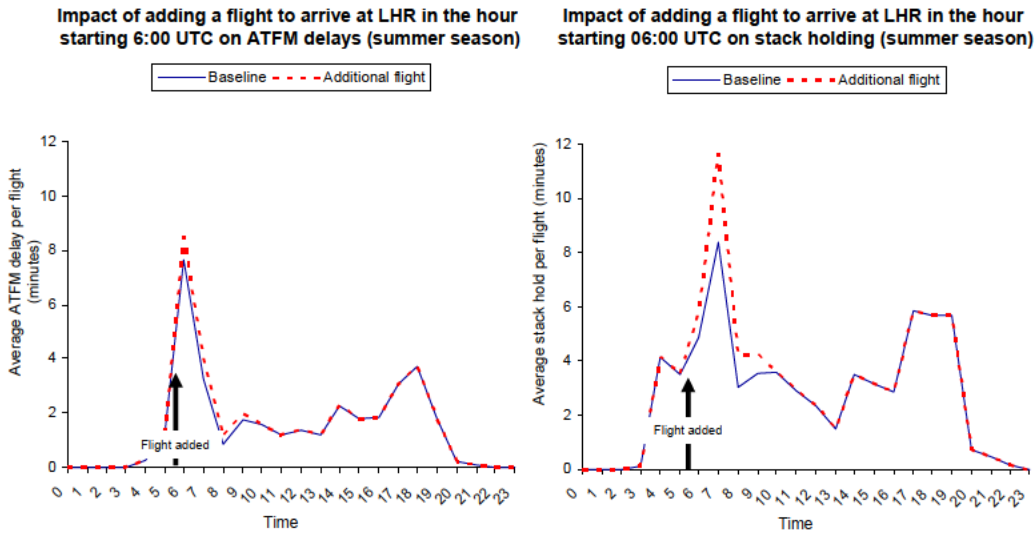
5.34 To test the sensitivity of the current situation at Heathrow to small perturbations, an analysis has been performed using the statistical models described above to assess the impact of adding or removing a single flight from a given hour compared to the baseline predicted by the model. The results of this analysis are presented below for arrivals and departures (no attempt has been made to link the additional arrival with the additional departure).

Adding a flight in a given hour

Arrivals

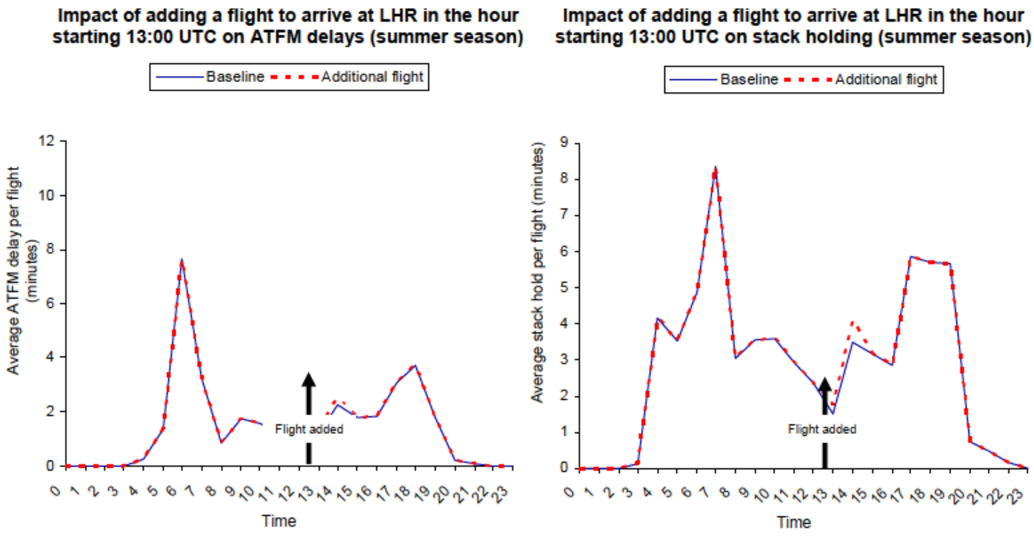
5.35 Exhibit 5-15 shows the impact of adding an additional flight to arrive at Heathrow at a high demand time at 06:00 UTC (07:00 local time) on both ATFM delays and stack holding. The figure shows that the impact on ATFM is limited whereas the impact on stack holding is more significant, increasing the average hold per flight from around 8 minutes to around 12 minutes at 07:00 (the hour following that in which the extra flight was added) with further knock-on effects until around10:00 when demand has decreased sufficiently for the system to recover its equilibrium.

Exhibit 5-15: Impact on airport ATFM delays and stack holding of adding an additional flight at 06:00 UTC in the summer season



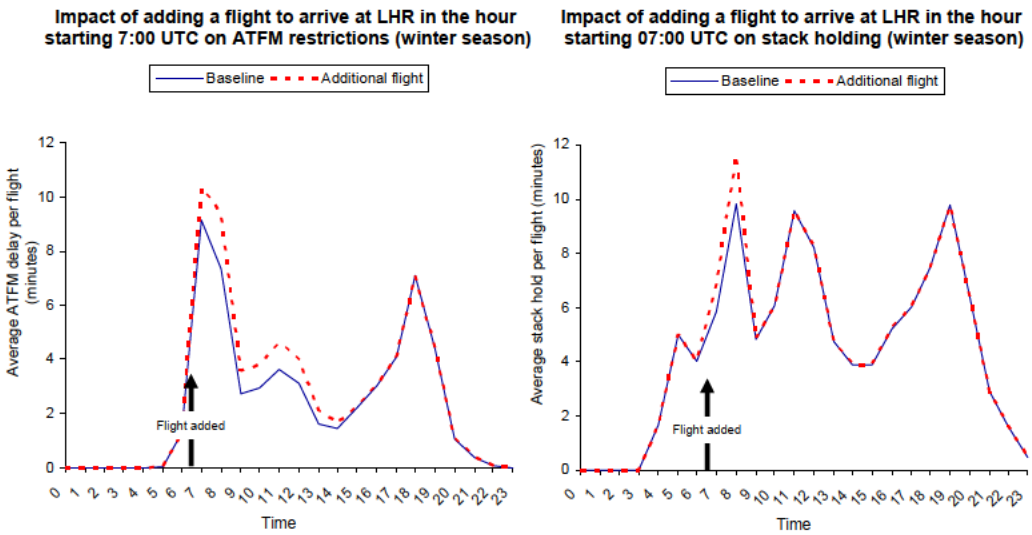
5.36 Exhibit 5-16 shows the impact on arrivals delays of adding a flight at a (for Heathrow) low demand time at around 13:00 UTC in the summer season. In this case the impact on both ATFM delays and stack holding is minimal.

Exhibit 5-16: Impact on ATFM delays and stack holding of adding an additional flight at 13:00 UTC in the summer season



5.37 For comparison purposes, Exhibit 5-17 shows the impact of adding an extra arrival at 07:00 UTC on arrivals delays in the winter season. In this case, there is an increase in average ATFM delays and average stack holding times at and shortly after 07:00. The impact on the stacks quickly dissipates but the increased average ATFM delay per flight persists until around 15:00. This persistence is due to the demand/capacity ratio of the hours subsequent to 07:00 being greater or near to 1 causing a knock-on effect from hour-to-hour until the demand/capacity ratio is sufficiently less than 1 to create a fire-break.

Exhibit 5-17: Impact on ATFM delays and stack holding of adding an additional flight at 07:00 UTC in the winter season

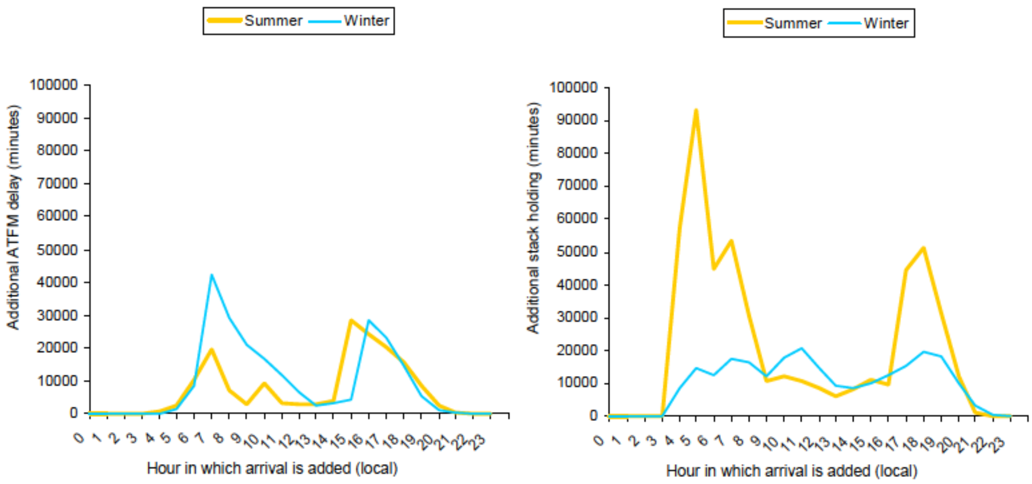


5.38 Exhibit 5-18 shows the impact in terms of total additional ATFM delays and total additional stack holding time cause by adding a flight at a given hour in the summer and winter seasons. The figure shows that when the flight is added just before or at a peak in the average delay curves, the impact can be very large.

For example, Exhibit 5-18 shows that adding a flight at 05:00 local time in summer results in an increase in stack holding time of around 90000 minutes over the whole year – equivalent to the entire stack holding at Gatwick over the same period. This occurs because the demand/capacity ratio for the stacks at 05:00 local time and the following few hours is high; the demand/capacity ratio at that hour and subsequently is very near to or above 1 meaning that the gradient of the delay curve (Exhibit 5-3) is very steep and increasing. Together these factors mean that the average delay is very sensitive to even small additions of demand. This sensitivity is confirmed through operational observations (see section 4) where small changes in demand (from 39 to 40 an hour) cause a very large increase in holding. This scenario, of course, does not correspond to an operational reality because before incurring such a high increase in stack holding, NATS would extend the use of TEAM to manage the situation. The impact of TEAM at 06:00 local time can be seen in the large fall in the increase in delays caused by adding a flight at 06:00 compared to adding one at 05:00.

5.39 The impact of adding the additional flight at 05:00 local time on ATFM delays is much lower than that on the stacks because at that time there is very little demand at Heathrow for arrivals from Europe, most arrivals being intercontinental flights.

Exhibit 5-18: Summary of the impact of adding a flight in a given hour on ATFM delays and stack holding in the summer and winter seasons



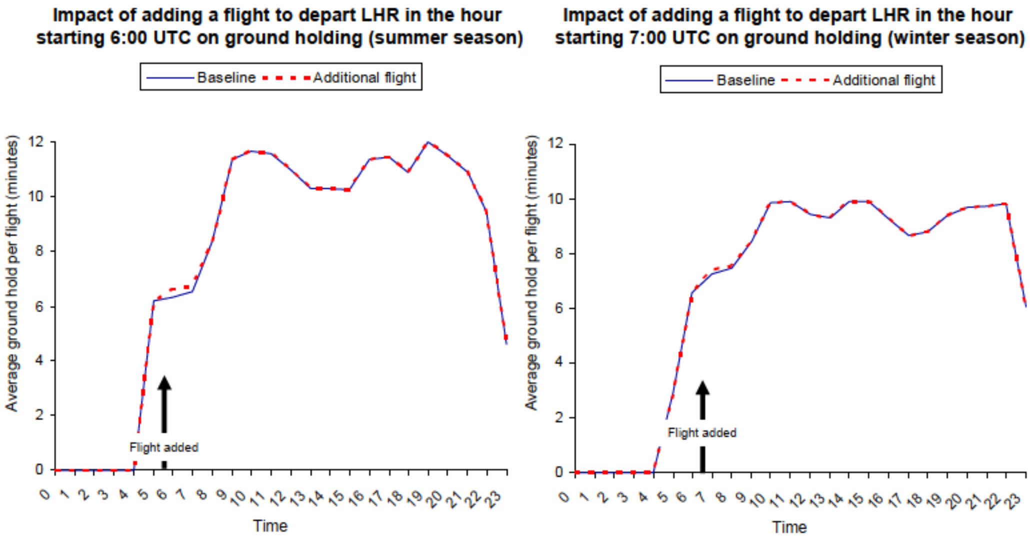
5.40 Exhibit 5-18 also shows that in summer addition of a flight has a greater impact on stack holding than on ATFM delays whereas the reverse is observed in winter.

Departures

5.41 Exhibit 5-19 shows the impact of adding an additional flight on average ground holding times for a flight added at 07:00 local time in the summer and winter seasons.

5.42 The figure indicates that at this time, ground holding is largely insensitive to the addition of a flight because of the low level of the demand/capacity ratio at that time (see Exhibits 5-11 and 5-12).

Exhibit 5-19: Impact on ground holding of adding an additional flight at 07:00 local time in the summer and winter seasons



5.43 In contrast, Exhibit 5-20 shows the impact on ground holding of adding an additional flight at 11:00 local time in the summer and winter seasons. In the summer season, the average ground holding time per departure is increased by up to one minute in the hour that the flight is added and the two subsequent hours. The equivalent impact in the winter season is minimal. Again this impact is due to the demand/capacity ratio at the time the flight is added and shortly afterwards.

Exhibit 5-20: Impact on ground holding of adding an additional flight at 11:00 local time in the summer and winter seasons

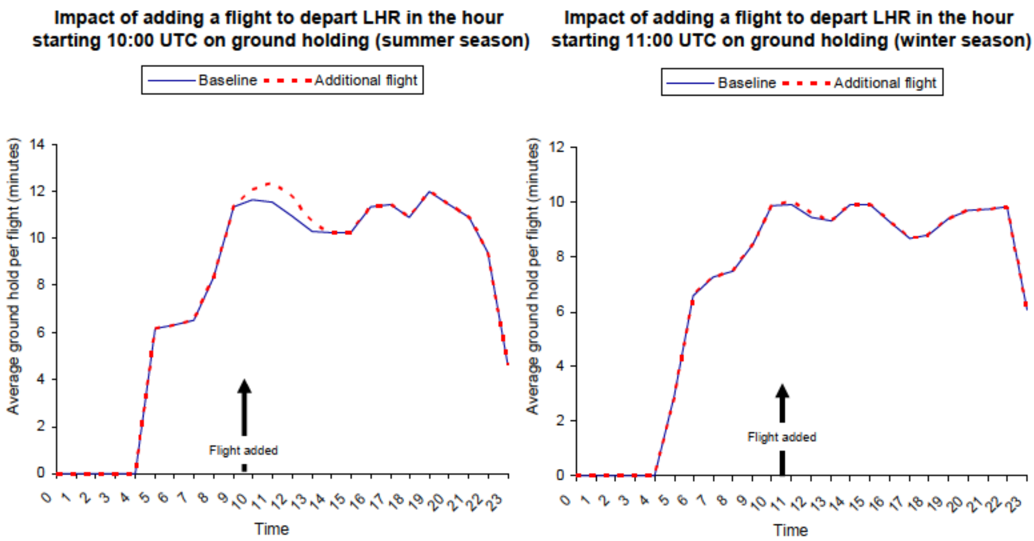
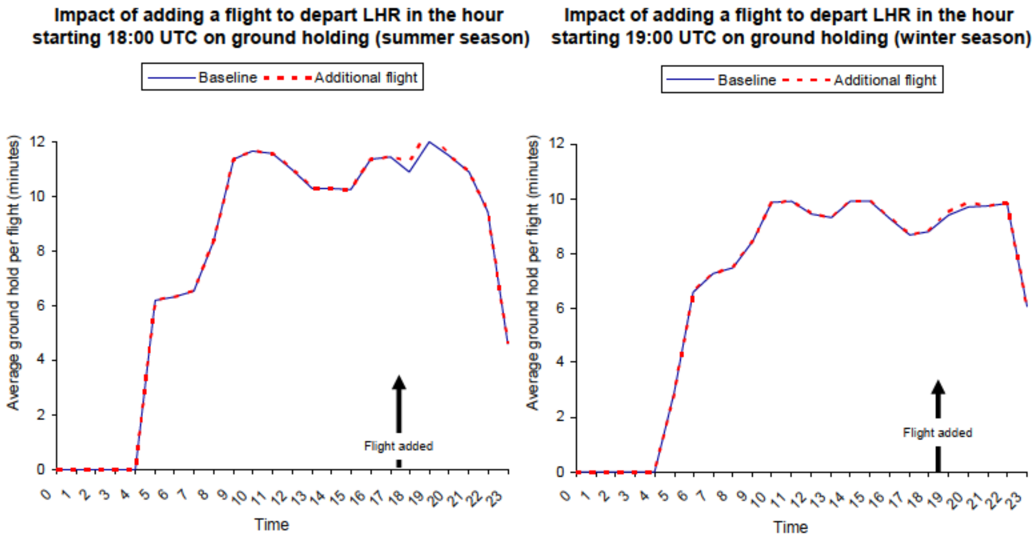


Exhibit 5-21 shows that the average ground holding time per flight is insensitive to addition of a flight in the early evening at 19:00 in both summer and winter seasons.

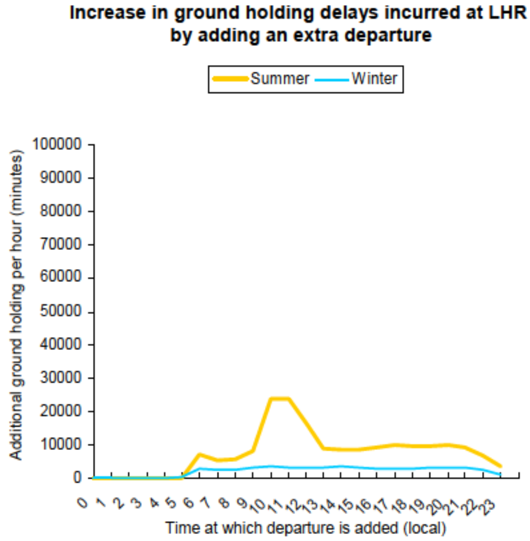
Exhibit 5-21: Impact on ground holding of adding an additional flight at 19:00 local time in the summer and winter seasons



5.44 Exhibit 5-22 summarises the impact of adding a flight on ground holding by showing the total additional ground holding time that would be generated by adding a flight in a particular hour. The main feature in the curve describing the impact of adding an additional flight on ground holding is a peak in the summer season when a flight is added between 10:00 and 13:00 local time. This peak occurs because of the high demand/capacity ratio at those times.

5.45 More generally, adding a flight has much less impact on ground holding than it has on ATFM delays and stack holding. Mathematically this is explained by the fact that the delay curves for ground holding (Exhibit 5-5 are significantly flatter than the equivalent curves for ATFM delays and stack holding (Exhibits 5-3 and 5-4). Operationally, the demand/capacity ratio for ground holding has a value that does not exceed 1 whereas for both ATFM and stack holding there are peaks during the day where the demand/capacity ratio exceeds 1. This indicates that the ground situation is more controllable – for example aircraft are not allowed to push back until the system can cope with them – than the airborne situation where aircraft actually arrive or are predicted to arrive at the top of stack in a more random, less controlled fashion influencing both ATFM delays and the stacks themselves.

Exhibit 5-22: Summary of the impact on ground holding of adding a flight in a given hour on departure delays in the summer and winter seasons



Subtracting a flight in a given hour

Arrivals

5.46 The converse of adding a flight at a given hour, is subtracting a flight from a given hour – this could be realised by not reallocating a slot when it has been given up. Exhibits 5-23 and 5-24 illustrate the impact of subtracting a flight at times around the morning and evening peaks of the average ATFM delay and stack holding curves.

Exhibit 5-23: Impact on ATFM delays and stack holding of removing a flight at 06:00 UTC

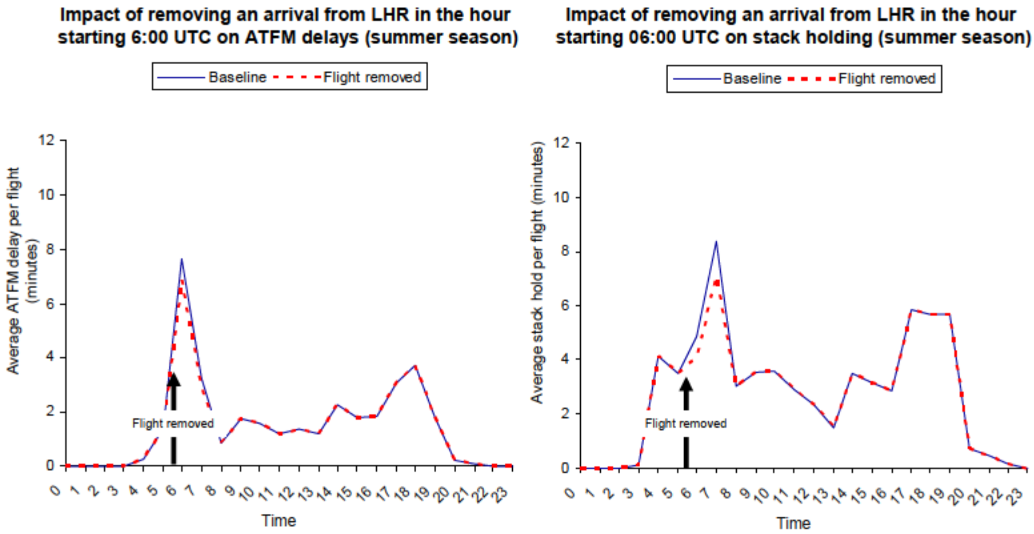
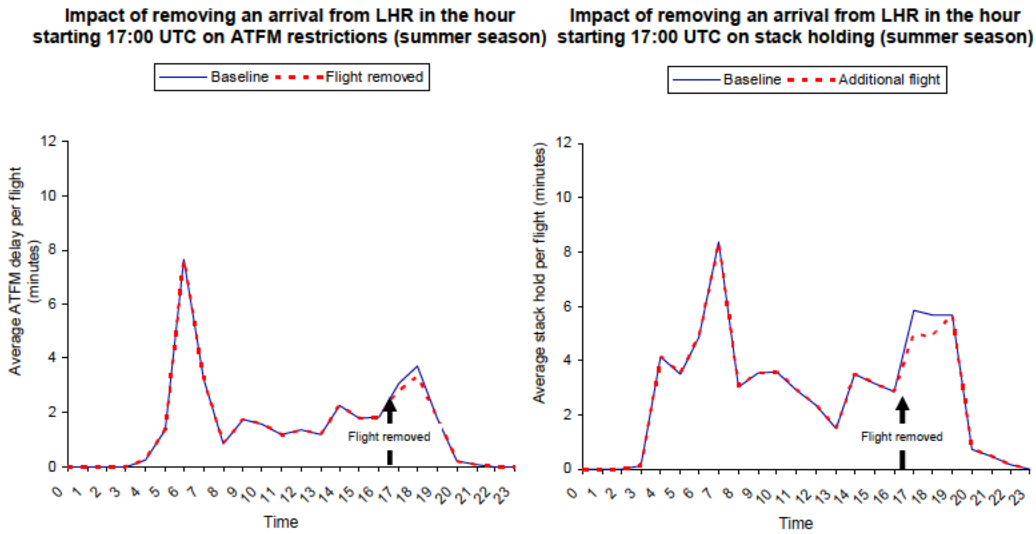


Exhibit 5-24: Impact on ATFM delays and stack holding of removing a flight at 17:00 UTC

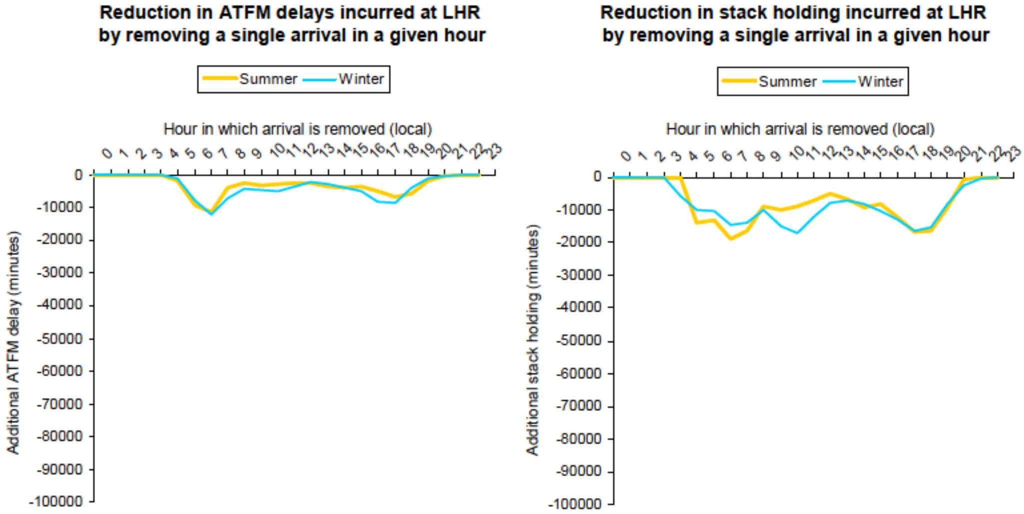


5.47 The sensitivity of the average ATFM and stack holding delays is much less when a flight is subtracted than when one is added for two main reasons:

- subtracting a flight moves the demand/capacity ratio down the delay curve whose gradient, being exponential in nature, becomes flatter as the demand/capacity ratio decreases; hence the removal of a flight would be expected to have less impact than the addition of a flight. For example, moving down the curve from a demand/capacity ratio of 1.0 to 0.95 reduces the average stack holding time by around 2.4 minutes whereas increasing the demand/capacity ratio to 1.05 increased the average stack holding time by around 4.8 minutes
- the knock-on effects to subsequent hours are much less pronounced when removing a flight than adding one
- adding flights multiplies the average by a higher number than the baseline to reach the total delay whereas subtracting flights reduces the factor by which the average is multiplied to determine the total stack holding time.

5.48 Exhibit 5-25 illustrates the impact of these effects showing that removal of a flight around one of the peaks results in a reduction of around 20000 minutes of stack holding over the season as opposed to the 90000 additional stack holding minutes that result from the addition of a flight at the same time.

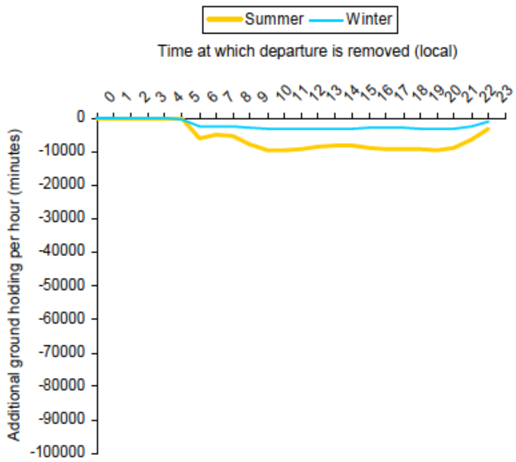
Exhibit 5-25: Summary of the impact of removing a flight in a given hour on ATFM delays and stack holding in the summer and winter seasons



Departures

5.49 Exhibit 5-26 summarises the impact on the total ground holding time of subtracting a flight at a given hour for both the summer and winter seasons. As the delay curves for ground holding are much shallower and flatter than they are for stack holding, the impact of removing a flight is much closer in magnitude to the impact of adding a flight with the exception of the peak in the middle of the day observed when adding a flight in the summer season.

Exhibit 5-26: Summary of the impact of removing a flight in a given hour on ground holding in the summer and winter seasons



Additional TEAM

5.50 The first realistic scenario investigated concerns extending the application of TEAM beyond 06:00 local time where it is consistently applied at present (as

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well as being used on an ad hoc basis when necessary). TEAM delivers benefits for arrivals around the times when there are peaks in the average stack holding time, that is to relieve pressure on the stacks when it is building up. The benefits of applying TEAM at other times are likely to be more limited. Therefore the scenario has been defined to investigate the impacts on both arrivals and departures of the additional application of TEAM around the morning peak, extending its application to cover the three hour period from 06:00 to 08:00 local time as well as applying it consistently over a three hour period in the evening peak from 17:00 to 20:00 local time.

Arrivals

5.51 Exhibit 5-27 shows the impact on the average ATFM delay per flight and the average stack holding time per flight of the extended application of TEAM in the summer season. In all cases there is a significant reduction in the peaks by a factor of around 50%.

Exhibit 5-27: Impact on ATFM delays and stack holding of operating TEAM from 04:00 to 07:00 and from 16:00 to 19:00 UTC in the summer season

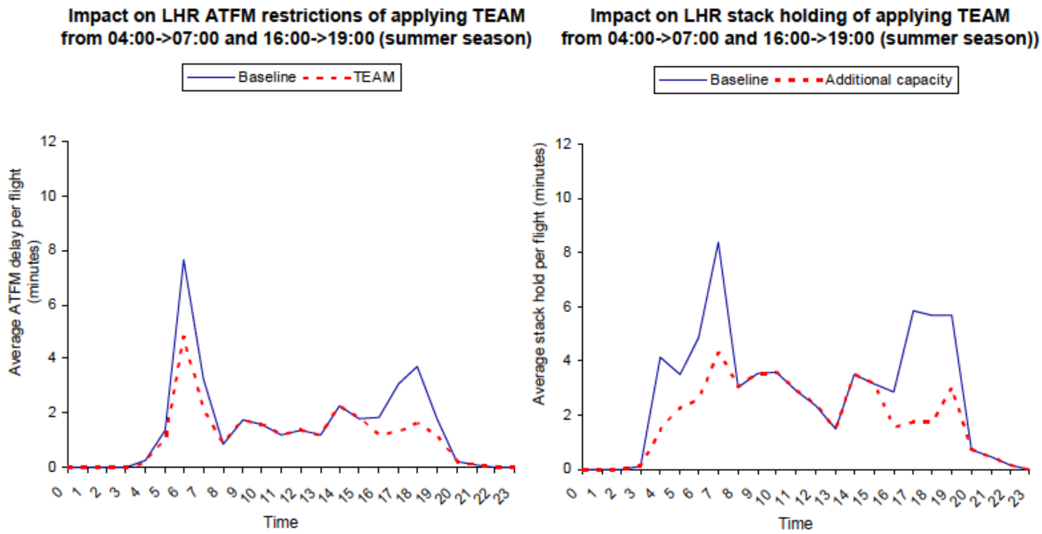
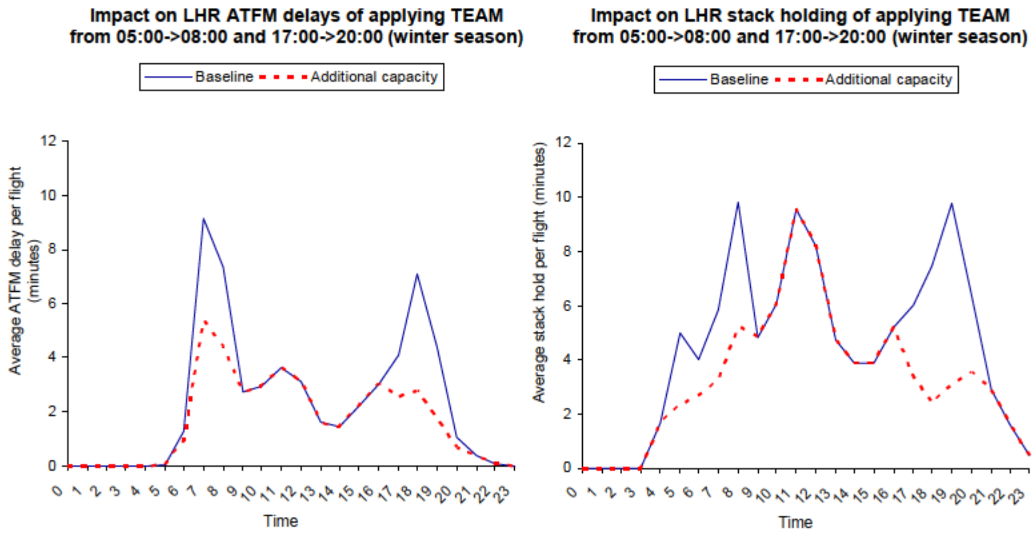


Exhibit 5-28 shows the impact of the additional application of TEAM on arrivals during the winter season. Again, there are marked reductions in the scale of the ATFM delay and stack holding peaks.

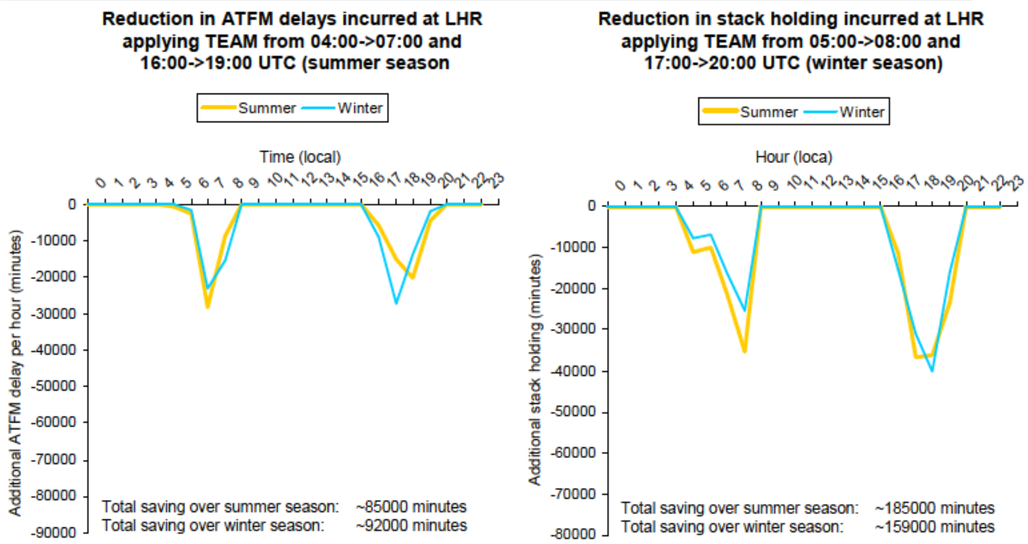
Exhibit 5-28: Impact on ATFM delays and stack holding of operating TEAM from 05:00 to 08:00 and from 17:00 to 20:00 UTC in the winter season



5.52 Exhibit 5-29 summarises the impact of additional TEAM on arrivals through the total savings achieved in ATFM delays and stack holding over the summer and winter seasons. The figure shows that this application of TEAM might be expected to save:

- approximately 85000 minutes of ATFM delays over the summer season and approximately 92000 minutes of ATFM delay over the winter season
- approximately 185000 minutes of stack holding over the summer season and approximately159000 minutes of stack holding over the winter season.

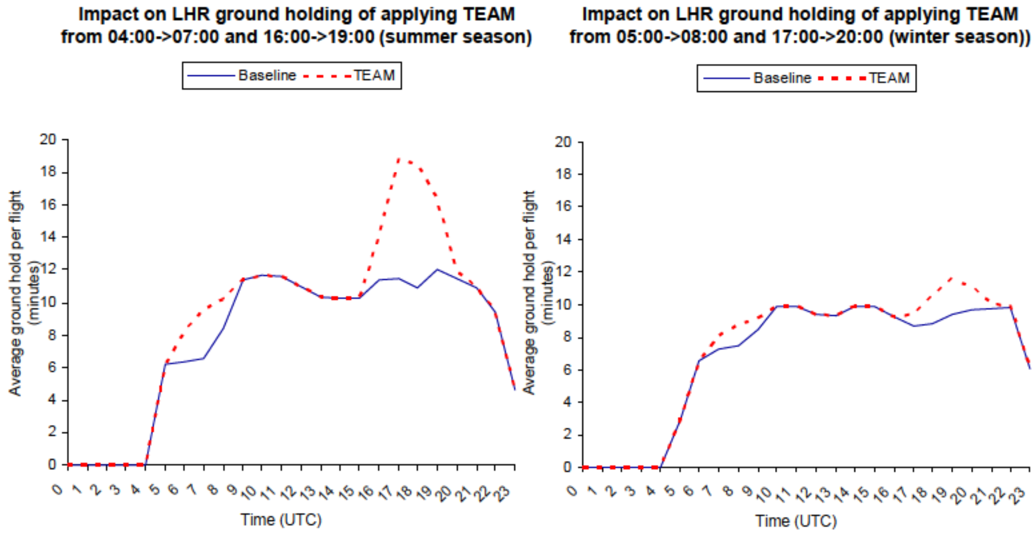
Exhibit 5-29: Summary of the impact on ATFM delays and stack holding of additional deployment of TEAM



Departures

5.53 TEAM, although a benefit to arrivals, is expected to have a negative impact on departures as it effectively reduces the capacity of the departures runway. This has been investigated by assuming that TEAM reduces the capacity of the departures runway by around 4 to 6 movements an hour when it is applied. The results of this capacity constraint on the average ground holding times per flight in summer and winter seasons are shown in Exhibit 5-30 where it can be seen that the impact is greatest in the evening where the demand for departures is higher than in the morning.

Exhibit 5-30: Impact on ground holding of additional operation of TEAM

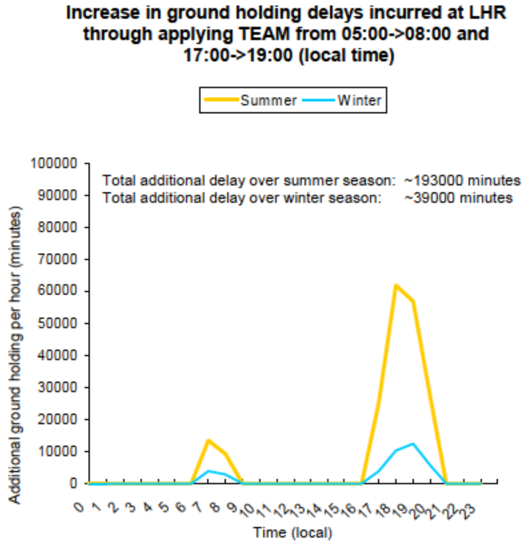


5.54 Exhibit 5-31 shows the total increase in ground holding over the summer and winter seasons caused by the additional application of TEAM:

- in the summer season it might be expected that total ground holding would increase by around 193000 minutes
- in the winter season it might be expected that total ground holding would increased by around 39000 minutes.

5.55 The large difference in the impact in the summer and winter is caused by the higher levels of demand for departures at the times TEAM has been assumed to be applied during the summer season than in the winter season.

Exhibit 5-31: Summary of the impact on ground holding of additional deployment of TEAM



5.56 Purely in terms of operational minutes lost and saved (irrespective of the differential costs of those minutes) additional application of TEAM appears to be positive in summer (where approximately 270000 minutes in saved on arrivals at a cost of an additional 193000 minutes lost on departures) and strongly beneficial in winter (where the total saving on arrivals is around 251000 minutes compared to a loss of 39000 minutes on departures).

Mixed mode – 5% capacity increase

5.57 The minimal application of mixed mode operations is expected to deliver around a 5% capacity increased across the day. The impact of this level of mixed mode operation has been assessed based on the delay curves derived from current operations on the assumptions that:

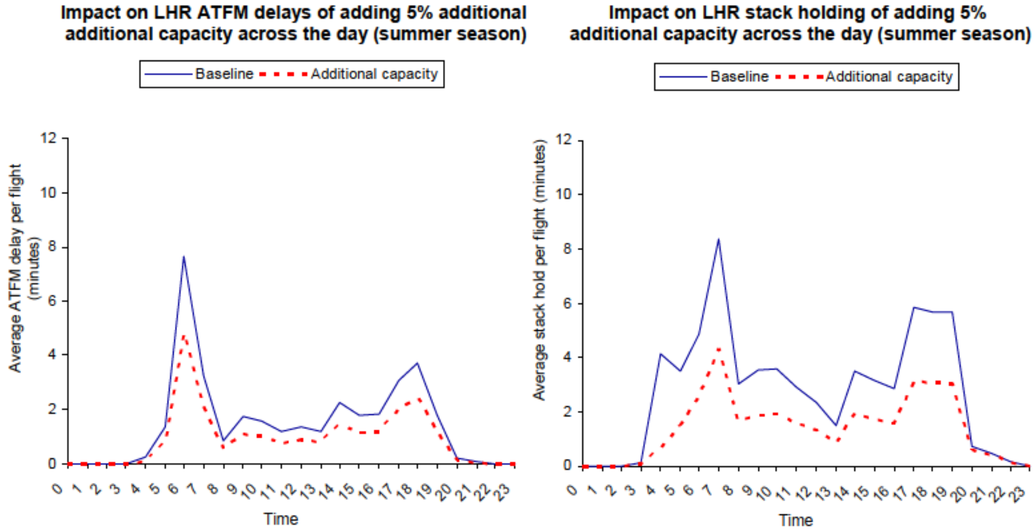
- the increase in capacity
- the change in operational procedures

are not too great to invalidate this approach.

Arrivals

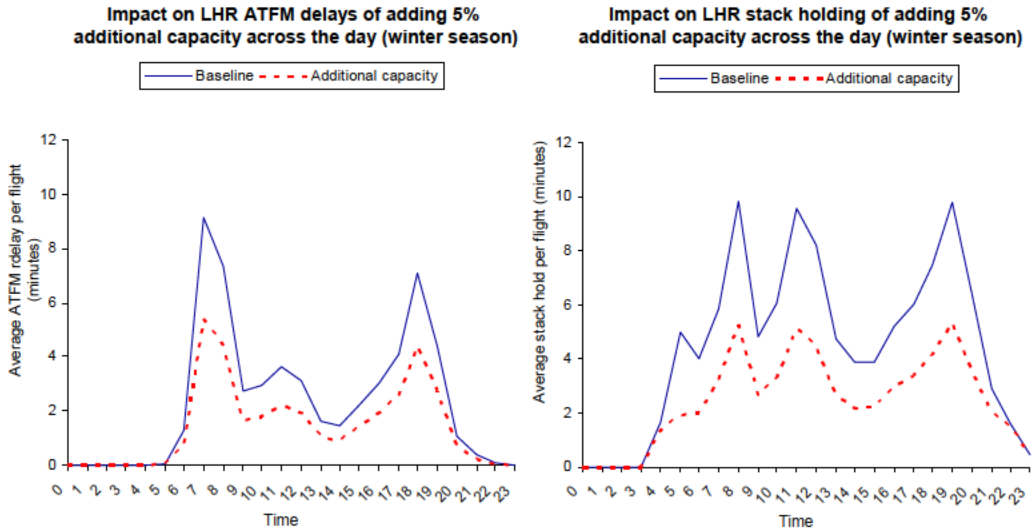
5.58 The impact of this 5% capacity increase on average ATFM delays and average stack holding in the summer season is shown in Exhibit 5-32. As expected the increase in capacity reduces the average delay/holding time across the day with the reduction being greatest in the peaks.

Exhibit 5-32: Impact on ATFM delays and stack holding of additional 5%capacity throughout the day in the summer season



5.59 Similarly, Exhibit 5-33 shows the decrease in average ATFM delays and stack holding times predicted for the winter season. The decreases in the average delays in the winter season is greater than the decreases predicted in the summer season.

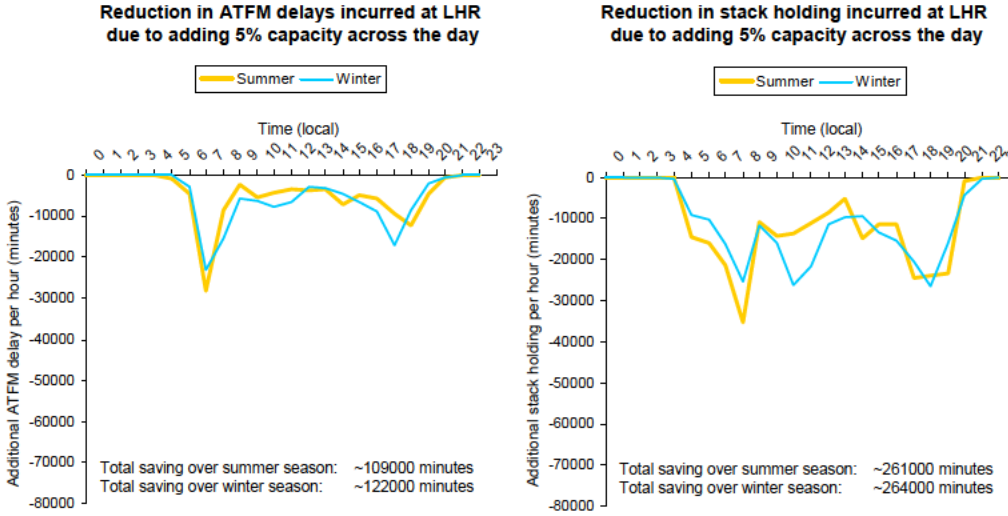
Exhibit 5-33: Impact on ATFM delays and stack holding of additional 5% capacity throughout the day in the winter season



5.60 Exhibit 5-34 shows the total time savings predicted for ATFM delays and stack holding for the summer and winter seasons. Application of minimal mixed mode that delivers a 5% capacity increase might be expected to deliver:

- total savings in ATFM delays of approximately 109000 minutes in the summer season and 122000 minutes in the winter season
- total savings in stack holding of approximately 261000 minutes in the summer season and 264000 minutes in the winter season.

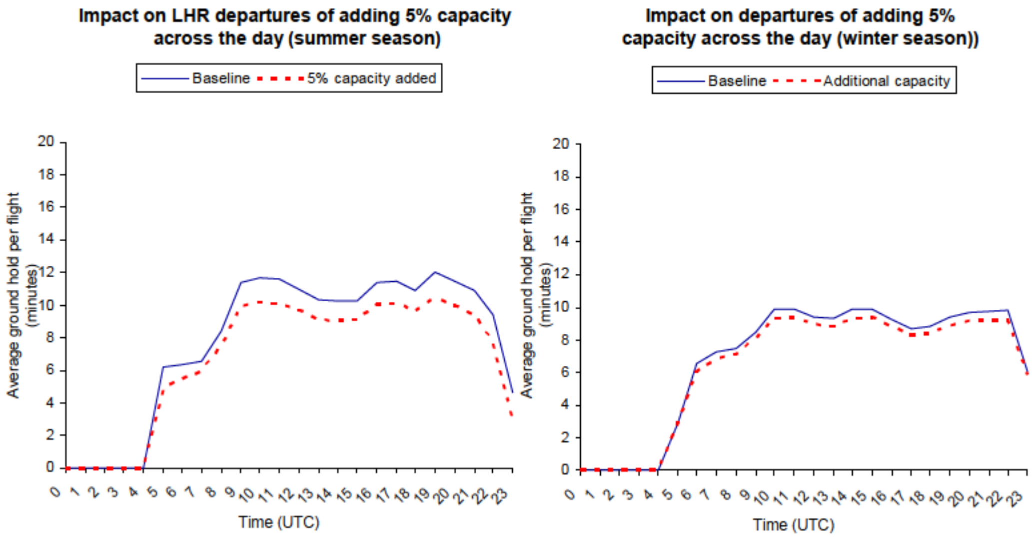
Exhibit 5-34: Summary of the impact on ATFM delays and stack holding of additional 5% capacity throughout the day



Departures

5.61 The impact of a minimal mixed mode on average ground holding for departures is illustrated in Exhibit 5-35. In this case the impact is greater in the summer season than in the winter season because the delay curve for the summer season is steeper than the delay curve for the winter season (see Exhibit 5-5).

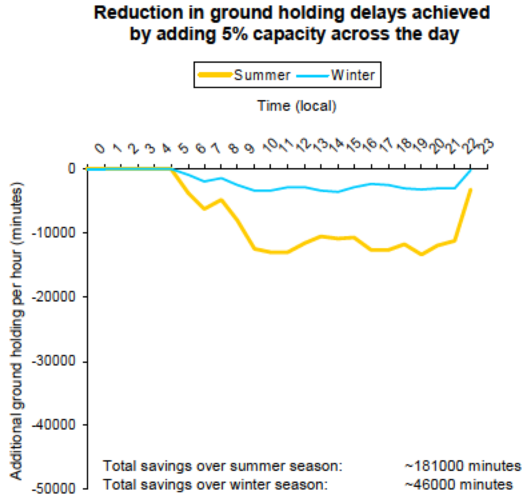
Exhibit 5-35: Impact on ground holding of additional 5% capacity throughout the day in the summer and winter seasons



5.62 Exhibit 5-36 shows the total savings in ground holding achieved by a 5% mixed mode for the summer and winter seasons:

- in the summer season the reduction in total ground holding is predicted to be around 181000 minutes
- in the winter, the reduction in total ground holding is predicted to be approximately 46000 minutes.

Exhibit 5-36: Summary of the impact on ground holding of additional 5% capacity throughout the day



Mixed mode – 10% capacity increase

5.63 As with the 5% application of mixed mode, an intermediate step to full capacity mixed mode giving a 10% increase in capacity has been assessed using the delay curves derived from the current operational situation. This assessment is probably at the limit of the validity of the method derived using current operational data as the increase in capacity is substantial and the operational procedures applied may be significantly from those in current use. However, the results are useful in giving an indication of the impact of a 10% capacity increase.

Arrivals

5.64 Exhibits 5-37 and 5-38 illustrate the impact on the average ATFM delays and average stack holding times of increasing capacity by 10% across the day. The reductions are substantial, especially in the peaks, and the time series profiles of the delays across the day are starting to lose their peaks and become flat and featureless.

Exhibit 5-37: Impact on ATFM delays and stack holding of additional 10% capacity throughout the day in the summer season

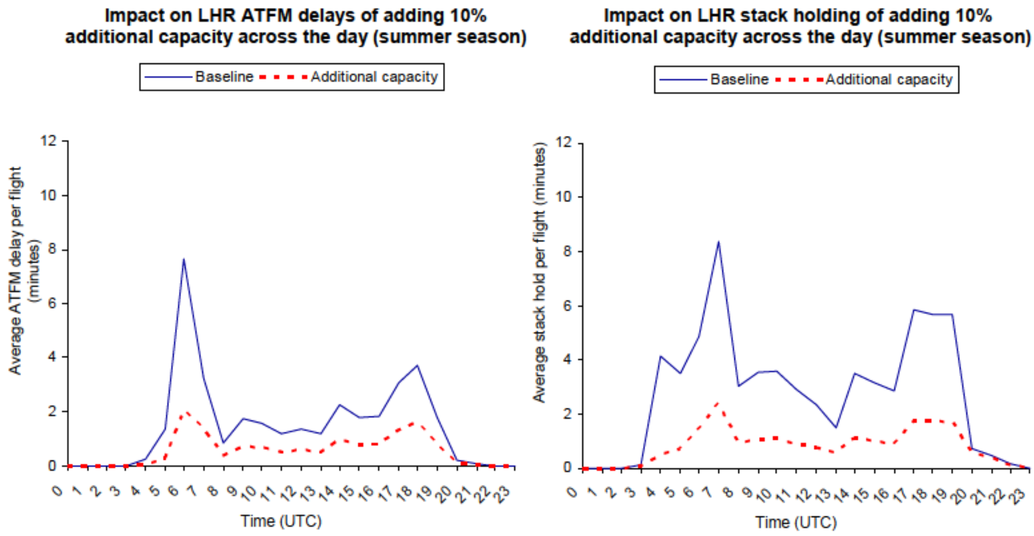
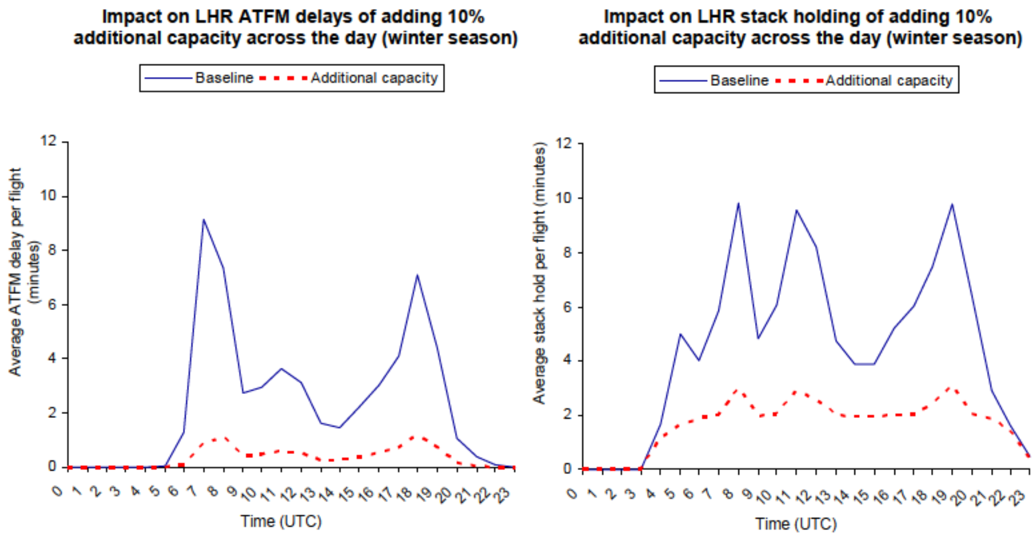


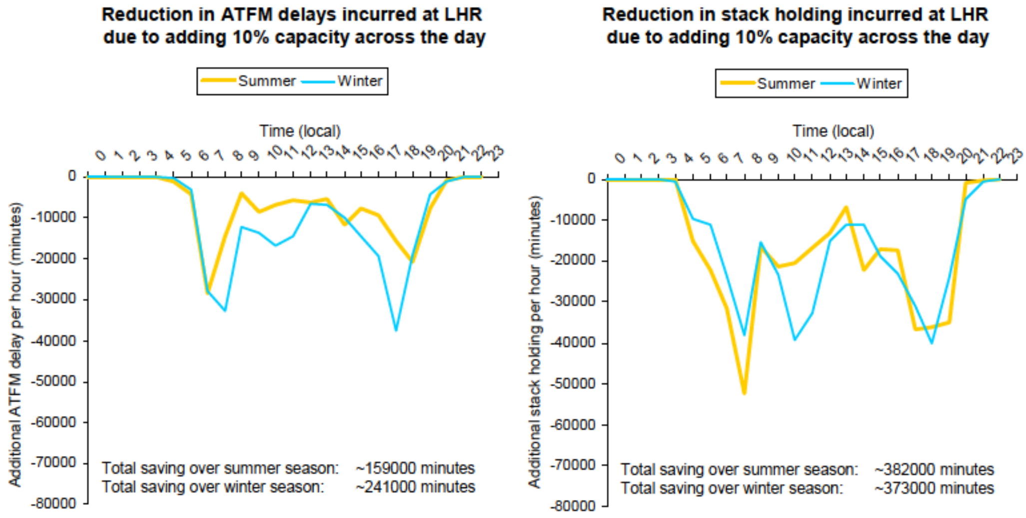
Exhibit 5-38: Impact on ATFM delays and stack holding of additional 10% capacity throughout the day in the winter season



5.65 Exhibit 5-39 shows the reduction in total ATFM delays and stack holding times for the summer and winter seasons that are predicted for a mixed mode implementation that delivers a 10% capacity increase:

- total ATFM delays are predicted to be reduced by approximately 159000 minutes in summer and 241000 minutes in winter
- total stack holding times are predicted to be reduced by 382000 minutes in summer and 373000 minutes in winter.

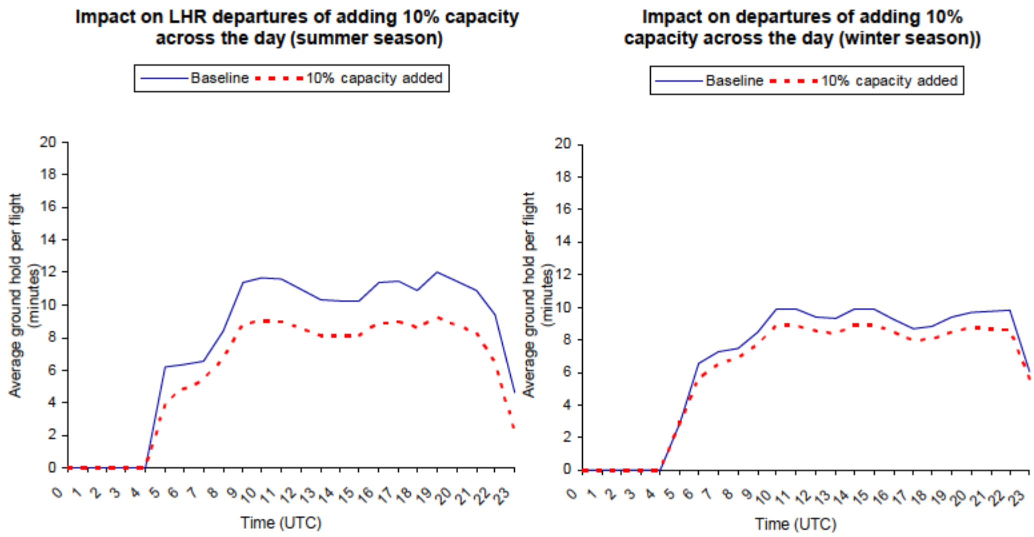
Exhibit 5-39: Summary of the impact on ATFM delays and stack holding of additional 10% capacity throughout the day



Departures

5.66 Exhibit 5-40 shows the impact on ground holding of adding 10% additional capacity across the day.

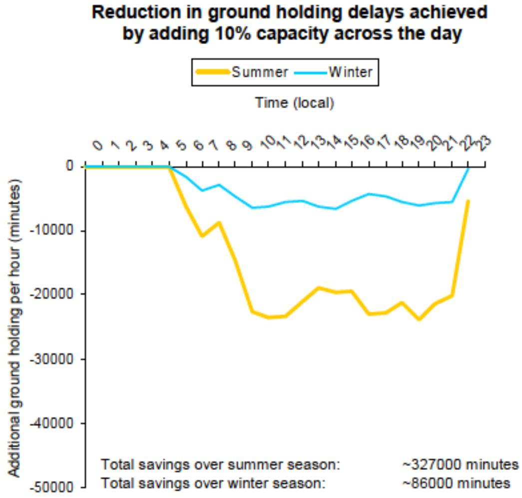
Exhibit 5-40: Impact on average ground holding per departure of additional 10% capacity throughout the day in the summer and winter seasons



5.67 Exhibit 5-41 illustrates the savings in total ground holding time that might be expected from a 10% increase in capacity:

- savings over the summer season are predicted to total around 327000 minutes
- savings over the winter season are expected to total approximately 86000 minutes.

Exhibit 5-41: Summary of the impact on total ground holding of additional 10% capacity throughout the day



Mixed mode – 15% capacity increase

5.68 The penultimate scenario is the application of full capacity mixed mode operations. This cannot be modelled using statistics derived from current operations as the expected increase of around 15% in capacity and the much changed operational procedures cannot be reasonably extrapolated from the current situation. For this reason, the delay curve and validation of the statistical approach have been performed using data obtained from NATS HERMES simulation, which gives the only accepted prediction of mixed mode operations at Heathrow.

Arrivals

5.69 Exhibits 5-42 and 5-43 show the impact of full capacity mixed mode operations on average ATFM delays and stack holding for the summer and winter seasons. In all cases, the delay is much reduced to below around 1minute across the day, except for morning peak in average ATFM delays at around 07:00 UTC in the summer season.

The average delay profiles become flat and featureless and resemble those observed in reality for Gatwick (see for example Exhibit 4-30) where there is an excess of capacity over demand except in the summer peaks.

Exhibit 5-42: Impact on ATFM delays and stack holding of maximum capacity mixed mode operations throughout the day in the summer season

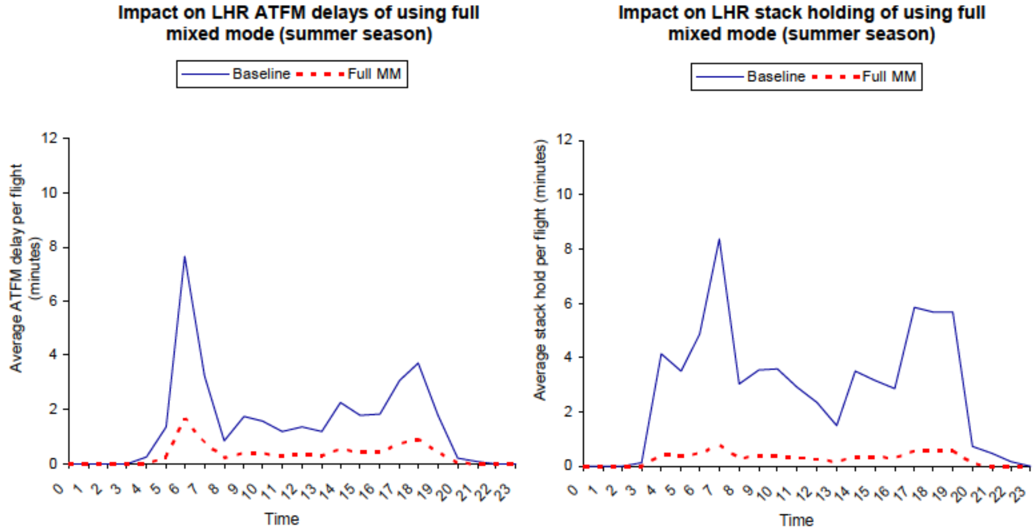
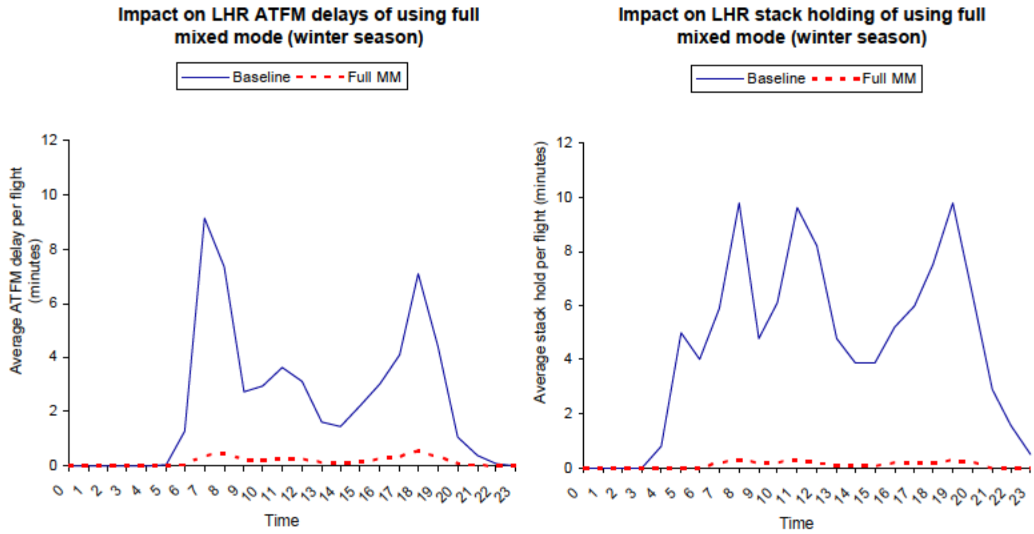


Exhibit 5-43: Impact on ATFM delays and stack holding of maximum capacity mixed mode operations throughout the day in the winter season



5.70 Exhibit 5-44 summarises the impact of full capacity mixed mode on total ATFM delays and total stack holding times over the summer and winter seasons. The following savings are predicted:

- total ATFM delays are expected to be reduced by approximately 196000 minutes and 265000 minutes in the summer and winter seasons respectively
- total stack holding is expected to be reduced by approximately 486000 minutes and 548000 minutes in the summer and winter seasons respectively.

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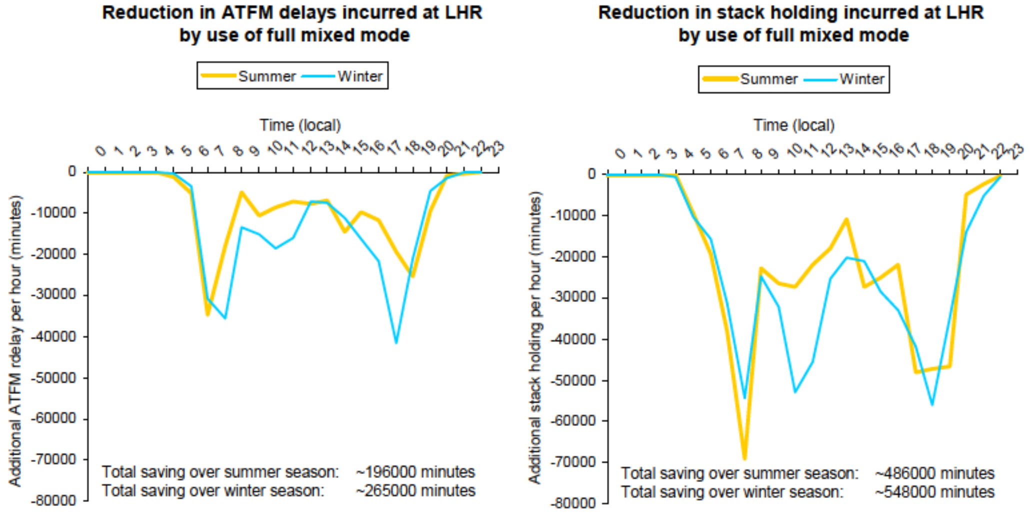
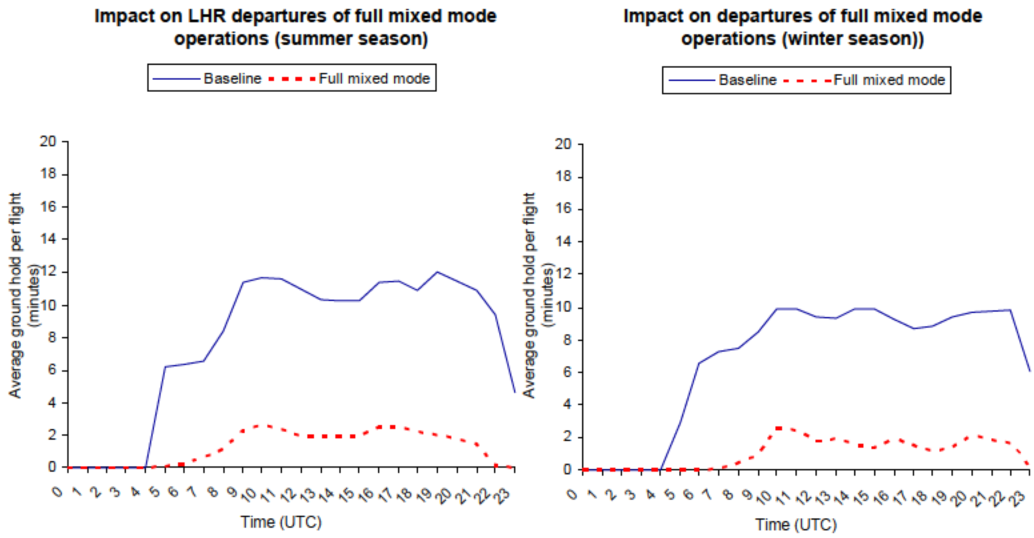
Exhibit 5-44: Summary of the impact on ATFM delays and stack holding of maximum capacity mixed mode operations throughout the day



Departures

5.71 Exhibit 5-45 shows the impact of full capacity mixed mode operations on average ground holding predicted for the summer and winter seasons. Although there are substantial reductions in ground holding, these are not to the same extent as for arrivals adding weight to the hypothesis that there are other factors than the runway that contribute to ground holding.

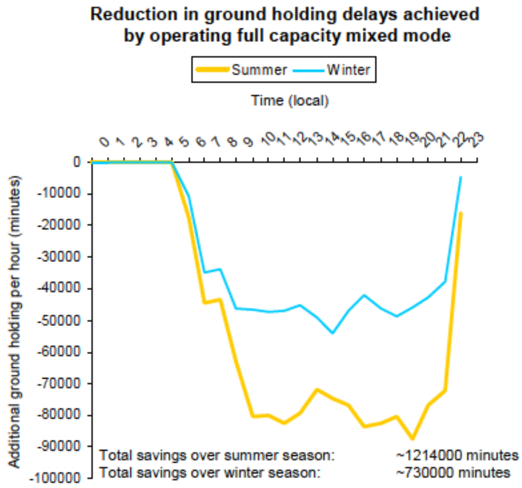
Exhibit 5-45: Impact on average ground holding of additional maximum capacity mixed mode operations throughout the day in the summer and winter seasons



5.72 Exhibit 5-46 shows the total savings in ground holding achieved by full capacity mixed mode over the summer and winter seasons:

- in the summer the total saving is predicted to be approximately 1214000 minutes
- in the winter the total saving is predicted to be approximately 730000 minutes.

Exhibit 5-46: Summary of the impact on ground holding of maximum capacity mixed mode operations throughout the day

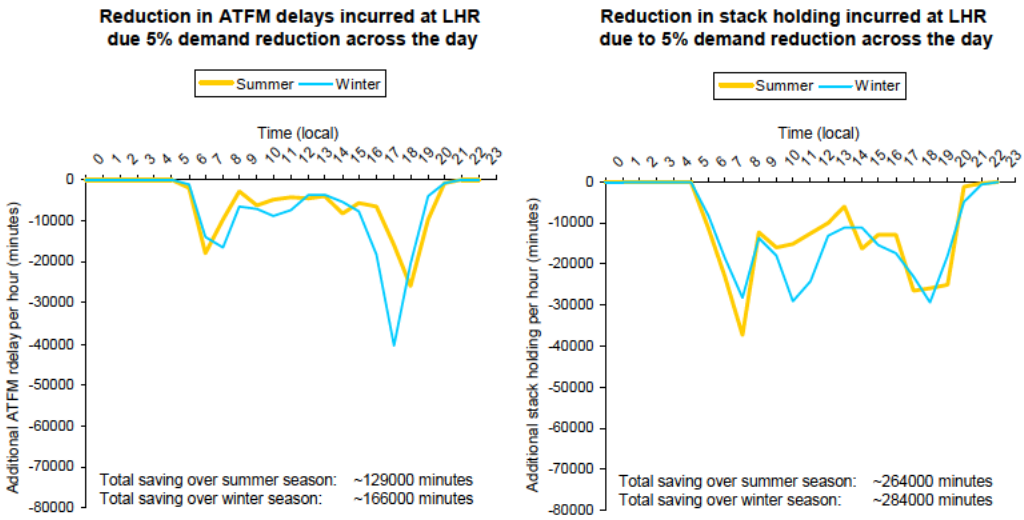


Indicative reduction of demand by 5%

5.73 The final scenario investigates the theoretical situation that demand be reduced and capped around 5% below its current level. This would equate to the removal of approximately 2 arrivals and departures slots per hour.

Arrivals

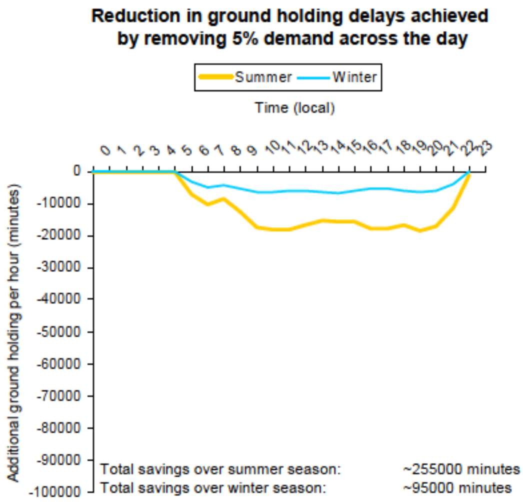
Exhibit 5-47: Summary of the impact on ATFM delays and stack holding of suppressing demand at 5% below its current levels throughout the day



5.74 Exhibits 5-47 and 5-48 summarise the impact on total airport ATFM delays, total stack holding and total ground holding of capping demand at 5% below its current level:

- total ATFM delays would be expected to be reduced by around 129000 minutes in summer and 166000 minutes in winter
- total stack holding would be expected to be reduced by around 264000 minutes in summer and 284000 minutes in winter
- total ground holding would be expected to be reduced by around 255000 minutes in summer and 95000 minutes in winter.

Exhibit 5-48: Summary of the impact on ground holding of suppressing demand at 5% below its current levels throughout the day



Recovery from Disruption

Introduction

5.75 At Heathrow, disruption associated with the runway is due to a reduction in the runway flow rate caused principally by either low visibility conditions or adverse wind conditions. As Heathrow operates in segregated mode, the spacing between arriving aircraft must be minimised to maximise the flow rate. Both adverse wind conditions and low visibility cause the spacing between (principally) arriving aircraft to be extended beyond the minimum separation applied on normal operating days.

5.76 Under good visibility and appropriate headwind conditions aloft, the minimum spacing between aircraft pairs can be as low as 2.5 nautical miles (nmi) on final approach once established on the localiser and within 20nmi of the runway threshold. The headwind conditions must be such that the application of the 2.5nmi radar separation minimum results in the appropriate spacing being achieved approaching the runway threshold for the clearance to land procedures.

5.77 The separation of the aircraft is monitored by the air traffic controller using radar, who intervenes if separation minima look like being infringed (either by updated speed instructions, or missed approach procedures). Distance separation fluctuates on approach as the ground speed changes under changing wind conditions and reducing airspeeds. If the wind speed and direction is such that the spacing between aircraft pairs is likely to be compressed beyond a minimum level then the separation between the aircraft must be increased and, hence, the runway flow rate reduced.

5.78 In the case of low visibility conditions, the leading aircraft must clear both the runway and the landing aids' protection area before the trailing aircraft reaches a specified point on its approach. This clearance takes a longer time than simply clearing the runway and, hence, the separation between successive aircraft must be extended. Separation can be increased up to 8nmi if there is very poor visibility indicating greater than 50% capacity reduction compared to the best separation minimum of 2.5nmi.

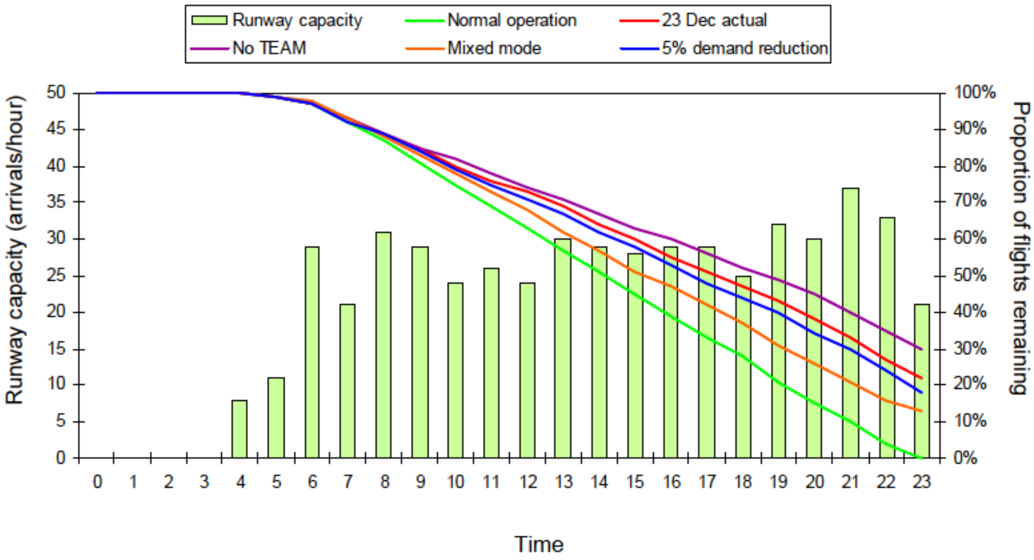
5.79 Gatwick, as a single runway airport, however, operates in mixed mode with interspersed arrivals and departures using the same runway. The spacing between arriving aircraft is therefore naturally greater at Gatwick than at Heathrow and Gatwick is less affected by adverse wind and visibility than is Heathrow (see Exhibit 4-49 and Exhibit 4-50).

Disaster days

5.80 Disaster days at Heathrow occur around 10 to 15 times per year and result in large number of cancellations, very significant ATFM delays and increased night movements. On these days the runway flow rate is severely restricted over the whole day by wind or fog. 23 December 2007 is an example of such a day.

5.81 As the restriction persists across the day there is no time when the restriction is lifted to recover to normal operations. Under current operations a simple addition of capacity cannot, therefore, add to the runway resilience – the runway flow rate is restricted to well below its maximum by the adverse conditions and will negate any additional capacity.

Exhibit 5-49: Impact of various demand reduction scenarios on recovery rates during disaster days



5.82 Resilience on these so-called disaster days must rely, therefore, on a change in operations, such as a move towards time-based separations (TBS) which could make a contribution to resilience when operations are disrupted by wind by reducing the impact that variable wind conditions have compared to the current situation where separation is defined on a distance basis.

5.83 Exhibit 5-49 shows the evolution of arrivals at Heathrow as experienced on 23 December compared to normal operations (see Exhibit 4-51) together with the runway capacity in terms of arrivals per hour achieved through the day. The exhibit illustrates that increasing the nominal runway capacity in segregated mode operations would not be beneficial as the realised capacity is much reduced. The figure also illustrates the impact of possible changes of operations that might be used to manage the disruption:

- removing the use of TEAM would significantly worsen the situation with around a 30% shortfall of arrivals over the day compared to a shortfall of around 20% with TEAM. The no-TEAM scenario was investigated by removing the flights that actually arrived on the departures runway during the day.
- capping the demand at 5% below the current level (scenario 7 in Exhibit 5-1) would mean that a lower proportion of flights were cancelled but at the cost of fewer flights on non-disrupted days. Cancellation of flights is effectively a reduction of demand to enable operations to continue as best as possible and to minimise the cost of recovery
- mixed mode operations would increase runway resilience by naturally increasing the spacing between arrivals at Heathrow (cf Gatwick) and therefore minimising the impact of the increased separation necessitated

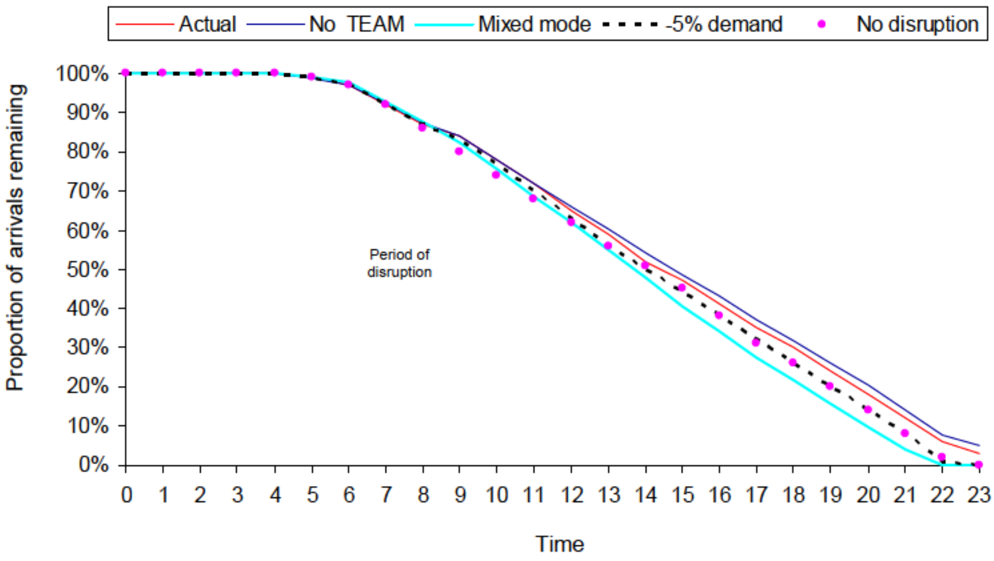
by the adverse conditions. This would not make use of the additional capacity provided by mixed mode operations but rather take advantage of the increased robustness that the concept provides

5.84 The case study comparing Heathrow and Gatwick performance on 23 December reported in section 4 shows that during the normal operating day Heathrow suffered a capacity reduction of around 25% whereas over the same time Gatwick suffered a capacity reduction of around 12%. Exhibit 5-49 shows the benefit that could be generated from mixed mode operations at Heathrow on a day such as 23 December, assuming a reduction of 12% capacity rather than the 25% currently experienced. This simple scenario shows that the benefit of mixed mode would be to reduce the number of flights that could not arrive during the disrupted day from around 22% (~113 flights) to around 13% (67 flights), a reduction of around 40%.

Recoverable days

5.85 In contrast to the disaster days above, recoverable days comprise a period of disruption followed by a return to normal operations. In theory, if additional capacity were available in the return to normal operations it should be possible to catch up, at least partially, by the end of the day. The 5 November case study reported in section 4 is an example of this type of day, which occurs typically 40 to 50 times per year at Heathrow. Exhibit 5-50 shows the evolution of arrivals throughout the day comparing the actual situation on 5 November (red line) with an equivalent day with no disruption (purple points) and various strategies for recovering after the period of the disruption, which is shown as the grey shaded area on the chart (from 06:00 to 09:00). In the following, mixed mode refers to a full mixed mode scenario with a capacity increase of around 15%.

Exhibit 5-50: Impact of various capacity enhancement and demand reduction scenarios on recovery rates during recoverable days



5.86 During the actual day of 5 November, TEAM was applied during and after the period of disruption until ATFM delays recovered to their normal levels at around 14:00 when the evolution of arrivals also matched that of the normal day. Subsequently, the rate of arrivals reduced again and by the end of the day there was a significant shortfall of arrivals, compared to the normal days. Exhibit 5-50 shows that without the application of TEAM (derived by subtracting the arrivals on the departures runway from the overall arrivals flow rate) after the period of disruption, the traffic evolution would not have caught up at 14:00 and there would have been an even greater shortfall at the end of the day.

5.87 Exhibit 5-50 shows that a reduction of 5% in demand would also enable operations to recover by around 14:00 and to remain at the norm for the rest of the day. In effect, the reduction in demand more than compensates for the 3.5% cancellations that took place on 5 November.

5.88 Exhibit 5-50 also shows the evolution of traffic that could be achieved with mixed mode operations. During the period of disruption mixed mode would allow a higher flow rate than for segregated mode operations and the 15% capacity increase would allow traffic to recover to the norm by around 12:00. Subsequently, the additional capacity and robust operations during the day would ensure no further disruption.

5.89 Exhibit 5-51 shows the hourly arrivals runway flow rates supporting these scenarios and, in particular, illustrates the effect of TEAM and mixed mode.

Exhibit 5-51: Illustrative arrivals flow rates for various capacity enhancement and demand reduction scenarios on recovery rates during recoverable days

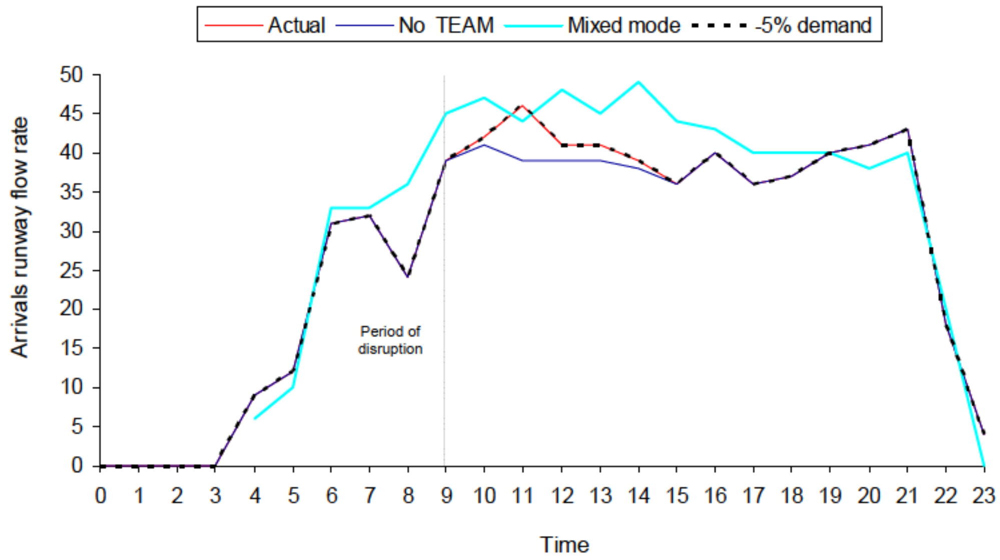


Exhibit 5-52 summarises the performance of each of the scenarios.

Exhibit 5-52: Comparison of the performance of the various scenarios to aid recovery

Actual	Never	15
No TEAM	Never	29
-5% demand	14:00	33[14]
Mixed mode	12:00	0

Conclusions

5.90 The analysis of the case studies shows that:

- the application of TEAM on both disaster and recoverable days eases the situation compared to that in which TEAM is not applied. Without TEAM on the disaster day, the shortfall in arrivals would have been up to around 40% greater than that achieved and around 50% greater than that achieved on the recoverable day
- management of disruptions by reducing or capping demand would require the cap to be set at or below the number of cancellations that occur, and its benefits would likely be outweighed by the fact that the capped flights would not be able to operate during the remainder of the time. Cancellations are, in fact, a mechanism used by the airlines to cap demand to allow some operations on disrupted days

[14] This shortfall is compared to the current situation and not the schedule with reduced demand

- it is not possible to recover from the disaster days that occur between 10 and 15 days per year. However, use of mixed mode operations on these days would ease the situation and could result in a reduction in shortfall of flights (and cancellations depending on particular airline policy) by around 40%. This benefit arises from the natural robustness of mixed mode operations against the requirement to impose increased separation for arriving aircraft in adverse wind and visibility conditions. Simple addition of capacity would not ease the situation on disaster days in segregated mode operations as the operational capacity is already reduced well below that available on normal days
- use of mixed mode on recoverable days at Heathrow would allow full recovery similar to that achieved at Gatwick on similar types of day. There is a dual benefit on the recoverable day in that mixed mode reduces the impact of the disruption (wind or fog) as well as speeding up the recovery by providing additional capacity.

SUMMARY

5.91 The following table (Exhibit 5-53) summarises the impact of the various scenarios on ATFM delays, stack holding times and ground holding times compared to baseline of the current situation whereas Exhibit 5-54 shows the same data normalised to the number of flights operating in each season.

Exhibit 5-53: Summary of the impact of each scenario on total ATFM delays, stack holding and ground holding times

	ATFM delays (000s minutes)		Stack holding (000s minutes)		Ground holding (000s minutes)	
Scenario	Summer	Winter	Summer	Winter	Summer	Winter
Baseline (excludes severely disrupted days which are treated separately)	352	396	565	602	1404	924
Change due to each scenario						
Addi ional flight (worst case)	+29	+42	+93	+21	+24	+3
Flight removed (best case)	-12	-12	-19	-17	-10	-3
Additional TEAM	-85	-92	-185	-159	193	39
TWASS MM, current SIDs (+5%) capacity	-109	-122	-261	-264	-181	-46
TWASS MM, enhanced SIDS (+10%) capacity	-159	-241	-382	-373	-327	-86
Full capacity MM +15% capacity	-196	-265	-486	-548	-1214	-730
5% reduction in demand	-129	-166	-264	-284	-255	-95

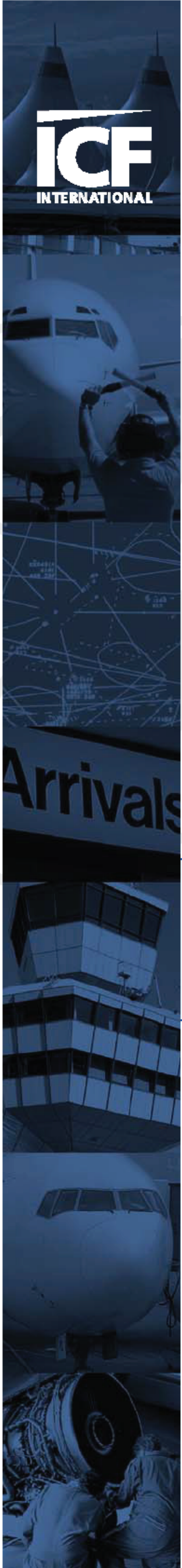
Exhibit 5-54: Summary of the impact of each scenario on the seasonal average ATFM delays, stack holding and ground holding times per flight

	ATFM delays (minutes per flight)		Stack holding (minutes per flight)		Ground holding (minutes per flight)	
Scenario	Summer	Winter	Summer	Winter	Summer	Winter
Baseline (excludes severely disrupted days which are treated separately)	2.49	3.98	4.00	6.05	10.02	9.20
Change due to each scenario						
Additional flight (worst case)	0.20	0.42	0.66	0.21	0.17	0.03
Flight removed (best case)	-0.09	-0.12	-0.13	-0.17	-0.07	-0.03
Additional TEAM	-0.60	-0.92	-1.31	-1.60	1. 38	0.39
TWASS MM, current SIDs (+5%) capacity	-0.77	-1.23	-1.85	-2.65	-1.28	-0.46
TWASS MM, enhanced SIDS (+10%) capacity	-1.13	-2.42	-2.71	-3.75	-2.32	-0.86
Full capacity MM +15% capacity	-1.39	-2.66	-3.44	-5.50	-8.60	-7.33
5% reduction in demand	-0.96	-1.75	-1.97	-3.00	-1.90	-1.00

5.92 The qualitative impact of the scenarios can be summarised as:

- in terms of sensitivity, adding a flight, especially at an inappropriate time has significantly more negative impact than removing a flight, that is the addition or subtraction of flights is asymmetric
- additional TEAM can deliver benefits in terms of reduced ATFM delays and stack holding times for arrivals but there is an associated but not equivalent cost in increased ground holding, especially if TEAM is applied at times when the demand for departures is high
- in terms of the pure operational benefit of reducing holding times and discounting economic effects, the scenarios in order of increasing preference would be: i) TWASS mixed mode, current SIDs adding 5% capacity; ii) a 5% reduction in demand; iii) TWASS mixed mode, with enhanced SIDS adding 10%; iv) full capacity mixed mode.

When considering the ability to increase robustness against both severe and recoverable disruption, mixed mode is clearly the preferred option. The use of both runways for arrivals and departures gives improved resilience against the types of conditions that most usually cause disruption - adverse wind conditions and fog – and the greater the availability of spare capacity after a disruption event has ended, the quicker that the situation can be recovered.



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Part III:
ECONOMIC ANALYSIS

6 Economic Analysis Methodology

Overview

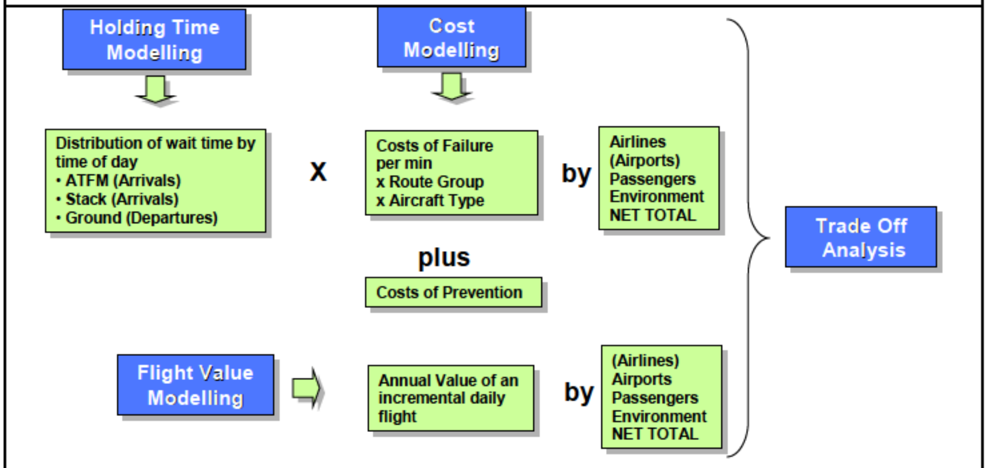
6.1 Runway capacity at Heathrow and Gatwick constrains the number of flights that can be operated and also the level of performance that can be achieved. The number of flights operated has a direct impact on the airlines' and airports' earnings, and the benefits associated with users of the flights. At the same time additional flights increase the airport's contribution to noise and other forms of pollution, and the flights themselves have a further environmental impact through fuel burned and resulting CO2 and other emissions.

6.2 As the number of flights increases, so does the risk of delay as queues form to access the runway for both arrivals and departures, as described in the previous sections. Overall delay performance is also affected by many other factors including airlines' despatch performance, stand and taxiway congestion, air traffic restrictions en-route and congestion at destination airports. The capacity of the overall system is regularly reduced by weather and other events which can affect any one or all of these components. To minimise the impact of increased congestion on delays and punctuality, airlines extend their planned block times with further costs incurred.

6.3 The study focuses specifically on the impact of marginal changes in demand relative to capacity in three stages of the flight operation:

- Airborne holding in the arrivals stack prior to landing
- ATFM holding at out-stations
- Departure holding at prior to take-off.

Exhibit 6-1: Analysis Overview



Source: SH&E

6.4 Exhibit 6-1 shows the stages of analysis conducted. The Holding Time analysis examines current performance of the runways at Heathrow and Gatwick, and the distribution of the holding times by time of day. This was used to calibrate the models so that various possible scenarios could be evaluated to estimate the change in holding times. Each scenario looked at the difference in the mean and also in the distribution of delay duration, and reflected a change in the balance between demand (aircraft take-offs and landings) and runway capacity. The scenarios are described below.

6.5 The outputs from this stage were then used to assess the costs and benefits for airlines, passengers, airports and impact on the environment. In parallel the costs and benefits of adding or removing additional flights were calculated. The analysis also assessed the fixed costs that airlines incur in providing aircraft, crew and other resources to mitigate the effects of extended queuing times (Costs of Prevention).

6.6 Finally, the trade-offs between the component benefits and costs were considered together to develop our conclusions.

Overview of Economic Modelling

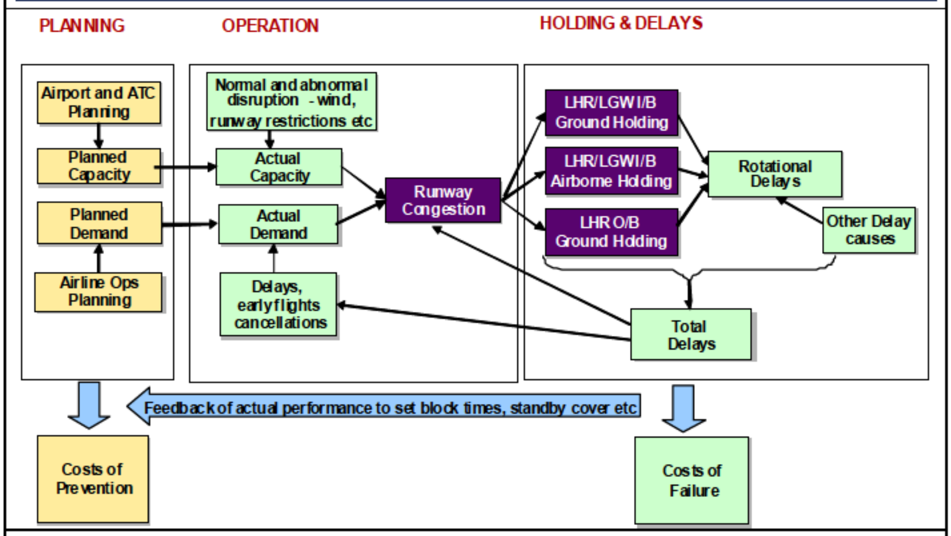
Scope of Economic Evaluation

6.7 Estimation of the costs and benefits associated with the scenarios listed in Exhibit 5-1 requires the modelling of a complex set of interacting relationships. The scope includes the impact of changing the balance between demand for and capacity of the runway resource at Heathrow and Gatwick Airports on holding times and consequential economic impacts, but does not attempt to assess the total costs of poor performance leading to delays and cancellations. The focus of the economic evaluation therefore is the changes in costs and benefits for airlines, airports and their passengers, plus the environmental impact of changes to holding times during normal operations (around 300 days a year) and also on the further 50 or so days where there is already significant delay due to runway congestion, usually associated with flow rate restrictions because of weather.

6.8 We have not attempted to assess the economic consequences of major disruption, nor the benefits of increased runway resilience in improving the recovery time from such events. Many of the costs and impacts associated with such events are not routinely collected by airlines and airports in a way which enables costs to be easily allocated to specific events. It is also difficult to see what action could be taken in terms of restricting flights year round which could be justified economically given the relatively few days (around 15 a year) when major disruption occurs.

6.9 We have broadly followed the approach recommended by the DfT[15] in assessing the cost-benefit impact on passengers, airlines, airports and the environment. However there are some differences in the detail – for example we have not modelled the change in the passengers spilled to other UK airports. We have not attempted to quantify broader economic impacts such as those on the UK economy or employment, nor have we distinguished the geographical location of where the costs and benefits accrue. The details of the method and assumptions used are given in Appendix C.

Exhibit 6-2: Impacts of Holding Times on Costs



Source:SH&E Analysis

[15] DfT website, Appendix H of "UK Air Passenger Demand and CO2 Forecasts", November 2007.

6.10 Exhibit 6-2 shows the interaction between ***planning processes***, on the day ***operation*** including the ***holding times***, the impact then on ***airlines' delays***, and how this then feeds back into the planning of subsequent seasons. Airlines plan their schedules assuming that time will be spent holding based on experience of previous seasons. In the short term flights held for longer than the planned holding time have an impact on departure and arrival delays. There are then knock-on effects on subsequent flights (rotational delays). The cumulative effect of persistent increased holding is then reflected in the sector block times airlines use to construct their schedules, which in turn creates an increase in the number of aircraft and crew required for any given operation. Because airlines set planned block times at a percentile of actual block times (for example the 65%ile) then these costs can be higher than is required on average. Airlines can also and do build in extra resilience by increasing the number of standby crew and aircraft beyond that needed for sickness and aircraft un-serviceability.

Costs of Prevention versus Costs of Failure

6.11 Costs are incurred at the planning stage (extra crews and aircraft for example to cover expected holding) and at the operations stage (fuel burned, passengers compensated when delays occur for example). We refer to planned expenditure as ***Costs of Prevention*** – investments made to minimise the impact or incidence of delays – and costs incurred as a direct or indirect result of delays occurring as ***Costs of Failure***. In the short term Costs of Prevention can be considered as fixed, i.e. if holding times extend then the airline experiences worse departure and arrivals punctuality with cost impacts for the directly affected airline and passengers. In the longer term, however, most of these costs are "planned out" by airlines adjusting their schedules and resourcing.

6.12 Clearly for airlines there is a trade off between the Costs of Prevention (which primarily fall to them) and the Costs of Failure which affect them and their passengers. Existing schedules already reflect some of the costs of extended sector times. For the Baseline Case (i.e. performance as in Summer 2007 and Winter 2007/08) we have calculated the total "cost of holding" with current performance, and then the change to this figure in each scenario. In evaluating the impact of shorter or longer holding times we have assumed that airlines continue to reflect the change in their block times, and do not simply allow performance for themselves and their passengers to deteriorate.

6.13 We separately discuss the direct and immediate increases in delays if holding times increase within a season i.e. delays worsen because sector times are unrealistic. Given the lags in the airline planning processes, in the short term this is what is most likely to happen. See paragraph 6.11 .

Uncertainty in holding time duration

6.14 Airlines and passengers are affected by any increase in the duration of holding times and delays. The impact is worsened by the need to plan for these delays which themselves are variable and uncertain. So one question we have been asked to address is what is the additional cost associated with this uncertainty, and how does this element change under each scenario. See paragraph 7.47

Costs and Benefits of Additional Flights

6.15 On the other side of the equation we have derived the ***benefits of additional flights*** to passengers (User Benefits), and to airlines and airports (Producer Benefits), and to the UK (Air Passenger Duty revenue). The DfT methodology assumes that all the Producer Benefit accrues to the airport in terms of a pro rata increase their profits. Passengers benefit from time saved through having a more convenient and time-efficient schedule, as well as the incremental value obtained by new passengers who benefit from lower fares.

6.16 Finally, we have assessed the ***environmental impact*** of additional flights and of increased holding time, both airborne and on the ground. The main impacts considered are those of carbon emissions and noise. CO2 emissions have been estimated based on the ICAO Engine Emissions Databank, Issue 15-B, with costs applied using DEFRA guidance, and in line with the DfT's usage in their November 2007 paper[16]. This includes the additional impact of CO2 emissions at altitude through the application of a "radiative forcing factor" as a simple multiplier: we have used the value of 1.9 in line with current DfT assumptions.

[16] DfT website, "UK Air Passenger Demand and CO2 Forecasts", November 2007

6.17 Exhibit 6-3 shows the main cost items affected by holding. This framework describes which costs we have included and under what circumstances.

Exhibit 6-3: Cost Impact Framework

			EITHER		OR
A		B	C	D	E
Base Case	Increase demand relative to capacity	More time holding	More Primary Delays	More Rotational Delays	Higher Costs of Prevention
Existing holding times	CONSEQUENCES	Longer time holding Increased uncertainty	Holding time exceeds expected causing delay	Late incoming crew and aircraft affect later flight departures	Standby Crew Standby Aircraft Longer block times Use of ground and air buffers
FAILURE & PREVENTION	COST IMPACTS	FAILURE			PREVENTION
Y	A/c Ownership				Y
Y	Fuel	Y			
Y	Maintenance	Y			
Y	Crew Variable	Y			
Y	Crew Fixed				Y
	Airline Other				
	Airport Charges	Not significant	Not significant		
	Handling				
	Pax Expenses		Y		
	Pax Compensation				
	Mis-connecting bags				
	MCT				Not quantified
Small	Airport Operator Costs	Small and not quantified			
Y	Value of Pax Time	Y		Y	
Y	Environment	CO2 and NOX emissions			
	Future Revenue		Competition with other hubs. Not quantified		

Source: SH&E

6.18 Column A defines which costs and impacts are included in calculating the Base Case Holding Costs. The assumption is that time spent holding ties up aircraft, crews and passengers and that the time released could be fully utilised, so all costs of owning aircraft and employing crew are included. This includes both Failure and Prevention costs in that we do not separate out how much of the current holding time is built in to airlines' schedules, and how much is additional and contributing to further delays: as we are measuring the marginal change this has not been necessary.

6.19 Column B indicates those costs that are directly affected by an increase in holding times in the short term i.e. regardless of whether additional holding times are subsequently incorporated in to airlines' schedules.

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6.20 Columns C & D indicate those costs which are incurred if the increased holding times are not incorporated but result in delays, and Column E indicates those which are incurred if holding times are incorporated and there is minimal impact on delays. When delays do occur many flying costs are not increased but just occur later. However some passenger related costs such as compensation and missed connections are driven by delays and not directly by the holding times. Similarly rotational delays cause the same costs on later flights, even though most operating costs can be assumed to be unchanged.

6.21 Our analysis of the delay statistics of carriers based at Heathrow and other carriers operating there shows that around 20% of all delays at the airport can be attributed to holding. The carriers which are not based at Heathrow and only perform turnarounds at the airport suffer a larger proportion of their delays due to holding.

Exhibit 6-4. Holding Related Delays vs. All Delays

	Holding-related delays		ATMs
	Arriving	Departing	
	Share	Share	Share
Base carriers	12%	15%	54%
Other carriers	29%	29%	46%
Combined	20%	21%	

Source: SH&E Analysis

Airline Specific Costs of Failure

6.22 The direct costs for airlines when extended holding or delays occur, as outlined in Exhibit 6-3, include:

- Additional fuel costs due to holding on the ground and in the air;
- Increased maintenance costs;
- Increased crew costs;
- The costs of providing delayed passengers with food and refreshments and possible over-night hotel accommodation;
- The costs of re-booking and accommodating passengers on other airlines when connections are missed;
- The costs of handling mis-connecting bags for connecting passengers; and
- Loss of business from passengers who change their travel plans and either cancel their journeys completely or travel by a surface mode.

Passenger Value of Time (VOT)

6.23 We have used the following figures from the DfT to put a monetary value to the time passengers spend in holding and delays:

- Passengers travelling on business purpose: 0.91 GBP / min
- Passengers travelling on leisure purpose: 0.14 GBP / min

6.24 These figures are linked to earnings levels. We have not varied this with duration of delay or circumstance beyond a simple Business/Leisure split. The University of Westminster study highlights some of the potential pitfalls when applying a Value of Time approach, particularly the diversity of values estimated by different sources. See Appendix E: for a summary of alternative sources contained in the "Standard Inputs for Eurocontrol Cost Benefit Analyses", 2005 Edition.

6.25 The "Heathrow Economics Study" report, Buchanan for GLA, September 2006, argues that business passengers' flights outside "the standard working day" should have less than 20% of the normal rate applied. For most business travellers today the concept of "the standard working day" is not particularly relevant: time spent on travelling is an integral (but unwelcome) part of adding value for their company and it is difficult to see how a 20 minute delay at 15:30 is worth 5 times more than a 20 minute delay at 19:30. Business travellers expect to be compensated for the social costs (such as late arrivals home) within their overall package; increasing those costs must surely increase an expectation of increased compensation. It could also be argued that applying salary linked costs as the Value of Time does not recognise fully the added value derived from the activity, just the marginal cost to the company.

Impact on Airline Revenue

6.26 We have excluded any assessment of the impact of delays and/or lengthened sector times on the airlines' revenue in that if one airline experiences worse performance then although it may lose passengers, another airline will probably gain them, so the net result is zero. This argument does, however, overlook one of the main concerns expressed by airlines, which is that if performance at Heathrow deteriorates then connecting passengers will switch to other hubs such as Amsterdam, Paris and Frankfurt to avoid Heathrow.

6.27 This latter argument is more applicable if the increased holding resulting from adding flights were not compensated for by lengthening sector times. Our assumption is that they will continue to be so, and so actual delays and misconnections should be no worse. The main impact then is that by lengthening total journey time, some journeys via Heathrow will appear lower in the Global

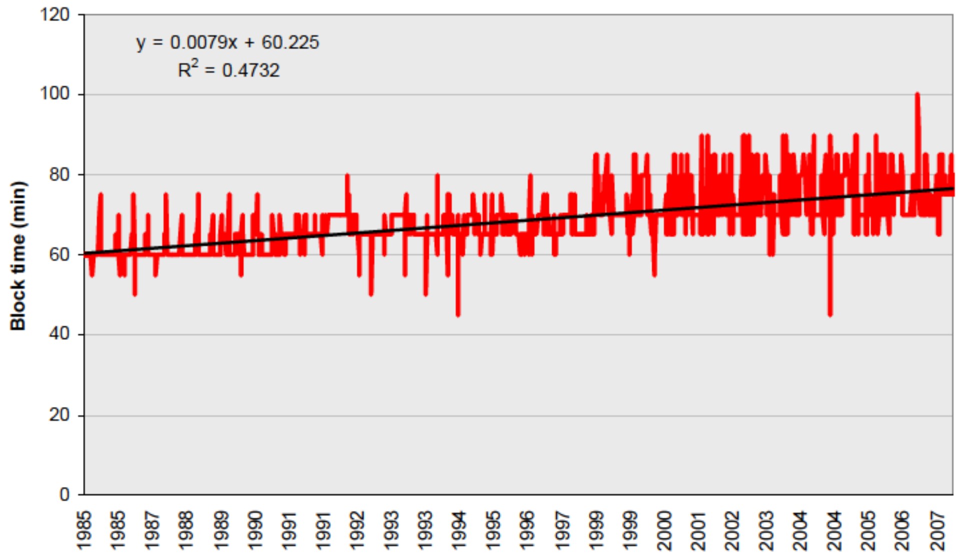
Distribution Systems screens relative to journeys connecting at other airports, resulting also in a loss of share for Heathrow, and at the margin some connections will become unviable as they fall below the Minimum Connection Time.

Airline Specific Costs of Prevention

Increased Sector Times

6.28 From previous studies and interviews with airlines we know that the most significant Costs of Prevention are aircraft time and crew time. Airlines use sector block times based on actual achieved times; by definition any additional delays occurring between push-back and arrival on stand are reflected in later seasons in the block times. Expanded block times increase flying hours and hence the total number of aircraft and crew required to cover a given schedule. The inclusion of scheduling buffers either on the ground or in the air has a similar effect.

Exhibit 6-5. The Increase of Scheduled Block Times on the CDG-LHR Route



Source: OAG

6.29 Block times to and from Heathrow have grown steadily over many years; see the example of Heathrow to Paris CDG in Exhibit 6-5 above. The result is that although punctuality may not have appreciably worsened, average journey times have increased which is costing all airlines operating there considerable sums each year. This effect is relatively stronger on short-haul routes where the total block times are smaller; hence the holding time is relatively larger. In addition to the airline costs, there is the cost of passengers' time and the environmental cost of the fuel burned.

6.30 In calculating these costs we have assumed that additional time spent holding is added incrementally to current block times, minute for minute. In practice, airlines use a percentile measure (typically the 65th percentile) so an increase in holding times of 5 minutes say may result in an increase in block times of 6 minutes. So our approach possibly underestimates the incremental change.

6.31 An argument put forward in previous work is that the marginal increase in crew and aircraft flying time is unlikely to generate the need for an extra crew member or aircraft in the fleet for any one airline. In practice, of course, each airline will decide how to respond given its own circumstances. If an airline has a large fleet based at Heathrow, then 5 minutes a sector on a shorthaul aircraft could add up to 30 minutes in a day. Over a fleet of 30 aircraft this can easily add up to an extra aircraft or more. Smaller and non-UK based airlines may not suffer from this directly, but have to sacrifice some other flying opportunities instead. If they are unable to adjust their departure/arrival times because of slot constraints then the cost would be incurred in worse performance, which may cost more or less.

6.32 Many longhaul operators' schedules are heavily constrained by time differences, jet curfews and the difficulty of scheduling extra sectors with their aircraft. So a marginal increase in block time may have no impact. Equally there will be some carriers for which aircraft or crew integrations only just work, and even a small increase in block times could have a step change in crewing and/or aircraft required.

6.33 For the purposes of this study we argue that the simple "fixed cost per block hour" approach is the most reasonable when looking at the total impact on all operators at Heathrow.

Standby Crews and Aircraft

6.34 Airlines often acquire additional spare crews and aircraft to improve their operational resilience and to cope with aircraft technical problems or peaks in crew sickness. The resourcing philosophy and the proportion of standby crews and aircraft vary from airline to airline. For small airlines the costs of having a standby aircraft are too high relative to the total cost base to be justified. Larger airlines can allocate yet further crew and aircraft to standby to give cover for operational disruption and delays. Again practice varies between airlines. Some airlines' philosophy is that standby aircraft are only to cover technical despatch problems. Others will say that 50%, for example of the cover is specifically committed to improving punctuality: the standby aircraft on shorthaul fleets can be deployed to break the chain of rotational delays that can occur through the day.

6.35 Because of this variability in practice between airlines we have calculated the potential costs of holding standby crews and aircraft base on the following assumptions:

- Standby crews and aircraft are only deployed on shorthaul operations;
- The ratio of standby aircraft to total fleet is 1 in 30;
- The total fleet required to operate Heathrow is derived from total block hours on flights in and out of Heathrow divided by industry standard daily utilisation for shorthaul aircraft.
- 50% of the standby is allocated to operational performance and delay management
- Holding delays (i.e. departure delays accredited to holding) account for 20% of the total delay minutes.
- Each standby aircraft attracts pro-rata a normal crew complement and the associated fixed costs.

Minimum Connection Times

6.36 Minimum Connection Times (MCT) at Heathrow have increased over time and are longer than at comparable European hubs. Most of this relates to congestion within the airport rather than to late arrivals, but with uncertainty in arrival times it becomes more difficult for connecting passengers and their bags to make their onward flights. So an element of the MCT covers expected arrival delays. From our discussions with airlines we have not been able to attribute a proportion of the existing MCT to late arrivals i.e. by how much would the MCT be reduced if all holding related arrival delays could be eliminated. Same terminal MCTs at Heathrow are currently 60 minutes.

6.37 The benefits of a reduced MCT would be that some connecting passengers may be able to connect to a more convenient flight (passenger time saved), and airlines may be able to attract new passengers from other European hubs by offering more and/or better connections. The benefits for airports and airlines of reduced MCT are considerable as significant investments are made to improve the infrastructure and facilities for transfer passengers.

6.38 However, we have not quantified this cost, and believe that the expected benefit (i.e. the probability of being able to reduce MCT with increased runway resilience multiplied the incremental value gained by passengers and airlines) is low relative to other costs because:

- It only affects transfer passengers. So around two thirds of Heathrow's passengers are unaffected. Of current possible connections being sold many are not constrained by the Minimum Connection Time;

- Most LHR arrival delays are caused by factors other than LHR runway related constraints;
- Even if holding delays were reduced, other aspects of the LHR system for connecting passengers may mitigate against reducing the MCT.

Rotational Delays

6.39 When delays (primary delays) occur they impact later flights causing further delays (rotational delays) on flights operated by the same crew or the same aircraft. This has an impact mainly on passengers; costs such as fuel are unaffected. To estimate this effect we have examined the relationship between primary delays and rotational delays using three airlines' Heathrow and Gatwick data which together account for over 55% of the Heathrow arrivals and departures. We have looked at long-haul flights separately from short-haul, and also the differences between Heathrow-based and non-Heathrow carriers: non-Heathrow carriers will minimise the ground time, so there is less opportunity for recovering from a late inbound flight. A carrier based at Heathrow will usually schedule any spare non-flying time to be at Heathrow to give greater flexibility in controlling operations.

Relationship between holding (ground, airborne) and delays

6.40 An underlying assumption in our analysis is that the more time that is spent holding (within a given season), the worse punctuality becomes. This assumption allows us simply to sum the changes in the expected holding times and infer the increase in arrival and departure delays.

6.41 The statistical modelling referred to in Exhibit 4-28 and Exhibit 4-29 shows that although for longer ATFM delays and stack holding there is a clear 1-to-1 relationship with expected delay (i.e. one minute increase in ATFM delay or stack holding increases average delays by one minute), for shorter holding times there is no statistically clear conclusion. A pattern cannot be discerned because of many other factors which can cause delays are masking the contribution of ATFM delays. Also, scheduled arrival times reflect the historic average AFTM delay. Similar analysis for the stacks (not included in the report) gives a matching result. However, a reasonable assumption would be to conclude that if an aircraft has to circle above London for 3 minutes longer than was planned, or was held on the ground prior to departure for 3 minutes longer, then the expected arrival delay would also increase by 3 minutes: this is the relationship we have assumed. This relationship has been used to translate the modelled change in holding delays into changes in total delay minutes for purposes of economic analysis. In practice, this only affects the calculation of passenger related costs and the Value of Time calculation for rotational delays in the case where airlines do not incorporate increased holding into their block times.

6.42 A plausible further argument is that if the mean holding time were to increase then the incidence of holding delays (i.e. flights arrive later than scheduled because of extended holding) would also increase. The associated increased costs would be incurred even when the increase in the mean is reflected in the scheduled block times. We have calculated these costs on the assumption that they increase by the same % as the mean holding time, but not included them in the main analysis and results as it is an unproven hypothesis: to test this we would have to analyse airline punctuality data over several years to determine the relationship between holding times and delays attributed to holding.

Relationship between Primary Delays and Rotational Delays

6.43 We have used airline delay statistics (three airlines combined) to understand the impact of primary delays on rotational delays, deriving the factor by which to scale primary delays up. The accuracy of these numbers depends on the consistent and accurate attribution of delays to codes, but the results are broadly in line with the factors used by the University of Westminster, which were based on an American Airlines study of its US domestic operation.

7

ECONOMIC ANALYSIS RESULTS

COST OF HOLDING

7.1 We have analysed the Base Case for the seasons of Summer 2007 and Winter 2008/08 to calculate how much cost is incurred at current levels of operation and delay. The original intent was to assess the impact of changing demand versus capacity at both Heathrow and Gatwick. Because Gatwick is not as fully utilised, the resulting change in holding delays is much smaller and so the balance of benefits of extra flights are most likely to outweigh the incremental holding costs. As a result the scope of the detailed economic analysis and discussion has been restricted to Heathrow only.

7.2 The total annual "cost of holding"[17] at LHR amounts to £433 M as detailed in the following Exhibit 7-1.

Exhibit 7-1: Annual Costs of Holding at LHR

Baseline	Unit	Annual			
		ATFM	Stack	Ground	**Total**
Measures					
Delay	min 000s	617	1,133	2,351	**4,100**
CO2	tonnes	-	227,506 t	75,452 t	**302,957 t**
NOx	tonnes	-	1,146 t	378 t	**1,524 t**
Costs					
Fuel	million GBP	-	£ 48.7 m	£ 16.1 m	**£ 64.8 m**
Aircraft maintenance	million GBP	-	£ 7.6 m	£ 16.0 m	**£ 23.6 m**
Aircraft ownership	million GBP	£ 5.9 m	£ 14.5 m	£ 30.5 m	**£ 50.9 m**
Crew	million GBP	£ 6.7 m	£ 12.2 m	£ 24.9 m	**£ 43.7 m**
Other passenger costs	million GBP	£ 0.4 m	£ 1.6 m	£ 2.3 m	**£ 4.3 m**
Passenger VOT	million GBP	£ 29.9 m	£ 65.5 m	£ 130.5 m	**£ 225.9 m**
CO2 cost	million GBP	-	£ 9.4 m	£ 10.7 m	**£ 20.1 m**
Total costs	million GBP	**£ 43.0 m**	**£ 159.5 m**	**£ 230.9 m**	**£ 433.4 m**

Source: SH&E Analysis

7.3 These figures include the costs directly incurred by holding, plus the resources committed to operating the longer flight times that holding requires. To this can be added a further allowance of £3 million to £5 million annually for a share of standby aircraft, crews and ground staff used to protect poor punctuality attributable to extended holding. This figure reflects only the share of standby costs attributed by airlines to runway congestion; this attribution is based on a combination of the full cost, airline delay statistics and also their judgment about how standby resources are justified and utilised.

[17] See earlier discussion in paragraph 6.17 for definition of "cost of holding".

7.4 Other Passenger Costs are those costs incurred by airlines and passengers when congestion builds and extended holding times affect punctuality. These costs are more difficult to calculate precisely, but cover such things as mis-connecting passengers and bags as well as passenger compensation. Holding delays are largely compensated for by extending scheduled sector times, but even so holding related delays account for up to 20%[18] of the total delay minutes at Heathrow.

7.5 Of the airlines we spoke with, many of the costs reported such as the need for overnight accommodation and meals were incurred most often on the small number of days when there was significant disruption. Many of the passenger related costs (e.g. compensation) are only applicable when delays are extended – EC compensation for example only applies for flights delayed by at least 2 hours. Holding delays account for around 20% of the total delay minutes and only a proportion of the passengers on those flights were delayed long enough to incur costs. Only 3% of passengers are delayed more than 2 hours[19] which is the minimum period to qualify for compensation under EU legislation.

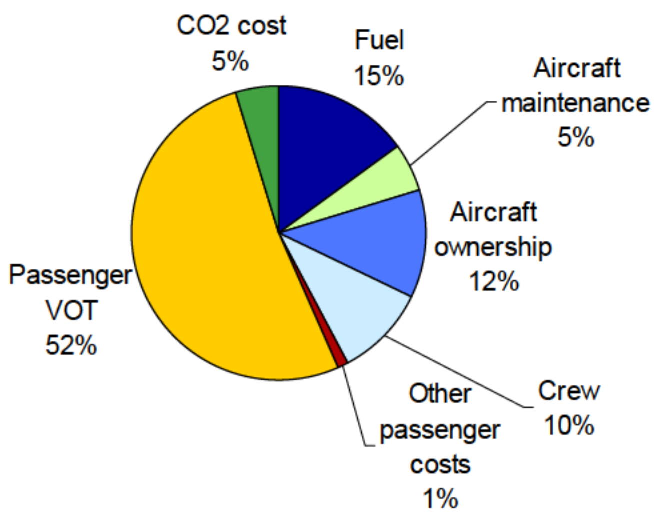
7.6 By applying airline reported costs to holding related delays we have estimated an overall cost for passenger costs which is low. We have included a notional 1% of total holding costs as an upper bound to be added to cover all these costs together. The relationship between holding delays and the associated uncertainty in punctuality is discussed in 7.50 and the following paragraphs

7.7 As well as directly measurable costs such as fuel the £433 million figure include the cost of the value of passengers' time (VOT) and also the cost of CO2 emissions. The importance of passenger VOT is more clearly shown in Exhibit 7-2 below.

[18] Based on 12 S07 and W07/08 LHR and Arrival and Departure punctuality data from BA, bmi and Lufthansa. This data reflects individual airline practice in allocating codes, and unique and consistent identification of runway congestion as opposed to other air traffic control causes is not possible.

[19] Based on the same punctuality data, adjusted for typical aircraft configurations and passenger load factors.

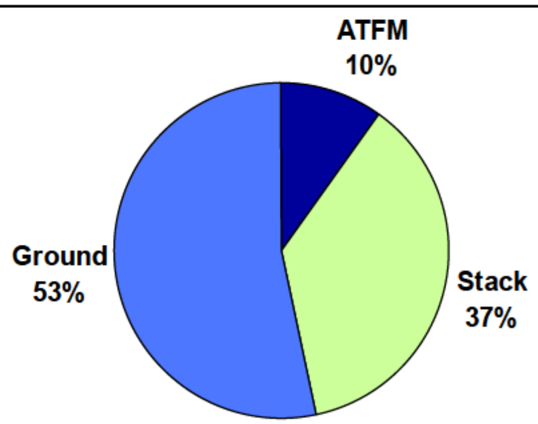
Exhibit 7-2: Holding Costs Breakdown



Source: SH&E Analysis

7.8 The break down between the departure and arriving queues is summarised in the next two exhibits (Exhibit 7-3, Exhibit 7-4), together with their share of the total costs. The airborne stack costs are the most expensive per minute, but ground holding is the largest absolute cost because of the number of minutes spent holding. Ground holding for inbound flights is a much smaller figure because the delays are less and the engines are not started generally until the captain receives slot clearance.

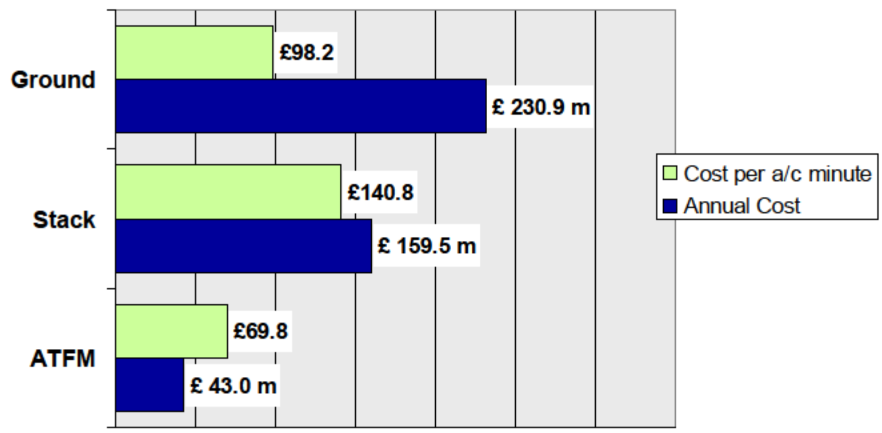
Exhibit 7-3: Holding Costs by Type



Source: SH&E Analysis

7.9 These total holding delays are equivalent to 8.5 minutes per flight, 7.3 minutes for arrivals and 9.7 minutes for departures, and the cost per minute of holding delay is £ 105 per minute.

Exhibit 7-4: Annual Holding Cost Totals and Per Minute



Source: SH&E Analysis

7.10 The cost equates to approximately £900 for each aircraft landing and each aircraft departing, compared to an overall cost per flight of £30,000 to £35,000. These figures obviously vary according to flight length and size of aircraft. The ATFM costs for example are only incurred by shorthaul flights, and larger aircraft burn more fuel. At around 3% the holding costs are of the same order of magnitude as airline operating margins, implying that any worsening of this situation will have a direct and measurable impact on airline profitability that will in some cases make the difference between a profit and a loss.

7.11 The difference in operating conditions and airlines schedules between summer and winter does not give rise to significant differences in the costs. The seven month summer period has a Cost of Holding equal to £247 million while the shorter five month winter period has a cost of £160 million. The slightly more costly winter months experience more weather related delays.

7.12 Details of the cost calculations are given in Appendix B: Costs of Holding and Delays. A summary of the key economic assumptions and factors which drive these results is given in the following table:

Item	Value	Source
Fuel Cost	0.70 GBP / kg	Average price of AMS-ROT Jet type kerosene for May 2008.
Passenger Value of Time	Business: 0.91 GBP / min Leisure: 0.14 GBP / min	Department for Transport
Cost of Carbon	21.8 GBP / tonne	2007 value, based on the DEFRA and DfT methodology
Airline Costs	Various	AEA, ICAO, individual airlines, US Form 41, Airline Fleet and Network Management

Results of the Scenarios

7.13 The holding costs in Exhibit 7-1 above are the baseline against which the scenarios defined in Exhibit 5-1 and listed below are now compared:

- Scenarios 1 & 2: Sensitivity testing: flights added or removed each hour;
- Scenario 3: Additional application of TEAM;
- Scenarios 4,5,6: Application of Mixed Mode operations: +5%, +10%, +15% capacity;
- Scenario 7: Reduction of demand across the day.

7.14 For Scenarios 1 & 2, where flights are added or removed each hour, we have calculated the change in Net Benefits. The Net Benefits of the extra flights are made up of several elements:

- The benefits new passengers gain from the additional flights (Generated User Benefits)
- The value of time saved by existing passengers who benefit from more convenient schedules (Existing User Benefits)
- Additional profits airports make from additional passengers (Producer Benefits)
- Increased Air Passenger Duty (APD Revenue)

Less the offsetting costs incurred

- The environmental costs of extra flights
- The increased costs of holding, as summarised in Exhibit 1-6 above.

While the actual benefits from any additional flights may vary by time of day and also depend on the flight destination and aircraft size, the methodology of benefit estimation works at a more aggregate level and does not allow that level of differentiation.

7.15 For the other scenarios we have calculated the change in holding costs only, assuming that the flight schedule does not change. The holding costs are incurred by all flights operating in and out of Heathrow during the affected period, whereas the additional flight benefits accrue only to the additional flight itself.

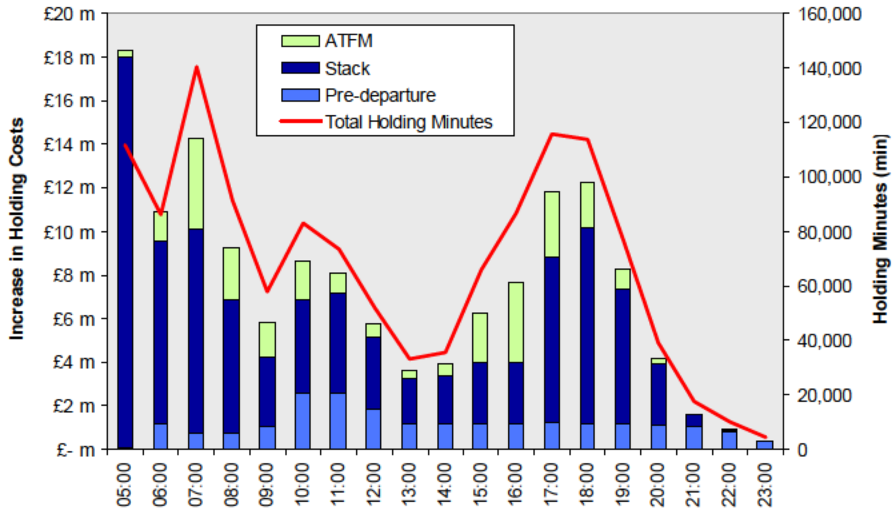
Evaluation of Scenarios

Scenario 1: Impact of adding one flight each hour

7.16 In this scenario we firstly look at the impact on Heathrow holding costs (including passenger "value of time" and the cost of carbon) when flights are added each hour. We then look at the costs and benefits derived from the extra flight itself, and finally at the net benefit.

7.17 The effects of adding one arrival and one departure flight in each hour on holding times were described and discussed in 5.44 and subsequent paragraphs. The annualised cost impact of adding flights is illustrated in the following exhibit.

Exhibit 7-5: Extra Holding Cost for Additional Flights



Source: SH&E Analysis

7.18 This shows that the increased costs are highest for stack holding, accounting for over 66% of the incremental costs. Overall incremental costs are particularly high in the early morning arrivals peak when there is a high proportion of wide-bodied aircraft, and also the evening peak. The peak is £18.3 million and the **average across the operating day is £7.5 M.**

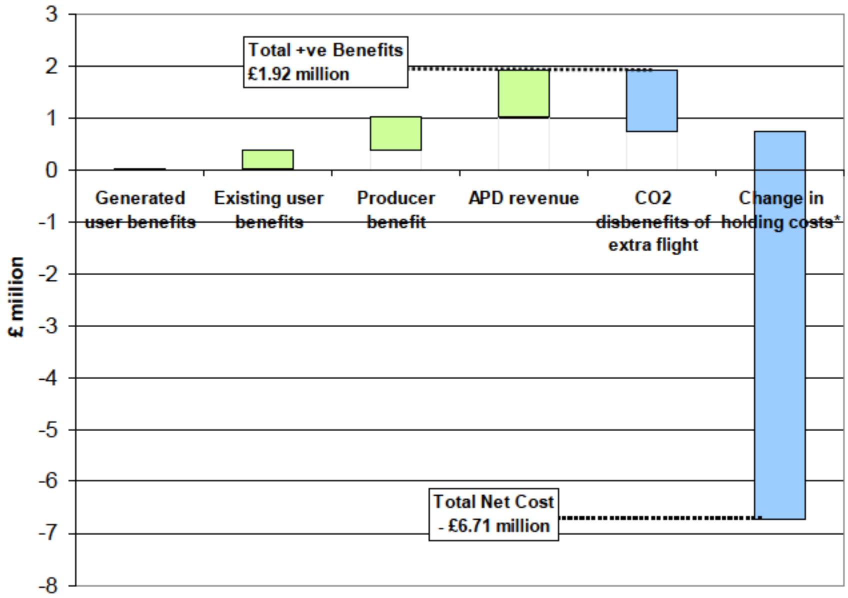
Benefit from extra flights

7.19 When flights are added there is an expected benefit to the airport (additional profit), to passengers (increase in consumer surplus) and also from additional APD collected. At the same time there is the Carbon Cost from the extra flights. We have calculated the Net Gain from adding an additional frequency averaged across all routes and all times of day. As discussed in Appendix C:, the expected profit based on the DfT methodology uses airport aggregate data and does not reflect specific variations by airline, route, season, day of week or time of day. Whilst conceptually the approach could be refined to reflect some of these factors such as the mix of business and leisure passengers – a departure at 0700 on a Monday to Milan will have a different mix and seat factor to an 1100 departure on a Saturday to Barcelona - for this analysis we have assumed each extra flight has the same average costs and benefits.

Net Benefit(Loss) after Holding Cost impacts are included

7.20 We have then calculated the combined change in Total Net Benefit of adding an arrival and a departure in the exhibit below:

Exhibit 7-6: The average net loss from adding a daily pair of flights at LHR



Source: SH&E Analysis

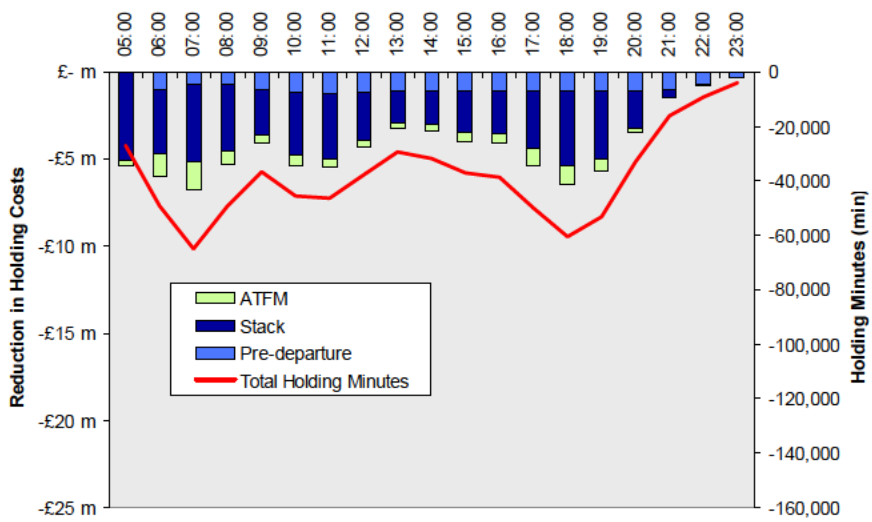
7.21 The total average annual benefit from adding an extra flight is £0.74 million. **This gives a net result per flight pair added of a loss of -£6.71 million when the increased holding costs are considered.**

7.22 The total net effect of adding flights is a loss regardless of when the flights are added during the day. The benefits that airlines and passengers might achieve with the new flights are outweighed by the negative effects imposed on other airlines and passengers in terms of increased holding costs.

Scenario 2: Impact of withdrawing a flight each hour

7.23 Within this scenario we have looked at the net impact of withdrawing a flight pair each hour. The gain in terms of reduced holding costs of removing flights, shown in the following exhibit, is less than the increased costs when adding flights. The annual average gain has a peak of £6.8 million and an **average across the operating day of £4.3 M.** The difference between adding and subtracting flights of roughly two-to-one is simply a function of the corresponding change in delay minutes, and the fact that as demand is added without any increase in capacity the deterioration in performance becomes ever faster.

Exhibit 7-7. Reduction in holding costs if flights are removed in each hour



Source: SH&E Analysis

7.24 When we then consider the lost benefit (User, Producer, APD, CO2) of the withdrawn flights, **the average total net gain reduces to £3.52 million a year.**

7.25 In making this calculation we have assumed that the impact on producer and user benefits are the same as the gain when adding a flight, but in the opposite direction. In practice the decision making process is unlikely to be this symmetrical. Flights will be added where the airline that can afford the risk and investment, and can acquire the slots needed, sees the greatest opportunity. When flights are withdrawn it is likely to be from destinations which would provide the poorest returns. It could be argued that the spread for an individual airline between adding and subtracting a flight is not that great because airlines have the option of either making those changes within their own slot portfolio, or negotiating slot swaps through the IATA scheduling process to secure the changes they want.

7.26 It would still seem beneficial overall to reduce flights if that were a practical proposition.

Conclusions from Scenarios 1& 2

7.27 The conclusions from the sensitivity test scenarios are as follows:

- The additional holding costs and environmental impact outweigh the potential combined gains to airlines, airports, passengers and APD from adding extra flights.
- The average net additional cost is £6.7 million a year for each flight pair.
- The net cost of adding extra flights is highest in the morning and evening peaks, with a reduced impact during the middle of the day.
- Similarly there is a smaller average net gain of £3.5 million a year theoretically realised if one flight pair is reduced in any hour.

Other Scenarios 3 to 7: Extended TEAM , Mixed Mode and Reduced Demand

7.28 For the remaining scenarios it has only been necessary to estimate the change in holding costs as the flying programme is assumed to be constant, except for Scenario 7, Reduced Demand. The reduction in total annual holding costs is shown in the following exhibit. Note that Holding Costs includes both the passenger value of time, and also the CO_2 costs which are shown separately in the table.

Exhibit 7-8: Scenarios 3 to 7 - Annual Reduction in Holding Costs

Nr	Scenario	Holding Costs million GBP	Holding time min 000s	CO2 emission tonnes	CO2 costs million GBP	Nox emission tonnes
3	Extended TEAM	£ -32.3 m	-251 min	-59,000 t	£ -2.7 m	-293 t
4	Full Mixed Mode 15%	£ -348.2 m	-3,459 min	-273,000 t	£ -10.1 m	-1,366 t
5	Mixed Mode 10%	£ -164.2 m	-1,568 min	-164,000 t	£ -6.6 m	-826 t
6	Mixed Mode 5%	£ -106.2 m	-983 min	-114,000 t	£ -4.6 m	-575 t
7	Reduction of Demand	£ -122.5 m	-1,193 min	-116,000 t	£ -4.6 m	-578 t

Source: SH&E Analysis

7.29 The scenario 3, extended application of TEAM, shows a decrease of holding costs in the range of £32 million despite the fact that the pre-departure holding in this scenario increases: this effect is counterbalanced by the larger reduction in ATFM holding and stack holding times which have significantly higher costs per minute.

7.30 The scenarios where Mixed Mode is applied to different levels all show decreases in holding costs and emissions attributable to lower congestion.

Scenario 7: 5% Reduced Demand

7.31 In this scenario we have removed two flights in each hour (Arrivals and Departures) to give an approximately 5% reduction in demand. We have not modelled the flight benefits explicitly, but have assumed the marginal gains/(losses) from subtracting flights are the reverse of adding flights, as for Scenario 2, Withdrawing one flight per hour, and multiplied by 19, the number of commercial hours in the day.

Exhibit 7-9: Impact of Reducing Flights on Holding Costs

Season	Change in: Holding costs (incl. CO2) million GBP	Holding time min	CO2 emission tonnes	CO2 costs million GBP	Nox emission tonnes
S07	£ -66.1 m	-648,648 min	-58,546 t	£ -2.3 m	-292 t
W0708	£ -56.4 m	-544,587 min	-57,597 t	£ -2.3 m	-286 t
Annual	£ -122.5 m	-1,193,235 min	-116,143 t	£ -4.6 m	-578 t

Source: SH&E Analysis

7.32 In this scenario the costs and emissions go down as a consequence of the reduced holding times, but this gain is offset by loss of benefits from the cancelled flights which would amount to £14.1 million annually per fight pair, giving **a Net Benefit for this scenario of £108 million a year**.

SENSITIVITY OF RESULTS TO KEY ASSUMPTIONS

7.33 The sensitivity analysis has examined the trade-off between Cost of Holding affecting all flights, versus the benefits that might accrue should a single extra flight be added in each hour, i.e. Scenario 1. We have tested the sensitivity under this scenario of the User and Producer Benefits, APD, Environmental Costs, the Holding Costs (including C02) and the change in Net Benefit with respect to the following critical assumptions:

– Fare elasticity;

– Passenger VOT.

– Fare levels of the extra business passengers

– Radiative Forcing Factor

– Cost of Fuel

– Cost of Carbon

7.34 The following table shows the impact on the change in the benefits from adding a flight pair, on the change in Holding Costs, and on the net resulting benefits when the above parameters are varied by +/- 25%:

Exhibit 7-10: Sensitivity to Key Assumptions for Scenario 1

Parameter to change	Parameter value			Change in benefits		Change in holding costs		Change in net benefits	
				Annual benefit £0.74		Annual Cost £ 7.46		Annual Net £ 6.71	
	Base value	+25%	-25%	+25%	-25%	+25%	-25%	+25%	-25%
Average fare	£284.8	£356 0	£213.6	+1%	-1%			-0%	+0%
Passenger value of time / hr	£25.1	£31.4	£18.9	+12%	-12%	+12%	-12%	+12%	-12%
Price elasticity	-1 00	-1.25	-0.75	-1%	+1%			+0%	-0%
Radiative forcing factor	1.90	2.38	1.43	-39%	+39%	+1%	-1%	+5%	-5%
Fuel price / kg	£0.7	£0.9	£0.5			+5%	-5%	+5%	-5%
Cost of CO2 / tonne	£21.8	£27.3	£16.4	-39%	+39%	+1%	-1%	+5%	-5%

Source: SH&E Analysis

7.35 We have not tested the sensitivity for all scenarios, as the calculation method and assumptions are similar in each scenario and would yield similar results.

7.36 The results of the sensitivity analysis show that even relatively large changes in the key parameters do not have a significant effect on the overall results. The most sensitive parameter is the Passenger Value of time which accounts for a significant proportion of the Holding Costs and hence the net benefit.

7.37 Fuel accounts for around 15% of Holding Costs, and any change in Fuel Cost has a direct pro-rata effect on the incremental costs. So a 25% change in the price of fuel has a roughly a 5% change on the Net Benefits.

7.38 The combined effect of the cost of CO2 and the Radiative Forcing Facto assumptions are of the same order of magnitude as fuel, and changes in either of these assumptions have the same effect.

7.39 The overall conclusion is that even with significant changes to the various parameters used, the main result that costs of holding heavily outweigh the benefits of incremental flights is unchanged.

Costs of Prevention versus Cost of Failure

7.40 In calculating the impact on Holding Costs in the above scenarios we have assumed that any increase in expected holding times is incorporated in a procedural way into subsequent seasons' sector block times. An alternative strategy would be for airlines to limit further sector time increases and instead accept a worsening of on-time punctuality for both arrivals and departures. To understand the economic consequences of such a policy we have calculated the increased incidence of delayed departures and arrivals, and the associated impact on costs.

7.41 Based on airline supplied total costs of delay and passenger disruption and allocating this cost to all passengers delayed more than one hour, we have derived an upper bound of £15 for a cost per passenger (delayed more than one hour).

7.42 The distribution of current departure delays weighted by the average number of passengers per flight indicated that an extra minute of delay for all passengers would increase the number of those delayed over an hour by around 75,000 passengers a year. At £15 per passenger this would add £1,112,500 of passenger delay related cost to all airlines. This is a fairly crude measure but it does give an indication of the sensitivity of delay costs to an increase of one minute in holding delays if block times are not increased.

7.43 The Costs of Prevention associated with holding are primarily the costs of assigning additional crews, aircraft and ground staff to cover the increased schedule time. This excludes the Failure Costs of Passenger VOT, fuel burned, passenger disruption costs and the cost of carbon. By dividing theses costs by the delay minutes we derive a typical Holding Cost of Prevention of £23 per minute. (data used is as shown in Exhibit 7-1: Annual Costs of Holding). If this cost is added to every departure and arrival then the approximate LHR Holding Cost of Prevention for an incremental minute in the buffers = 480,000 ATMs per year x £23 = £11,000,000. This far outweighs the simplistic calculation of Failure Costs above at £1.1 M for an increase of one minute in the average holding time.

7.44 The implication of this is that purely from an airline cost perspective, the airlines current approach of building increased holding delays into the schedule only makes sense if they also place a significant value on protecting customer service standards.

Passenger Time Buffers

7.45 Airlines and their passengers both argue that it is not just longer time holding or mean delays that are costly, but that there is an additional cost in the uncertainty of delays or actual arrival time. For passengers this would translate into either taking an earlier flight than maybe would be needed if schedules were reliable, or allowing a buffer in the working day on arrival and not scheduling meetings as early as they could have been. Either way there is likely to be some time wasted in the form of a passenger "time buffer" which is analogous to the schedule buffers used by airlines.

7.46 A measure of the level of uncertainty is the 95th percentile of the various distributions as described earlier. The Heathrow data shown in Exhibit 4-61 is reproduced below:

Exhibit 7-11 Summary of Heathrow Holding Delays

		Stack	ATFM	Ground	Pre-start-up
Summer	Total (000s mins)	565	389	1404	537
	Average (mins)	5.3	2.8	10.0	4.6
	95th %ile	10-15	15-25	14-22	19
Winter	Total (000s mins)	602	625	942	409
	Average (mins)	6.0	5.3	9.2	4.4
	95th %ile	15-20	35-45	14-22	18

Source: Helios Analysis

7.47 From this we can see that for the Stack and Ground delays the 95th percentile is roughly double the average. For AFTM and pre-start-up the spread of delay times is much larger. An extremely cautious passenger who wanted to ensure a 95% chance of being on time at their final destination would have to add a buffer into their journey plan at least equal to the current average holding minutes. If this were the case, and all this time were wasted then this would effectively double the cost of passengers Value of Time as calculated in the Cost of Holding in Exhibit 7-1, which would mean an additional £226 million annually.

7.48 In practice few people are this cautious, and not all trips are time critical so many passengers take the risk of a delay rather than trying to insure against it – planning to waste some time on every trip to avoid the risk of being delayed one trip in twenty is not practical. Secondly the time will not all be wasted, as it will most likely result in passengers taking an earlier flight if one is available and as this is a planned event, they should be able to re-organise their day around that. Thirdly, for many trips there may not be a practical option of taking an earlier flight or setting a planned meeting on arrival at a later time. Fourthly the buffer would not be planned to cover solely the runway congestion triggered delays, but also problems on arrival such as baggage and onward journey to the final destination.

7.49 Our conclusion is that only a small proportion of the theoretical upper bound of £226 M is likely to be incurred in practice, but without further research into actual passenger behaviour when planning trips it is difficult to judge how small.

Effects of uncertainty in holding times on airlines

7.50 A similar argument applies to airlines. The extent to which they build buffers in to cover the mean holding delay is already included the Costs of Holding as calculated. We have also calculated the holding delay share of standby cover as being between £3 and 5 million. We have not however estimated the cost of further buffers being built into airlines plans which occur in two ways.

7.51 Firstly the practice when setting schedule block times is to use a percentile of historic actual times, usually 65% or higher, and not the mean. The logic behind this is that by planning to the mean (or at least the median which will be close but different) would result in 50% of flights arriving later than scheduled. Adding a buffer large enough to ensure all only a few flights arrive late would extend block times to an uneconomic extent, and would also result in most flights arriving early which in itself can cause problems. The percentile chosen is then a compromise.

7.52 Secondly airlines build some slack into the schedule by either extending minimum working times for turn-rounds, or deliberately not scheduling too tightly to allow some resilience and ability to recover from delays when they occur. This has not been measure as it varies from carrier to carrier, and also from year to year as aircraft availability cannot always be adjusted in line with demand.

7.53 The current Cost of Holding relating to aircraft ownership at Heathrow is, from Exhibit 7-1, around £50 million. A judgement based on our discussions with airlines would be that there is at least a further £10 million of hidden cost driven by the uncertainty in delays which is additional to the costs given to cover the average holding delays. This figure would need to be validated but is consistent with estimates made by British Airways.

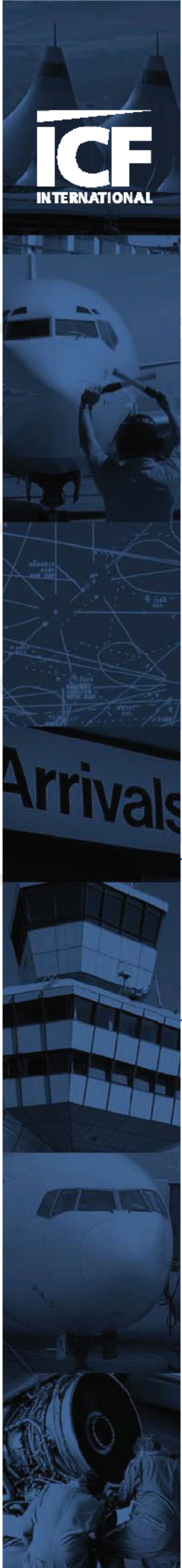
Environmental Impact

7.54 There are several potential environmental impacts to consider both from additional flights on one hand, and from increased holding delays on the other. These are primarily carbon emissions from fuel burned, other emissions (nitrous oxides), noise, and the local impact of additional traffic to and from the airport.

7.55 The only element measured in economic terms is the carbon consumption, although the NOx emissions were also calculated. There is no noise impact from ATFM Ground Holding, and only a very small impact from increased time in the stacks or taxiing.

7.56 The increased release of carbon dioxide and nitrous oxides were calculated similarly to the fuel burn of the airlines. We have estimated the CO2 and NOx emissions that correspond to the typical fuel burn values of aircraft operating to Heathrow using the values from the ICAO Engine Emissions Database. (see values in Exhibit 9-1) Then we scaled up these numbers according to the traffic mix and holding times of each scenario. We have then applied the Radiative Forcing Factor of 1.9 for CO2 in the stacks, following the DfT methodology, to reflect the expected greater impact on CO2 released at altitude

7.57 We have also expressed the CO2 emissions in monetary terms, using the DEFRA recommended £19/tonne increasing by 2% a year in real terms from the base year value in 2000.



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Part IV:
Root Cause Analysis

8 ROOT CAUSE ANALYSIS

INTRODUCTION

8.1 This part of the report, prepared by XPX Consulting, can be read as a stand-alone document, but most benefit is gained if read in conjunction with the other parts. The root cause analysis concentrated on a thorough assessment of the current operation, modelling of some optional scenarios in terms of the impact on airborne and ground holding and quantifying the economic impact of these changes to the capacity/demand balance – all in order to inform policy development on that balance. The scope of the main study was both Heathrow and Gatwick airports.

8.2 This section of the document reflects the work, undertaken by XPX Consulting, which is directed at understanding better why the current position has evolved in the way it has and to postulate directions of improvement opportunities – compatible with the optional scenarios of the modelling and also to help ensure that any implementation arising from policy and operational changes would have the best possible chance of success.

8.3 By common consent, and by comparison with benchmarks, the operational performance and robustness at Heathrow, in particular, are unsatisfactory. There are numerous causes – many going beyond runway demand and capacity, and therefore outside the scope of this study – but nevertheless, sound runway performance and resilience are essential conditions of overall airport success.

8.4 The focus of this section of the report will be on Heathrow – the operational analysis has demonstrated for Gatwick that the combination of overall spare capacity and mixed mode operation creates less pressure on runway performance, resulting in much lower levels of queuing (for arrivals at least) and cancellations and, therefore, fewer seriously disrupted days. The overall level of runway resilience at Gatwick can be expected to remain acceptable unless and until the demand levels increase in the afternoon period and/or excessive delays on departures cause a knock-on effect to arrivals.

8.5 Also the bias will be towards arrivals rather than departures. Departures runway scheduling limits are higher than for arrivals and therefore are less of a constraint, unless TEAM is in operation. Holds in the departures process are also more difficult to analyse at a root cause level within the scope of this short exercise. Queuing for arrivals is largely transparent through ATFM data and airborne holds – only speed controls and/or re-directed flight plans are difficult to assess – whereas the operational analysis has demonstrated for departures the difficulty in separating different causes of demand bunching and the capacity restrictions implied in MDIs and intermediate forms of queuing.

8.6 The views expressed are based on review of the same data as used in the operational analysis, additional data and analyses from stakeholders, the outcomes of previous exercises and discussions with a wide cross-section of stakeholders. In addition, at the request of the CAA, in order to aid debate XPX has incorporated some of its own viewpoints and tentative suggestions for future work to improve runway resilience, based on its own experience and informed by the operational analysis in the main report.

SUMMARY

8.7 The discussion will point to four main strands of root cause issues:

- Pressure on the Capacity Declaration procedures to create additional capacity – but with a process which does not have, nor is asked to have, a full set of planning parameters, metrics, and targets to make it sufficiently operationally realistic. An example is in-bound pre-departure ATFM delays which, although often caused by factors beyond the airport's control, happen on a daily basis - it would therefore seem prudent to have a collective stakeholder response in addition to the schedule buffering introduced by airlines (using their own internal assumptions). The process also lacks any real power to drive any difficult changes – particularly reductions in capacity/demand. This is exacerbated by the current lack of economic trade-off metrics.
- Pressure on tactical ATC management to correct the imbalances created by weaknesses in the plan, airline adherence to plan and factors outside their control. Over time, tactical reserve positions have been eroded and effectively incorporated into the assumed operation e.g. TEAM in the early morning. Small but measurable increases in demand and adverse trends in aircraft mix are adding to the problems and potentially further weakening resilience.
- Bunching of runway demand, caused in part by peaks within the schedule but also by airline processes and performance which do not consistently deliver aircraft on plan (although again recognising network factors which may be beyond their control).
- Gaps in the governance structure and processes which result in limited incentives and sanctions around adherence to plan and responses to endemic issues. While there are many planning and performance committees and improvement initiatives, there are few system-wide key

performance indicators (KPIs) – resulting in gaps e.g. again relating to the ATFM delay problem described above and, until recent community effort, a fully co-ordinated response to days of serious disruption. This can be exacerbated by funding debates where benefits and costs accumulate in different organisations.

8.8 It should be stressed that the airport and its community of airline users have a set of planning, governance and performance review structures which are fully compliant with EU slot regulations, safety and DfT regulations, and IATA scheduling guidelines, and which are highly respected in the aviation industry. However, the problems of congestion, environment and disruption specific to Heathrow appear now to demand a new and higher order of targeting, planning and managing at the airport. We have assumed for the purposes of this study that the legislative and regulatory frameworks mentioned above will remain in place as the context for Heathrow operational planning, albeit that some of the parameters affecting demand and/or capacity may be modified.

8.9 Clearly, there are no simple solutions – different levels of mixed mode have been modelled in the main exercise (and in other studies) and operationally it has the advantage of potentially allowing increased demand and/or restoring tactical capacity (and increased arrival separations) to improve resilience.

8.10 Short of mixed mode, or alongside it, there are a number of options which could be developed – some of which are already on the continuous improvement agenda and some of which could be addressed through a co-ordinated effort if the relevant targets, objectives and amended governance structures could be agreed. Examples include:

- Changes to the shape of the schedule and incorporation of more extensive and realistic planning parameters to smooth patterns of capacity and demand. Subject to technical feasibility and further detailed modelling (beyond the scope of this study), holds should be reduced by levelling flows over the day. It is possible that technical constraints associated with such a move could lead to a marginal reduction in capacity – which may carry economic penalties to airlines as a result of losing some commercially valuable slots in the peaks.
- Targeted reductions in capacity to induce a reduction in demand. Some modelling has been reported in the main report on general reductions – in practice there would be a range of options, the most valuable in terms of operational performance concentrating on "firebreaks" – short gaps or reductions in the airport's daily schedule - to relieve the impact of the peaks. The resultant loss in aircraft traffic movements would be off-set, in terms of passengers, through demand shifting to other services either

side of the change in the schedule (leading to higher load factor and/or reinforcing trends to larger aircraft).

- Resilience and operational control improvements to help restore tactical resilience. These measures are unlikely to allow increases in demand but would assist resilience and facilitate punctuality improvement. Examples include:
  - Improved control and process discipline from implementation of wider Collaborative Decision Making – this is in development at Heathrow.
  - Time-based separation – this would be a significant development requiring substantial work on the safety case for moving from current distance-based separation.
  - Extended application of TEAM – there are detailed options which are more specific than those modelled in the main project. This may require Government policy approval, given the noise implications, depending on the level of change required to the guidelines.
- A fuller package of targets, planning parameters and KPIs within a strengthened governance structure could tighten control of the operation and introduce more sanctions and incentives. Steps might include changes to the "first come, first served" procedures, new measurement points in the processes and trade-off decision support.
- Achieving change of this kind would also tighten the distribution curves to improve predictability - other drivers of poor punctuality at the airport could then be addressed with greater confidence and less interaction with runway performance.

8.11 These approaches address the identified root causes, but in terms of measured impact, most would be reflected in specific elements of performance (e.g. ATFM holds or cancellations) - rather than the fundamentals of the relationship between capacity and demand which was the focus of the main study. Therefore, rather than talk about overall improvement, it is necessary either to construct a package of changes or to specify more granular targets (e.g. reduced number of disrupted days) and to prioritise relevant initiatives.

8.12 In any event, a more holistic view of targets and governance is likely to be required to balance the historic pressures to increase the level of demand with acceptable operational integrity.

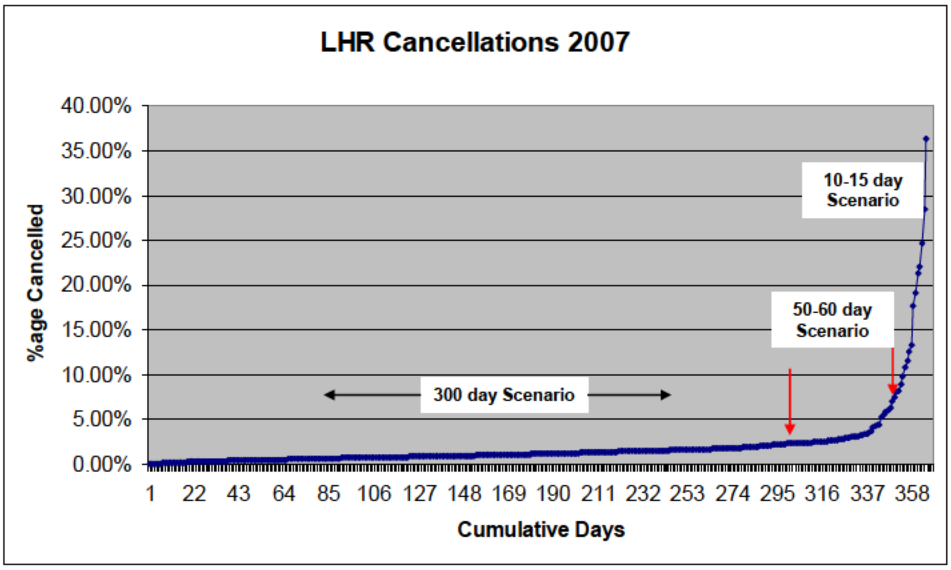
8.13 The rest of this section sets out a more detailed examination of the root cause issues and realistic responses.

8.14 To understand the underlying issues and possible mitigating solutions it is useful to look at three different operational scenarios at the airport (simplified from the spectrum observed):

- For 300 days of the year, the runway and airport system achieve at least 98% of the planned programme – i.e. less than 2% of flights are cancelled for operational reasons (although this does not necessarily imply high levels of punctuality)
- For 50-60 days the corresponding completion is between 93 and 98% - disruption and delays are significant but, by and large, the airport is able to recover back to schedule in time for the following day. Airlines may have to make major operational changes (e.g. to aircraft and crew allocations) to achieve this.
- For the other 10-15 days the figure is less than 93%, equating to at least 50 flight-pair cancellations - disruption and delays are very significant, often with repercussions to schedules and operations on the following days.

8.15 These scenarios are consistent with the test conditions used in the main report. The number of days at each cancellation level is shown in Exhibit 8-1.

Exhibit 8-1: Distribution of Number of Cancellations for Heathrow in 2007



Source: XPX analysis of ACL data

8.16 The 10-15 day scenario usually is driven by severe weather conditions significantly reducing runway capacity (or occasionally, a major bottleneck somewhere else in the system e.g. caused by a security incident). The number of actual events may have been smaller but can have generated serious knock-on effects into the following day(s).

8.17 The 50-60 day scenario can be caused by a large variety of conditions – most commonly related to weather but also a range of issues such as short operational incidents or problems elsewhere in the European network.

8.18 As well as almost certainly leading to serious punctuality problems, both scenarios will threaten Night Jet Movement quotas at LHR and lead to steps to avoid breaching curfews at some destination airports. They will also cause punctuality and cancellation problems to be disproportionately concentrated into shorthaul routes as longhaul inbounds will be prioritised by the ATFM system and longhaul departures will be protected by the airlines for a series of operational and commercial reasons. The problems may be further concentrated by the biasing of cancellations by base airlines into routes which provide the quickest and least penalising relief – hence domestic and near continental routes will tend to suffer more.

8.19 In the 300 day scenario, the runway does not inhibit the completion of the programme in total – but other issues can cause a pattern of capacity and demand which creates significant punctuality problems and knock-on problems for the runway

8.20 For a complete picture, each "regularity" scenario should be accompanied by a hold pattern as illustrated in the main report (covering the basic data and the case studies of December and November last year), and relevant punctuality data (which is beyond the scope of this phase).

8.21 To a large extent, the pattern of the three (simplified) scenarios described above is an inevitable consequence of a "full" airport, driven by the commercial pressures to maximise schedule slots. However, there are no structured policy, planning or operational processes which consider whether the above pattern is acceptable, exacerbated by the lack of trade-off criteria, which this overall initiative should help to inform.

8.22 While any improvement initiative would benefit all these situations, there are differences in their characteristics and root causes and therefore in the steps which might create opportunities.

8.23 Each of these three scenarios is now considered in a little more detail.

10-15 day scenario

8.24 It is almost impossible to plan strategically for the 10-15 day scenario, or substantially to improve resilience, short of radical action to support flow-rates through Mixed Mode or to reduce capacity substantially (- virtually certain to be uneconomic). The benefit of Mixed Mode and spare capacity was illustrated in the case study comparison between Heathrow and Gatwick in the main report.

8.25 Within the existing broad operating regime (i.e. predominantly Segregated Mode) the focus needs to be on anticipation of problems, protocols to govern cancellations equitably and beneficially, contingency plans for all aspects of the airport system (extending to hotels etc) and procedures to apply for possible relaxation of the NJM[20] quota. These topics are currently the subject of an airport community consultation and policy development process – in response to some of the experiences of recent seasons.

50-60 day scenario

8.26 It is difficult to plan strategically for this scenario. From time to time consideration has been given to, say, schedules which vary by the month to reflect differing anticipated weather and global wind conditions – but the current Northern Hemisphere 2-season approach has always been concluded to be the "least worst" approach. The observations which underpin the modelling of airborne and outbound ground holds in the Capacity Declaration Process are based on "normal" days but an average cannot realistically embrace the range of conditions experienced.

8.27 In some ways, this is the category which would benefit most from policy, technological and operational improvements. Typically in this scenario, the cause of disruption is a particular issue (e.g. wind) and therefore may be mitigated by specific improvements which address that cause – in the case of winds, Time Based Separation. (Time Based Separation is the most effective antidote to the reduced flow rate normally connected with high winds).

8.28 On the schedule front, relatively small reductions in demand might be expected to generate significant results (as discussed again in the main report). Although full impact assessment has not been done, it is possible that focussed "firebreaks" might be more beneficial than across-the-board reductions. This is because gaps or reductions of this nature may allow airlines to re-establish their operations for the rest of the day. Benefits may, therefore, be felt more in

[20] Night Jet Movement – the number of aircraft movements outside normal operating hours

punctuality than in measured runway performance – however, this would clearly be to the overall benefit of the airport.

8.29 Operationally TEAM is already used within guidelines with a net benefit in runway utilisation, but currently there are few other tactical alleviation options remaining. Some airlines have been forced to generate tactical cancellation algorithms to address the situation. Although difficult to quantify, it also appears that in this 50-60 day scenario (when the European network is stretched), the way in which the CFMU[21] system works, combined with pilot behaviours, may exacerbate recovery difficulties. Issues include the ways in which flight plans are/are not deleted or up-dated and the use of EOBT (Estimated Off-Block Time) figures in the process of assigning CTOTs[22]. These issues can have the effect of rendering some of the information used in the CFMU allocation system as inaccurate – the net effect being that potential take-off slots can go unused, slowing recovery.

8.30 It would be technically possible for the anticipation and contingency approaches being developed for the 10-15 day scenario to be extended – but this is not planned at present.

8.31 More detail on optional solutions is discussed below.

BASE CASE – THE 300 DAY SCENARIO

8.32 This is effectively the base case scenario. Some level of operational cancellation will be inevitable in response to technical problems and punctuality recovery. The remainder of any disruption may relate to runway issues, but the runway contribution to any operational difficulties is driven more by the detailed way in which demand and capacity are distributed over the day. Comprehensive benchmarking on cancellations is difficult as different airports use different reporting methods and definitions. However, restricting the benchmarks to LGW shows similar patterns up to this 300 day level.

8.33 In this “300 day scenario” operational cancellations remain below 2% (as seen in Exhibit 1)This does not imply that 2% is necessarily an acceptable level of cancellations – it is around 14 flight pairs per day – but it seems to represent the upper level of relatively typical current operations, with no significant external pressures.

[21] Central Flow Management Unit – the Eurocontrol organisation which co-ordinates the network response to capacity bottlenecks
[22] Calculated Take-off Time – the take-off time assigned by the CFMU to balance capacity and demand in constrained elements of the European network

8.34 To understand the issues in this base case it is valuable to pose four questions:

- Is the base plan realistic and feasible?
- Is there a systemic pattern to operational outcomes which could be understood and addressed?
- Are variances managed adequately through the airport's performance management system?
- Do the governance, regulatory and policy frameworks help or hinder performance?

The Plan

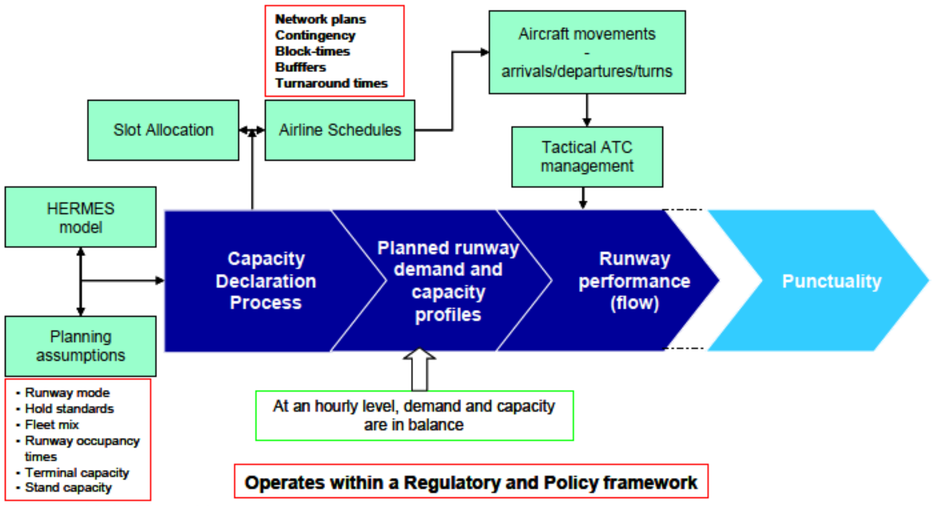
8.35 The Capacity Declaration and Scheduling processes deliver a plan (both for demand and capacity) which should, in theory, produce no more operational difficulties than holds – airborne inbound and ground outbound – which can be reasonably anticipated by airlines in their block-time assumptions and therefore their schedules. Although this has obvious cost and environmental penalties, the historic view has been that this was acceptable to maximise runway utilisation. A maximum of 10 minutes average hold[23] (arrivals and departures) has been set as a standard within the process, although for arrivals this is compromised by the facility to introduce ATFM holds.

8.36 These are the key runway parameters that are assumed in the Capacity Declaration Process and the assessment of whether any additional demand can be met within the runway scheduling limits.

8.37 The process is intended to be a pragmatic reflection of what is achievable rather than a calculation of a theoretical capacity with contingency allowances. The process is illustrated in Exhibit 8-2.

[23] The average 10 minute delay criterion was first introduced in the early 1990's to respond to excessive delays in the busy hours. This pre-dates more sophisticated co-ordination processes and ATFM procedures.

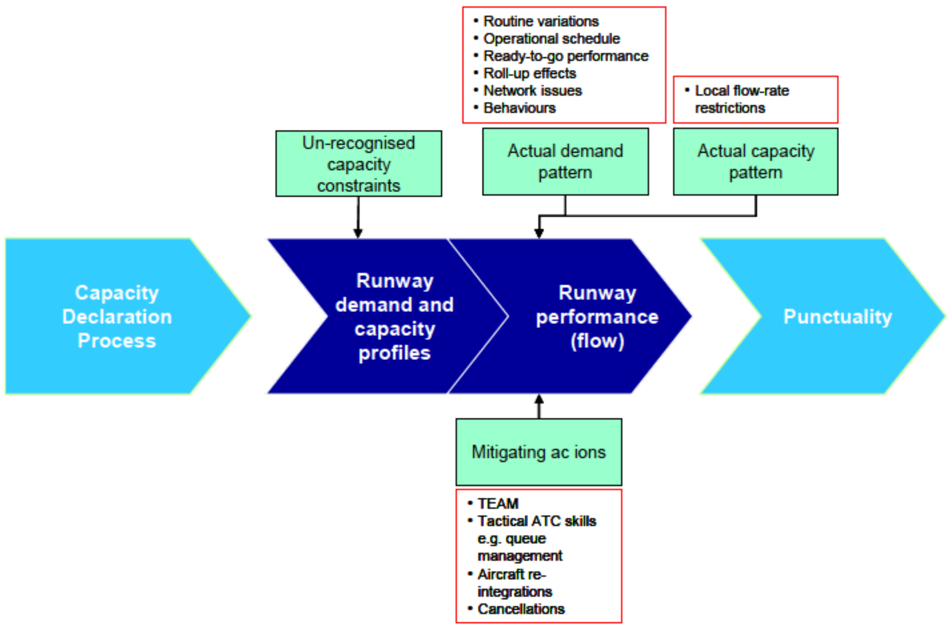
Exhibit 8-2: Relationship of Capacity Declaration and Runway Performance



Source: XPX Consulting

8.38 Clearly it does not produce the intended result in practice, typically resulting in peaks in the runway demand:capacity ratio which underpin much of the operational challenge. There are a host of reasons for poor runway performance (and resultant punctuality problems) in a highly complex set of interdependencies – many of which are connected to the rest of the European network, the ability of airlines to execute processes on time and the levels of contingency which can be justified. The main ones are shown in Exhibit 8-33 below.

Exhibit 8-3: "On-the-day" Influences on Runway Performance



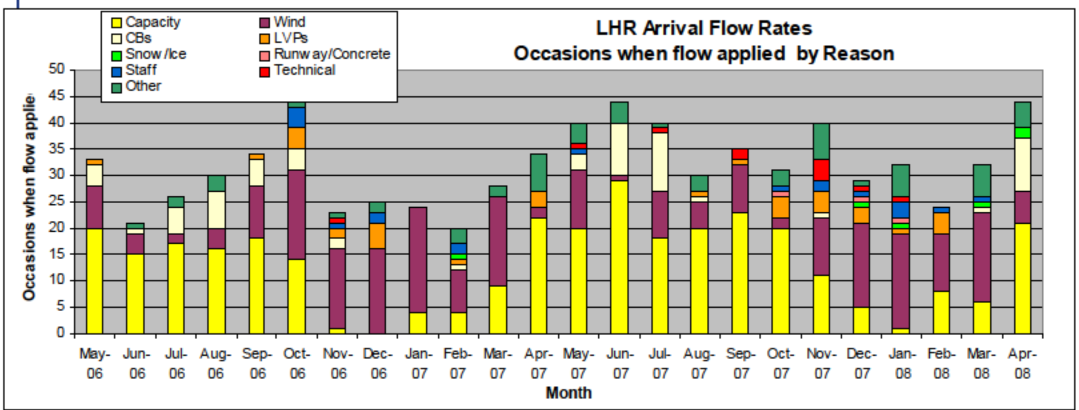
Source: XPX Consulting

8.39 The collective planning process is restricted to the airport and its immediate environment. Although the Runway Scheduling Limits meetings do report some pre-departure delays and undelayed demand in the observed data for the previous season, no specific account is taken in the agreed schedule pattern. As LHR flow restrictions and the resultant pre-departure holds occur on an almost daily basis and result in ATFM holds of the same order of magnitude as airborne holds, this seems a significant and systemic gap, which is likely to contribute to the observed lack of resilience in runway operations. (Source of quantification: Helios analysis). Airlines can introduce additional buffers but they are difficult to target and very expensive in shorthaul aircraft utilisation, again as quantified in the main report. The process has also continued to squeeze more slots into the schedule over recent seasons, although at a marginal level. Between Summer 2003 and Summer 2007 the Runway Scheduling Limits for arrivals grew by 4 movements per day (+0.6%) and the average number of scheduled arrivals rose by 19 (+2.9%) for the same period. The difference between the two is created by airline schedules "filling in" the small number of unused airport slots. (Source: XPX analysis of ACL data)

8.40 Airline Block Time calculation processes will potentially capture the effects of airborne holds and ground holding off-blocks but not delays resulting from air traffic flow regulations.

8.41 There is prime facie evidence that the airspace in the adjoining sectors can also inhibit tactical airport capacity – both for arrivals and departures. This initial view has been formed as one possible interpretation of the pattern of regulations observed and reflected in Exhibit 8-4 below.

Exhibit 8-4: Incidence of Flow-rate Regulation



Source: Airline Analysis

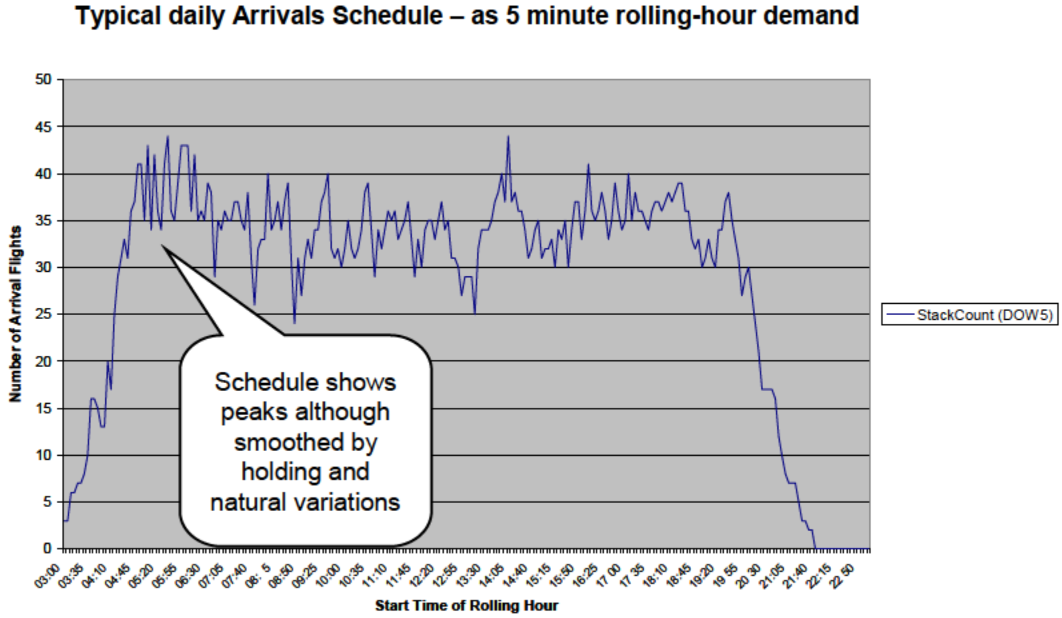
8.42 The numbers of capacity-based regulations (coloured yellow) appear to peak in a seasonal fashion over the summer. There is very little variation in the Heathrow schedule over this time, so a plausible interpretation is that the level of air traffic generally, and specifically in airspace adjacent to Heathrow, may be playing a part – i.e. the total traffic in the airspace around Heathrow does have a seasonal pattern, due to airports such as Luton and Stansted, whereas Heathrow traffic is much less seasonal, other than the general differences between the Winter and Summer seasons.

8.43 It could be postulated that Minimum Departure Intervals (MDIs) could also be influenced in this way, although there is no supporting data as yet. Although the levels of ATFM delay (as measured in minutes) are not large they do initiate restriction processes which can be disruptive beyond their immediate impact due to the periods of recovery from them.

8.44 The trends in some of the variables in the capacity model are also adverse – e.g. the required separation for the A380, and the increasing proportion of "heavy" aircraft to "medium", particularly at certain times. As an illustration, the proportion of wide-body aircraft at Heathrow has grown from 34% in Summer 2006 to 37% expected in 2008. (Source: ACL). These issues are understood by the community, but if no co-ordination parameter is broken, it is difficult to make any explicit allowance in scheduling for this information. Slots can equally be allocated to Long- or Short-haul without regard to the impact on the arrivals flow rate arising from the mix of aircraft types – the binding constraint on scheduling aircraft types are constraints from stand or terminal capacities.

8.45 A contribution to the problem is also found in the shape of the schedule which bunches within the hour around commercially attractive times. However, there are detailed co-ordination constraints which will limit the effect. This effect is illustrated by looking at a rolling hour schedule, based on 5 minute intervals as shown in the Exhibit below. Of course, within a clock hour, the schedule always remains within the Scheduling Limits.

Exhibit 8-5: Schedule expressed as a Rolling-Hour Demand



Source: XPX Analysis of ACL data

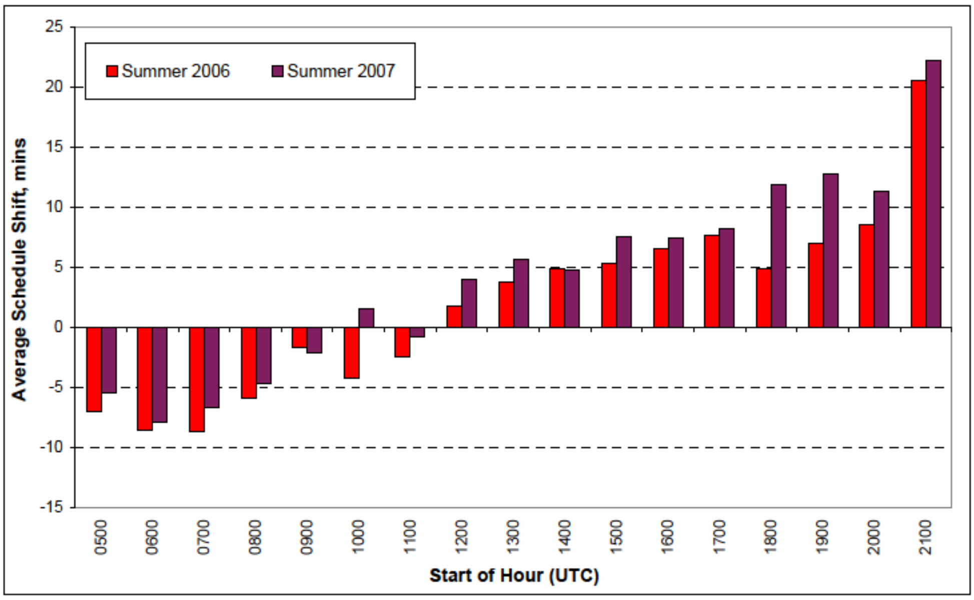
8.46 The improvement challenge in these areas is therefore to smooth the capacity and demand better over the day, and to recognise the full set of constraints and operational realities. Potential techniques are discussed later. These are not without penalties – the longhaul peaks are there for commercial and operational reasons. However, if holds could be materially reduced there would be prospects for a significant net benefit. ACL have been progressively attempting to achieve a level of smoothing through a process of slot flexing around the peaks.

Operations

8.47 In practice, actual demand patterns vary from plan. Particular difficulty is created when over-demand is anticipated, which prompts flow-rate regulation to manage the number of aircraft down to safe levels in airspace sectors or the stacks. Equivalent over-demand can be produced in departures. The reasons for over-demand are complex – combining the "self-fulfilling" element of planning for a hold in airline block-time assumptions, pilot behaviours, airline delays, the natural variations in block-times that result from winds, and changed flight plan routings and aircraft speeds.

8.48 The extent of "schedule shift" – i.e. the amount that aircraft are off-schedule, varies over the day, so the original schedule and plan are no longer being adhered to, and pressure is put on tactical ATC to increase flow-rates, if possible, or to initiate regulation procedures which will restore the demand: capacity balance. An example is shown below in Exhibit 8-6

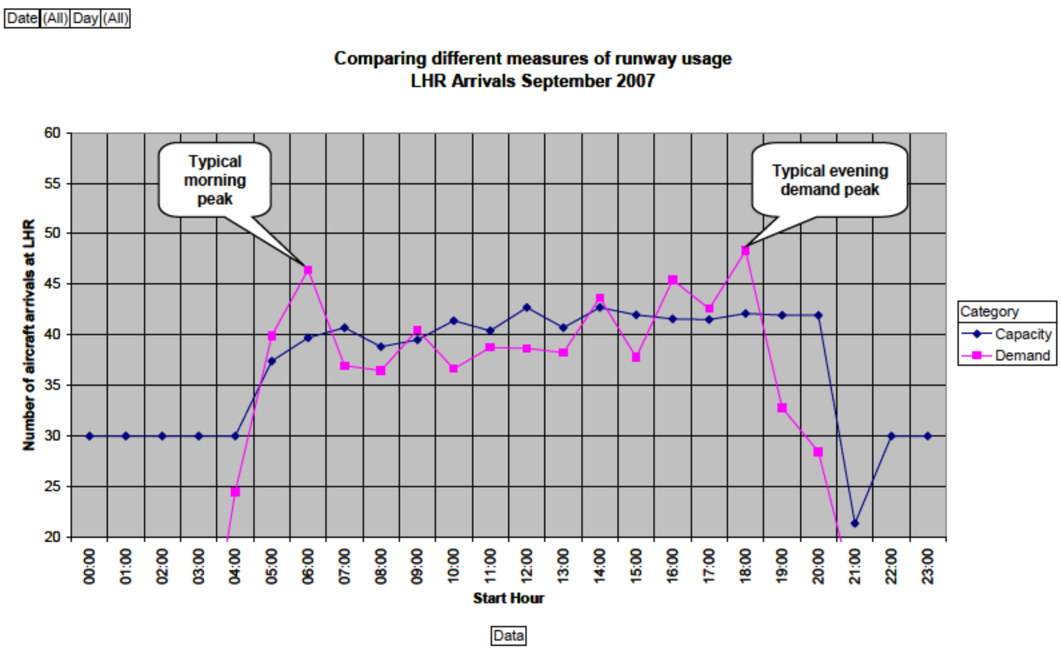
Exhibit 8-6: Short-haul Schedule Shift for Arrivals



Source: NATS Capacity Studies

8.49 A negative figure indicates arrival into area at a time in advance of what would be strictly necessary to match the schedule – a positive indicates delay. Different patterns exist for Long-haul and for departures, but the same basic point applies. These figures also appear to be worsening over recent years (Source: XPX analysis of NATS Capacity Studies). "Early" arrivals can be absorbed to an extent with airborne holds – "late" obviously cannot. It can be seen how the above pattern would help create the bi-modal distribution characterised so consistently in the main report, ands illustrated in Exhibit 8-7 below

Exhibit 8-7: Typical Distribution of Capacity and Demand over the Day

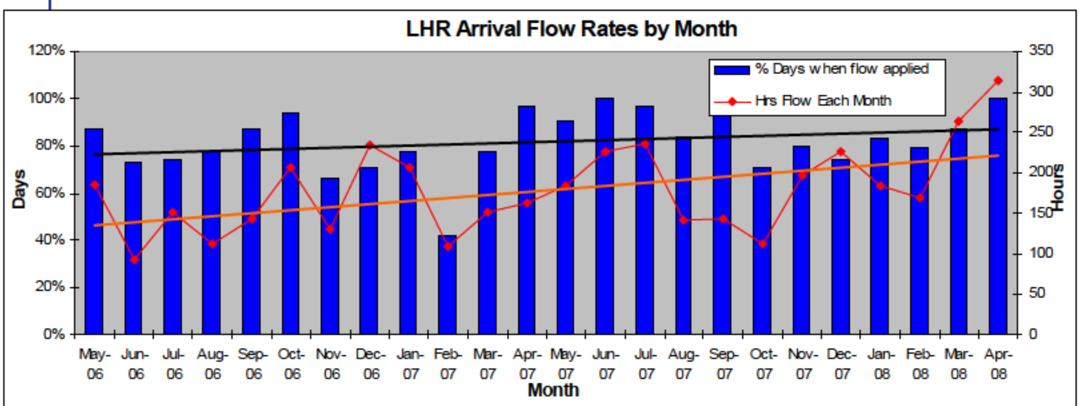


Source: XPX Analysis of Helios and CFMU data

8.50 The demand bunching from that bi-polar picture can be mitigated early in the morning with TEAM (which is applied now at Heathrow on an almost daily basis). The evening peak is more difficult, and is an increasing problem, based on delayed short-haul flights and a number of long-haul flights arriving at the same time. Thus the same basic conditions are re-created but with less flexibility due to departures demand.

8.51 Capacity may also be limited in the base case scenario owing to a short-duration weather or capacity issue. Flow-rate regulations are common and have trended upwards in recent years. Exhibit 8-8 illustrates.

Exhibit 8-8: Occurrence of Regulation at Heathrow

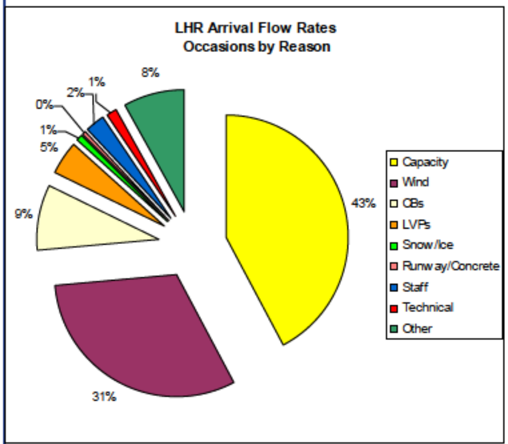


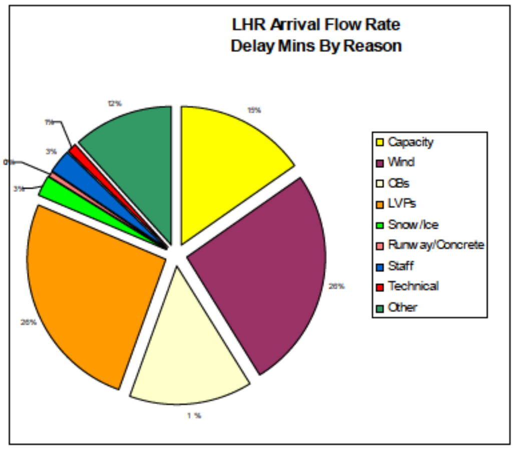
Source: Airline Analysis

8.52 The average over this 2-year period is regulation occurring on 25 days per month for a total of 184 operating hours per month, i.e. around 7 hours per affected day on average. Of course, not all are equally penalising as was illustrated in the main report.

8.53 In order to get a fuller picture, one should also look at the cause and extent of delays generated. Exhibit 9 shows the number of occurrences broken down by reason the resulting minutes of ATFM hold broken down by the same reason code.

Exhibit 8-9: Occurrence of Regulation and Level of Delay – by Reason





Source: Airline Analysis

8.54 It can be seen that three most interesting situations are:- capacity-related accounting for 43% of occasions and 15% of delay; wind-related accounting for 31% of occasions and 26% of delay; and Low Visibility accounting for 5% of occasions but 26% of delay.

8.55 However, whatever the reason and severity, flow-rate regulation is a fairly "blunt instrument" in the way in which the CFMU process works and the time-lag to restoring full flow. Judgement is involved for NATS Traffic Managers in both applying and relaxing constraints. In the base case scenario flow rate levels are unlikely to drop to the point of generating significant cancellations (of the order of 38 movements per hour for two hours as a guideline).

8.56 Possible improvement initiatives are discussed shortly, including ones already on the agenda of the airport.

8.57 Many operational improvement initiatives are assumed and/or supported and facilitated as part of the SESAR initiative (or the intermediate Eurocontrol DMEAN and TMA2010 programmes) as the airport contribution to increasing capacity and performance in the European network. To derive maximum benefit, similar processes should be adopted in a "critical mass" of European airports.

Performance Management

8.58 There are a number of community committees which monitor aspects of performance – the most relevant being the Slot Performance Committee, the Flight Operations Performance Committee and the Capacity Limits and Runway Performance Improvement Groups. In addition, the airlines will have their own measures, particularly around on- and off-stand punctuality.

8.59 However, the process measurements which underpin the data submitted to these groups do not always facilitate removing the layers of a problem to get at underlying causes.

8.60 As an example, the lack of transparent data around MDIs and their impact blurs understanding issues such as airspace limitations on outbound SIDs24.

8.61 As a final comment in this section, care should always be exercised in assessing opportunities based solely on delay "codings", i.e. the attribution of delay to one of a number of common causes – they can sometimes mask other factors at play and, therefore, action which appears to eliminate a problem may only reveal another, previously hidden, one. Thus impact analyses should always attempt to measure the success of underlying processes and not only their apparent results.

Governance and Policy and Regulatory Frameworks

8.62 This is a large topic and will form the focus of discussions on how the conclusions of this study can be used to inform policy development. At this stage, however, a few observations can be made on how the current framework can inhibit the development of solutions.

8.63 The combination of slot regulations, the Capacity Declaration Process (all of which are consistent with IATA Worldwide Scheduling Guidelines) and slot exchange practices creates, in effect, a "one-way valve" with limited opportunities to reduce capacity – slots in peak periods are unlikely to return to the pool. The performance of the slot management arrangements is subject to a limited number of metrics, designed to ensure that as demand rises, capacity is not created at the expense of degradation in service (i.e. longer delays). There are, however, a number of 'missing metrics' which would be needed to be factored into a more comprehensive management of demand versus capacity. There is also clear evidence, from the operational and financial analysis in the main report, which indicates clearly that the current and prospective balance of the system is not at an economic optimum – in other words, current regulations, slot

[24] Standard Instrument Departure – the routing allocated to departing aircraft

coordination and airlines' operational performance have resulted in economically wasteful 'over-scheduling' (with associated adverse environmental impacts).

8.64 The lack of performance standards has already been mentioned – in practice there are very few binding external constraints, sharp sanctions and / or incentives to motivate collective performance development among stakeholders. Clearly each individual stakeholder experiences "pain" as a result of collective failure (and contributes to it) but the commercial and competitive pressures, allied to differing KPI structures and corporate ambitions, slow the pace of development. Airlines in particular are locked into a 'free rider' problem as a result of their slot ownership – marginal additional slots have a high positive value to airline acquiring them, as illustrated by values attached to slots in the secondary market, but impose a higher negative cost on Heathrow airlines and passengers in general.

8.65 In essence, the governance mechanisms in these operational areas lack some of the checks and balances required to match the obvious and appropriate desire to maximise throughput.

Optional Improvement Initiatives

8.66 The only strategies which could be expected to achieve an "across-the-board" step change improvement in runway performance and resilience at LHR are Mixed Mode operation or significant demand reduction. Mixed Mode has been modelled in the main report (and other studies) and is, of course, the subject of consultation by the Government involving many factors beyond operational resilience. Reduced demand has been modelled at both the general level and for reductions at specific times. These both move performance along the demand: capacity power-law curve and in the model produce a range of quantified impacts.

8.67 Short of Mixed Mode, there are a number of options which could be beneficial in the medium term – although individually on a smaller scale and influencing specific aspects of performance (e.g. cancellation levels or ATFM delays as opposed to broad improvement). Many are already on the agenda of the airport community in terms of continuous improvement initiatives or the larger-scale developments of airspace design and technologies in the UK and Europe. Others are not and are within the scope of stakeholders and policy-makers to move forward.

8.68 Qualitative indications of impacts and benefits; and implementation and accountability issues are discussed later. Quantitative analysis and detailed feasibility assessments have not been undertaken as part of this study.

8.69 At present we will simply list the main elements of the "menu". For the purposes of this section, improvements could arise from one or more of:

- Targeted and specific reductions in movements.
- Sustaining landing rates (in particular) over a wider range of weather and operational conditions
- Smoothing and matching realistic demand and capacity more evenly over the operating day
- Optimising all relevant operational processes
- Tightening control and adherence to plan through performance management

8.70 Some improvements would be necessary just to reverse the downward graph over the last few years and future adverse trends – although the early signs from T5 operation indicate that improved operating processes can improve punctuality which in turn should feed through to consistency of the runway operation.

8.71 In more detail, the main current and optional initiatives are as follows.

8.72 Optional demand reduction scenarios are modelled in the main report. For individual airlines there are obvious commercial penalties as well as the collective resilience benefits. With targeted and specific demand reduction the downside could be minimised if aimed at consistent problem periods and linked to mechanisms to maintain passenger throughput and schedule connectivity. To avoid specific disadvantages to any individual airline this would need to be implemented progressively through the re-timing of historic slots and/or the management of slots returned to the pool.

8.73 Extension of TEAM has also been modelled at a general level. There may be additional opportunities for very targeted extension of the application of TEAM. A specific example includes landing A380s under TEAM rules to minimise separation problems (an idea which has been raised in the community – and will be considered in more depth as their numbers and schedule timing begin to affect the airport). Another example is using TEAM to change the balance of arrival and departure delays i.e. deliberately increasing average departure delays to reduce arrivals delays, under normal conditions. (This is already effectively done under stretched circumstances). There may also be a small number of opportunities for tactical enhancement of departures – i.e. at certain times introducing specific departures on the arrival runway

8.74 Smoothing of the schedule can reduce periods where actual demand exceeds capacity on a consistent basis. This is achieved to a limited extent at present by voluntary flexing within the Scheduling processes (i.e. decreasing slots in one period and increasing by the same amount in another). Total runway capacity is not affected.

8.75 Extension and revision of the Capacity Declaration planning parameters would aim to better reflect the operational realities of the airport. Example areas are

1. pre-departure delays, particularly if these cannot be removed by smoothing techniques and operational improvements
2. possible airspace constraints for both arrivals and departures, and incorporating these into the planning process or taking mitigating action
3. possible changes to the standards applied e.g. targeting a reduction in airborne hold averages
4. co-ordination parameters which might limit the "heavy/medium" mix at certain hours of the day

There would thus be a significant extension of the parameters used in the co-ordination process, and a probable re-design of some of the mechanics, particularly to ensure that any process changes and results stayed within EU legislation and industry standards.

8.76 The community has been working recently on protocols for disruption management at times of capacity restriction. This has been in response to some major issues in the recent past when days of serious runway flow-restriction (or other incidents) have been compounded by failure in other aspects of airport logistics. Excessive weight can also be placed on base carriers who feel the greatest pressure to implement cancellations – to the benefit of the airport, but also competitors! Work is in progress to finalise protocols and procedures which would help mitigate the issues and set up control and decision-making structures. This is, however, restricted to days of significant disruption – i.e. the 10 – 15 day scenario of this report. In principle, such protocols and structures could be applied more broadly, into the 50-60 day scenario, in tandem with process and data improvements to better share operational status and plan information among stakeholders.

8.77 Time-Based Separation is an approach which has been mooted for many years and is the subject of both local and European research and development. At present, wake vortex separations, based on distance, necessarily imply a reduction in flow-rate when headwinds cause a reduction in the effective speed of arriving aircraft. Switching to separations based on time would obviously sustain landing rates at planned levels when they would otherwise drop. It is a large topic within the industry, and within programmes such as SESAR, but has major procedural and safety questions, which would need to be answered. For these reasons, it cannot be viewed as a "quick" solution, and is likely to require improvements in meteorological inputs. However, given the potential local benefits, there is a case for Heathrow to play a significant role in further development and validation of the concept.

8.78 Research and development, again at both local and European/Industry levels, continues into technologies and techniques which might reduce effective/average separations for both arrivals and departures. This includes a group of techniques with different characteristics but the same overall objective. Included are

- Wake vortex detection techniques which could increase both arrival and departure flow rates, at a tactical level, when cross-winds and climatic conditions disperse vortices rapidly.
- Arrival management software and procedures (AMAN) which can "fine-tune" sequencing and approach and implement any changes to sequencing policies, i.e. prioritise arrival and/or departure sequences according to a broader rule set.
- Aircraft equipment levels, and runway features to clear the runway as quickly and safely as possible

8.79 Although outside the direct remit of the local airport community, a number of stakeholders expressed the view the view that the way in which the details of the CFMU procedures work can reduce their effectiveness in balancing equitability of CTOT distribution with maximising the number of aircraft movements achieved. As mentioned earlier this seems to particularly affect significantly disrupted days (which is when they are most needed). A review is well beyond the remit of this study but the topic should be included in the list. (The issues are as much about airline and pilot processes and procedures as about those of CFMU itself – they often take the form of trying to ensure that a flight does not "go to the back of the queue" in the CFMU allocations).

8.80 Similarly some stakeholders felt that the processes by which Heathrow regulations are applied could be improved – principally relating to capacity-based ones. As indicated previously, the number of regulations has been trending upwards. Although based on CFMU data and Traffic Load Prediction calculations, there is still much judgment involved – views have been expressed that strengthening guidelines and data quality might aid the application and, in particular, relaxation processes, subject to safety considerations, of course.

8.81 Collaborative Decision Making is a Eurocontrol-facilitated programme which was founded on the recognition that the overall Air Traffic Management system has good knowledge and control over aircraft in the sky but poor information on the status and plans of aircraft when on the ground. The result is airspace capacity being wasted and growing congestion in airports. The influence on runway performance and resilience is indirect but important. Heathrow has been implementing a CDM programme to improve the tactical knowledge of the status of aircraft, their future movements and threats to the ability to operate to schedule; and to communicate these to all relevant parties. There are full development plans which would also integrate better with the European network. A more disciplined and informed process can assist in better demand information to improve ATFM decision-making and knock-on benefits of tighter punctuality.

8.82 Performance management has already been mentioned as an area of weakness. This is a large topic, but an example of additional data which would be illuminating is the adherence to assumed planned arrival times at the "top of stack" – this is a case where CDM data collection should be able to make a significant contribution, and help to identify why arrival on schedule is not being consistently achieved. It would also separate issues to do with outstation performance and ATFM delays from those concerned with stack holding and punctuality of arrival on stand.

8.83 We have not considered the other impacts of broader airspace re-design, airline contingency initiatives or provisions, or airline and airport improvements aimed at punctuality improvement or other service quality measures.

8.84 All of the above options bring implementation challenges but clearly there is a spectrum in terms of the degree of technology or regulatory issues involved. The notion of selecting a package of potential changes based on scale of impact and ease/speed of implementation is developed in later paragraphs.

8.85 The current policy and regulatory framework is not a barrier to many of the options listed above, for example

- Revision to the Capacity Declaration process within existing legislation, to modify parameters and targets or re-distribute demand
- Enhancement of Performance Management
- Stakeholder process improvements e.g. relating to flow-rate regulations or aligned planning procedures
- Collaborative Decision Making

- Tactical extension of TEAM

Of course, it is possible that implementation could be improved or accelerated by policy changes, for example relating to reporting requirements or governance. Also, at some point these changes could develop to the point of reaching the limits of current regulation e.g. extension of TEAM.

8.86 Other options would require significant technological development and/or safety regulatory approval. The main ones in this category are Time-Based Separation, any technologies to reduce separations and significant changes to TEAM, as indicated above

8.87 Clearly any developments which went beyond this range into Mixed Mode scenarios bring another higher level of policy and regulatory implications.

Impact and Benefits

8.88 From the above list, no single initiative can make a dramatic improvement against the fundamentals of the capacity and demand positions and the likelihood of influences outside local control. While any of them could feed through into broad performance improvement, the immediate benefit would typically be felt in more granular aspects of performance under each of the three scenarios.

8.89 Therefore, to achieve measurable impact, a package of steps would probably be needed, combined with wider stakeholder process developments and performance management to ensure delivery. Perhaps as important would be to establish the structural and governance changes which could sustain improvement and prevent re-emergence of the declining trends of recent years – whether or not additional capacity were available. We will return to this question later.

8.90 A tabular representation is given in Appendix A, relating the list of possible initiatives to the aspects of performance influenced and an indicative scale of impact. For the base case scenario, these aspects of performance are the different types of holding incurred, the amount of tactical flow-rate headroom (i.e. a measure of the tactical scope that ATC management might have), and the levels of cancellations. For the other scenarios, the main consideration is whether the number of days of measurable disruption could be reduced.

8.91 An example of how not all aspects of performance would be affected can be seen in the case of Time-Based Separation. TBS would assist in mitigating the effects of high winds and benefit both delays and cancellations on certain days. It would not, of itself, increase the flow-rate on which the "normal" capacity of the airport is set, nor influence operational problems of demand bunching on non-wind-affected days. Implementation would also be subjected to further relatively lengthy development and safety evaluation.

8.92 However, given that wind accounts for a significant proportion of the problems (25% of ATFM delays as an indicator), it is a potentially attractive approach.

8.93 Similarly, Scheduling Smoothing – probably in conjunction with Revised Planning Parameters – could be constructed in such a way as to reduce both regulation levels and airborne/ground holding. This would, therefore, be particularly valuable for Short-haul operations and hub connections in the base case scenario. However, it would be overwhelmed when weather conditions created prolonged flow-rate reductions.

8.94 Implementation would be sensitive – requiring re-casting of slots and changes to the Capacity Declaration process to be achieved over a number of years and in a manner which respected the relevant EU slot regulations.

8.95 Detailed extended application of TEAM and detailed demand reduction could assist on a broad front as they attack the basics of the capacity: demand relationship – but the realistic scale would be limited. Implementation of any schedule adjustment would be subject to the same issues as mentioned above.

8.96 The quickest form of performance improvement may come from extension of CDM and the data measurement and "Dashboard" opportunities which come from it. Although not directly influencing capacity or demand, the improved knowledge and ability to track more granular levels of process adherence may both improve discipline and lead to better quantification of root cause problems.

8.97 From within the long list of options, the four discussed above (Schedule shaping and planning parameters, TBS, extended specific TEAM operations, and Performance Management) appear to offer a possible core package for improvement, subject to the considerations of governance and emerging policy guidance.

8.98 We have not attempted to prepare business cases for these suggestions. Indeed, lack of trade-off metrics and rapid "what-if" scenario planning tools have inhibited change in the past. The main report itself provides some quantification of the operational and economic trade-offs which would be needed to calibrate such business cases in support of any changes.

8.99 Accountability for implementation is not straightforward. Performance management and process changes which do not require safety clearance can, (and will) obviously proceed through existing structures, although funding issues can be problematic e.g. current CDM development. Similarly, schedule-related issues can be raised in existing structures but are likely to fall foul of disparate stakeholder interests without a directional framework. Technical developments will require safety regulation, although they will simultaneously be on the agenda through European initiatives.

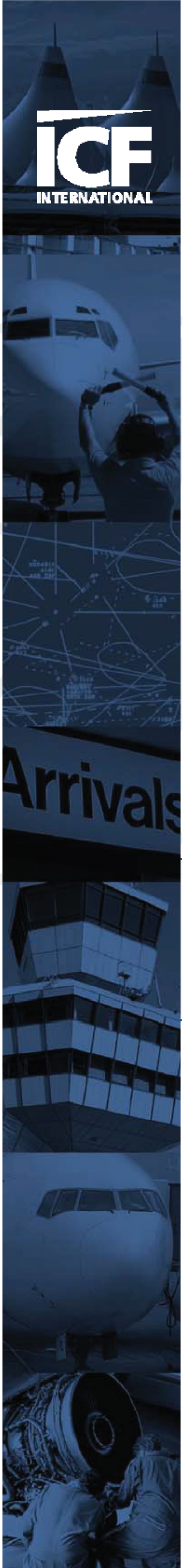
ACHIEVING CHANGE

8.100 The community puts a lot of energy and resource into trying to address the type of issue addressed in this study, as it does into other aspects of safety, infrastructure and performance. In the operational aspects discussed above and the type of improvement ideas outlined, it is difficult to get stakeholder alignment – the interests and benefits for different stakeholder groups (and individual ones within that) are diverse and difficult to embrace within a fully consensual process.

8.101 Therefore, it may be difficult to achieve pace and determination behind improvement opportunities even if business and feasibility cases look attractive.

8.102 A necessary condition for progress, and to withstand the type of pressure which has created the current position, is the strengthening of the governance arrangements – working to a set of agreed operational and developmental changes.

8.103 Through these mechanisms an operational transition could be mapped through to whatever future state is deemed appropriate at a policy level – whether that be improving the quality levels of a fundamentally-similar mode of operation through to a scenario with additional capacity. The prospect of a more robust capacity management governance process, volunteered by the industry, leading to better runway operational resilience and ultimately better passenger experience with lower environmental impact, pro rata, could be attractive to policy makers considering options for Heathrow expansion.



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Part V:
Balancing Resilience and Additional Flights

9

BALANCING RESILIENCE AND ADDITIONAL FLIGHTS

SCENARIOS AND OPERATIONAL RESULTS

The balance between resilience and enabling additional flights has been investigated for full and minimal mixed mode scenarios

- **These give the two extremes of the creation of capacity from mixed mode operations**
  - full mixed mode creates around a sizeable chunk (~15%) additional capacity (or 7 flights per hour) giving scope for a balance to be struck
  - the minimal mixed mode scenario might deliver lower levels of enhanced capacity more quickly
  - the scenarios allow extra flights to be enabled incrementally until a specified limit where resilience and the economic benefits of the additional flights are in balance
- **The full mixed mode scenario is based on the NATS full capacity mixed mode scenario used in the LHR consultation**
  - it is the most optimistic in terms of capacity increase
  - it is the most challenging to deliver (NATS states that it is operationally possible but may not be viable)
  - in addition to mixed mode operations, the full range of possible technical, operational and regulatory enhancements would have to be made, including improved scheduling, including:
    - *airspace structure*
    - *independent parallel approaches on the two runways*
    - *infrastructure improvements on the airfield*
    - *schedule smoothing*
    - *the Cranford restrictions are removed*
- **Only the runway elements are considered – other enabling factors such as taxiway, apron and terminal capacity are assumed to have been provided**

0

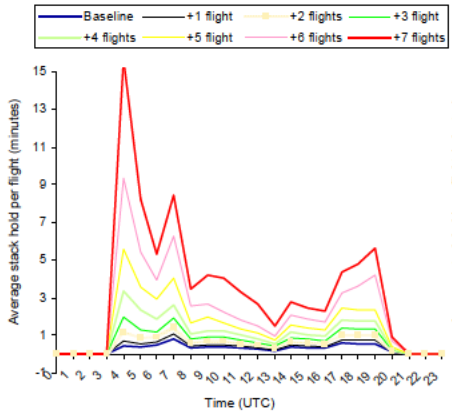
The analysis assesses the impact on delays of additional demand compared to a baseline for full mixed mode with current demand

- **All three of stack holding, ATFM delays and ground holding have been assessed**
- **Demand has been added incrementally across the operational day for up to seven flights per hour**

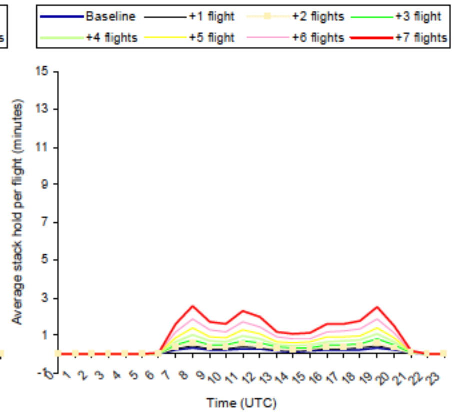
1

The impact of adding flights on stacks is severe in summer but is ameliorated by the marginally lower levels of demand in winter…

Impact on LHR stack holding of adding incremental demand across the day in full mixed mode operations (summer season)



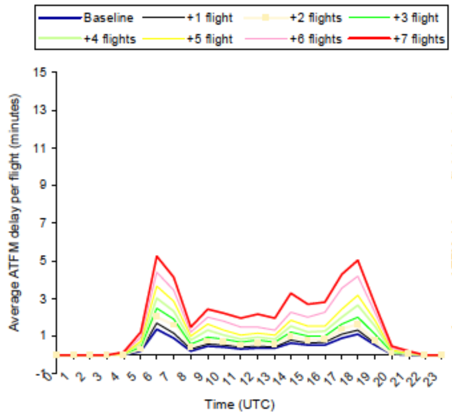
Impact on LHR stack holding of adding incremental demand across the day in full mixed mode operations (winter season)



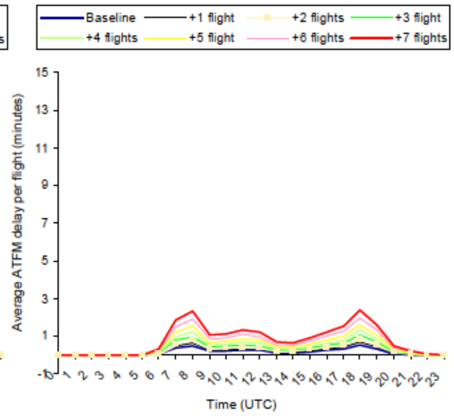
2

… whereas the impact on ATFM delays due to LHR regulations is more similar in summer and winter

Impact on LHR ATFM delays holding of adding incremental demand across the day in full mixed mode operations (summer season)



Impact on LHR ATFM delays of adding incremental demand across the day in full mixed mode operations (winter season)



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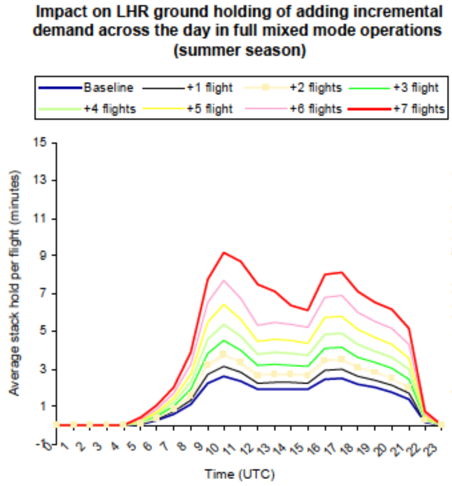
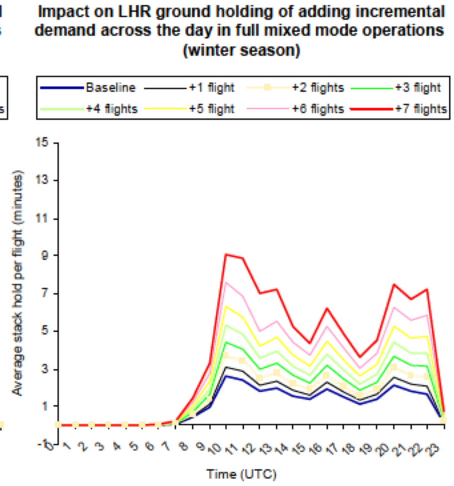
There is very little difference between summer and winter in the impact of adding flights on ground holding





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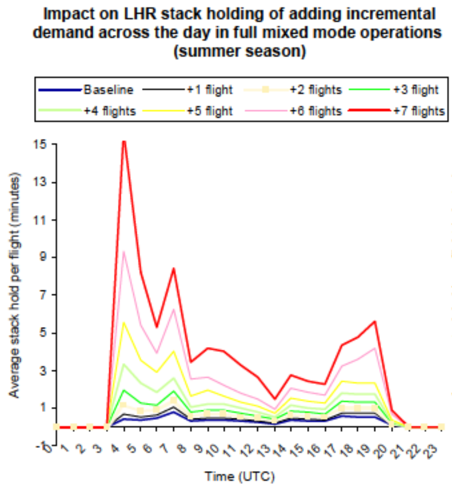
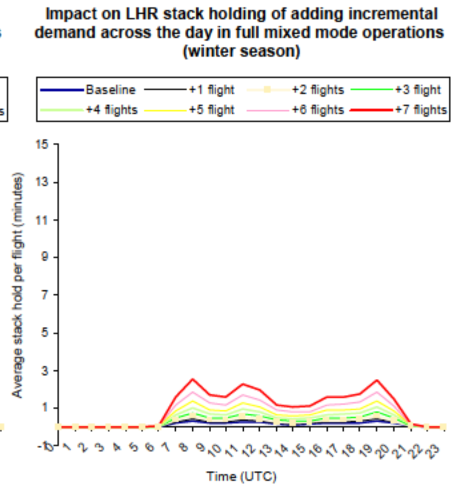
4

The impact of adding flights on stacks is severe in summer but is ameliorated by the marginally lower levels of demand in winter…





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5

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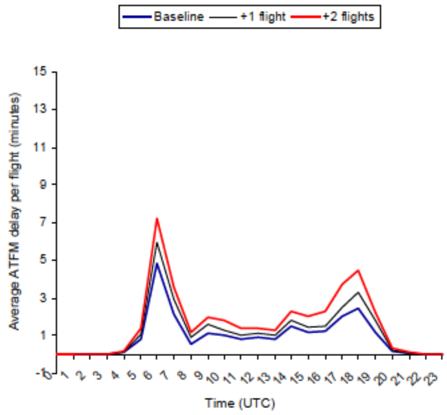
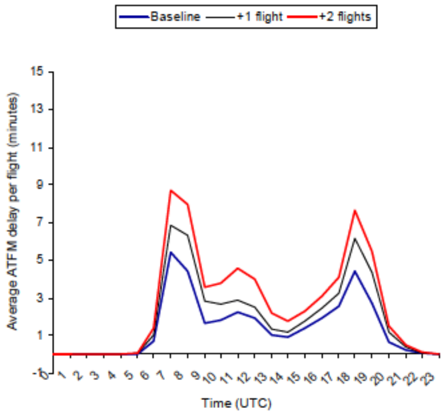
… whereas the impact on ATFM delays due to LHR regulations is more similar in summer and winter

Impact on LHR ATFM delays holding of adding incremental demand across the day in 5% mixed mode operations (summer season)



Impact on LHR ATFM delays of adding incremental demand across the day in 5% mixed mode operations (winter season)



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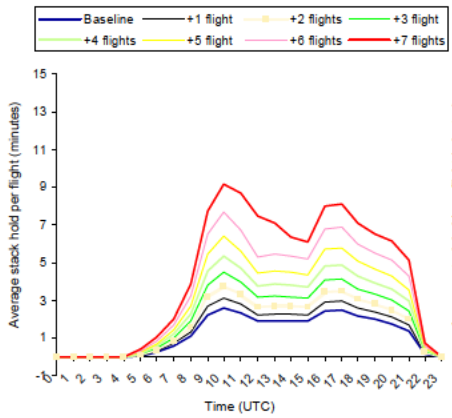
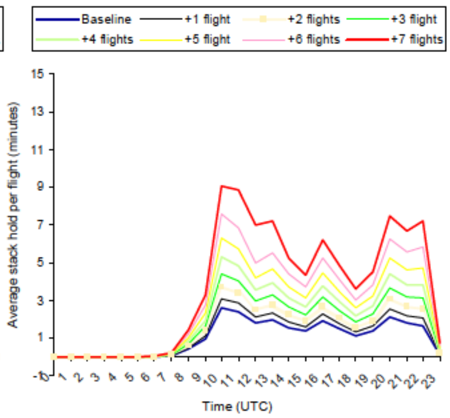
There is very little difference between summer and winter in the impact of adding flights on ground holding

Impact on LHR ground holding of adding incremental demand across the day in full mixed mode operations (summer season)



Impact on LHR ground holding of adding incremental demand across the day in full mixed mode operations (winter season)



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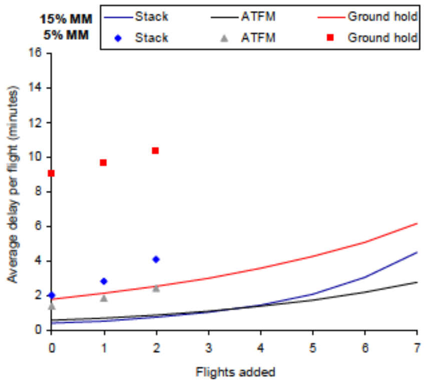
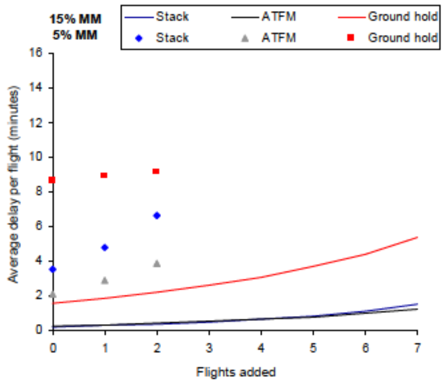
7

There is a clear relationship between the number of flights added and the average of each component of delay

Relationship between number of flights added and the average delay per flight (summer season)



Relationship between number of flights added and the average delay per flight (winter season)



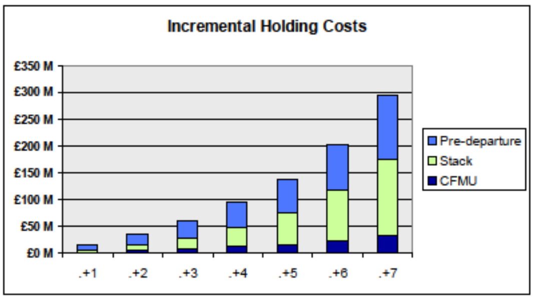
To keep average holding below 5 minutes for full mixed mode, a maximum of 5 of the available 7 slots per hour can be used

- **Ground holding is the dominant factor**
- **However, with 5 slots being used, the peaks for ground holding and stack holding exceed 5 minutes at key times**
- **Use of 4 slots would reduce the peak in the average holding time to below 5 minutes for stack holding but would be marginal at the peaks for ground holding**
- **Use of 3 of the available 7 slots would ensure that average holding did not exceed 5 minutes**
  - peaks for stacks are predicted to be around 2minutes
  - peaks for ATFM delays are predicted to be around 2.5 minutes (but note that these would still be incurred solely by short haul flights and would be much greater for each delayed flight)
  - peaks for ground holding would be expected to be around 4.5 minutes
- **Conclusion: operational considerations indicate that between 40 and 60% of the additional capacity delivered by mixed mode should be reserved for resilience**

We have analysed the economic impact of adding extra flights

- **To recap this means**
  - Calculating the incremental holding costs for airlines and passengers
  - This includes also the costs of the environmental impact in terms of carbon emissions, and also passenger value of time
  - We then estimate the benefits of additional flying and then compare the trade-off between extra holding costs and extra benefits.
- **The benefits of extra flights come from**
  - Existing passengers benefitting from more convenient schedules
  - New passengers gaining from new lower fares
  - Airports from the extra profit derived from additional flights and passengers
  - Addi ional Air Passenger Duty
  - with costs or dis-benefits coming from the carbon cost of the additional flights
- **In this further analysis we look at the trade off between benefits and increased holding costs as significant additional capacity is added, increasing the number of flights by up to 7 pairs per hour or rouhly 20% of current declared capacity.**

As flights are added, the costs increase exponentially



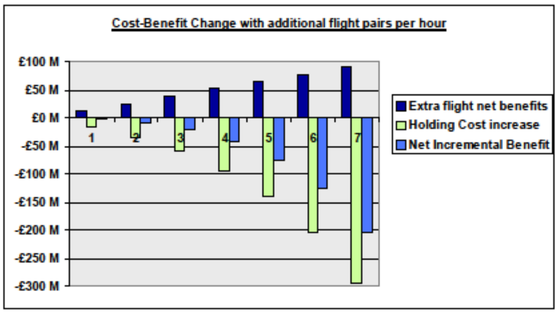
- **This represents the sum of total holding costs for Ground Holding, Inbound Stack and Departure.**
- **This includes the Cost of Carbon and the Radiative Forcing Factor of 1.9**
- **Figures are for one year at 2007 prices**

Estimation of the benefits entails some simplifying assumptions

- **We have assumed that benefits and costs of the extra flights are linear with additional capacity**
- **The only significant difference between our approach and that used by the DfT is in the calculation of Generated User Benefits**
  - we have assumed a fare drop based on a price elasticity; new or "generated" users now travel because the cost (fare) is now below their utility or threshold cost of travel.
  - the DfT would look at the reduction in the LHR shadow cost needed to drive passengers to other UK airports. Without running the DfT model it is not easy to see how quickly the shadow costs would drop as capacity is increased at LHR;
  - as noted in the main body of our report we have probably produced a lower estimate of the Generated User Benefits than would be obtained by completely replicating the DfT analysis.
- **By growing the Generated User Benefits linearly we have not explicitly reflected the fact that with additional capacity the fare itself would also be required to drop further**
  - This would cause the generated user benefits to increase as the square of the increase in capacity which would soon generate a very large figure which not be neither realistic or credible – the additional passengers would come from a combination of suppressed demand and price stimulation, not just the latter.
  - The counter argument is that the most beneficial flights would be added before the less beneficial flights.

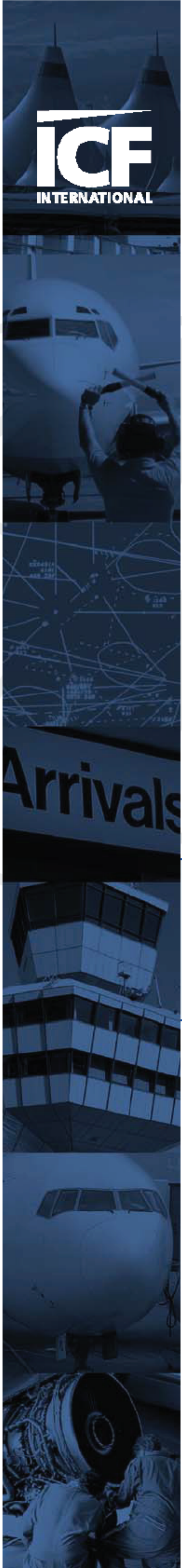
3

The net loss increases steeply as flights are added



- **The figures show the annual costs and benefits as 1,2,3… flights are added in each hour.**
- **The conclusion is that there is no balance point – additional flights increasingly worsen the situation, with increased holding costs outweighing the benefits of extra flights.**

4



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Appendix A:
Terms of Reference

Economic Regulation Group
Group Director's Office

Brandon Chapman
Director
NATS (Services) Ltd
Control Tower Building
Heathrow Airport
Middlesex TW6 1JJ

11 January 2008

Dear Mr Chapman

Department for Transport's remit to the CAA for advice on improving the air passenger experience: Runway resilience

I am writing to seek your views and evidence that would help the CAA to fulfil its remit to provide advice to the Department for Transport during 2008 on improving the air passenger experience at the UK's leading airports and principally Heathrow and Gatwick. I am writing in similar terms to those stakeholders listed in **Annex A** to this letter.

As you may be aware, on 21 November the Department for Transport (DfT) published an information pack which described the end-to-end journey experience passenger for air passengers, with particular focus on Heathrow[1]. This drew on available data from CAA, BAA and NATS. DfT described this document as a first step in better understanding the end-to-end journey and user experience. In the longer term, DfT's aims are to have a more systematic evaluation of end-to-end journeys, including by airport and by airline, and to commission a full suite of data gathering to underpin policy development.

In parallel with its document, DfT commissioned advice from the CAA, under section 16(1) of the Civil Aviation Act, in three areas:

- **Through-airport passenger experience**: scope for greater transparency about the quality of service that different parties offer to passengers. CAA to report by summer 2008 on progress made and lessons learned.
- **Heathrow Terminal 5**: CAA review of early passenger experience of T5, from check-in at departure through to baggage reclaim at arrivals, to report by summer 2008.

[1] Published at http://www.dft.gov.uk/pgr/aviation/airports/improveairpassenger.pdf

Civil Aviation Authority
CAA House K402 45-59 Kingsway London WC2B 6TE www.caa.co.uk
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- **Runway resilience**: CAA review, in cooperation with airlines and airport, of lessons learned from current operations at Heathrow and Gatwick, to report by early summer 2008.

(A copy of the Secretary of State's letter to the CAA is attached as **Annex B** to this letter).

This letter describes the context for the third of these topics (runway resilience) and sets out initial thoughts on how the CAA plans to take forward this remit and the inputs it is seeking from interested parties. The CAA is writing separately to interested parties on the first and second remits.

To avoid consultation overload the CAA is seeking to target the letters to their different audiences but would be content to copy individuals or groups other letters if they wish.

Context and motivation

Due to increasing demand and constraints on developing further runways, runways at Heathrow and Gatwick have been operating very near to capacity at certain times of the day for some years. Emphasis has therefore been on managing capacity and extracting more movements by fine-tuning use of limited runway and airspace resources – subject to absolute safety requirements and limits on airborne and ground-holding delays which are deemed to be acceptable. This has led to Heathrow and Gatwick being respectively the busiest two runway and single runway international airports in the world.

This intense usage does however come with associated costs: even in normal operating circumstances flights are subject to relatively large holding delays (including airborne holding in stacks on arrival), due to the broad range of factors, including weather, serviceability and en-route delays that impact on flight schedules. Maintaining high throughput rates, at Heathrow for example can only be maintained by having a ready pool of arrival traffic and, to date, this has been achieved by the use of holding stacks. Where the short-term capacity is further affected by, for example, by weather or emergency incident, the limited slack means that there is a relatively small margin before flow rates are affected. It also limits the rate at which the airport can clear any back-log of flights.

This balance between the number of movements and the implicit delays was agreed in broad terms by airports and airlines some years ago (increasing from 5 to 10 minutes average delay at Heathrow). There are a number of reasons to reconsider now whether current planned standards provide the best outcome for future operations:

- Is there an opportunity to place the interests of the passenger more firmly centre stage in assessing the balance in future between runway capacity, resilience and delays?
- In the context of environmental pressures relating to both noise and global warming, is airborne holding at current and projected levels an efficient use of resources?
- How far would greater resilience in the operation of these airports be an attractive feature for airlines aiming to offer a more reliable timetable?
- Does airline scheduling need to be addressed in a different way in future?

Such consideration is likely to be more useful where there is the prospect of additional capacity: such growth in potential capacity would offer the choice of taking some or all of the additional capacity in terms of additional resilience rather than additional volume in terms of releasing more slots. The introduction of mixed mode as an interim measure, on which the Government is currently consulting in the context of the Heathrow expansion consultation, could offer a realistic opportunity to reconsider the balance between capacity, resilience and delays.

Continued (2 of 3 pages)

Scope

The CAA suggests that its advice to DfT on this remit cover the following scope:

Runway resilience at Heathrow and Gatwick, with reference to:

- the relative costs and benefits of the current balance of intensity of use and resilience;
- any further technical changes in prospect which would affect this balance; and
- where an ideal balance might be struck if additional capacity were made available; and
- taking full account of the passenger interest and the environment.

Information sources

The CAA anticipates two main sources of information to meet this remit: first, responses from interested parties to this commissioning letter and further dialogue with industry on this topic; and second, the outputs from technical consultancy commissioned by the CAA. The CAA currently envisages that the latter would encompass:

- airport-specific data collection, analysis and modelling of delay in various normal and abnormal operating scenarios;
- collation and modelling of available information – e.g. cost of various categories of holding delay (including environmental costs), value of additional slots.

Views invited and suggested timetable

In light of the context outlined above, the CAA would welcome your views on the lessons to be learned for future runway resilience from current operations at Heathrow and Gatwick.

In order to assist the CAA in meeting its remit for advice to the DfT by summer 2008, we suggest the following timetable:

- Written responses to this initial scoping letter, by 29 February 2008;
- CAA commissions consultants to provide initial scope of analysis – January to March;
- CAA holds bilateral meetings with stakeholders – March to April;
- CAA's consultants work with stakeholders on analysis – March to May;
- CAA convenes stakeholder workshop - May;
- CAA submits preliminary advice to DfT by end June 2008.

I look forward to your reply. I, or Daniel Storey here (020 7453 6270), would be happy to discuss further this remit and request for views.

Yours sincerely

[redacted]

Continued (3 of 3 pages)

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Civil Aviation Authority

REQUIREMENT

Advice to CAA on resilience in runway operations at Heathrow and Gatwick

Terms of reference

Introduction

1. On 21 November 2007, the Department for Transport (DfT) published an information paper that described the end-to-end journey experience passenger for air passengers, with particular focus on Heathrow. This drew on available data from CAA, BAA and NATS. DfT described this document as a first step in better understanding the end-to-end journey and user experience. In the longer term, DfT's aims are to have a more systematic evaluation of end-to-end journeys, including by airport and by airline, and to commission a full suite of data gathering to underpin policy development.

2. In parallel with its document, DfT commissioned advice from the CAA, under section 16(1) of the Civil Aviation Act, in three areas:

   - Through-airport passenger experience: scope for greater transparency about the quality of service that different parties offer to passengers. CAA to report by summer 2008 on progress made and lessons learned.
   - Heathrow Terminal 5: CAA review of early passenger experience of T5, from check-in at departure through to baggage reclaim at arrivals, to report by summer 2008.
   - Runway resilience: CAA review, in cooperation with airlines and airport, of lessons learned from current operations at Heathrow and Gatwick, to report by early summer 2008.

   (A copy of the Secretary of State's letter to the CAA is attached as **Annex A**.)

3. These Terms of Reference address the third of these topics (runway resilience).

4. On 11 January 2008, the CAA wrote to interested parties to consult on the scope and timetable for the runway resilience element of the study in the following terms. (A copy of the CAA's letter is attached as **Annex B**.) The CAA sought the views of interested parties by 29 February 2008. The responses received are attached as **Annex C**.

Advice required

5. The CAA is hereby seeking to commission consultants to conduct the following tasks:

Page 1 of 9

- to provide advice on the runway resilience issues identified in the CAA's letter of 11 January 2008;
- to draw together or procure existing available sources of evidence and analysis (including relevant detailed modelling);
- to identify where this needs to be supplemented by further information gathering and or analysis;
- to fill in these gaps (to the extent that can be achieved within the budgets and timescales agreed); and
- to set out the trade-offs in a manner which can be used for informing future policy.

6. The DfT's request is explicit that the CAA's advice should be prepared in cooperation with the airports and airlines. The consultants will therefore have to interact with stakeholders extensively both to gather (or where relevant to procure) information from relevant parties, but also to ensure that its analysis is likely to be understood and be persuasive. To assist this the CAA envisages two workshops with stakeholders.

7. The CAA requires the consultants to set out the problem definition and a framework for bringing together each of the component parts of its analysis. On the basis of this, the CAA would require the consultants to provide advice on the following issues:

Relative costs and benefits of the current balance of intensity of use and resilience;

8. At a high level, the CAA would require the consultants to reach a view on the costs and benefits at the margin of scheduling an additional flight subject to current levels of capacity by time of day and season (given that both the costs and benefits are likely to vary through the day and the season).

9. Such an analysis would:

- identify the types of costs and benefits involved and the parties on which they fall;
- identify the expected costs arising from scheduling an additional flight: e.g. the costs of delay, additional flying costs, additional scheduling buffers etc:
  - in normal operating conditions; and
  - in non-normal conditions (i.e. where the service rates of traffic are reduced (e.g. by weather) or the pattern of traffic e.g. due to incidents);
- the value of these costs, having regard to the possibility that these costs may not be linear with the length of delays etc. This analysis should have cognisance of and draw on, where relevant, previous published research in this area[1].

[1] For example, research by the University of Westminster for Eurocontrol: Evaluating the True Cost to Airlines of One Minute of Airborne or Ground Delay, University of Westminster, May 2004, published at www.eurocontrol.int/prc/gallery/content/public/Docs/cost_of_delay.pdf

10. It is envisaged that this analysis will rely heavily on a critical review and use of existing sources of data and modelling where these are available and adequate, for example:

- the relationship between additional declared flights and delay (in normal operating conditions);
- existing authoritative estimates of the value of passenger time (e.g. used by DfT) or aircraft delay (e.g. Eurocontrol, University of Westminster) modified where appropriate (e.g. to reflect the passenger income or aircraft type at Heathrow or Gatwick);
- the airport super-logs of delay events;
- Eurocontrol CFMU delay data

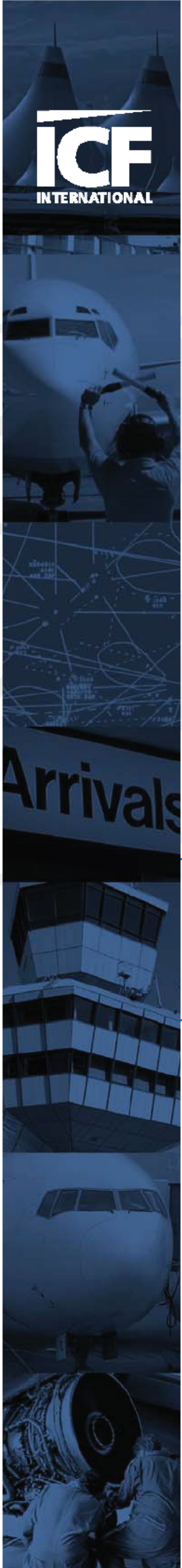
11. Where there are significant gaps in the available data or modelling, the CAA would expect the consultants to fill those gaps appropriate to the budget and timescales.

Any further technical changes in prospect which would affect this balance;

12. The CAA would require the consultants to review the prospective costs and outputs of the following with the relevant stakeholders (including DAP, NATS, airports, ACL, airlines):

- evolutionary improvements in effective capacity;
- the mixed mode options on which the Department for Transport consulted between November 2007 and February 2008[2];
- the quantification of the factors which could be taken into account when assessing where the balance might be struck if additional capacity were made available.

(The above analysis would be without prejudice to any decision which the Secretary of State for Transport may take on the future expansion of Heathrow capacity, following consultation from November 2007 to February 2008.)



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Appendix B:
Costs of Holding and Delays

COST OF HOLDING AND DELAYS

9.1 There have been several previous studies looking at the economic impact of delays. In particular

- "Costs of air transport delay in Europe", Institut du Transport Aerien, November 2000, for Eurocontrol.
- "Evaluating the true cost to airlines of one minute of airborne or ground delay", University of Westminster, May 2004 for Eurocontrol

The scope of and focus of both studies differed slightly from this study but we have based some parts of our analysis on them where appropriate.

9.2 Time limitation has precluded primary research so we have used previous studies, in particular the UoW supplemented with recent detailed data from several carriers coupled with industry published data e.g. ICAO, CAA Statistics. For carriers cost data we have based our analysis around AEA Data from those carriers that have kindly provided it as this gives a useful breakdown by route group and aircraft type.

Detailed traffic database

9.3 In order to model the correct traffic mix with the needed break-down we relied on the OAG schedules submitted by the airlines monthly. In the case of Heathrow the OAG schedules cover all the traffic of the airport because of the almost complete absence of non-scheduled operations. To fit our needs we have done some conversions on these schedules:

- We have converted the weekly schedules into monthly ones by scaling the frequencies up based on the number of Mondays, Tuesdays, etc… for the affected months of the S07 and W0708 seasons.
- We have matched up the aircraft types in the schedules with the corresponding number of first, business and economy seats of the aircraft of the airlines who operate to Heathrow.
- We have converted the seat capacity from step 2 into business and economy passenger traffic using average load factors for the given regions. The average load factors were those published by AEA for 2007.
- We have matched the typical fares to the passengers by region. Here we relied on the fare values published in the IATA Fare Tracker 2007 adding British Airway's fuel surcharge values to better represent the current situation.

9.4 The conversions appeared to be precise enough to reproduce Heathrow's overall traffic within a range of 1% compared to the traffic statistics published by the CAA. Our final traffic database broke-up Heathrow's traffic by the following main dimensions:

- Direction of operation (arriving-departing)
- Hour of operation, calendar day and season
- Region of operation (using the 10 standard regions of AEA)
- Operating carriers
- Operating aircraft types (using 27 different aircraft types)
- Scheduled block time of the flights
- Estimated number of passengers
- Estimated revenue

Airport costs

9.5 We have met and interviewed several professionals from BAA in order to try to identify the costs that the airport incurs due to runway-related delays. The result of the interviews was that it is not possible to separate those costs of the airport which relate to delays, or especially to runway-related delays. The general view was that the airport faces no substantial extra costs due to delays. The main reason behind this is that even if some of the traffic is delayed it still passes through the airport. Therefore, the airport generates the same revenue, only some minutes or hours later than originally scheduled.

9.6 BAA has stated it unlikely that longer dwell time of passengers as a consequence of delays would materially increase commercial revenue through the passengers' spending. This is because the average passenger spending profile levels off or even reduces above 151 minutes dwell time.

9.7 An important element in BAA's case is the effect of the single till regulation on the airport. This type of regulation channels back all possible extra revenue of the airport that it collected due to delays to the users at the end of the regulatory periods in the form of lower user charges for the next period. Therefore, any possible gains of the airport in commercial revenues are only temporary.

9.8 BAA has formulated its official view on the subject in a letter that is attached at the end of this appendix.

Impact on airlines

9.9 Our study concentrated on runway-related holding, namely

- ATFM holding,
- stack holding and
- pre-departure holding.

9.10 From an airline's perspective the main difference between the three types of holdings is the wear and tear of the aircraft and the fuel burn. Having consulted professional airline pilots we concluded that generally aircraft do not use their engines during ATFM holding and prefer to avoid using the APU as well. During pre-departure holding the usual practice is to run the engines on idle thrust as this quote from a pilot describes it: *"the taxiing phase is best represented by engines at idle thrust. In most situations, similar to an automatic car, the pilot must apply the brakes to keep the aircraft from moving with the engines at idle power. In certain situations with excessive payloads or the need for acceleration and speed, the pilot may provide a throttle blip to get the aircraft moving or attain a higher ground speed. Because of this reality, we find it appropriate to use the idle thrust levels and fuel burn for the taxiing phase of flight."*

9.11 The following table summarises the different rates used to estimate the fuel burn of the aircraft and the corresponding emissions.

Exhibit 9-1. Fuel Burn Rates and Corresponding CO2 and NOx Emissions

	Pre-departure holding NO APU			STACK			TAXI		
	Fuel burn	CO 2	Nox	Fuel burn	CO 2	Nox	Fuel burn	CO 2	Nox
Aircraft	kg / min	kg / min	kg / min	kg / min	kg / min	kg / min	kg / min	kg / min	kg / min
A300	-	-	-	76	247	1.4	13	44	0.2
A310	-	-	-	71	231	1.2	12	40	0.2
A319	-	-	-	34	111	0.5	7	22	0.1
A320	-	-	-	36	117	0.5	7	23	0.1
A321	-	-	-	46	151	0.6	7	23	0.1
A330	-	-	-	87	284	1.8	15	49	0 3
A340	-	-	-	50	163	0.9	9	30	0 2
ATR	-	-	-	12	40	0.1	3	9	-
B733	-	-	-	35	115	0.3	7	23	0.1
B734	-	-	-	37	121	0.4	7	24	0.1
B735	-	-	-	34	109	0.3	7	24	0.1
B736	-	-	-	35	114	0.3	7	21	0.1
B737	-	-	-	34	110	0.3	7	21	0.1
B738	-	-	-	36	119	0.3	7	21	0.1
B744	-	-	-	155	503	2.7	14	46	0 2
B752	-	-	-	53	173	0.8	10	33	0 2
B763	-	-	-	74	239	1.2	13	42	0 2
B772	-	-	-	102	332	2.3	19	61	0.4
B773	-	-	-	122	397	2.7	22	70	0 5
BAE146	-	-	-	12	40	0.1	3	9	-
CRJ	-	-	-	16	53	0.1	4	13	0 0
E145	-	-	-	16	51	0.2	3	10	0 0
E190	-	-	-	27	88	0.2	4	13	0 0
F50	-	-	-	28	91	0.2	7	23	0 0
MD82	-	-	-	44	144	0.4	8	27	0.1
Q400	-	-	-	12	40	0.1	3	9	-
Other	-	-	-	**61**	**199**	**1.0**	**10**	**32**	**0.2**

Source: US Form 41, ICAO Engine Emissions Database, Boeing (exclude Radiative Forcing Factor)

9.12 Using the typical fuel burn and emissions rates, the traffic database, the holding times, an average fuel price and an average price for CO2 emissions we estimated the cost of fuel and CO2 that airlines face in the different scenarios.

9.13 For CO2 burned in the air (i.e. in flight, in stack holding but not ground holding) we have applied the DEFRA recommended Radiative Forcing Factor of 1.9. [25]

9.14 To estimate the maintenance and aircraft ownership costs we have used average values by block minute of these variables as shown in the table below.

[25] DEFRA (June 2007) *Act on CO2 Calculator: Public Trial Version Data, Methodology and Assumptions Paper*
www.defra.gov.uk/environment/climatechange/uk/individual/pdf/actonco2-calc-methodology.pdf

Exhibit 9-2. Aircraft Maintenance and Ownership Costs

Aircraft	Maintenance cost GBP / min	AC ownership costs GBP / min
A300	17.35	14.02
A310	14.98	6.83
A319	3.96	9.21
A320	4.35	10.03
A321	4.93	11.26
A330	6.44	18.81
A340	10.23	16.32
ATR	2.40	8.74
B733	6.55	6.56
B734	6.42	8.12
B735	4.78	6.20
B736	3.64	8.39
B737	3.85	12.33
B738	4.07	13.20
B744	12.02	17.95
B752	7.94	8.72
B763	8.39	11.97
B772	11.03	22.01
B773	12.14	33.62
BAE146	5.46	5.18
CRJ	2.63	7.81
E145	2.30	4.91
E190	2.88	18.00
F50	3.89	2.70
MD82	4.40	2.63
Q400	2.40	10.26
Other	6.72	12.45

Source: US Form 41 and Airline and Fleet Management

9.15 Using the holding times, the traffic database and the values above we calculated the aircraft ownership and maintenance values corresponding to each scenario. We have assumed that similarly to fuel burn ATFM holding does not generate aircraft maintenance costs, because the aircraft is kept on-blocks and typical maintenance schedules are based on actual off-block times. In the case of aircraft ownership costs we have assumed that the ATFM holding contributes to the costs, because typical lease agreements and accounting practices are based on calendar time instead of block times.

9.16 Crew costs were estimated similarly to the aircraft-related costs with the difference that in this case we have tied the costs to different airlines instead of aircraft types. The ICAO financial databases provided us crew cost levels for many of the airlines operating to Heathrow. We have converted these to per block-minute levels as shown below.

Exhibit 9-3. Crew Costs of Different Airlines

Carrier	Average cost / block min GBP	
	Pilots and co-pilots	Cabin crew
British Airways	5.61	7.31
Virgin Atlantic	5.57	4.93
British Midland	4.80	2.20
Air Canada	3.76	2.87
Air India	2.79	1.98
Air France	9.51	7.80
American Airlines	5.18	3.42
Austrian Airlines	5.79	2.98
Cathay Pacific	8.70	5.86
Continental	4.22	2.72
CSA	2.45	1.27
Delta	4.66	2.48
Iberia	6.54	5.94
Jet Airways	4.04	0.79
KLM	-	-
Lufthansa	5.28	5.41
Qantas	-	-
SAS	8.57	5.61
Swiss	4.12	3.85
United	4.13	3.08
Other	4.94	4.73

Source: ICAO

9.17 From the interviews with the airlines we have concluded that they normally pay the full crew costs (fixed and variable, salaries and allowances) regardless of whether the flights are delayed or not. Therefore, we assumed that crew costs are incurred during all the three types of holding.

9.18 We have used these crew costs a second time when estimating the costs of keeping standby crews as resilience. At this occasion we have split the above costs into fixed and variable parts, assuming that the variable part is not paid to the crew on stand-by. The split was done based on the airline cost statistics published by the CAA. These only included domestic carriers, therefore we had to assume that foreign carriers split their costs equally to the average of the domestic carriers.

Impact on passengers

9.19 In theory, holding queues do not automatically affect passengers, because passengers are only affected if the flight is delayed compared to the original schedule. Therefore, before applying the holding times directly to the passengers we first had to establish the correlation between these and the schedule punctuality of the airlines. In Heathrow's example statistical evidence showed that holding times directly convert to flight delays, therefore we assumed that all holding time directly affects passengers in the form of delays.

9.20 Theory also suggests that all primary delays during the day have a knock-on effect called rotational delays on subsequent flights when the aircraft are tightly scheduled to perform several flights during the day. This is irrelevant for those costs which are related to aircraft operations, because the aircraft will still perform the same flight schedule, only somewhat later during the day. On the other hand passengers might be affected by the rotational delays if the schedule gets disrupted by these.

9.21 In Heathrow's case statistics showed that 1 minute of primary delay could cause up to a further 0.55 minutes of rotational delays depending on time of the day, region of operation, etc. However, we had to disregard this fact in our calculations, because our holding and delay data already included the rotational effects. Therefore, scaling them up by a rotational multiplier would have meant double-counting some of the delay time.

Passenger Value of Time

9.22 The DfT suggests the use of the Value of Time (VOT) figures for transport related economic studies. The VOT converts passengers' time into monetary value. It is a relatively recent approach used in transport related economics, and the methodology is still evolving. See Appendix E: Passenger Value of Time – Eurocontrol Figures for a review of other studies.

9.23 We have found two different sets of VOT values, both suggested by the DfT. The first set was published in the "Value of Travel Time Savings in the UK: Summary Report. January 2003". This suggested the following values:

Exhibit 9-4 VOT from "Value of Travel Time Saving in the UK. Summary Report. January 2003" (1997 values)

	Business travellers		Leisure travellers	
	Commuting	Other	Commuting	Other
Income band	GBP / min	GBP / min	GBP / min	GBP / min
0 - 17500	0.036	0.046	0.066	0.059
17500 - 35000	0.059	0.059	0.066	0.059
35000 -	0.086	0.071	0.066	0.059

Source: DfT

9.24 The above values have the advantage that they distinguish between the VOT by different income bands. We have used these values and the passenger traffic break-down by income bands for Heathrow from the Airport Passenger Survey which is published by the CAA to calculate weighted average VOT values for business and leisure purpose travellers. For the business passengers we

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calculated annual employment costs and divided those by 1808 annual working hours as suggested by the DfT. For the leisure passengers we scaled up the 1997 GBP values to current using the nominal GDP / capita growth rates as suggested by the same study. The results were the following values:

- Business purpose travellers: 0.99 GBP / min (59.64 GBP / hr)
- Leisure purpose travellers: 0.08 GBP / min (4.99 GBP / hr)

9.25 The "Values of time and operating costs. TAG Unit 3.5.6" publication by the DfT suggested somewhat different numbers to use.

Exhibit 9-5. VOT Values from "Values of Time and Operating Costs. TAG 3.5.6" (2002 values)

	Business (average)		Leisure	
	GBP / hr	GBP / min	GBP / hr	GBP / min
Market price	26.73	0.45	4.46	0.07

Source: DfT

9.26 Finally, during the personal interviews with the DfT we came to the final set of values that were used in our own calculations. These values were the following:

Exhibit 9-6 The VOT as Suggested by the DfT During Interviews (2007 values)

VOT	GBP / hour
UK business	50.67
UK leisure	8.48
Foreign business	58.12
Foreign leisure	8.48
Domestic scheduled	33.37

Source: DfT

9.27 Weighting the above values by the corresponding traffic share we calculated the following values that were subsequently used in all other calculations:

- Business purpose travellers: 0.91 GBP / min (54.70 GBP / hr)
- Leisure purpose travellers: 0.14 GBP / min (8.48 GBP / hr)

9.28 The traffic database estimated the business and leisure passengers based on the cabin split. Therefore, before using the above VOTs we had to modify this split to reflect purpose of travel. We did this by dividing the total number of passengers on each flight by the business-leisure split provided in the CAA's statistics. Finally, multiplying the holding times with the modified traffic data and the VOTs we calculated the total VOT values for each scenario.

Estimation of environmental impact

9.29 The environmental impacts were calculated similarly to the fuel burn of the airlines. We have estimated the CO2 and NOx emissions that correspond to the typical fuel burn values of aircraft operating to Heathrow using the values from the ICAO Engine Emissions Database. (see values in Exhibit 9-1) Then we scaled up these numbers according to the traffic mix and holding times of each scenario, and included the Radiative Forcing Factor of 1.9.

9.30 We have also expressed the CO2 emissions in monetary terms, using the DEFRA recommended value of £19/tonne in 2000 increasing in real terms by 2% a year.

Exhibit 9-7. Letter from BAA Regarding Costs of Delays to the Airport

BAA/Q5/752

Runway Resilience Study
Cost of Runway Delay to the Airport Operator

Background

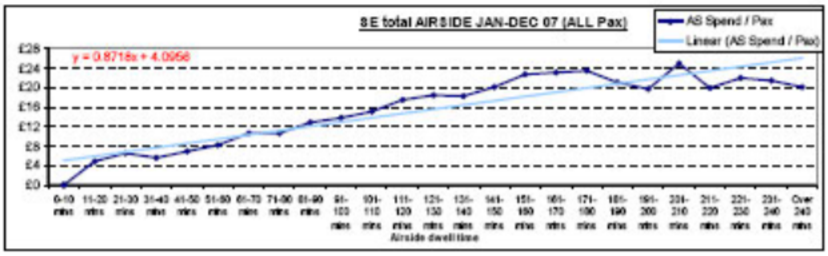
1. As part of the runway resilience study being carried out by the CAA, BAA have been asked by SH&E Limited to provide a view on the cost of runway delays to an airport operator. BAA have been asked to consider the costs from two perspectives; the "cost of failure" and the "cost of prevention". Within these areas any potential benefits to the operator are also to be considered.

2. This is a hugely complex area with many interdependencies and as a result it is difficult to define the exact costs and benefits that arise directly from runway delay. It is also worth stating again that the decision around runway capacity and delay is one which is taken jointly by airlines, the air navigation service provider and the airport operator in conjunction with ACL, who are responsible for overseeing the capacity declaration process.

Cost of Failure

3. Cost of failure to airports is most significant when flight cancellations occur. Costs can also occur due to the aerodrome congestion charge and in addition to this there are costs associated with reputational damage and passenger choice regarding whether to use the airport again in the future. Delays occurring at the end of the day can also lead to night flight dispensation costs. However calculating all of these costs, particularly future passenger choice and reputational damage, is extremely difficult. In relation to airline and passenger delay costs, the costs to an airport operator are relatively small by comparison.

4. In terms of benefits of delay to an airport operator, it has been suggested that airports will benefit due to the increase in passenger spend in the airport retail outlets during a delay. Attached below is a chart outlining how the typical passenger spend profile in the international departure lounge varies according to time.



5. It shows that passenger spend typically levels off or even reduces after 151-160 minutes. This covers all passenger spend, not just purely flights which have been delayed. It is difficult to draw conclusions from this data as it includes data for all passengers. In addition, the data relating to very long dwell times is thin. It is also worth noting that passengers, whose flights are delayed, may be waiting on the aircraft or in a gateroom when a delay occurs.

6. BAA's retail strategy is to want passengers to choose to shop. It would not be a plausible strategy to cause delay to passengers as they would be less likely to return to the airport. In any event, any retail upside will return to the airlines through the regulatory process via the single till.

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7. For arriving passengers, there may be some additional spend by those meeting them (eg increased car park spend). However it could be argued that as the number of aircraft arrive ahead of schedule (eg early morning long haul arrivals) the net effect of this is relatively minor.

Cost of Prevention

8. LHR airport is the busiest two runway airport in the world and LGW is the busiest single runway airport in the world. Over the course of a number of years numerous runway holding points and rapid exit taxiways have been added in order to decrease runway occupancy time\delay resulting in increased capacity. Much of this benefit has therefore been banked and there is relatively little that can be done to improve capacity through the building of new infrastructure at these airports, short of additional runways. Changing the way the runways operate at LHR (eg introducing mixed mode) could provide additional capacity. If the Cranford agreement were to be rescinded as part of this decision, some new RETs on 09R would be required to optimise the runway capacity, plus an additional runway hold on 09L.

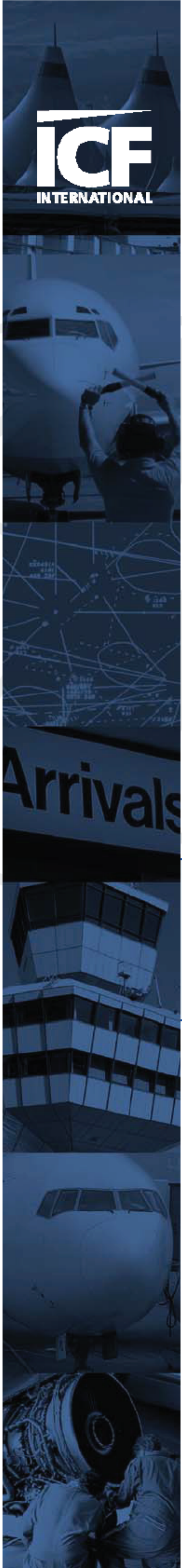
9. In the future if separations between aircraft could be reduced then this could lead to additional capacity. However this will be dependent on ATM technology which could better optimise aircraft separations on the approach to the airport and\or the aircraft design itself and whether the issue of wake vortex could be lessened. All this will come at a cost, however, it is not possible to define at this stage what the costs and benefits would be.

Overall Conclusion

10. As mentioned at the outset it is a difficult task to calculate the cost of delay for an airport operator, specifically due to the runway performance.

11. There are some failure costs for the airport operator, which are relatively small by comparison to airlines and passengers and relatively little to be gained in terms of benefit (eg due to passenger retail spend). As much of the preventative measures have already been taken to maximise runway throughout, it is recommended that the cost\benefit analysis of runway delay to the airport operator is that it is cost neutral.

Source: BAA



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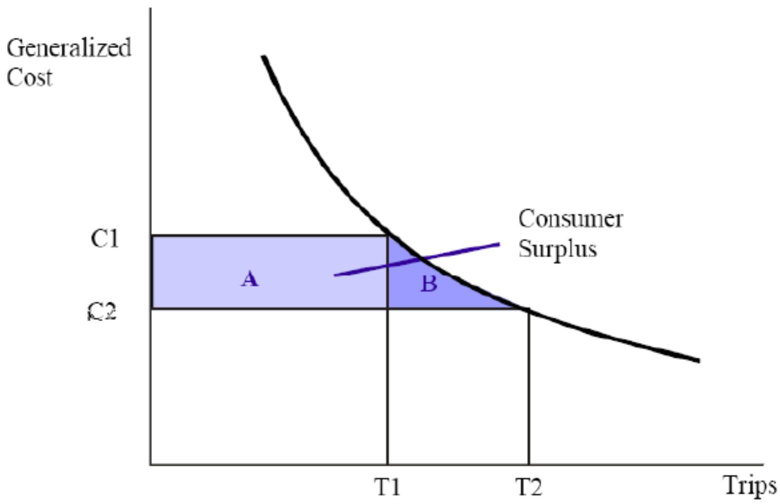
Appendix C:
EXTRA FLIGHTS – BENEFIT AND COST ASSUMPTIONS

Background- theory of consumer surplus

9.31 When extra flights are added there are changes to the costs and benefits for consumers (passengers) and suppliers (airlines and airports). Economic theory describes these effects as changes to the consumer surplus and supplier surplus. Wider economic considerations such as the impact on local employment and further benefits to the economy of UK or EU have not been considered in this study. The Department for Transport has laid down guidelines[26] for calculating the costs and benefits when evaluating transport infrastructure proposals which we have followed in our evaluation, adapting as appropriate for this assignment. This was extended by 2007 to include Air Passenger Duty and the "cost of carbon" as described in the DfT paper of 2007.[27]

Exhibit 9-8: Theory of Consumer Surplus



Source: US DOT

[26] DfT, National Transport Model Working Paper 4.

[27] DfT 'UK Air Passenger Demand and CO2 Forecasts' (November 2007),

http://www. dft.gov.uk/pgr/aviation/environmentalissues/ukairdemandandco2forecasts/

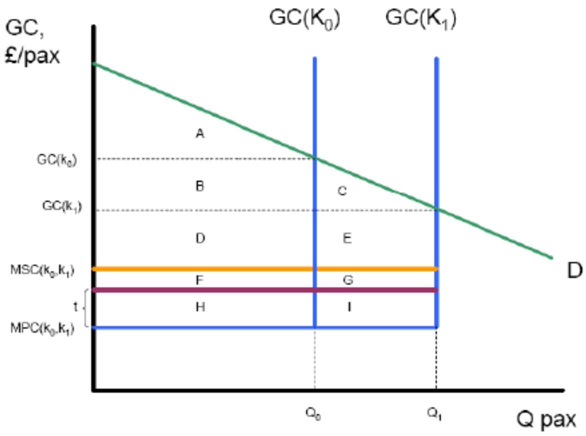
9.32 The conventional calculation of the change in "consumer surplus" assumes a price-demand curve based on price elasticity. In Exhibit 9-8 the price is referred to as the Generalized Cost, which is common in transport studies where there may be no explicit fare paid, and other costs to the consumer such as time spent in traffic jams need to be taken in to account. If the cost is reduced from C1 to C2 then the price demand-curve is used to calculate the extra number of passengers. The "consumer surplus" is defined as the difference between the cost to consumers for a good or service, and the value they place upon the good or service. In the exhibit, this equates to the area above the horizontal line above C1 or C2.

9.33 The change in consumer surplus is then the area between the two horizontal lines C1 and C2, consisting of the rectangle A and the (approximated) triangle B. A = consumer surplus gained by existing passengers; B = consumer surplus gained by new passengers, who will now travel because the cost of travel has dropped below their value.

9.34 In many cases estimating price elasticity is based simply on the fare paid, although there is also recognition that the air fare is only one of the costs of taking a trip, and elasticity with respect to total trip cost would in theory be more meaningful. While leisure passengers are generally considered to be price-sensitive, business passengers are more time-sensitive.

9.35 The DfT method defines the following categories of benefits:

Figure H1: Demand and capacity at a hypothetical airport



- Generated user benefits: C = value gained by new users attracted by the lower "fare"
- Producer benefits: E+G = airport profit per passenger x additional passengers
- APD revenue: +I

- Carbon costs: -G-I = Carbon/ATM x extra ATMs x £/tonne x 1.9 (Radiative Forcing factor)

And, not shown on the diagram,

- Existing User Benefits: +EU = Value of time x time saved from better/more frequent schedules.

9.36 The "fare" used in calculating the "Generated User Benefits" C equates to the average airport revenue/passenger plus a shadow cost, which is the fare premium needed in the DfT's UK airport demand allocation model to switch surplus demand at Heathrow to other UK airports and so balance demand against capacity. When extra capacity is added, or demand changes, the required shadow costs to balance capacity and demand also change. It does not directly relate to the average fare paid by passengers to airlines.

9.37 In our modeling we have not attempted to replicate the DfT modeling of demand at all UK airports and have effectively ignored the change in shadow costs. However we have assumed that the relationship between demand and "fare" is driven by the same price elasticities as calculated for airlines. We have used the price elasticities to calculate the % fare reduction required to generate the incremental demand, assuming passenger load factors are maintained.

9.38 The "Generated User Benefits" we have derived therefore will be lower estimates than those derived by the DfT, since our results do not reflect the change in the shadow costs.

Price Elasticity

9.39 As discussed above, the method to calculate Generated User Benefits depends on fare elasticities. Price elasticities can be calculated at different levels – airline and route specific analysis gives much higher values than analysis at total market or country to country level because of the cross-elasticity effect of passengers switching between airlines, or leisure passengers switching their destination because of price.

9.40 A recent study by IATA[28] estimated worldwide elasticities as -1.4 at the Route/Market level, -0.8 at the National level, and -0.6 at the Pan-National level. The paper gives geographic variants, and also variants for long haul and short haul, but there is no distinction between Business and Leisure.

[28] "Estimating Air Travel Demand Elasticities", prepared for IATA by Intervistas Consulting, December 2007

9.41 The most recent DfT UK Air Passenger Demand (November 2007) has lower elasticities than previously assumed in their 2000 forecast, and in particular it has zero elasticity assumed for UK Business passengers (-0.5 in 2000), -1 for UK Leisure (-1.3 in 2000) and no elasticity assumption for foreign passengers.

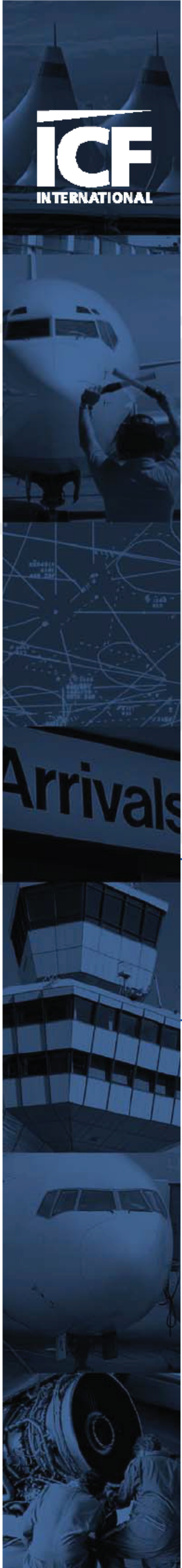
9.42 Analysis of the UK leisure market in 2005[29] by the UK CAA gives leisure figures between -0.7 and -0.8 which are consistent with the IATA figures at National level (e.g. UK to US leisure market).

9.43 For our analysis we need elasticities which are closer to route elasticities as we are assessing the impact of adding capacity and hence fares changes on one route, not the impact on a total market of an average fare change. The elasticities we have used are for Business Passengers -0.3 and for Leisure Passengers -1.

Routes versus Regions

9.44 When modelling the impact of adding an extra flight, we would ideally have some assumptions about which route or region the flight would be added to. In practice the DfT method does not allow this level of differentiation – shadow costs, and producer costs and benefits are single values for each airport - so this aspect has not been modelled either for User Benefits or Producer Benefits.

[29] "Demand for Outbound Leisure Air Travel and its Key Drivers", December 2005



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Appendix D:
STATISTICAL DISTRIBUTIONS

INTRODUCTION

9.45 This annex contains the statistical distribution functions derived for Heathrow for:

- stack holding times for arrivals
- airport ATFM delays attributed to Heathrow
- ground holding delays for departures.

9.46 The distributions are presented for each hour over the summer and winter seasons and are presented as both the frequency distributions of the holding times/delays as well as the associated cumulative distributions.

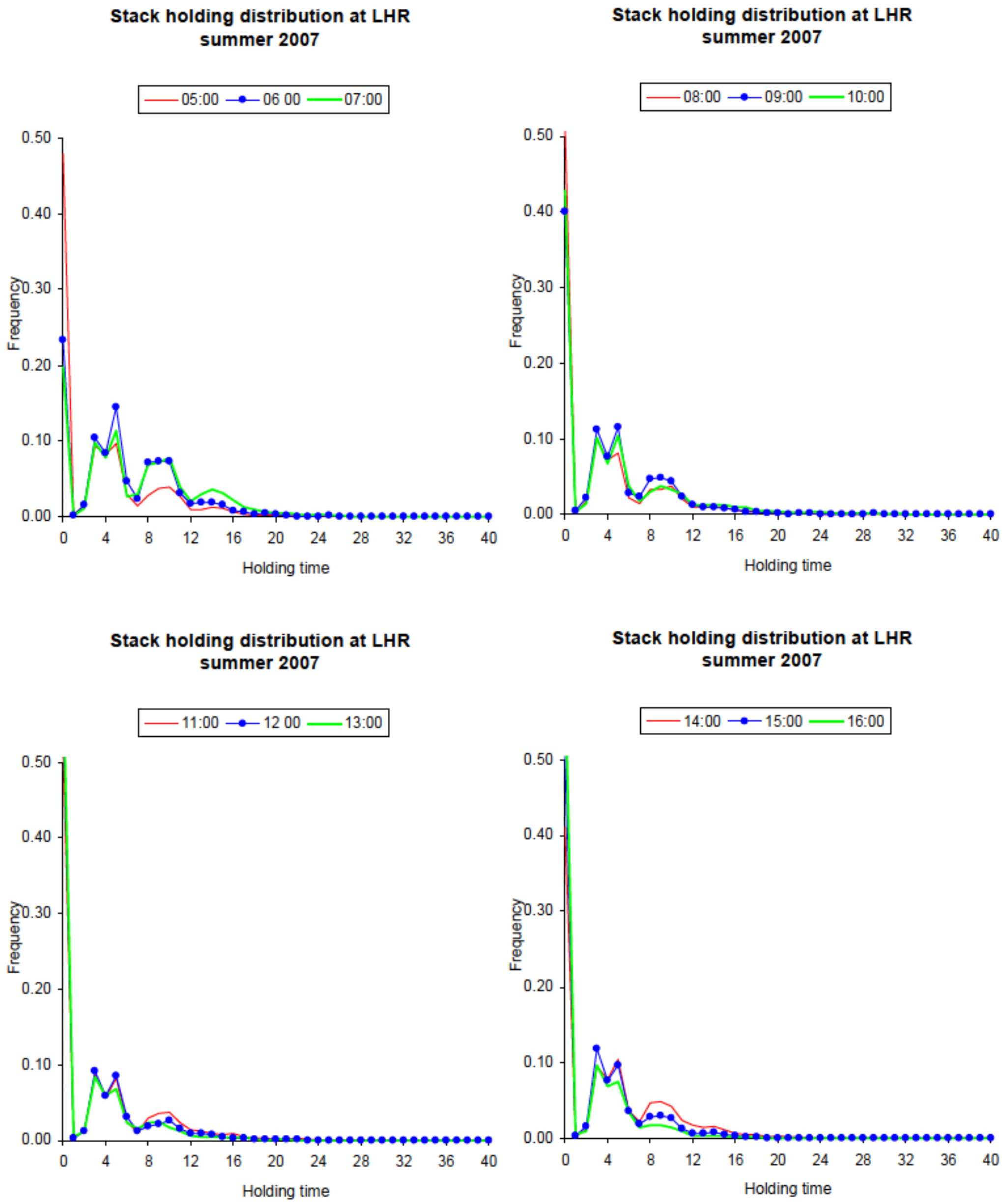
STACK HOLDING TIME DISTRIBUTIONS

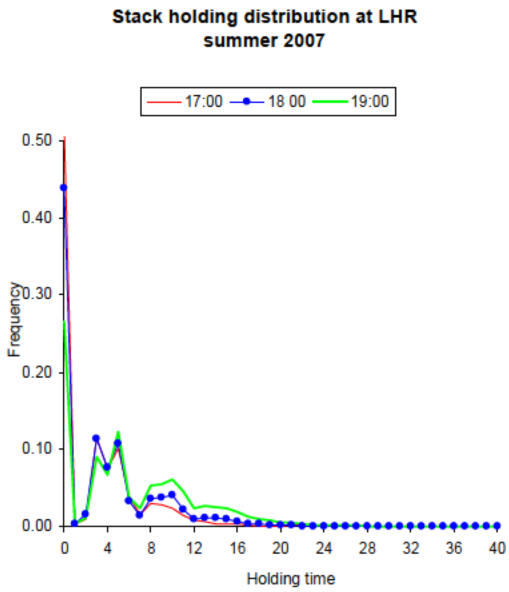
Distributions

9.47 The stack holding time distributions are shown in the following exhibits. The main characteristics of the distributions are:

- a main peak at zero holding time corresponding to the aircraft that are not subject to stacking
- a series of side peaks roughly centred on multiples of 2.5 to 3 minutes which corresponds to the time that an aircraft takes to make a complete circuit of the stack.

Exhibit D-9-9: Stack Holding Distributions for Heathrow for Summer 2007





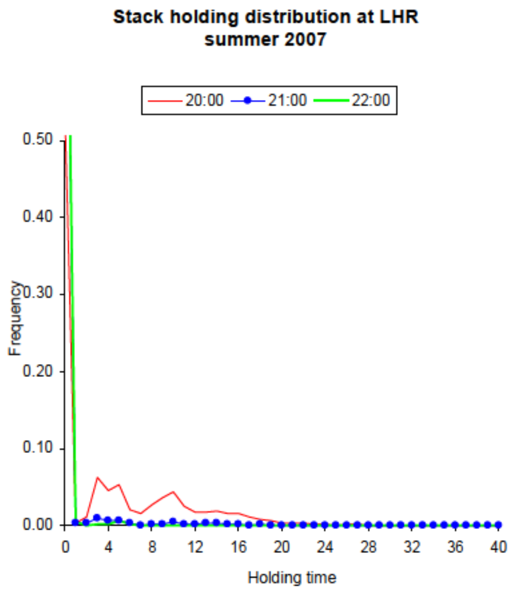
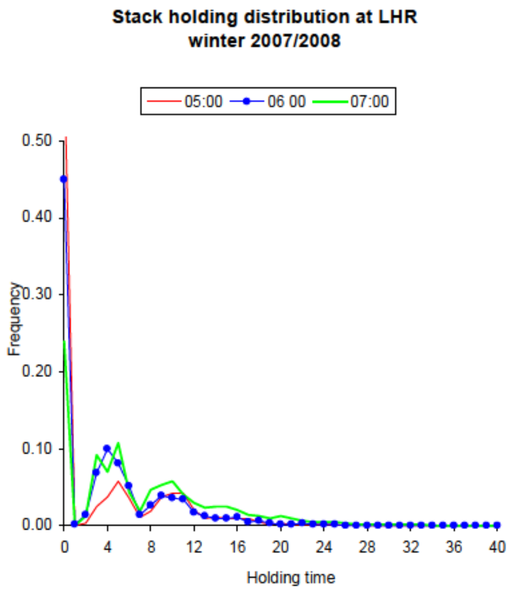
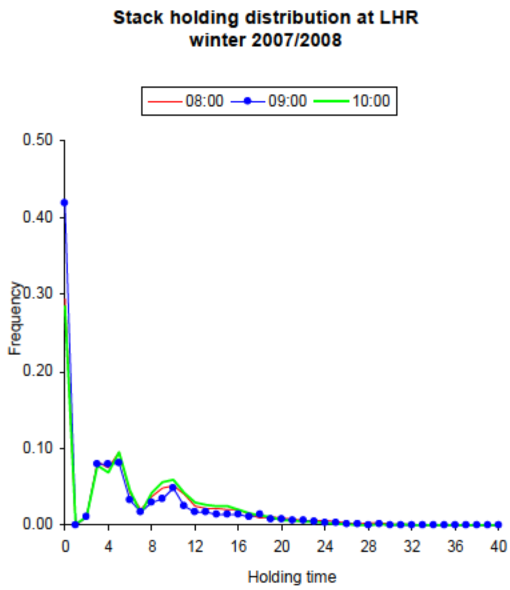
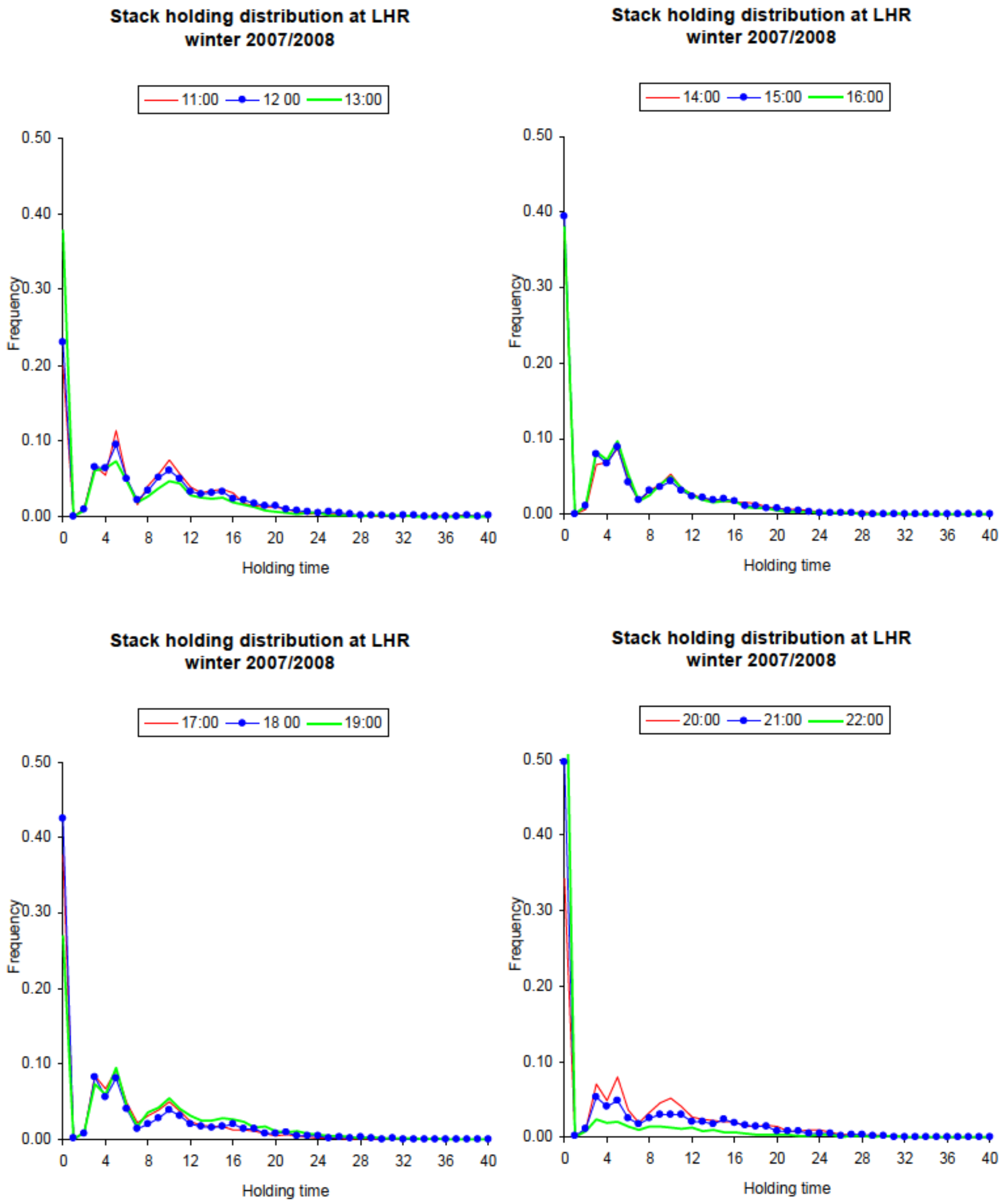


Exhibit D-9-10: Stack Holding Distributions for Heathrow for Winter 2007/2008



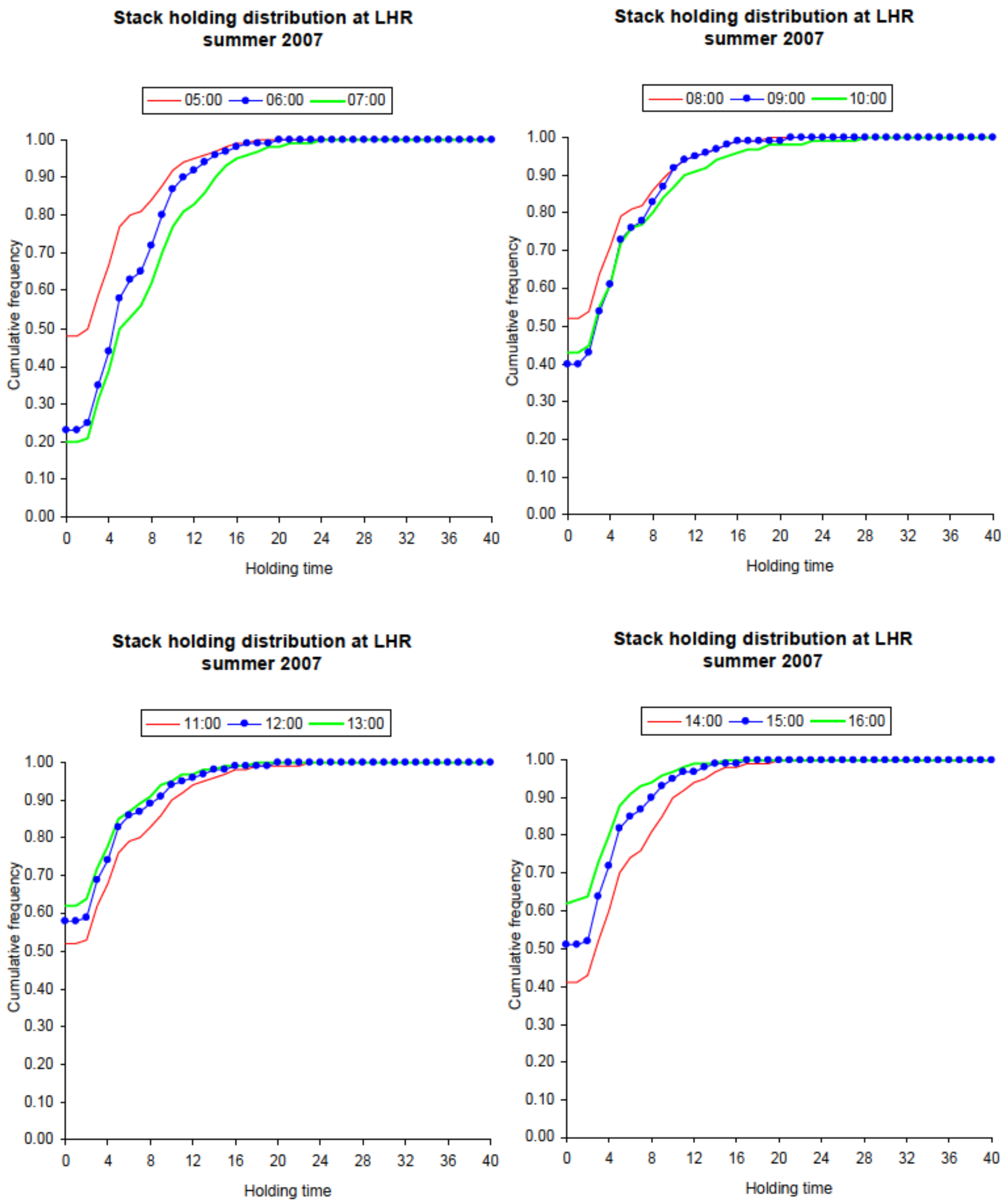


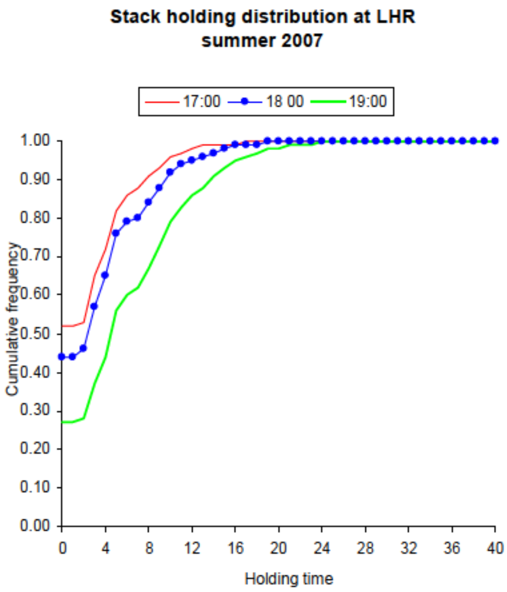


Cumulative distributions

9.48 The following exhibits show the cumulative distributions of stack holding times for Heathrow in the summer 2007 and winter 2007/2008 seasons. In some cases the distributions are modulated at 2.5to 3minute intervals again indicated the average time that aircraft spend in a circuit in the stack.

Exhibit D-9-11: Cumulative Stack Holding Distributions for Heathrow for Summer 2007





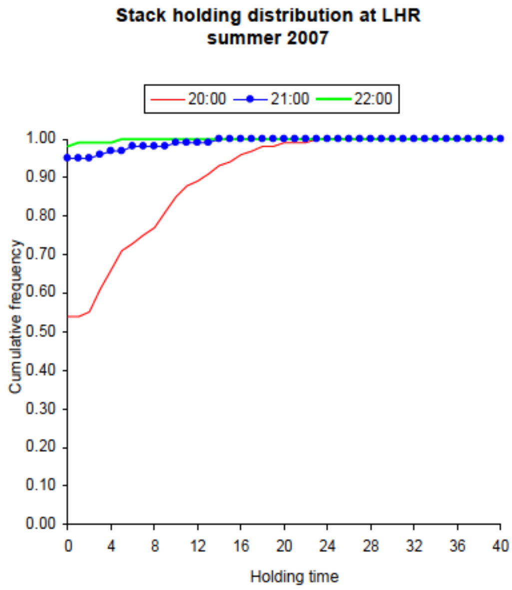
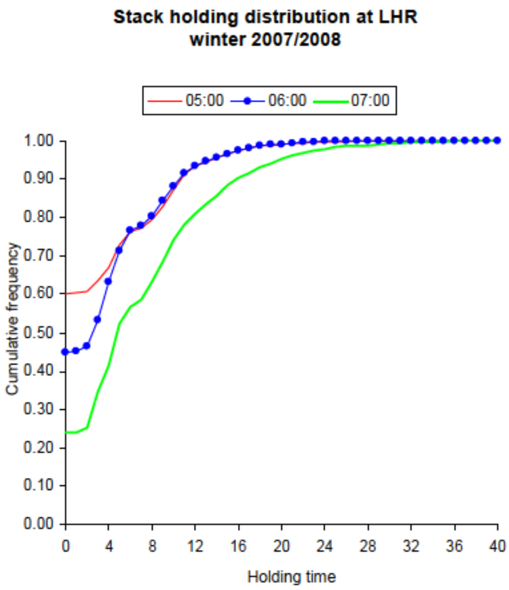
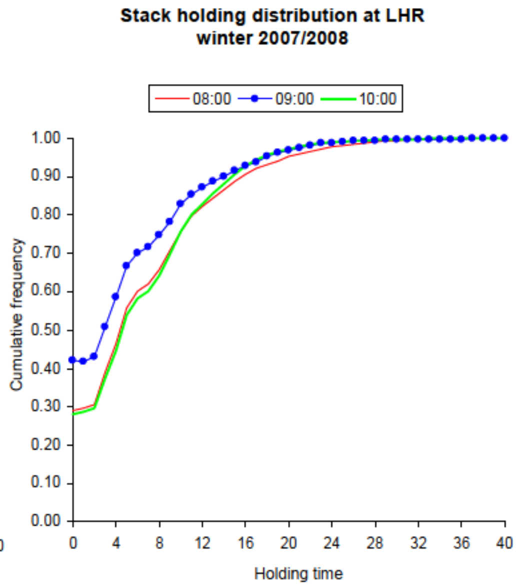
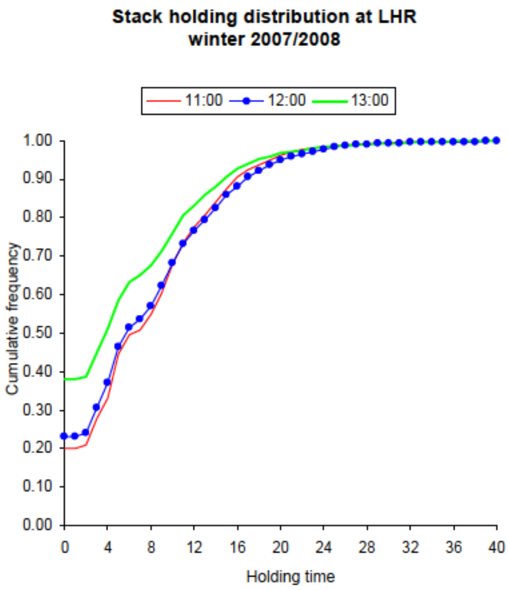
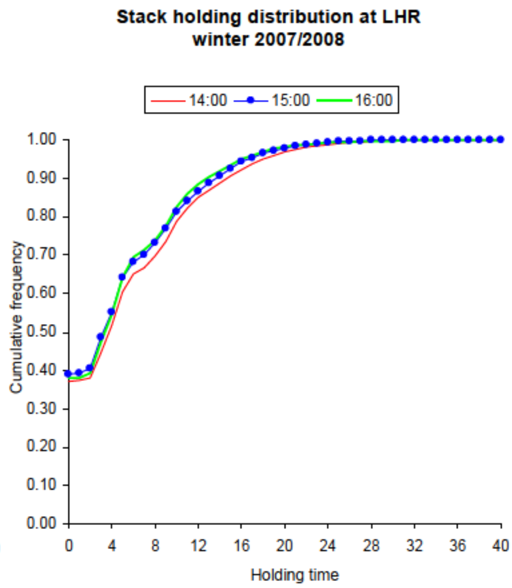


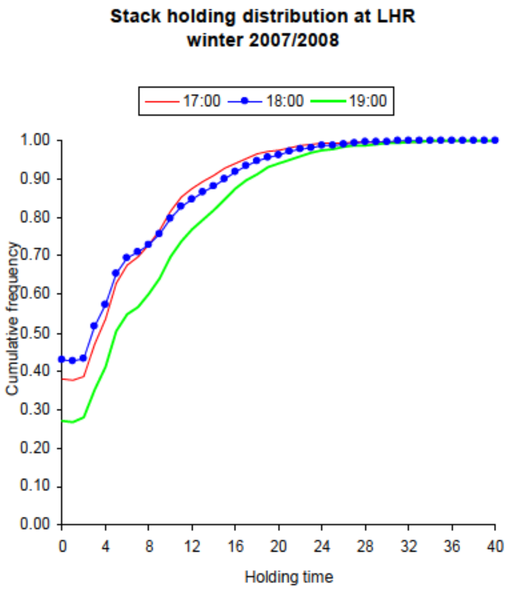
Exhibit D-9-12: Cumulative Stack Holding Distributions for Heathrow for Winter 2007/2008

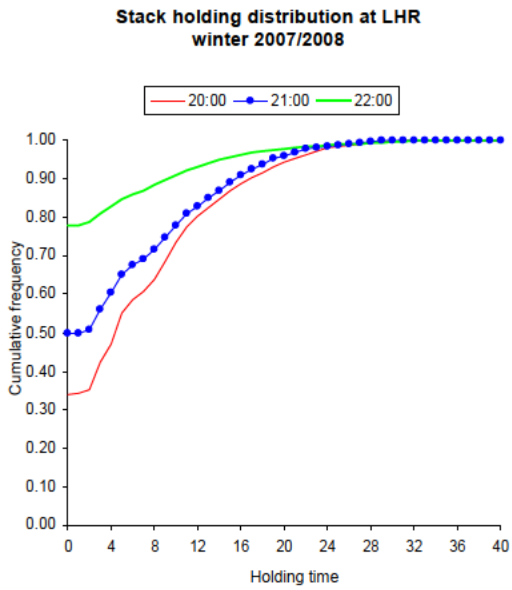










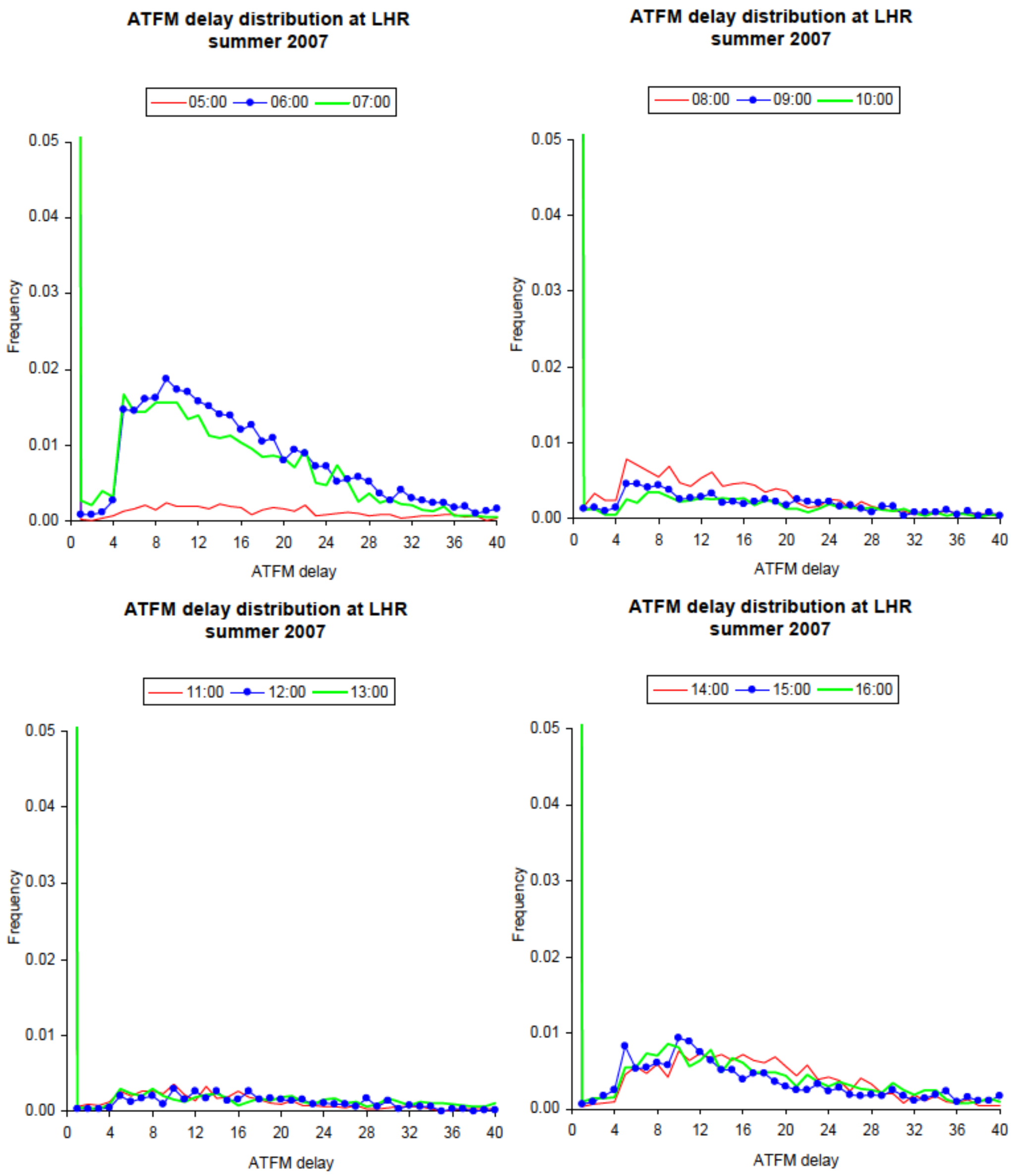


ATFM DISTRIBUTIONS

Distributions

9.49 The following figures show the frequency distributions for ATFM delays attributed to Heathrow. In each case there is a large peak at zero delay indicating the aircraft that are not subject to ATFM delay. At some times, there is also a distinct side peak indicating some structure to the delays. However, in other cases there is very little structure to the distribution indicating that the delays can be random in nature.

Exhibit D-9-13: ATFM Delay Distributions for Heathrow for Summer 2007



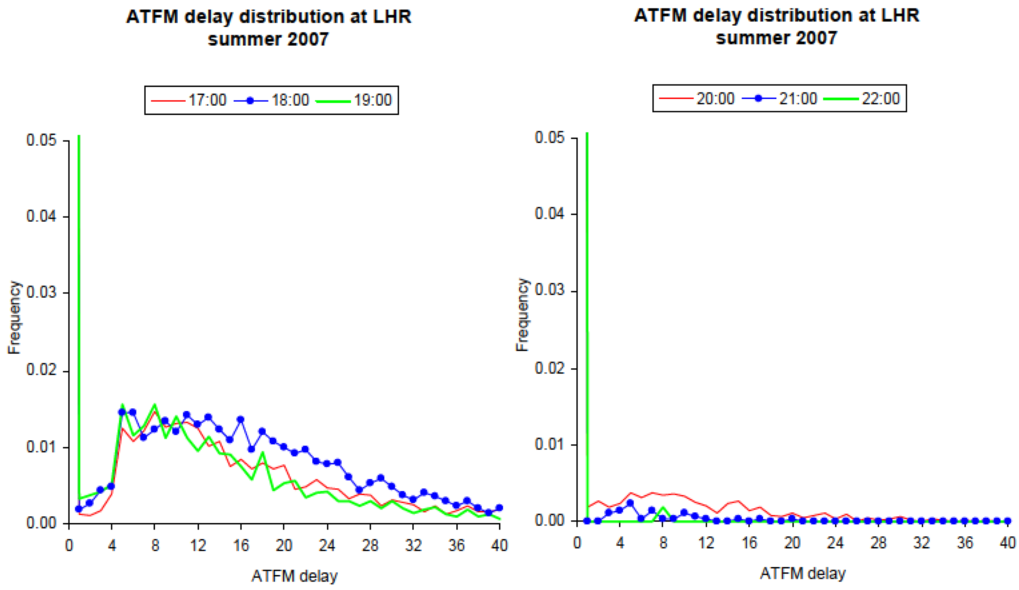
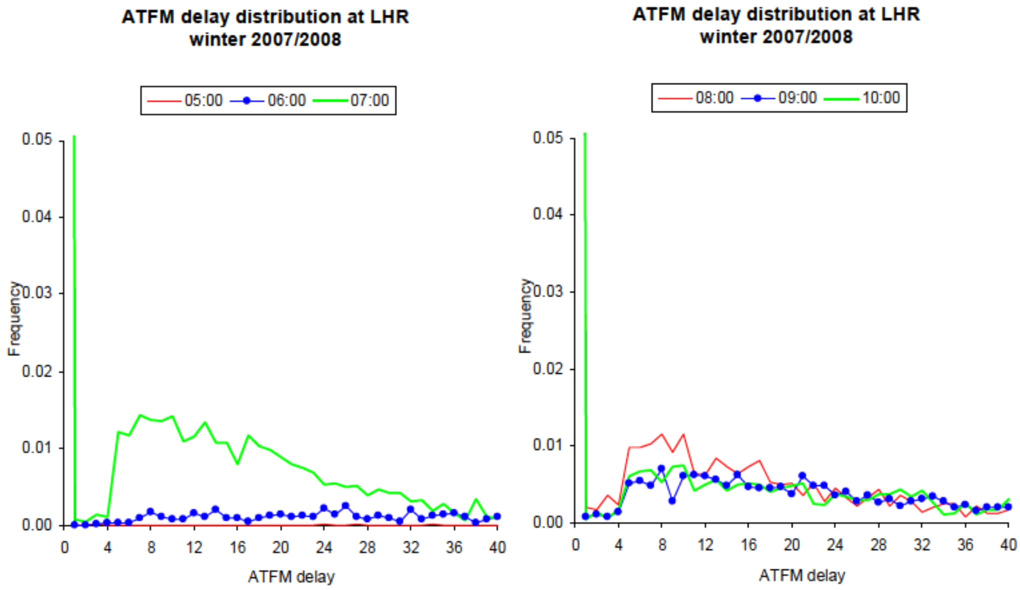
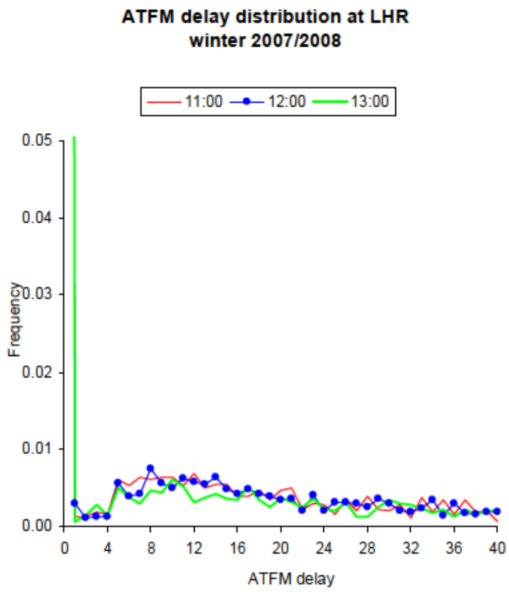
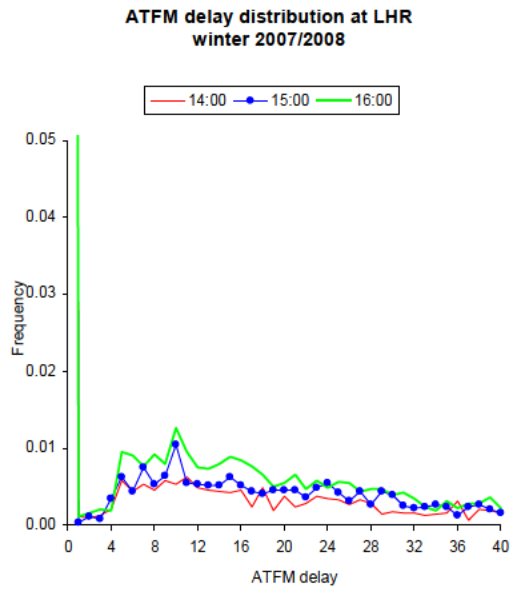
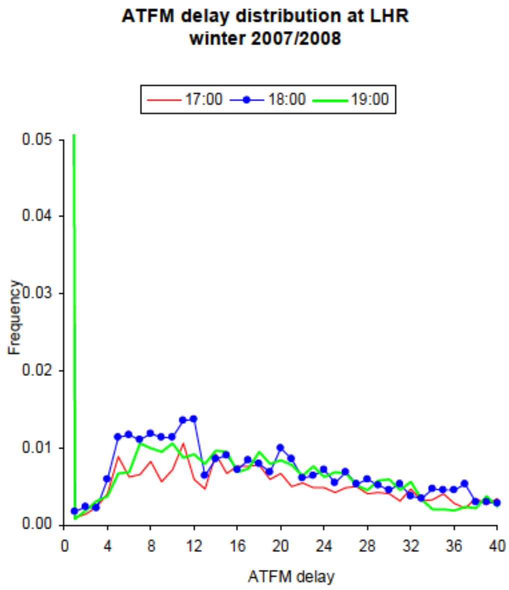


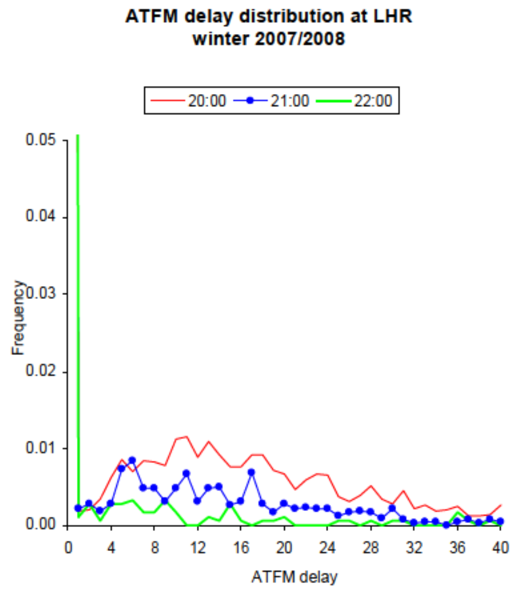
Exhibit D-9-14: ATFM Delay Distributions for Heathrow for Winter 2007/2008







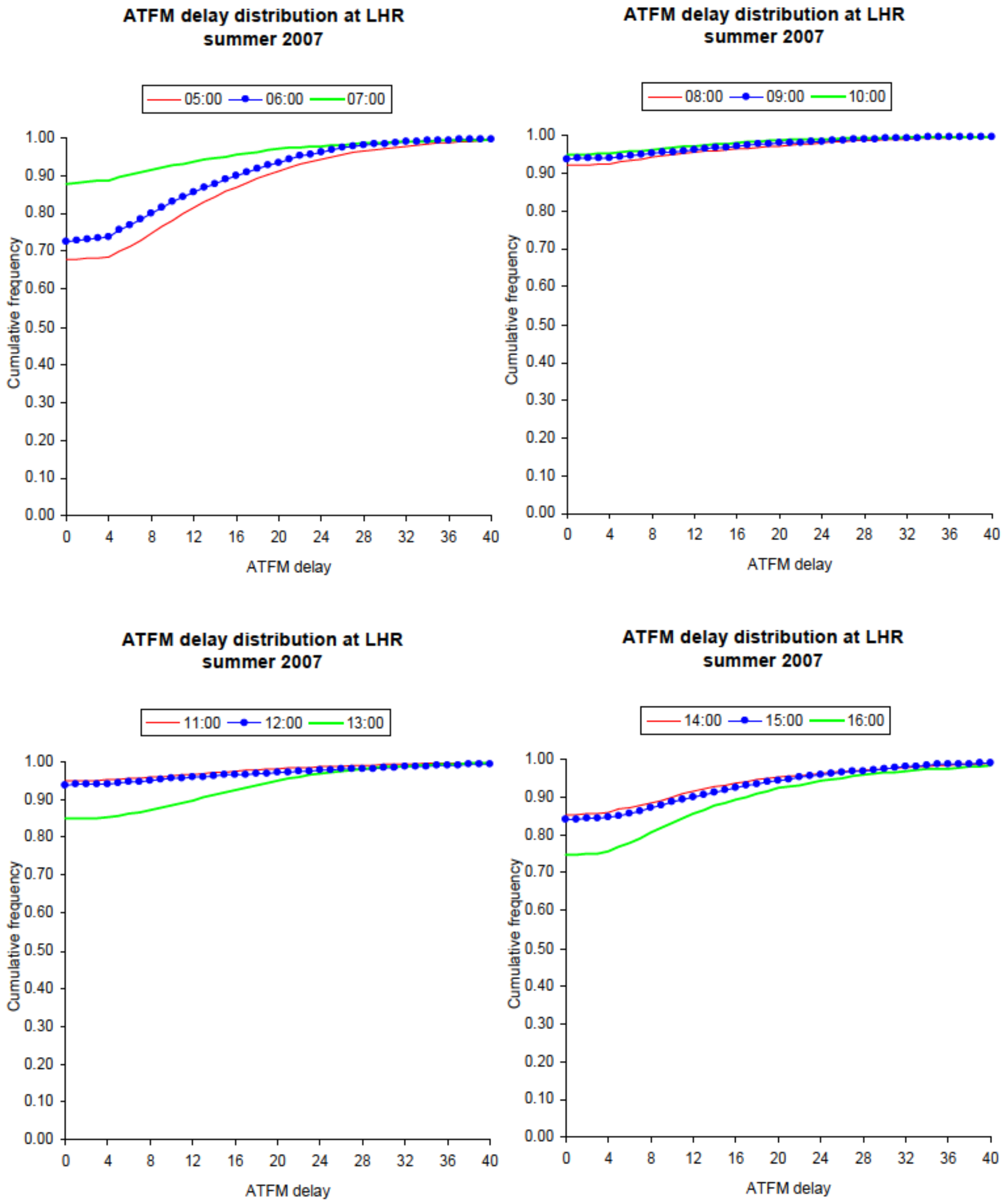


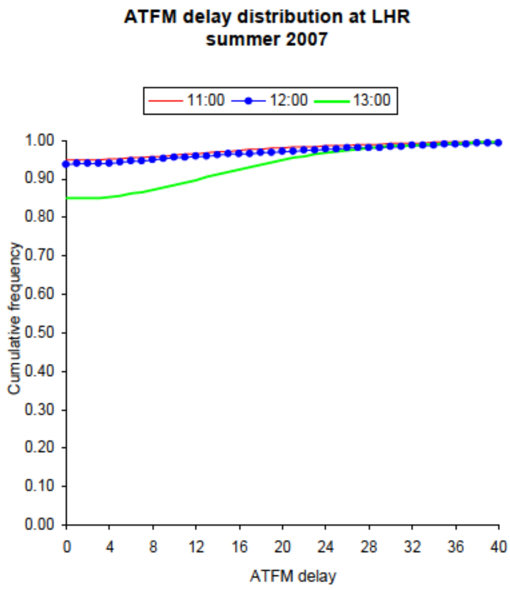


Cumulative distributions

9.50 The following exhibits show the cumulative distributions for Heathrow ATFM delays. The distributions generally increase monotonically and are fairly structureless.

Exhibit D-9-15: Cumulative ATFM Delay Distributions for Heathrow for Summer 2007





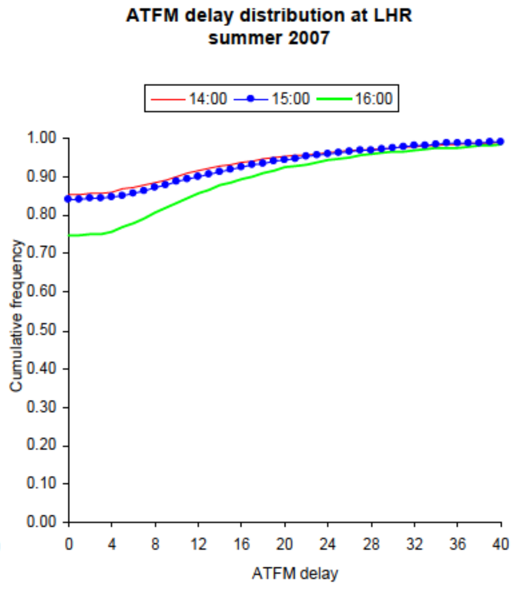
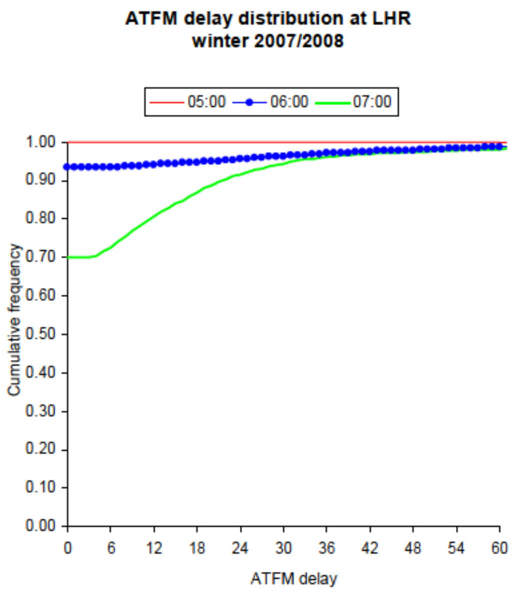
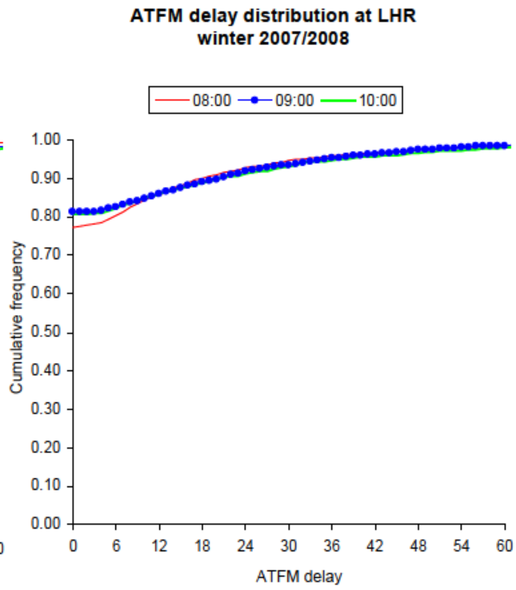
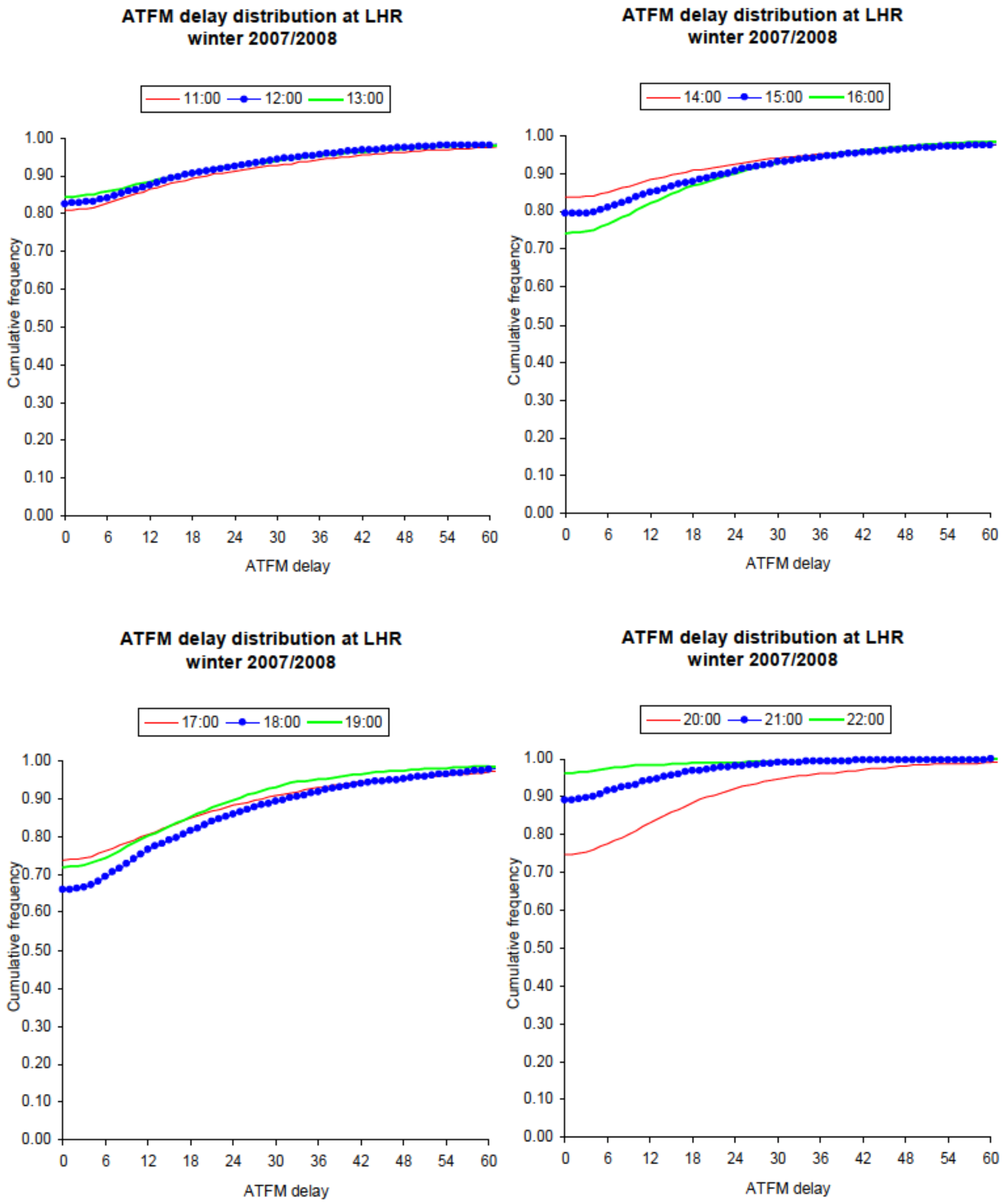


Exhibit D-9-16: Cumulative ATFM Delay Distributions for Heathrow for Winter 2007/2008







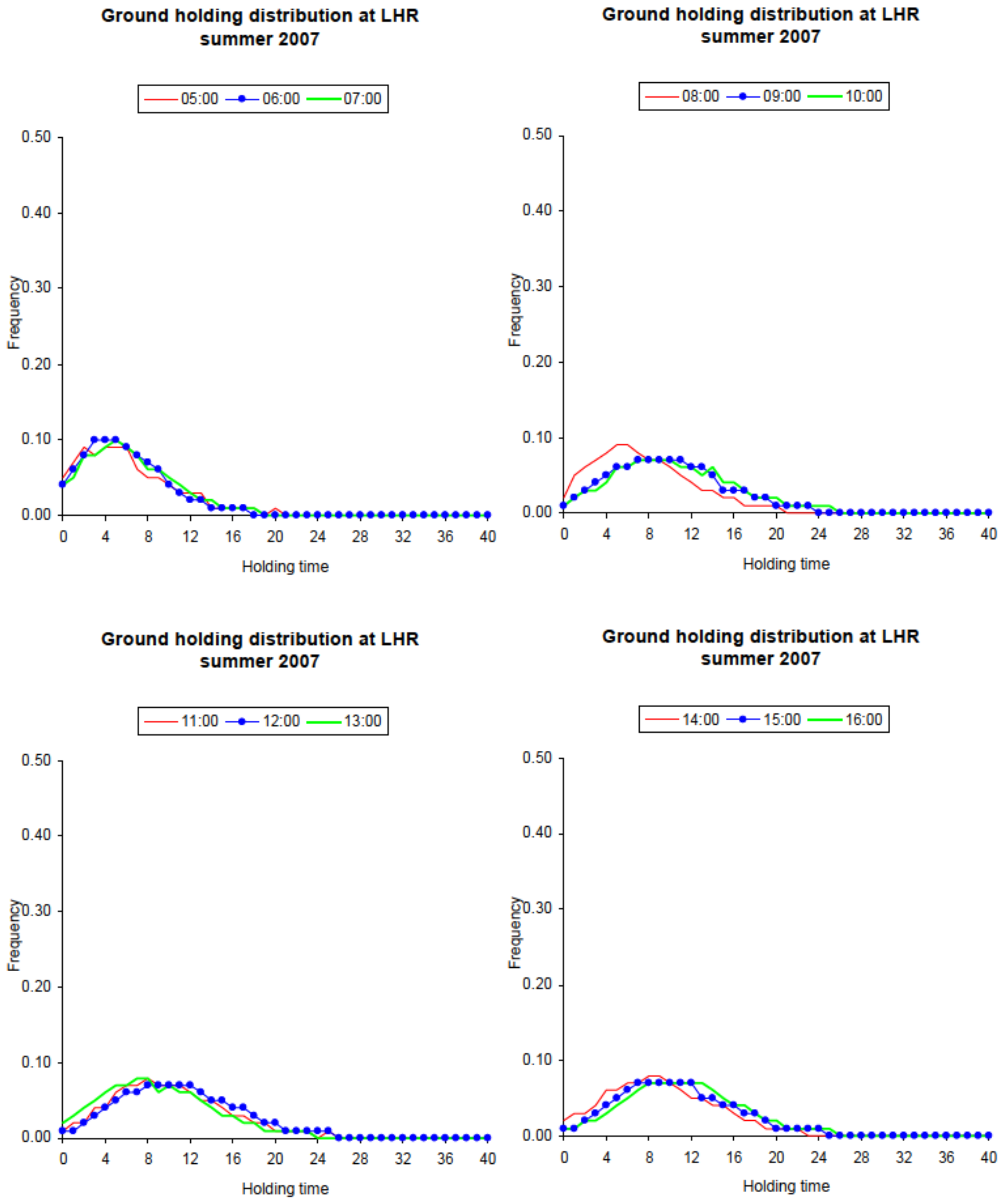
GROUND HOLDING DISTRIBUTIONS

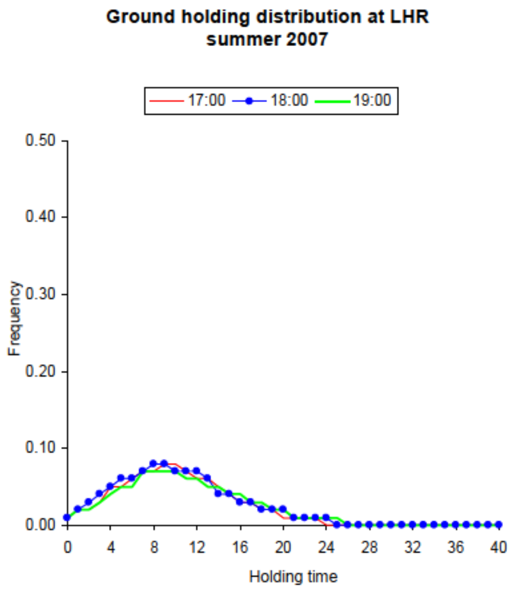
Distributions

9.51 Exhibits D-9 and D-10 show the ground holding time distributions for departures from Heathrow for the summer 2007 and winter 2007/2008 seasons respectively. These distributions differ from the stack holding and ATFM delay distributions in that:

- they do not have a central peak but do have a well-structured side peak following an approximately normal distribution in all cases
- there are very few departures that are not subject to holding.

Exhibit D-9-17: Ground Holding Time Distributions for Heathrow for Summer 2007





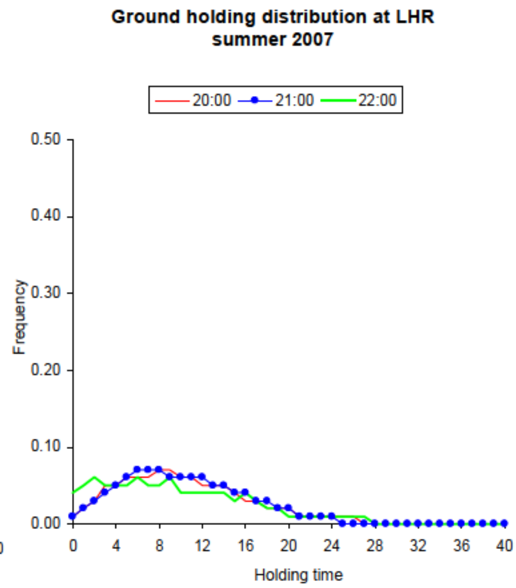
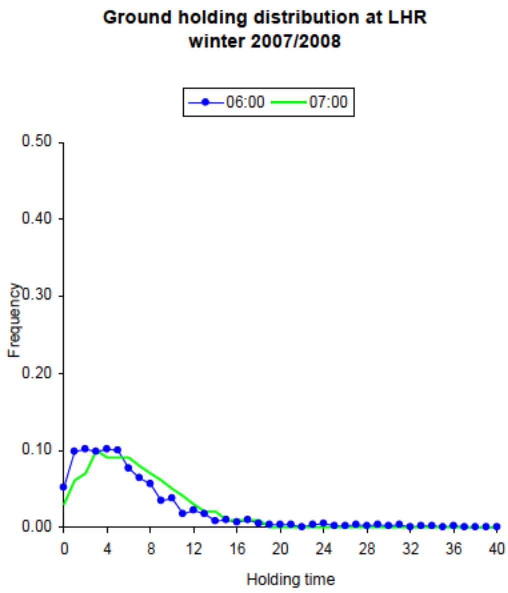
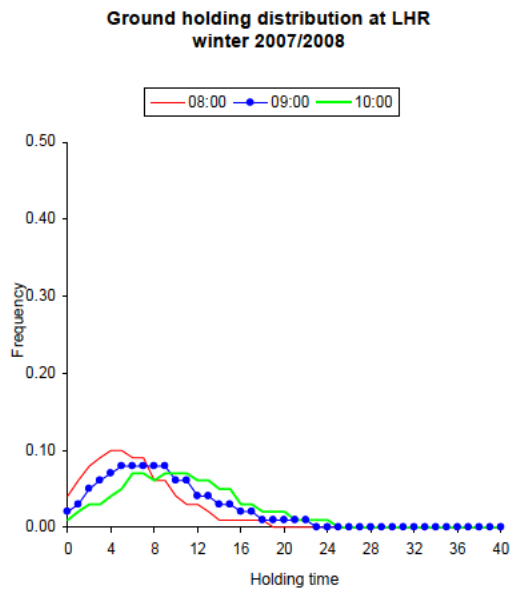
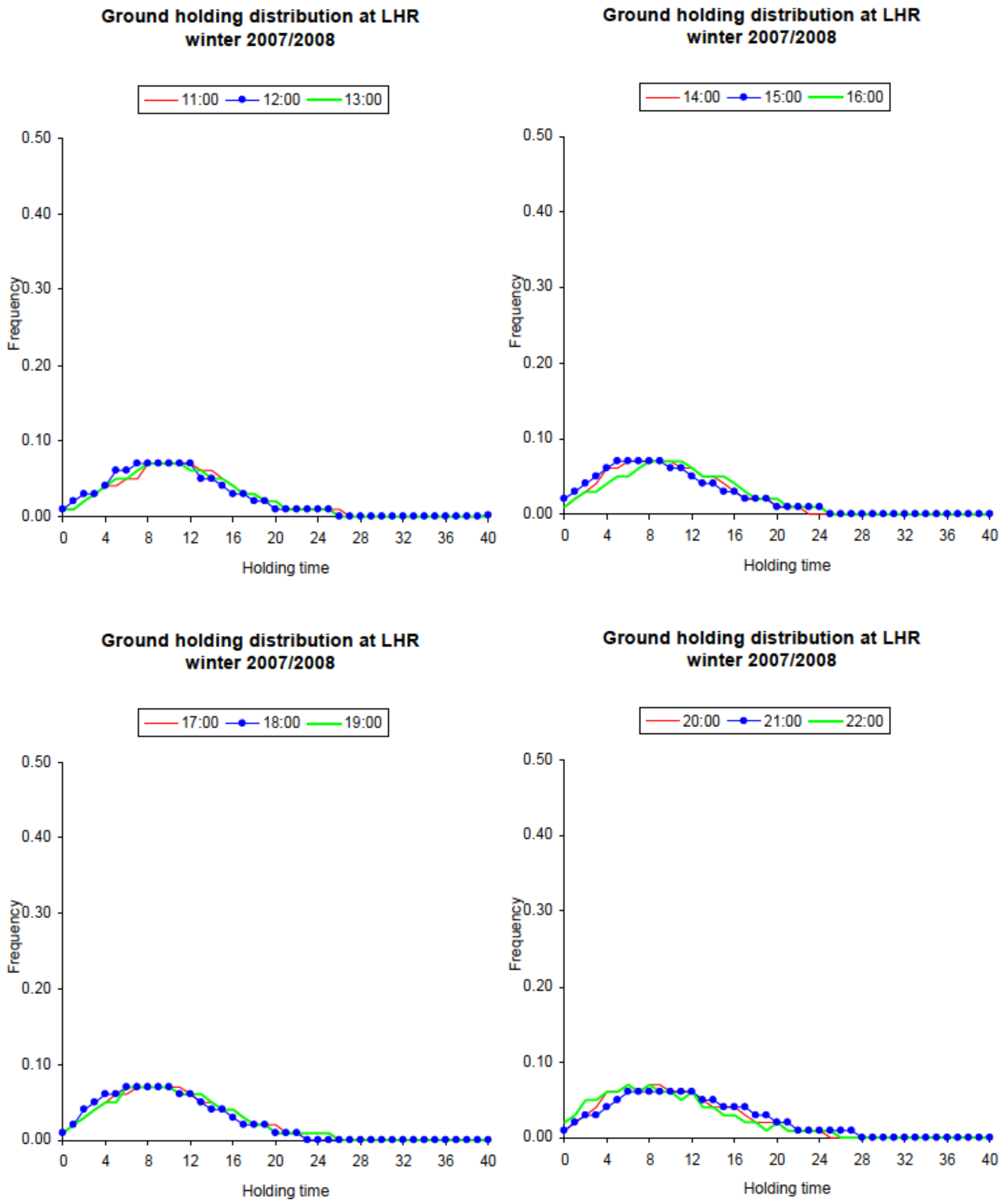


Exhibit D-9-18: Ground Holding Time Distributions for Heathrow for Winter 2007/2008



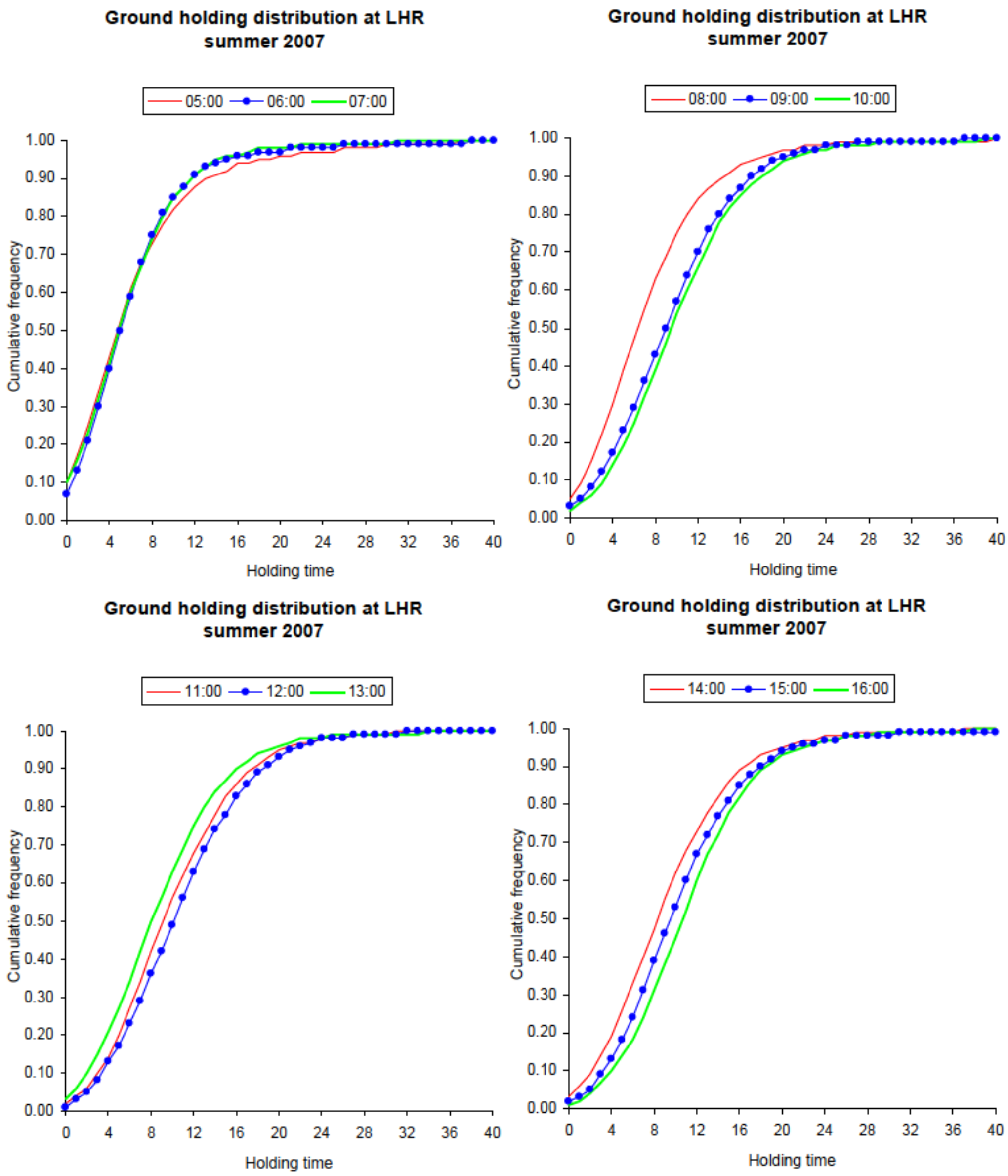




Cumulative distributions

9.52 Exhibits D-11 and D-12 show the ground holding time cumulative distributions for departures from Heathrow for the summer 2007 and winter 2007/2008 seasons respectively.

Exhibit D-9-19: Cumulative Ground Holding Time Distributions for Heathrow for Summer 2007



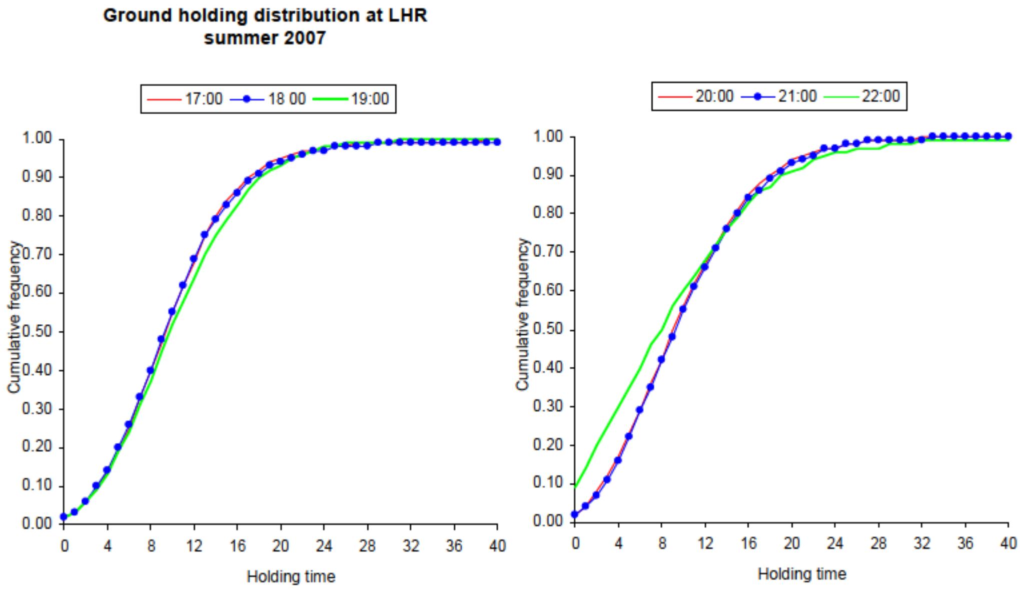
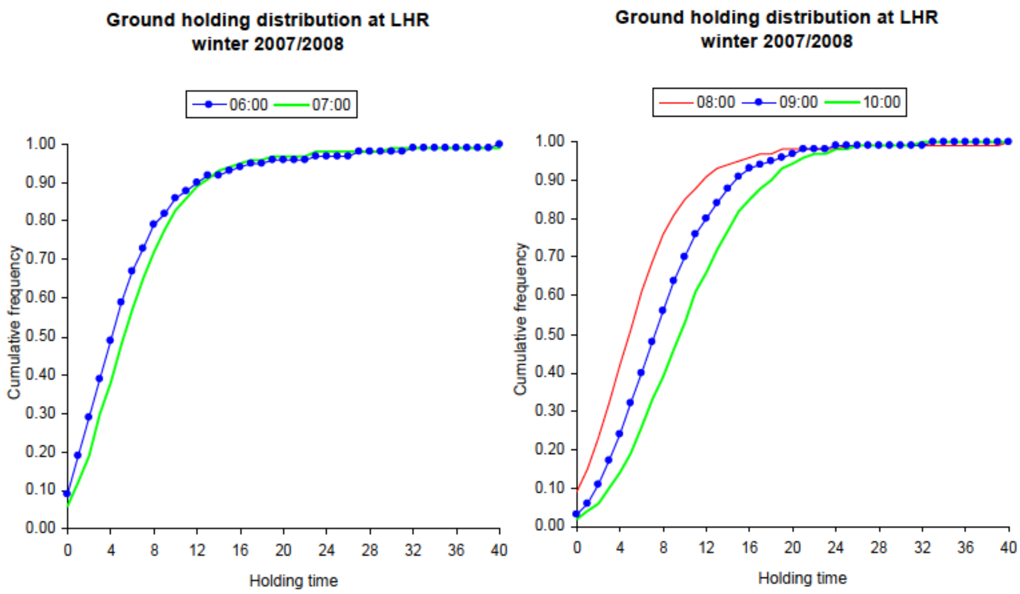
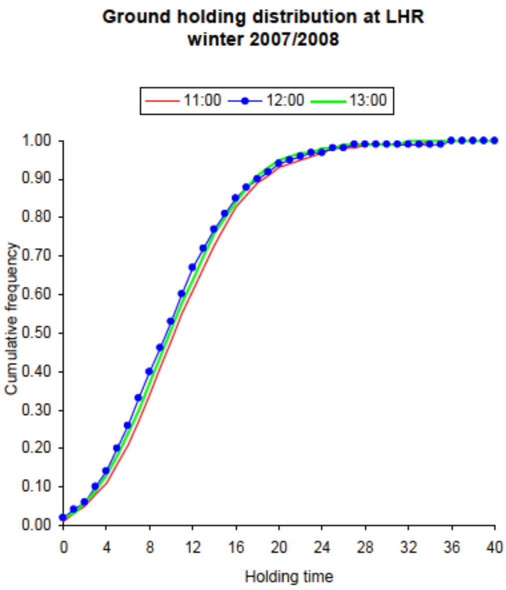
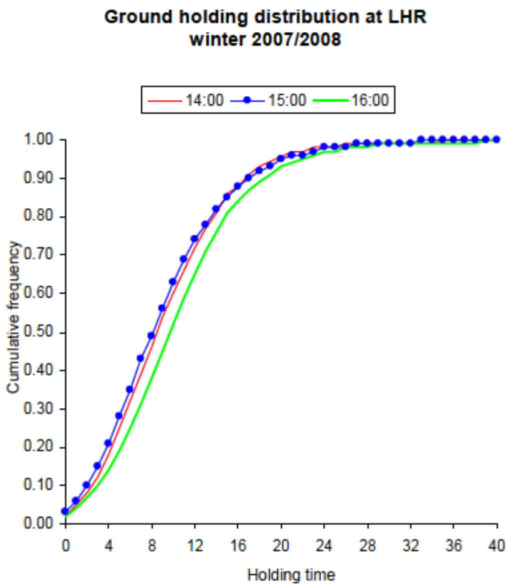
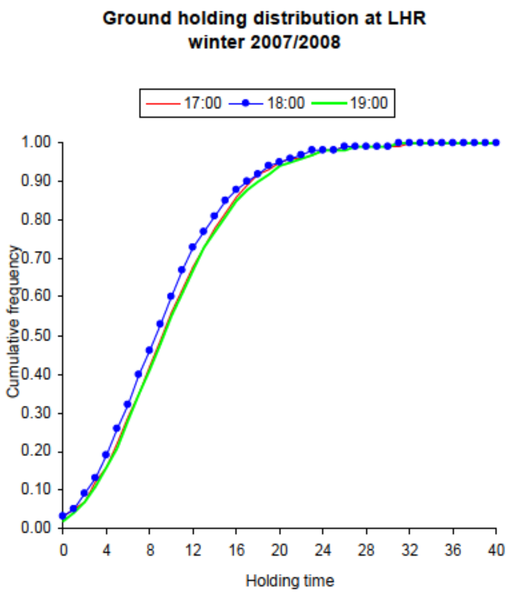


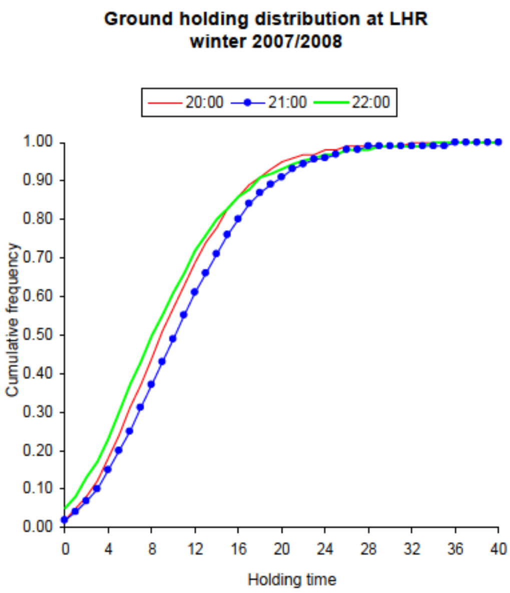
Exhibit D-9-20: Cumulative Ground Holding Time Distributions for Heathrow for Winter 2007/2008

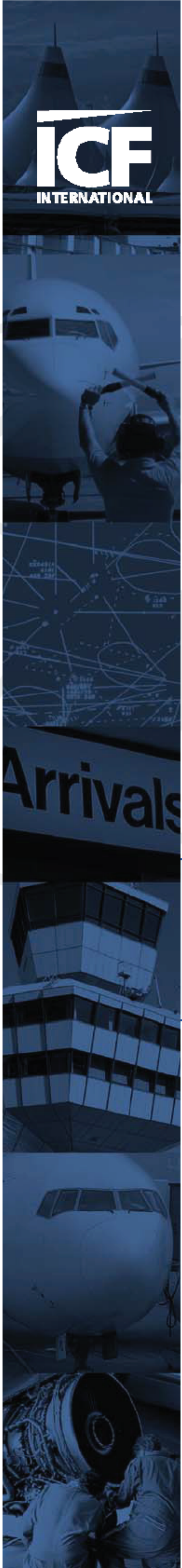



Ground holding distribution at LHR winter 2007/2008
11:00
12:00
13:00
Cumulative frequency
Holding time


Ground holding distribution at LHR winter 2007/2008
14:00
15:00
16:00
Cumulative frequency
Holding time


Ground holding distribution at LHR winter 2007/2008
17:00
18:00
19:00
Cumulative frequency
Holding time


Ground holding distribution at LHR winter 2007/2008
20:00
21:00
22:00
Cumulative frequency
Holding time



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Appendix E:
PASSENGER VALUE OF TIME – EUROCONTROL FIGURES

The following extract is from the Eurocontrol "Standard inputs for Cost Benefit Analyses" which can be found at:

http://www.eurocontrol.int/cba/studies/standardinputs/standardvalues.doc

PASSENGER VALUE OF TIME

Explanation

The value to a passenger of time spent travelling.

Value [1]: € 38 - € 49 per hour per passenger (Adjusted from 1999 prices)

Date: Study estimated 1999 costs.

Source: "Costs of Air Transport Delay in Europe", ITA, November 2000. (See http://www.eurocontrol.int/prc/reports/stu2/documents/stu2.pdf)

This source is recommended by EUROCONTROL

Value [2]:

	Private Travel	Business Travel
Travel time	€ 22.7 per hour	€ 28.8 per hour
Waiting time between departures	€ 2.6 per hour	€ 9.7 per hour

The value of time (VOT) for delays is assumed to be 50% higher than the VOT for travelling time. (Values adjusted from 1999 prices).

Date: Values based on a study performed in 1997 (Ramjerdi et al).

Source: "Methods for Economic Appraisal in the Norwegian Aviation Sector", NCAA, October 1999.

Value [3]:

	Air Carrier	General Aviation
Personal	€ 18.30	€ 24.70
Business	€ 32.40	€ 35.20
All purposes	€ 25.00	€ 29.20

(Adjusted from US$ 1998 prices)

Date: 1998 costs.

Source: "Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs", FAA, 1998 (http://apo.faa.gov/econom98/toc.htm).

Value [4]: Business passengers: € 42.22 per hour
Leisure passengers: € 11.37 per hour

(Note that these values are at 1989 prices and cannot be compared directly with the other values)

Date: Values are those derived from CAP 548 (1989 prices).

Source: "Evaluation Of Economic Benefits For Cost Benefit Assessments, a discussion paper", Working Group for Financial Appraisal And Presentation, NATS, January 1994.

Discussion

Source [1]:

The average value of time was estimated based on the estimated distribution of passengers according to travel purpose as defined in "PASSENGER DISTRIBUTION", page 18.

Purpose	VOT per hour (€)	
	Low	**High**
Business	47	63
Personal convenience	28	33
Tourism	20	23
Average	**34**	**44**

Note that the difference between "personal convenience" and "tourism" is not defined in the source document.

Values were then inflated to give 2004 prices.

Source [2]:

The value of travel time that might alternatively be spent working has been calculated by applying gross wage costs. For leisure travel, the approach has been to apply the net wage rate, since that is the amount the wage earner must sacrifice to have additional leisure time.

The values in the source document are assumed to have been adjusted to 1999 prices. These values were then inflated to give 2004 prices.

Source [3]:

The value of passenger time saved or lost as a result of investments in transportation facilities or regulatory actions. It is based upon guidance furnished by the Office of the Secretary of Transportation (OST) ("Departmental Guidance for the Valuation of Travel Time in Economic Analysis," Office of the Secretary of Transportation Memorandum, April 9, 1997).

For air carrier passengers, the time values are derived from the Air Transport Association of America Air Travel Survey, last conducted in 1993, escalated by the increase in median annual income to U.S. households from 1993 to 1995 as reported in Bureau of the Census, Current Population Reports, Money Income of Households, Families, and Persons in the United States, Series P-60. The value for personal travel is 70 percent of the weighted average of annual income categories in the survey for "visit friends," "sightseeing," and "other" travel divided by an assumed 2000 hours of work per year. The value for business travel is 100 percent of the annual income category in the survey for "business" divided by 2000 hours of work per year. When considering general aviation passengers as a separate category, a value of 70 percent of the median hourly income of AOPA members is established for personal travel and 100 percent of median hourly income for business travel.

The fractions of 70 percent and 100 percent were recommended by a panel of transportation economists. High and low values representing a plausible range of values based on variation in panel member opinions are provided for use in conducting sensitivity analysis.

	Air Carrier (cost per hour)	General Aviation (cost per hour)
Personal	$19.50	$26.30
Business	$34.50	$37.50
All purposes	$26.70	$31.10

Source [4]:

Values are derived from CAP 548.

Comparison with other industries

Values of time from several studies in Europe give varying values of transport times:

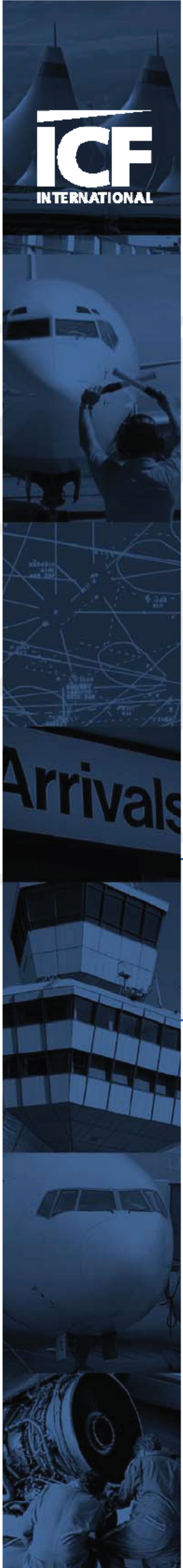
Mode	Value of time (1998 € per hour)
Bus	6 - 81.6
Car	2.8 - 53
Ferry	9.4 - 16.3
Train	0.3 - 18.4

Source: "TRACE, Costs of private road travel and their effects on demand, including short and long term elasticities", prepared for the European Commission Directorate-General for Transport.

The source provides full details of the value of time results.

Comments

Source [3] gives marginal values i.e. value of passenger time saved or lost. Source [2] gives separate values for time spent travelling and value of time for delays. It is unclear whether sources [1] and [4] give values which are marginal values or average values.



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Appendix F:
ROOT CAUSE ANALYSIS - IMPACT OF OPTIONAL IMPROVEMENT INITIATIVES

	300 day scenario						50-60 day scenario	10-15 day scenario
	Pre-departure in-bound holds ("ATFM")	**Airborne in-bound holds ("Stack")**	**Ground holding outbounds**	**In-bound tactical flow-rate headroom**	**Out-bound tactical flow-rate headroom**	**Cancellations**	**Disrupted days**	**Seriously disrupted days**
Mixed Mode (3 scenarios)	Modelled in study			++ to +++ (for same traffic)	++	++	Recovery modelled in case studies	
Extension of TEAM	General - Modelled in study Detailed – specific opportunities for e.g. A380			++ +	Off-set on departures	+	Recovery modelled in case studies	
Demand reduction	General and some specifics - Modelled in study Other detailed opportunities in peaks			+ to ++ +	+	+	Recovery modelled in case studies	
Schedule smoothing (beyond current slot flexing)	++ Counters schedule demand peaks	++ Reduces required planned buffers	+	Does not change flow-rate capacity		+	+ When early morning flow restrictions	Probably overwhelmed
Revised planning parameters	++ Reduces capacity regulations	++ Parameters can be set to reduce holdings (may include changes to airline planning parameters and process)	++ Reduces MDIs	Does not change headroom unless capacity must be reduced to meet parameters		+ Reduced canx from capacity regulations	+ Plan should remain more resilient due to less bunching	Probably overwhelmed
Protocol for disruption								Mitigation and planned response

	300 day scenario						50-60 day scenario	10-15 day scenario
	Pre-departure in-bound holds ("ATFM")	**Airborne in-bound holds ("Stack")**	**Ground holding outbounds**	**In-bound tactical flow-rate headroom**	**Out-bound tactical flow-rate headroom**	**Cancellations**	**Disrupted days**	**Seriously disrupted days**
Time-based separation	Resilience against wind-based flow regulation and stacking (assumed >38 flow-rate for 300 day scenario) Subject to further development and safety approval Consistent with SESAR objectives and programme			+ Maintain planned level for more hours		+ Reduced canx for wind-based flow restriction	++ Resilience against winds	Probably overwhelmed, esp non-wind
Separation reduction techniques e.g. AMAN, ROT reductions, MLS, Wake Vortex detection	Benefit of increased flow-rate headroom. Required to counter negative trends on aircraft mix. On-going development programme Consistent with SESAR objectives and programme Note: many techniques will require Safety Regulation and/or clearance			++ But some techniques not proven yet	+ But not proven yet	Marginal benefit	Main benefit in 300 – day scenario	
CFMU process improvement	+ Main benefit on disrupted days						+ Reduces spurious data within process	+ Reduces spurious data within process

	300 day scenario						50-60 day scenario	10-15 day scenario
	Pre-departure in-bound holds ("ATFM")	**Airborne in-bound holds ("Stack")**	**Ground holding outbounds**	**In-bound tactical flow-rate headroom**	**Out-bound tactical flow-rate headroom**	**Cancellations**	**Disrupted days**	**Seriously disrupted days**
NATS regulation process evolution and decision support	+ Minimised regulation with some additional predictive support. Potentially faster relaxation					+ When canx would have been triggered by capacity regulations	Limited benefit if outside "normal" range	
Collaborative Decision Making	+ FUMs will support better information for decisions						Improved rotational performance due situational awareness	Improved response but limited outcome
Performance management system and process KPIs	Benefit from increased airline discipline in adhering to planned milestone timings. On-going target-setting, data quality improvement, root cause analysis and solution development							Track adherence to protocol and KPIs
Revised sequencing policy		Holding reduced for "compliant" operations (linked to AMAN)	Can effectively be managed within existing rulesets			+ For compliant operations	May be difficult to sustain under pressure	Will be difficult to sustain under pressure. Revert to disruption protocol

Notes:

Excludes

- Significant airspace redesign
- Network effects outside local stakeholder control or influence
- Airline contingency initiatives/provisions to protect or recover service
- Airline and airport process improvements aimed at punctuality improvement or other service quality measures
- Effects of infrastructure development
- Economic or environmental benefits linked to e.g. reduced holding and tighter 95^{th}-ile distribution levels
- Business cases for individual pieces of development

Some options may not be independent e.g. Schedule Smoothing is of limited value if the Performance Management System does not track and motivate adherence to a revised schedule (beyond the fairly broad parameters of slot performance measures for 80% compliance)

Colour code for initiatives

Initiative in active development and implementation

Initiative under active research and development with limited implementation as yet

No major active programme although may have stakeholder awareness as an issue and opportunity

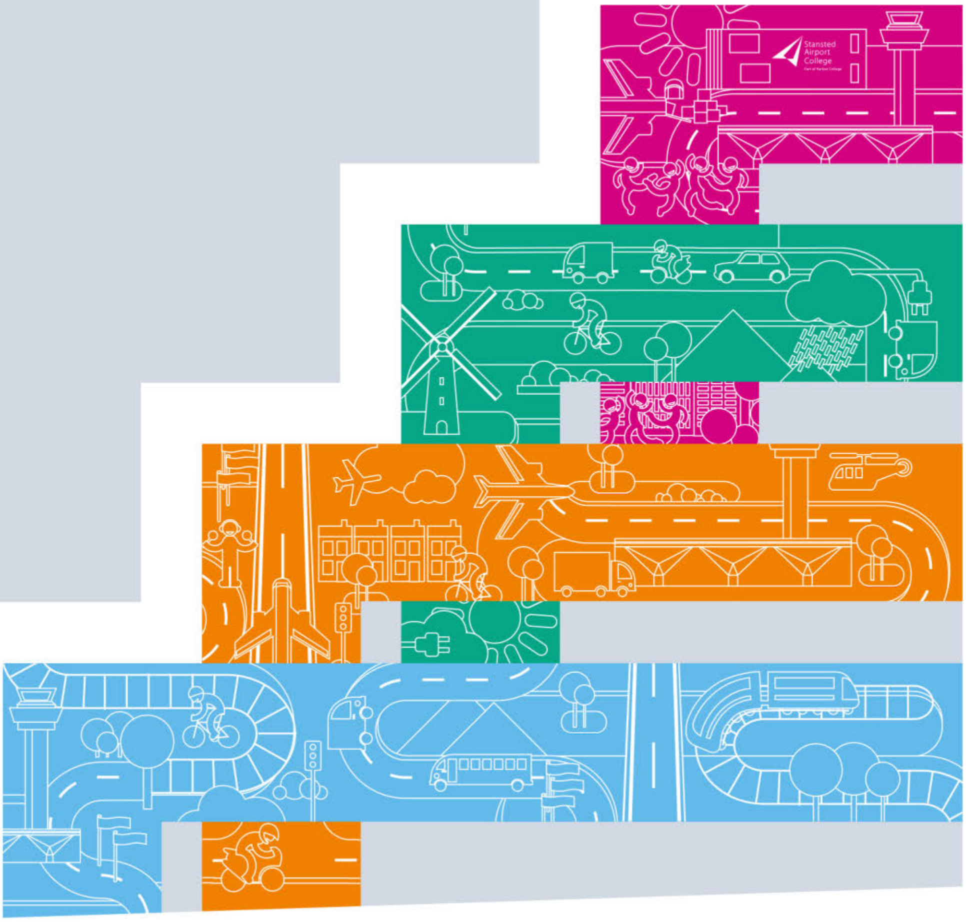
Indicative scale of impact shown as range from "+" to "+++"

TRANSFORMING LONDON STANSTED AIRPORT

35+ PLANNING APPLICATION

Planning Statement

February 2018



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MAG London Stansted Airport

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Contents

List of Appendices

1 Introduction

1.1 This planning statement is in support of the planning application by Stansted Airport Limited (STAL) for works to facilitate making best use of the existing single runway at London Stansted Airport ('Stansted').

1.2 MAG's acquisition of Stansted in 2013 saw the start of a new era for the airport. The number of airlines and routes has increased, and passenger numbers have grown to 26 million. Investment has led to more choice, better facilities for passengers and stronger competition in the market. Stansted's contribution to the local economy has increased, with new jobs and better connectivity for local businesses. Stansted is expected to serve 35 million passengers by the early 2020s, and a new runway at Heathrow is at least a decade away. It is crucial that we make best use of our existing capacity in order to meet local demand and double our contribution to the local economy. To do this, we need permission to grow beyond our current passenger limit of 35 million passengers. But we intend to do this without increasing the number of flights we are allowed to handle, and to contain our impact within the environmental limits that have already been set.

1.3 This application seeks full planning permission for airfield infrastructure to support growth at Stansted; but with the cap on the number of passengers raised from 35 million passengers per annum (mppa) to 43mppa. The existing limit on the total number of aircraft movements (passenger and cargo air transport movements (ATMs), plus 'other' air movements) of 274,000 a year is to remain unchanged. However, it is proposed that this limit would be a singular limit and not sub-divided as per the operational limits contained within the current permission. The existing agreed limits on the aircraft noise envelope are also to remain unchanged.

1.4 To make best use of the single runway, additional airfield infrastructure is required to ensure that the efficiency and resilience of the airfield is maintained during peak periods of the operation. This application includes the following airfield infrastructure:

- Two new taxiway links to the runway (Rapid Access Taxiway (RAT) and Rapid Exit Taxiway (RET));
- Six additional remote aircraft stands (adjacent Yankee taxiway); and
- Three additional remote aircraft stands (forming an extension of the Echo Apron).

1.5 This airfield infrastructure comprises the proposed development for which STAL are seeking planning permission and to which new planning conditions to control annual passenger and air transport movements should be attached.

Structure and Purpose of this Planning Statement

1.6 The aim of this planning statement is to provide the case for the application and set out the development's compliance with the statutory planning tests, as defined by the Town and Country

Planning Acts, in order that the Local Planning Authority is able to form a balanced planning judgement.

1.7 The structure is as follows:

- **Section 2**: sets the context for the development;
- **Sections 3 & 4**: describe the planning history and details of the application;
- **Section 5**: sets out the relevant statutory Development Plan policies, against which the application will be judged, and other relevant national, regional and local policies and strategies;
- **Section 6**: contains a detailed planning appraisal, the level of compliance with the Development Plan policies, the effects of the scheme and a summary of the likely environmental impacts;
- **Section 7**: then describes the mitigation measures that are appropriate and relevant;
- **Section 8**: describes the benefits arising from the development. The further growth of Stansted is set against a wider range of policies (national, regional and local) and an assessment of how the development will aid delivery of their objectives; and
- **Section 9**: draws together the conclusions in relation to the Development Plan and other material planning considerations.

Environmental Impact Assessment

1.8 STAL has considered the requirement for an Environmental Impact Assessment (EIA) in accordance with the requirements of Regulation 15 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 ('the EIA Regulations'). Having considered the potential environmental impacts of the proposed development, STAL is of the view that the proposed development constitutes EIA development. Submission of a request for a Scoping Opinion to Uttlesford District Council ('the Council') was made in June 2017, and a response was received on 21st December 2017. An Environmental Statement (ES) and other technical reports (e.g. a Transport Statement and Statement of Community Involvement) form part of this application, alongside this Planning Statement, to ensure the relevant policies and material issues are considered.

2 Making Best Use of Stansted Airport

A New Era for Stansted

2.1 MAG's acquisition of Stansted in 2013 marked the start of a new era for the airport. Under new ownership, STAL's positive commercial approach to working with airlines has brought significant benefits for consumers and the UK economy through increased investment, stronger competition and greater choice.

2.2 Overall, this approach has resulted in a rapid increase in Stansted's passenger numbers from 17.8 million in 2013 to 25.9 million in 2017. A reinvigorated Stansted has seen the total number of destinations rise from 150 to 190 over the last five years, and an increase in frequencies to key destinations.

2.3 At the same time, new airlines have been attracted to broaden the range of services on offer. Most recently, Emirates announced that it will begin daily services to Dubai from June 2018, complementing the new routes to New York, Boston and Toronto with Primera Airlines from April 2018. These new services are good examples of how people and businesses from the region are sharing in Stansted's recent success, and enjoying the convenience and wider economic benefits of a growing network of routes from their local airport.

2.4 Stansted has unrealised potential. Over the next decade Stansted will be the primary opportunity for aviation growth in the South East, with the airport's existing runway having the capacity to serve 43 million passengers per annum by 2030. Stansted is a key strategic asset and making best use of its capacity will deliver further social and economic benefits, and help drive local and regional growth.

2.5 To support Stansted's development, STAL is planning to invest over £600 million in new infrastructure and facilities. This will transform the airport, offering a better passenger experience, while ensuring that Stansted plays an important strategic role in improving the UK's connectivity, and continuing to be a catalyst for economic growth and prosperity to the region. Stansted's growth will deliver significant further benefits for consumers and businesses, both in communities around the airport and across the wider region. This includes the social and economic benefits of substantial numbers of new jobs. In particular, the ability for airlines to introduce new services at Stansted will provide greater convenience and consumer choice, and help maintain competition across the London system.

2.6 With significant growth to date, and further growth in demand forecast over the next decade, Stansted is at the point where it is right to consider the framework for the airport's growth beyond the current planning limit of 35 million passengers a year. A new framework will provide local communities with clarity around how growth beyond the current passenger cap will be managed, and enable STAL to invest in new transport infrastructure for the region with confidence in its ability to make best use of Stansted's capacity.

2.7 The remainder of this Section addresses:

- Stansted's initial development under BAA;
- changes under MAG ownership since 2013, including a new vision for Stansted, route development, economic and community benefits, investment in facilities;
- the benefits of improved connectivity;
- the future growth in aviation and Stansted's role in the national and regional market;
- the infrastructure needed to support growth; and
- a new planning framework for the next chapter in Stansted's history.

Stansted Airport's Development under BAA

2.8 Stansted has developed as a key component of the UK and the South East aviation market over the last three decades. Following the Government's 1985 decision to approve the phased expansion of the airport, a new 957hectare (ha) masterplan was developed which provided for the transfer of commercial aviation activities to a major new terminal and freight complex to the south of the runway. The first phase of this development opened in 1991. Growth continued in a planned and phased manner up to the initial permitted limit of 15mppa. Subsequent permissions provided for further growth to 25mppa in 2003 (the '2003 Permission') and to 35mppa in 2008 (the '2008 Permission').

2.9 Stansted's development has spanned a period of huge liberalisation in European aviation. Most significantly, the opening-up of the European Union (EU) aviation market was the catalyst for the emergence and rapid growth of 'low-cost' airlines. The UK market was one of the first to be transformed by the low-cost revolution, with new airlines opening routes to existing and new destinations at much lower airfares, making leisure and business travel more affordable and accessible.

2.10 From the mid-1990s, Stansted worked with low-cost airlines to develop new services to a wide range of new destinations. These airlines saw Stansted as a good way to serve the growing London market, and were particularly attracted by the availability of spare capacity, competitive airport charges and modern airport facilities. This resulted in both Ryanair establishing Stansted as its principal UK base, and significant growth by other airlines including easyJet, Buzz and 'Go'.

2.11 Stansted's growth was matched by further phased investment in infrastructure, with terminal extensions and new airfield infrastructure developed in line with the airport's original masterplan and its well defined Operational Area.

2.12 Stansted continued to grow strongly until 2007. The Global Financial Crash and the subsequent recession saw a reduction in aviation demand globally, leading to a decline in air traffic at European and UK airports, with Stansted's throughput declining to a low point of 17.4 million in 2012. Stansted's traffic was further impacted by BAA's decision to increase airport charges in 2007 and the resulting breakdown in commercial relationships with major airline customers. The Competition Commission's market investigation of BAA's ownership of the three London airports also contributed to a lack of strategic direction at Stansted, which continued until the airport's sale to MAG in February 2013.

Stansted Development Under MAG

2.13 MAG acquired Stansted in February 2013 and has overseen a strong recovery in the airport's performance. In 2017 Stansted handled 25.9mppa, a growth of 8.1 million passengers in five years.

2.14 Prior to acquisition, MAG's confidence in Stansted's prospects was founded on the fundamental strength of its catchment and a view that it had significant unrealised potential. MAG's vision for Stansted was to make it the South East's premier airport for 'low-cost' air travel and develop a wider choice of airlines and destinations so that it could serve as the global gateway for its core catchment covering the East of England and London.

2.15 MAG was clear that Stansted's potential could be realised by:

- offering competitive terms to airlines to help develop and sustain a wider route network and a broader choice for passengers;
- investing to transform the airport's facilities to improve the passenger experience and commercial performance;
- focusing on improving the efficiency of airport operations to enable Stansted to compete effectively with other airports;
- adopting a pro-active and strategic role in the growth of the wider region, working with others to help drive economic activity through improved connectivity; and
- pressing for improvements to the rail services and infrastructure along the West Anglia main line.

2.16 MAG's acquisition of Stansted in 2013 saw immediate action on a range of strategic initiatives:

- an £80 million investment in the terminal facilities to provide a new larger security screening area, a rearranged check in zone, a larger departure lounge, new retail and catering facilities, and a range of new car parking products to provide greater choice;
- the refurbishment of Satellite 1 to provide the standard of facilities required by full service and long-haul airlines;
- new commercial arrangements with airlines, supported by improvements in the way that Stansted operated; and
- an enhanced programme of community engagement, with a focus on education, skills and employment to help support and grow the local economy.

2.17 In 2015, following public consultation, Stansted published a new masterplan known as the Sustainable Development Plan ('SDP'). The SDP set out MAG's new ambition for Stansted and its approach to the development of the airport. The plan identified the benefits and impacts associated with Stansted's future growth, and established detailed policies and targets across a range of topics, ranging from public transport to community engagement.

2.18 The objectives of the SDP are as follows:

- to make Stansted the best London airport;
- to plan for growth to make full and efficient use of existing capacity;
- to support economic growth in the region;
- to manage and contain environmental impacts;
- to be active and supportive partners in the local community; and
- to maintain Stansted's position as the best major airport in the UK for access by public transport.

2.19 These objectives were widely supported by local people, businesses and other stakeholders. There was particular support for Stansted playing a stronger role in the region's development, recognising the strategic importance of global connectivity to many of the businesses based in the airport's catchment. Since the publication of the SDP, STAL has been working hard to achieve these objectives and progress is reported in more detail below.

Aviation Development

2.20 New ownership has enabled Stansted to compete more effectively to attract airlines and passengers, supported by long term commercial agreements with airline partners. The airport's growth from 17.8 million passengers in 2013 to 25.9 million passengers in 2017 has exceeded our original expectations and demonstrated the extent of Stansted's previously untapped potential.

2.21 One of STAL's key objectives has been to increase the range of services on offer, both in terms of destinations served and the number of airlines operating from Stansted. Over the last five years, we have made significant progress. For example:

- in 2017 Stansted served 190 destinations, an increase of 40 over the last five years;
- 22 airlines operated from Stansted in 2017, an increase of 14 over the last five years;
- Stansted offered an average of 3,375 services per week in the 2017 summer season, an increase of 841 (33%) over the last five years; and
- 14% of passengers at Stansted in 2017 were travelling on business, an increase of 633,000 (22%)over the last five years.

2.22 Stansted is the best-connected UK airport for flights to Europe, serving more destinations than any other airport.

2.23 Ryanair continues to operate the largest number of services, with over 20 million passengers in 2017 (compared with 12 million in 2013). The number of passengers travelling on other airlines has also increased from 4.8 million in 2012 to 5.7 million in 2017, providing greater choice and competition.

2.24 Jet2 chose Stansted as its first base in the South East and announced the start of new services in 2017, with seven aircraft operating to 21 destinations. Following the success of its first summer, Jet2 has decided to increase its fleet at Stansted in 2018 to ten based aircraft to provide 60% more seat capacity and services to 33 destinations. British Airways has also added passenger services to its cargo operation at Stansted, with a network of summer leisure routes which has proved popular with passengers.

2.25 Stansted has also been successful in developing a range of long haul services, which will save passengers from having to make lengthy journeys to other London airports. Historically, there has been a concentration of long haul flights at Heathrow. However, over the last few years airlines have increasingly recognised the strength of regional demand for long haul services in the East of England and London, and the opportunity to serve these passengers directly from Stansted.

2.26 For example, established airlines such as Thomas Cook and TUI now serve long-haul city destinations from Stansted as well as a range of typical leisure destinations.

2.27 From April 2018, Danish airline Primera Air will open a new base at Stansted to provide direct flights to New York (daily), Boston Logan (four times a week) and Toronto (three times a week). Primera will be the first airline for nine years to fly scheduled services to the USA. Flights will be operated by Primera Air's brand-new Airbus A321NEO aircraft.

2.28 At the same time, WOW Air will also commence services to the USA, via Reykjavik. This will connect to a wide range of onward destinations including New York (Newark), Chicago, Pittsburgh, Miami, Toronto, Boston, Montreal, Washington D.C., Los Angeles and San Francisco. WOW has also announced new routes from Reykjavik to Detroit, Cleveland, St. Louis and Cincinnati (commencing April 2018).

2.29 In December 2017, Emirates announced that from June 2018 it would be launching a new daily service to Dubai, the largest hub in the Middle East. The route will be operated by Emirates' new three-class Boeing 777-300ER, with connections through Dubai to its network of global destinations including Hong Kong, South Africa, Shanghai, Singapore and Mumbai (popular business destinations from the region) as well as services to Australasia and the Far East. The aircraft also has significant cargo capacity, which will offer local businesses new trade opportunities and contribute to the profitability of the route.

2.30 These new services are significant milestones in Stansted's ambition to provide the region and its economy with the widest possible range of services, and better meet the global connectivity needs of the 7.5 million people living in its catchment. STAL is confident that Stansted can build on this recent success and continue to expand its network as the airport grows.

Community and Economic Benefits

2.31 Stansted's growth since 2013 has significantly increased the value of its contribution to the regional and national economy.

2.32 Stansted now contributes around £1.2bn to the local East of England economy and around £6 billion in wider economic benefits to the UK in terms of direct, indirect and induced benefits, as well as business productivity and tourism. This represents an increase of 49% over the last four years. The airport is already the largest single employment site in the East of England, with 200 companies based at the airport. On-site employment has increased from around 10,200 in 2012 to around 12,000 in 2017. Over 75% of employees live in Essex and Hertfordshire.

2.33 The wider economic benefits attributable to Stansted have also grown as the airport has got busier. For example, the expanded route network provides stronger connectivity to and from the region, which in turn will have made the region more accessible, more productive and more competitive. Stronger connectivity also strengthens the region's ability to attract inward investment and visitors – both domestically and internationally.

2.34 One of our key aims is to ensure the benefits of airport growth are felt locally. The annual 'Meet the Buyers' event is designed for local suppliers to win business from airport based companies. In 2013, 116 local companies attended and an estimated £1.8m worth of orders were placed locally. By 2017, attendance had increased to nearly 300 companies and £4.7m of contracts were awarded locally.

2.35 STAL has also committed to building stronger links with local schools to demonstrate the exciting range of careers in aviation, with a focus on science, technology, engineering and maths. To support this, we opened an on-site Aerozone facility in 2015 which provides a dedicated education centre that inspires young people and will help to create a skilled regional workforce for the future. Since it opened, over 7,000 young people have attended the Aerozone, complementing our wider programme of education, employment and skills development.

2.36 Over the last three years, STAL has been working with Harlow College, Essex County Council, South East LEP and Uttlesford District Council to fund and develop an on-site college that will strengthen the region's further education capability. Work on the new £11m college started in late 2017, with the first intake of students due to start in September 2018. It has been developed and funded as a joint initiative by MAG. As part of the 'MAG Connect' programme, the college will provide places for 500 students, delivering the technical skills and education needed for careers in STEM subjects, as well as airport engineering, business studies, logistics, supply chain management, asset management, and many other aviation specific skills, both at the airport and with other local employers.

2.37 With around 200 companies based at Stansted, STAL has created an Airport Community Network to co-ordinate and deliver a wide range of activities in local communities. This enables all companies to contribute to initiatives such as training and mentoring programmes, providing school governors, environmental projects and supporting local voluntary and charitable groups.

Environmental Improvements

2.38 STAL recognises that aircraft noise is an important issue for local communities, and is committed to reducing and mitigating our impacts. Aircraft noise is understandably a key concern for local people. However, aircraft and engine design has improved markedly as aviation has grown over the last decades. This has brought significant reductions in the noise impact of individual aircraft. Stansted's operations are now dominated by some of the most modern aircraft in service. For example, the 90dB(A) noise footprint of a B737-800 (one of the most common aircraft at Stansted used by Ryanair) today is 2.7sqkm compared to a footprint of c.10sqkm for the B737s (737-200 hush-kitted) that were typically operating in the early 2000's.

2.39 This trend for each generation of aircraft to be significantly quieter than the previous generation is set to continue. Boeing and Airbus are now producing their next generation of aircraft, which bring two important changes; being both quieter and with lower emissions than aircraft using Stansted today. The 90dB(A) noise footprint of the Boeing 737Max8 (to be used by Ryanair) is predicted to be 1.3sqkm, half that of the current B737-800 variant.

2.40 Alongside the improvements in engine technology have been improvements in aircraft performance. We continue to work closely with airlines, air traffic control and our Consultative Committee to encourage early fleet replacement and explore ways in which aircraft can be flown more quietly, such as higher rates of climb (which enables noise to dissipate more quickly) and the ability to more accurately follow specific flight paths.

2.41 The key noise measure – the 57 LAeq 16hr noise contour - has reduced from 30.8sqkm in 2007 to 24.8sqkm in 2016. This is well within the permitted noise limit of 33.9sqkm.

2.42 One of STAL's objectives has been to address a long-standing community concern about over-flying of villages on one of the main departure routes to the south. In 2017, we introduced 'Performance Based Navigation', which uses technology within the aircraft to enable it to follow a much more precise flight path, and to do so consistently. The majority of departures from Stansted now use this procedure, which has led to an 85% reduction in the number of people overflown in the Hatfield Heath and Broad Oak areas.

2.43 Other notable environmental improvements in the last five years have been a reduction in the airport's waste, with only 1% now going to landfill, and 65% of all waste material being recycled or recovered. A comprehensive energy efficiency programme is helping to deliver the target of a 15% reduction in total energy demand in the five years from 2013 to 2018. Stansted is now 'carbon neutral' in respect of airport emissions (aircraft carbon emissions being controlled separately) and has received ACI Europe Carbon Accreditation level 3.

2.44 Managing Stansted's impact on the region means taking an active approach to managing how people travel to and from the airport. We have worked with Government and the rail industry to deliver service improvements in the new franchise, and a range of improvements have now been introduced by Greater Anglia. These include new and longer trains on the Stansted Express, more competitive fares and a range of improved customer facilities. These have all contributed to Stansted's continued success in the use of public transport; maintaining one of the highest public transport 'mode shares' among UK airports with 52% in 2017. Coach travel accounts for around 25% of passenger trips with 16 services per hour in peak periods to a range of London destinations. Over the last 10 years public transport use by staff has increased from 7% to 23% through a Staff Travel Plan, discounted Travelcard and improved services. Alongside regional partners, we will continue to press Government and Network Rail to make major investments in the West Anglia main line infrastructure, to provide greater capacity and more reliable and faster journey times

Driving & Supporting Regional Growth through Improved Connectivity

2.45 Stansted's recent growth has provided a firm foundation for assessing its contribution to regional and national connectivity. Its spare runway capacity, the strength of its catchment and the scale of the route network means it will play an important strategic role in meeting the UK's connectivity needs over the next decade.

2.46 As there is limited ability for other airports to grow significantly beyond their current passenger volumes, especially at Heathrow and Gatwick, Stansted's growth will deliver significant benefits for consumers and businesses. In particular, the ability for airlines to introduce new services at Stansted will help maintain competition and keep airfares down across the London system. This gives local communities and businesses the benefit of convenience and avoids lengthier surface access journeys to those congested airports.

2.47 Stansted's unrivalled access to European destinations, and its increasing number of long haul destinations, will support growth in international connectivity and trade in the period immediately after the UK leaves the EU. Crucially, Stansted is in the strongest position of all London airports to support a growth in connectivity during the next decade because it has runway capacity to accommodate new services to new destinations. This will make an important contribution to realising the Government's vision for a prosperous and global Britain and delivering the recent Industrial Strategy.

2.48 Stansted will reinforce and strengthen the region's economic impact and it features strongly in its regional partners' ambitions for growth, prosperity and regeneration. The airport provides important connectivity for business by supporting the movement of people and goods. It also helps attract inward investment and visitors (for business, leisure and education). The wide and increasing range of air services from Stansted offers the region's residents direct links to cities and region across the world – a valued element of modern life. Stansted's growth over the next decade is expected to lead to the creation of 5,000 new on-site jobs and billions of pounds in additional economic activity.

2.49 The East of England is a fast-growing region, with an expanding population and a growing economy. Cambridge is building on its global reputation for education, science and technology. The regional growth areas are focused on key transport corridors; with Stansted being at the junction of two such corridors the London–Stansted–Cambridge corridor (LSCC) and the A120 Haven Gateway. These two corridors provide crucial inter-regional and international connectivity from Stansted and the Haven ports.

2.50 The region has a clear growth agenda, with significant new housing proposed to meet the needs of a growing economy and expanding population. Within the LSCC, population growth is twice the national rate; between 2000 and 2014 the Corridor's population grew by 19.1% compared with a national average growth rate of 9.7 %[1]. This level of growth is projected to continue at a steady rate. At a local level, the emerging Local Plan for Uttlesford identifies a need to provide for around 14,100 new homes by 2033 to meet the needs of the current and projected increase in population[2].

2.51 Stansted is ideally positioned to provide global connectivity to the world-leading research institutions and technology/life sciences businesses located in the London-Stansted-Cambridge corridor as well as the burgeoning tech clusters in east London. These sectors are amongst the UK's strongest industrial assets, and they depend on quick and easy access to international markets to compete effectively. A wider network of long haul services has the potential to provide a huge boost to these businesses and help drive growth for an emerging global knowledge region.

2.52 Today, Stansted is the third largest air freight centre in the UK, handling around 10% of the UK's air cargo market. In 2017, 260,000 tonnes of freight, worth over £12bn, were handled on c.12,000 dedicated freighter flights. This helps connect local firms, small and medium sized enterprises in Essex and hi-tech companies in Cambridge, to global markets. In addition to dedicated air freight, the flights of DHL, FedEx, UPS and Royal Mail provide London with an express cargo hub for time critical, often overnight, deliveries.

2.53 Long haul services, such as those recently announced to the Middle East and North America, also bring trading benefits through the capacity to carry air freight. Belly-hold cargo is an important factor in maintaining the viability of long haul services, as well as giving local businesses easier access for importing or exporting goods. This new cargo capability will complement the existing 'all freight' services to, for example, Memphis and Qatar.

2.54 Broadening the mix of flights is designed to provide businesses in the airport's catchment with the connectivity they need to access global markets for moving people and goods. A network of long haul services to key destinations will help drive the region's development by providing businesses with direct access to customers, suppliers, investors and research partners around the world. Consumers will also benefit from greater choice, competition and convenience.

2.55 Stansted's growth will be of significant benefit, both directly in terms of employment opportunities, and indirectly by attracting companies and other organisations to invest in the wider region.

Improved connectivity, driving economic growth, can be harnessed to ensure that the economic benefits of a growing airport reach those who will benefit most.

2.56 Within Stansted's catchment area are some areas of need where economic and social regeneration is a priority; for example, the north London boroughs of Haringey, Tottenham and Enfield. The airport is well placed to support these aims, with an expanding number of jobs across a wide range of employment types and levels. Two particular challenges are access to employment and skills mismatch. A range of measures have been introduced to make rail and bus access easier and cheaper from these areas and to enable staff to travel to meet early and late shift times.

2.57 There is also increasing partnership working between airport businesses and the employment, training and education agencies in those boroughs. Regular jobs fairs have been successful and these residents will be able to take advantage of the new Stansted Airport College alongside the existing Airport Training and Skills Academy.

Stansted's Contribution to Meeting National and Regional Demand

2.58 In 2017, the Government's 'Call for Evidence' for a new aviation strategy set out the case to make more intensive use of existing airport capacity. At para 7.20 it states:

> *"The Government agrees with the Airports Commission's recommendation that there is a requirement for more intensive use of existing airport capacity and is minded to be supportive of all airports who wish to make best use of their existing runways including those in the South East. The exception to this is Heathrow, whose proposed expansion is proceeding through the draft Airports NPS process".*

The Government also acknowledge that this policy may involve raising planning limits.

2.59 The Government's proposed policy takes forward the Airports Commission's recommendation to recognise the 'crucial importance' of making better use of existing capacity and the 'imperative' of growing the UK's connectivity in the period before a new runway can be delivered at Heathrow.

2.60 The Government's latest draft of the Airports National Policy Statement also makes clear that making best use of existing runways complements its policy support for new runway capacity at Heathrow. This is covered in more detail in Section 5.

Stansted's Role within the London System

2.61 Stansted is no longer the 'third London airport'. While it is undoubtedly playing a significant role in providing short haul connectivity for the London and wider South-East market, it is also a critical infrastructure asset for the East of England region. In 2016, 6.5 million passengers from the East of England used Stansted, representing around a quarter of the airport's traffic.

2.62 Stansted is well placed to provide capacity for the wider South East and UK markets. As the fourth largest airport in the UK, with a wide range of facilities, excellent ground transport connections, a strong local market and potential to accommodate significant growth, it is an increasingly attractive opportunity for airlines and passengers; as evidenced by Primaria Air and Emirates. This trend is expected to continue, and new markets are being targeted in the US, Middle East, India and China.

2.63 Stansted's importance locally is demonstrated by the fact that over 60% of short haul flights taken by passengers travelling to or from Essex, Cambridgeshire and Suffolk are from Stansted.

Making Best Use of Stansted's Capacity

National Outlook

2.64 Air travel is now an essential component of many people's lives. The ability to travel by air has opened-up the world for trade, investment, tourism, sport and education. The social, economic and cultural benefits of air travel are well recognised and understood.

2.65 Following substantial growth in UK passenger numbers in the 1990s, the number of passengers at UK airports peaked at 235mppa in 2008. The Global Financial Crisis (GFC) in 2008 triggered a worldwide economic downturn which caused UK passenger numbers to fall by more than 10% between 2008 and 2010 to around 211mppa.

2.66 Since 2010, the aviation sector has recovered steadily such that by 2016 UK passenger volumes had reached a new peak of 268mppa; an increase of 17mppa on the previous year, which was itself a new peak. Growth in passenger demand at UK airports in 2017 has also been strong, and materially higher over the last few years than the forecasts produced by the Airports Commission in 2015.

2.67 The Government published new aviation forecasts in 2017 which show national demand continuing to rise consistently over the coming decades; the Government's baseline central forecasts show UK unconstrained demand growing to 356mppa by 2030 and 494mppa by 2050.

2.68 The DfT has confirmed that the principal purpose of its forecasts is to inform long term decisions on the need for, and timing of, additional runway capacity. They are not a view on the likely growth rates at individual airports. Their forecasts don't take account of important local, commercial and competition factors at the airport level, so the DfT suggest that for individual airport and short term (i.e. 10 years) consideration, then alternative airport specific forecasts should be prepared.

Regional Outlook

2.69 The London area system (comprising Heathrow, Gatwick, Stansted, London City and Luton) served 163 million passengers in 2016, equivalent to 60% of the UK's aviation traffic. While passenger numbers fell at all London airports between 2008 and 2010, the overall reduction was smaller than for non-London airports and traffic recovered more quickly to pre-recession levels. Over the last five years London airports have seen particularly robust growth, with passenger numbers increasing by almost 30mppa.

2.70 STAL's aviation forecasts show unconstrained passenger demand at London airports growing to 206mppa by 2028, equivalent to a compound annual growth rate (CAGR) of 1.9%. This scale of growth highlights the vital importance of making best use of all the runway capacity in the London airport system in order to meet forecast demand for air travel.

2.71 Amongst London's airports, Stansted is the largest one that currently has significant spare runway capacity. Heathrow already operates very close to its maximum runway capacity, with limited scope for further growth. Similarly, Gatwick is already the busiest single runway airport in the world and operates at capacity for extended periods.

2.72 The Government's preferred option for new runway capacity by 2030 is a third runway at Heathrow. The delivery of this runway will be a lengthy process and is expected to face significant challenges. The Government's chosen delivery mechanism is via a Development Consent Order (DCO) for a Nationally Significant Infrastructure Project (NSIP) under the 2008 Town & Country Planning Act. An NSIP scheme can only be submitted once the relevant National Policy Statement (NPS) has been endorsed by Parliament.

2.73 The Government intends to seek Parliamentary approval for the Airports NPS later this year. Allowing for the DCO process, land acquisition, construction and commissioning, the Government expect the new runway to be available by 2030.

2.74 On this basis, Stansted is the primary opportunity for aviation growth in the London system for at least the next ten years. The potential to handle up to 43 million passengers a year means it has the ability to contribute more capacity to the London system than any other airport over this period.

Stansted Outlook

2.75 The national and regional outlook described above means that the prospects for Stansted's growth over the next decade are strong, particularly considering:

- the continuing strong demand, both locally and across the wider London region;
- the availability of significant spare capacity at Stansted;
- strong and committed airlines looking to grow;
- capacity constraints biting at other London airports; and
- the underlying growth of housing and employment in the core catchment area.

2.76 As well as serving the Greater London area, Stansted serves the wider East of England region, including the key economic centres of Cambridge (the 'Silicon Fen'), the London-Stansted-Cambridge Corridor, the A120 Haven Gateway, the Cambridge - Milton Keynes – Oxford Arc and the newly announced Cambridge-Norwich Tech Corridor. There is a strong regional growth agenda in this catchment area (explained in more detail in Section 5) and this will increase the demand for air travel for both business and leisure.

2.77 STAL's forecasts show Stansted growing to 35mppa by 2023, and to 43mppa by 2028 (subject to permission being granted for the proposed development and a new planning cap). Capacity constraints at Gatwick and Heathrow over this period mean that Stansted's share of passengers in the London system is forecast to increase from 15% in 2016 to 18% in 2028.

2.78 STAL has also produced forecasts for aircraft movements at Stansted. In 2016 there were just over 180,000 aircraft movements, with passenger aircraft accounting for around 85% of all aircraft movements. Dedicated air freighters accounted for 14,000 movements, with positioning flights and general aviation representing a further 15,000 movements. The average numbers of passengers per passenger aircraft was 160. This is a product of the aircraft's size (number of seats available) and the percentage of seats occupied (load factor).

2.79 By 2028, the number of passengers per aircraft movement is forecast to have risen to 170 (CAGR 0.5%) due to a number of factors:

- airlines upgrading to aircraft with additional seats, including easyJet phasing out A319s (156 seats) in favour of A320s (186 seats) and A321s (235 seats), and Ryanair's transition to the B737MAX 200 (197 seats) from the B737-800 (189 seats);
- the introduction of long haul services at Stansted with some airlines using larger wide-body aircraft types such as the Boeing 787 and the larger Boeing 777 (to be used by Emirates from June 2018); and
- a small increase in the average load factor over the forecast period from 87% to 88%.

2.80 As a result, passenger volumes at Stansted are expected to grow more quickly (CAGR 4.9%) than passenger aircraft movements (CAGR 4.3%), which are forecast to increase from 152,000 in 2016 to just over 253,000 movements by 2028.

2.81 Stansted's traffic profile is at present defined by distinct peaks in the morning, lunchtime and in the evening. Of these, the morning peak period is the busiest as based aircraft leave for their first wave of departures. Initially, there will be some modest increase in the peak periods, after which growth will 'spill' in to the 'shoulder' period just after the morning peak hours. Beyond this, as a more mixed pattern of arrivals and departure is seen, activity starts to spread across the day. These changes will allow Stansted to make greater and more efficient use of its facilities, as more passengers and aircraft can be handled by the same facilities and infrastructure.

2.82 A further market trend relates to the nature of long haul routes. Traditionally, large aircraft flew the long-haul services and smaller aircraft flew short haul routes within Europe. This trend continued with the onset of low-cost airlines using narrow body Boeing 737 or Airbus A319/320 fleets across their short haul networks in the late 1990s and early 2000s.

2.83 Improvements in aircraft technology and airline business models mean that smaller, narrow body aircraft are now being used on some long haul flights. For example, airlines including Norwegian Air, WoW and Level are operating flights between Europe and North America using narrow body fleets. These smaller and more fuel-efficient aircraft have lower operating costs and make it possible for airlines to operate profitable long-haul services with fewer passengers than in the past.

2.84 These 'next generation' aircraft are quieter and lower in emissions compared to many of the older aircraft still operating today. They also have more seats than older versions of the same type, increasing the passenger capacity of each flight. For example, the new Boeing 737 Max8 can be configured for up to 210 seats, but the Ryanair specific variant *Boeing 737 Max200* will have 197 seats which is an increase of 8 seats from the Boeing 737-800 (189 seats) which Ryanair currently operate. Larger narrow body aircraft could carry up to 230 passengers from Stansted in the future.

2.85 STAL's forecasts suggest that this trend will help drive an increase in the average number of passengers per air transport movement (PAX/PATM) from 160 to 170 between 2016 and 2028. This will enable Stansted to grow its passenger numbers by 77% to 43mppa over the same period, while still being within the current cap on the total number of aircraft movements.

Infrastructure Needed for Best Use and Stansted Transformation.

2.86 From 1991, Stansted has been developed with a comprehensive airport-wide masterplan contained within a strong and maturing landscaped boundary. The airport is laid out to modern standards, enabling it to handle the largest aircraft operating today and support a highly efficient operation.

2.87 The masterplan in the original 1985 planning permission was designed to handle two phases of growth: a first phase to 8mppa and then a second phase to 15mppa. However, as Stansted has grown, its traffic has evolved in a way that has meant the operational capability of the airport's facilities and infrastructure has been greater than originally expected. For example, changes in the market, and the highly efficient operations of low-cost carriers, have enabled the existing infrastructure to handle much higher volumes of passenger and aircraft movements. We expect airlines to continue to make ever more efficient use of the airport's existing infrastructure and this will support significant growth over the next decade.

2.88 Stansted's design makes it possible to expand its landside, terminal and airside infrastructure in a phased and modular way. Parts of the original long-term plan remain to be implemented over the coming years to enable the airport to make best use of its capacity.

Stansted Transformation and Investment Programme.

2.89 Since 2013, MAG has invested c.£150m in the airport's facilities to handle the growth in traffic and also to meet the ever-changing needs of airlines and passengers. The broadening of the airline market has required improvements to domestic facilities, while the introduction of long haul services needs different check-in and passenger facilities.

2.90 MAG's initial investment programme has delivered an £80m upgrade to the terminal building, with major improvements to the security area, the departure lounge and a transformation of Satellite 1 for international passengers. This investment has improved the environment for passengers and helped attract new airline business.

2.91 STAL remains committed to meeting the evolving needs of its passengers and airlines, and the pace of growth over the last five years has brought forward the timing of investment in new facilities and infrastructure. Set out below is a description of the further investment in infrastructure and facilities that is planned.

Runway & Airfield

2.92 Stansted has a modern and fully capable runway with a full-length parallel taxiway, but it is currently under-utilised both throughout the day and also its potential hourly capacity. To enable best use of runway capacity, some minor taxiway improvements form part of this application and include a new rapid access taxiway and exit taxiway from the runway. These improvements will reduce runway occupancy times and reduce congestion by improving the sequencing of aircraft to and from the runway. These works will enable us to make best of the runway's capacity by enabling a greater number of aircraft movements per hour and increasing the runway throughput from 50 to 55 movements per hour.

Aircraft Parking

2.93 Completion of the original airfield masterplan will provide most of the necessary space to handle the manoeuvring, parking and passenger loading of aircraft associated with 43 million passengers a year. However, to provide greater resilience and flexibility, nine additional aircraft stands are proposed. These stands will enable the airport to meet forecast peak demand and respond better to unexpected incidents, including bad weather and operational disruption. Together with the taxiway works described above, these works comprise the extent of the airfield development necessary to accommodate growth over the next 10 years.

Terminal Facilities

2.94 The current terminal has an hourly capacity of 5,250 departing passengers per hour. Recent growth has largely been during the existing peak periods (e.g. morning, midday and evening peaks) and existing facilities are becoming congested during these times. Peak scheduled demand at Stansted reached 97% of the terminal capacity or higher on more than half of days through the Summer 2017 season. This was for both arrivals and departures. Over the same period, peak scheduled demand reached the maximum runway capacity on just 12% of days.

2.95 The projected growth in passenger numbers will require larger facilities, more space and investment to improve customer service and reduce congestion. These improvements are needed both from a capacity point of view and to meet the changing needs of passengers and airlines. The main investment will be a new Arrivals Building on a site adjacent to the existing terminal. This received planning permission from Uttlesford District Council in 2017. The new building will handle all international and domestic arrivals, with significantly more space and its own forecourt and road access. It will have more convenient links to the bus, coach and rail station and the car parks. Once complete, the transfer of all arrivals facilities to this new building will free-up significant space in the existing terminal to enable us to deliver major improvements and an expansion of the existing departures facilities, including:

- a second security search area;
- more bespoke check in facilities at either end of the building;
- a larger departure lounge with more seating; and
- a wider range of passenger facilities and amenities

2.96 This transformation of the terminal area will result in further major investment by MAG, to the scale of c.£600m over the next 6 years.

A New Framework for Stansted's Growth beyond 35mppa

2.97 Stansted's growth over the last 25 years has been in defined phases, consistent with the original long-term masterplan. The timing of development has varied to reflect the fluctuations in demand and the changing nature of the aviation market. This approach has provided an opportunity, at each phase, to take stock and reflect future needs in light of the circumstances at the time. As policy, the aviation market and local needs have evolved, so Stansted's operations, development and investment plans have altered to suit.

2.98 Each phase of growth has been an opportunity to assess Stansted's impact, and review, and where necessary update, the way in which environmental concerns need to be addressed. This process has also taken into account the views of local communities and stakeholders and best practice across the industry.

2.99 As a result, Stansted's development has been delivered in a way that explicitly takes into account the local and wider context and priorities. Planning conditions and mitigation have controlled the impacts of Stansted's growth and guided development. Overall, there has been an objective to minimise the impacts on local communities, while maximising the benefits for local people and stakeholders. Growth has taken place without breaching environmental limits, and this will remain the case with this application.

2.100 Stansted has seen significant growth in the last five years, with nearly 26 million passengers handled in 2017 and a CAGR of 8.2%. We forecast further growth in demand over the next decade to 43mppa by 2028, at a CAGR of 4.7%. With this rate of growth, it is clear that Stansted has now reached a point where it is appropriate and timely to establish the framework for its growth for the next 10 years and beyond the current planning cap of 35mppa. This framework for the next 10 years or so will need to take account of:

- emerging national policy and the benefits of making best use of scarce runway capacity at London's major airports;
- the strong desire for regional growth in the East of England, with an increasing population and significant new housing and economic development;

- the role that Stansted can play in meeting market demand and the benefits of improved connectivity for the region's residents and businesses;
- current best practice and the regulatory framework in terms of environmental management at airports, especially in relation to aircraft noise;
- the strategic transport objectives for the East of England and London; and
- Stansted's long-term masterplan as set out in the Sustainable Development Plan in 2015 following consultation.

2.101 There are two key benefits that arise from settling Stansted's future now.

2.102 Firstly, airlines and other businesses make long term investment decisions, and confidence and certainty about the future will help realise the potential benefits that aviation growth can bring. As Stansted approaches its existing planning cap, it is important to be clear about how further growth will be manged and controlled. This will provide certainty and clarity for local communities and all those with an interest in Stansted's operations and development. It enables local people to understand the implications of Stansted's growth beyond 35mppa, and helps shape the appropriate operating conditions and controls which are needed to manage environmental and other impacts.

2.103 Secondly, addressing these issues at this stage will help make the case for long term investments; not just at Stansted itself, but also in the wider region. Planned regional growth, alongside Stansted's expansion, will increase the strength of the arguments for major investment in the transport networks and services serving the East of England.

Summary

2.104 This section has set the context for this planning application, by outlining:

- how Stansted has steadily grown and evolved to meet changing circumstances; consistent with the principles originally established when it was identified as London's third airport;
- the benefits that growth has brought to the region, in terms of improved connectivity for local communities, more employment and investment and a major stimulus to the local economy;
- the role that Stansted is expected to play in the UK's aviation market in the time before any new runway is built to meet the South East's demands for air travel;
- its current rapid growth means it will reach the current cap of 35million passengers within 5 years;
- the relatively modest infrastructure that is needed to enable the existing runway to be used to its potential, and how this forms part of a wider investment programme; and
- the strategic case for raising the 35 mppa cap to enable the airport to make best use of its existing capacity.

2.105 The remainder of this statement goes on to assess the consequences of growth, and how this fits with aviation, planning, transport and wider policy objectives. In particular, it considers what 'making best use' means for local communities. This includes a summary of the technical assessments that have been carried out into the environmental and transport impacts of growth beyond the current 35mppa planning cap. The Statement also identifies the actions that are proposed to refine and enhance the extensive range of mitigation measures that help deliver the benefits of growth, while aiming to minimise any adverse effects.

3 Planning History of Stansted Airport

3.1 Since the Government's decision in 1985 to develop London's third airport at Stansted, there has been a considered and staged approach to the evolution of the planning and regulatory framework for the airport. Stansted has developed in distinct phases within the context of the original long-term masterplan. This has created complex layers of planning history and permissions that have a material impact on the consideration of this application.

1985 Permission (8mppa and 15mppa)

3.2 Outline planning permission was granted for a major development of Stansted as London's third airport in 1985 (the '1985 Permission') to accommodate growth to around 15mppa. The development was designed to take place in two phases: Phase 1 being growth to 8mppa; and Phase 2 being growth from 8 to 15mppa.

3.3 The development to support this growth was underpinned by a site wide masterplan and comprised a new passenger terminal, extensive areas of aircraft parking (new apron), expansion of the airfield and taxiway system, a wide range of supporting facilities and a comprehensive landscaping scheme.

3.4 The reserved matters for Phase 1 were approved in 1986 and 1987. The first phase of the development opened in 1991 and comprised (in summary) the new five bay terminal building, new areas of apron, cargo facilities, a hotel, associated facilities and supporting infrastructure, such as roads.

3.5 Reserved matters for Phase 2 were approved in 1999 and largely covered additional apron, various airfield taxiway works, terminal extensions (three additional bays, comprising one arrival and two departures bays) and two satellite buildings.

Parliamentary Orders on Aircraft Movement Limits

3.6 The 1985 Airports Policy White Paper supported a passenger air traffic movement limit *"to provide a means of controlling the rate of expansion at Stansted in the light of developments in the London system as a whole and to assure local residents that an appropriate balance will be struck between aviation and local interests in the use of the airport."*[3]

3.7 Consequently, the Stansted Airport Aircraft Movement Limit Order 1987 came into force on 1st June 1987 and introduced a limit of 78,000 aircraft movements in any one calendar year. This was increased over several amendments: in 1996 to 120,000 movements and to a limit of 185,000 movements in 1999.

3.8 This Parliamentary limit was unique in a UK context and was at odds with the local controls generally in force at other UK airports. Ultimately the Parliamentary limit was revoked by a further Order, which came into force on 16th July 2004. This followed the grant of the planning permission in

2003 (outlined below) and a bridging Unilateral Undertaking which created the existing regulatory control mechanism of annual aircraft movements through local planning conditions.

2003 Permission (15mppa to 25mppa)

3.9 In 2003, the Council granted permission for the growth of Stansted up to 25mppa, and 241,000 aircraft movements a year (the '2003 Permission'). The permission covered a wide range of airport infrastructure and associated development including additional apron, maintenance hangars, car parks, and a two-bay extension to the south-west elevation of the existing terminal to provide additional capacity to accommodate an uplift in passenger throughput from 15 to 25mppa. The application was accompanied by an Environmental Statement and Transport Assessment.

2008 Permission (25mppa to 35mppa)

3.10 In 2006, BAA Stansted applied to the Council to vary two planning conditions associated with the '2003 Permission'. Firstly, the application sought non-compliance with the annual passenger cap of 25mppa and secondly, it sought to increase the total annual aircraft movement limit from 241,000 per annum to 264,000 per annum. The proposed facilities and development to handle the increased throughput were the same as those granted in the '2003 Permission'. Much of this development has not been built and is no longer part of STAL's thinking. The consent for developments refenced "C" to "S" in that permission has now expired. Permission for developments "A" and "B" remains extant until October 2018, but are unlikely to proceed. Development of site "P" commenced in March 2017.

3.11 The application was made under Section 73 of the Town and Country Planning Act 1990 and would, when granted, have had the effect of creating a fresh permission. It was therefore required to be supported by an Environmental Statement, considering the potential environmental effects of the previously approved infrastructure as well as the removal of the passenger cap and increase in the aircraft movement limit. The supporting Environmental Statement covered the following topics:

- Air Noise;
- Air Quality;
- Archaeology & Cultural Heritage;
- Economic Effects;
- Energy;
- Ground Noise;
- Landscape & Visual Impact;
- Nature Conservation;
- Surface Access;

- Third Party Risk;
- Waste;
- Water;
- Construction; and
- Traffic Forecasts.

3.12 The Environmental Statement concluded that there were no significant adverse environmental effects arising from the proposed development, taking into account appropriate controls agreed as part of the '2003 Permission' Section 106 agreement and subject to certain additional mitigation measures (subject to a separate 2008 Section 106 agreement).

3.13 The application was recommended for approval but refused by the Council in 2006. Following a Public Inquiry, the application was granted on appeal by the Secretaries of State in 2008 (the '2008 Permission') with new planning limits on passengers and aircraft movements. This permission was lawfully commenced on 10 March 2017 through the implementation of an extension to the airport's fuel farm, and throughput exceeded 25mppa in May 2017.

3.14 The airport is currently operating within the terms of this permission and is subject to the following conditions:

- MPPA1: The passenger throughput at Stansted Airport shall not exceed 35 million passengers in any twelve-calendar month period.
- ATM1: Subject to ATM2 below, from the date that the terminal extension hereby permitted within Site "A" opens for public use, there shall be at Stansted Airport a limit on the number of occasions on which aircraft may take-off or land at Stansted Airport of 264,000 ATMs (Air Transport Movements) during any twelve-calendar month period, of which no more than 243,500 shall be PATMs (Passenger Air Transport Movements) and no more than 20,500 shall be CATMs (Cargo Air Transport Movements).
- ATM2: The limit in condition ATM1 shall not apply to aircraft taking-off or landing at Stansted Airport in any of the following circumstances of cases, namely:

  (a) the aircraft is not carrying, for hire or reward, any passengers or cargo;

  (b) the aircraft is engaged on non-scheduled air transport services where the passenger seating capacity of the aircraft does not exceed ten;

  (c) the aircraft is required to land at the airport because of an emergency or any other circumstance beyond control of the operator and commander of the aircraft; and

(d) the aircraft is engaged on the Queen's flight, or on a flight operated primarily for the purposes of the transport of government Ministers or visiting Heads of State or dignitaries from abroad.

The total number of take-offs and landings by aircraft in categories (a) and (b) above combined shall not exceed 10,000 in any twelve-calendar month period.

- AN1: The area enclosed by the 57dB(A) Leq16hr (0700-2300) contour, when calculated and measured by the Civil Aviation Authority's Aircraft Noise Contour Model 2.3 or as may be amended, shall not exceed 33.9sqkm using the standardised average mode from the date of grant of this permission. Any necessary account shall be taken of this requirement in declaring the capacity of Stansted Airport for the purpose of Council Regulation (EEC) No 95/93 of 18 January 1993 on common rules for the allocation of slots at Community airports. Forecast aircraft movements and consequential noise contours for the forthcoming year shall be reported to the Local Planning Authority annually on the 31st January each year.

Arrivals Building

3.15 Planning permission for a new Arrivals Building was granted in April 2017. The Arrivals Building is to be located on land immediately adjacent to the north-east elevation of the current terminal between it and the Radisson Blu hotel.

3.16 The new Arrivals Building is designed as an alternative to the previously approved two bay extension to the south-west elevation of the main terminal. Its construction will enable all current arrivals facilities to be transferred from the existing terminal building, which then in turn will be reconfigured to handle all departures activity.

3.17 Both schemes will deliver a much improved level of passenger service. The reconfiguration of the main terminal building for departing passengers will provide additional check-in and bag-drop facilities, a second security search area and enhanced departure lounge facilities. It will also provide the ability to develop customised facilities and varied services to be tailored for individual airlines or groups of passengers.

3.18 It is anticipated that the construction of the Arrivals Building will commence in early 2019.

Summary

3.19 Stansted's planning history is defined by phases of planned growth that have been proposed, considered and consented through the planning system at a national and local level.

3.20 The original intention to establish a planning and regulatory framework that would control the airport's growth has been successful: successive limits have been created and at appropriate times, new applications have been made with relevant environmental assessments. This has enabled planning judgements to be made on environmental impacts and socio-economic benefits at each stage, and appropriate mitigation and control measures put in place.

3.21 The current permission to grow to 35mppa was not regarded as full capacity of Stansted's runway; rather a staging post towards that point. This application maintains the historic approach to growth and is intended to provide a framework for the airport's future: 'growth within limits'. As such, it is consistent with the airport's evolution towards making best use of its capacity.

4 Application Site and the Proposed Development

Application Site

4.1 Stansted is located approximately 56km (35 miles) north-east of central London, and 50km (31 miles) south-east of Cambridge. The airport lies in a predominantly rural setting, with its site wholly within the local authority administrative district of Uttlesford in the county of Essex. The airport's operational area extends over approximately 957 hectares (ha).

4.2 The land required for the proposed airfield infrastructure is in four separate locations, within the existing airfield, and therefore entirely contained within the current airport Operational Area. Specifically, the gross development area amounts to an area of 8.8ha, of which 7ha is new hardstanding on existing airfield grass.

4.3 The red line plan (ref: NK017817-SK309 Location Plan) confirms the application site, which for this application is the Operational Area of the airport. The locations of the proposed airfield works are shown on plan STAL-STAL-001-PLA-001-001 Site Plan Rev 1.

The Proposed Development

4.4 This application comprises the following airfield infrastructure works (illustrated in Figure 1):

a) Two new links to the runway (a Rapid Access Taxiway and a Rapid Exit Taxiway);

b) Six additional remote aircraft stands (adjacent Yankee taxiway); and

c) Three additional aircraft stands (extension of the Echo Apron).

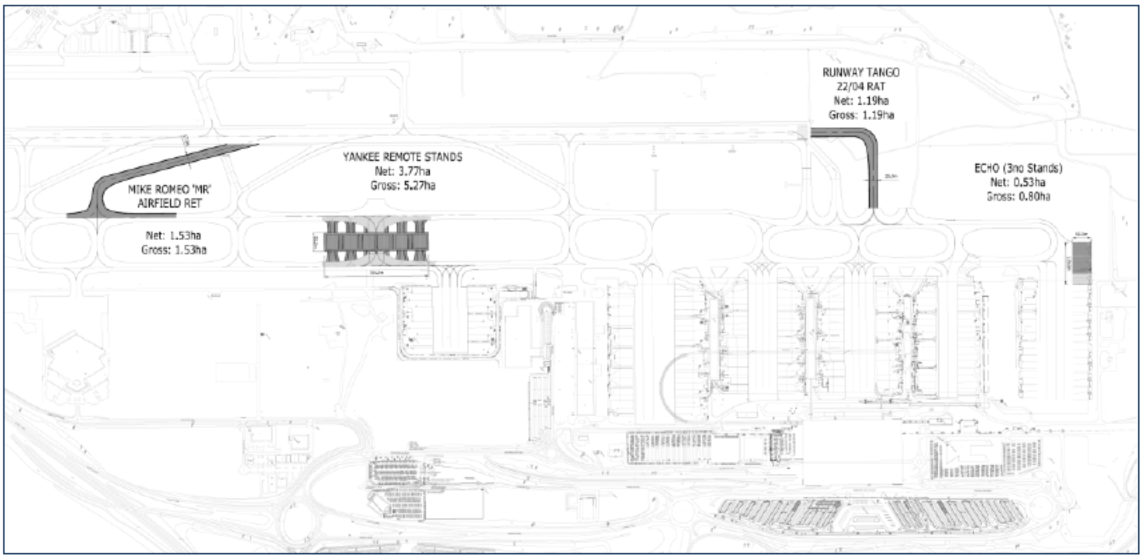

Figure 1: Location of proposed new airfield infrastructure

Rapid Access and Exit Taxiways and Stands

4.5 The locations of the new taxiways are based on operational and regulatory requirements and the performance characteristics of the aircraft using Stansted. This infrastructure will reduce runway occupancy times and increase runway throughput. Two new taxiways are to be provided which will link to the runway, comprising:

- *Mike Romeo* Rapid Exit Taxiway (RET); and
- *Runway Tango* Rapid Access Taxiway (RAT).

4.6 The Mike Romeo RET will provide a new link to the south-west of the runway to facilitate prompt aircraft exit from Runway 22 and will cover an approximate area of 1.5ha.

4.7 The Runway Tango RAT will provide a new link at the north-eastern end of the runway to allow for additional taxiing space and a new point of access to the 'start of roll' point on Runway 22 (the predominant south-westerly operation) and will cover an approximate area of 1.2ha.

Aircraft Stands

4.8 The proposed development includes the provision of nine additional stands to accommodate additional aircraft parking which will improve efficiency and ensure sufficient space to meet peak demand, especially for overnight based aircraft.

4.9 Six new aircraft stands are proposed to be located in the mid airfield ('Yankee Remote Stands') to provide additional parking for six International Civil Aviation Organization (ICAO) Code C aircraft and will mainly be used by based aircraft for overnight parking. Servicing and loading is likely to occur once the aircraft has been towed to a stand adjacent to the satellite piers.

4.10 A further three stands are to be added to the existing Echo Stands (located to the north east of the airport's airfield) to accommodate additional aircraft parking.

4.11 The aircraft parking stands will be concrete with an asphalt surface, with inset airfield lighting, drainage, cable ducts and other services as necessary, including Fixed Electrical Ground Power (FEGP), fuel hydrants and stand entry guidance system.

Relationship of the Physical Works to a Higher Passenger Limit

4.12 This new airfield infrastructure will enable the airport to make the best and most efficient use of its existing single runway, which will in turn enable it to increase its passenger throughput to 43 million in line with the objectives set out in the 2015 Stansted Airport SDP.

4.13 The previous planning permissions referred to above (principally the 1985 permission) included expansion to the airfield and taxiway layout, including eight remote stands on the Echo apron. These stands are now under construction, and due for completion in winter 2018-19. The remote stands the subject of this application are in addition to the previously approved airfield infrastructure in order to provide additional overnight aircraft parking to meet peak demands and provide resilience. The proposed RET and RAT works are modifications to the previously approved airfield layout, but in locations better suited to Stansted's current operating pattern.

4.14 The proposed taxiway works will lead to an incremental increase in runway capability in peak periods, with a modest uplift of five additional movements in any individual hour. More importantly, the taxiway works will improve the efficiency of the airfield which means that peak airfield operations (taxiing, take-off and landing) can be maintained over longer, more sustained periods without congestion or delays occurring. It is this, coupled with additional passenger aircraft stands, that unlocks the best use of the airfield and enables it to accommodate additional passenger aircraft traffic.

4.15 Stansted's runway is 3,048m long and capable of handling large, wide body aircraft (ICAO Code E and F). However, the majority of aircraft that currently operate at Stansted are smaller ICAO Code C (e.g. Boeing 737 or A320) narrow body aircraft. As set out in Section 2 of this Statement, this type of aircraft will continue to be the main component of the fleet mix at Stansted in the future. As such, the taxiway works are located so that smaller aircraft can access and exit the runway quickly and provide for efficient airfield taxiing, including aircraft holding before gaining Air Traffic Control clearance to enter the runway and take-off. This in turn results in an optimised airfield improving the efficiency of the operation, reducing congestion and aircraft delays. These efficiencies will improve aircraft punctuality and reduce fuel-burn while aircraft are waiting to take-off.

4.16 Smaller aircraft do not require the full length of the runway, particularly to land, and therefore, exit points are located at appropriate distances to ensure that aircraft vacate the runway as soon as possible. The RET is therefore located at the optimum position to minimise runway occupancy times and maximise the number of ICAO Code C aircraft exiting the runway at the earliest opportunity.

4.17 The addition of a further RAT provides optimisation and thus increased capacity, to hold and sequence aircraft before accessing the runway and gaining clearance to take-off.

4.18 The taxiway works are laid out specifically for the predominant mode of operation (westerly on Runway 22).

4.19 The six additional 'Yankee' stands create remote parking (typically overnight) which allows for more based aircraft to be operational in the peak morning period. The three 'Echo' stands provide remote bus-served stands which will also help to maximise the capacity of the airfield.

4.20 Together, these airfield works will accommodate the forecast number of 253,000 passenger aircraft movements for the period to 2028. The figure of 253,000 passenger aircraft movements takes into account expected increases in aircraft size and load factors, which result in a higher number of passengers per aircraft movement (as described in Section 2) and the ability to handle 43mppa over the next decade.

4.21 The movements forecast for cargo and 'other' traffic, do not significantly increase or meet previous levels of activity. This traffic therefore does not require any specific airfield improvements to accommodate their growth and in combination with the forecast passenger aircraft movements, totals 274,000 aircraft movements per year, the same as previously permitted.

4.22 Stansted is subject to Night Flight Restrictions set by the Government. The power for the Secretary of State to set night flight restrictions for designated airports is found in section 78 of the 1982 Civil Aviation Act. This application does not seek, or require any alteration to those limits. Instead, the forecast increase in passengers and passenger aircraft movements is contained within the hours of 0600 to 2330 or the 'daytime' period.

5 Aviation and Planning Policy Analysis

5.1 This section provides a review of the policies that are relevant to the consideration of the application. It starts with the main statutory policies of the Development Plan against which the application has to be judged. It then considers other policies, including a review of aviation, economic and transport policies and relevant local and regional policy matters, all of which are capable of being material considerations in the determination of this application.

The Development Plan

5.2 The following analysis focuses on the statutory Development Plan and land use policies specific to the application site and proposed development. The site is located entirely within the administrative area of Uttlesford District Council. The relevant Development Plan is the adopted and emerging Uttlesford Local Plans. Consideration has also been given to the Local Plans and policies in neighbouring authorities, such as the adopted and emerging Local Plans of East Hertfordshire District Council and Braintree District Council, and also the Minerals Local Plan and Waste Local Plan of Essex County Council and Southend-on-Sea Borough Council.

Uttlesford Adopted Local Plan (January 2005)

5.3 The Local Plan was adopted in January 2005. The majority of policies were 'saved' by the Secretary of State in 2007 and, in line with the National Planning Policy Framework (NPPF), the Plan's policies must now be attributed weight based on their consistency with the NPPF.

5.4 The Local Plan vision states that Uttlesford enjoys strong positive attributes which, amongst others, includes "*a growing network of domestic and international air services through Stansted Airport, which is a major employment site its own right*".[4] The vision goes on to state that the Plan "*seeks to maintain and improve on Uttlesford's positive attributes*".[5]

5.5 Within the Stansted Airport boundary, the Local Plan identifies six separate development zones, accommodating various land uses defined in policies AIR1 to AIR5:

- Policy AIR1 Development in the Terminal Support Area;
- Policy AIR2 Cargo Handling/Aircraft Maintenance Area;
- Policy AIR3 Development in the Southern Ancillary Area;
- Policy AIR4 Development in the Northern Ancillary Area; and
- Policy AIR5 The Long-Term Car Park.

5.6 Other planning policies in the Local Plan that are specific to Stansted Airport include:

- Policy S4 Stansted Airport Boundary;
- Policy S8 The Countryside Protection Zone;

- Policy AIR6 Strategic Landscape Areas; and
- Policy AIR7 Public Safety Zones.

5.7 An overarching requirement for each of the development zones is that individual buildings should be of high quality design, whilst at the same time reflecting their employment function. Furthermore, landscape planting is identified as an essential element of development to provide context to new buildings, roads and planting areas.

5.8 The airfield is situated within the Stansted Airport boundary which is defined on the Uttlesford Proposals Map. **Policy S4 – Stansted Airport Boundary** details that "*Provision is made for development directly related to or associated with Stansted Airport to be located within the boundaries of the airport. Industrial and commercial development unrelated to the airport will not be permitted on the site*".[6]

5.9 In addition to the site-specific policy set out above, the Local Plan also contains a series of policies on standard matters, such as access and design, and specific themes such as environment and transport, which are relevant to the proposed development. These are detailed below.

5.10 **Policy GEN1 – Access** identifies a series of criteria that need to be met for a development to be permitted. In summary, the surrounding network and access to the main road network must be capable of accommodating the traffic generated by the development safely; the design must not compromise road safety and must take account and be designed to meet the needs of all users and encourage movement by means other than driving a car.

5.11 For any building that the public will use, development proposals are required to provide safe, easy and inclusive access for all regardless of disability, age or gender.

5.12 The supporting text to the policy states that the impact of development on the road network will need to be assessed and Traffic Impact Assessments may be required, with transport infrastructure improvements to be sought where appropriate.

5.13 **Policy GEN2 – Design** details the criteria a development proposal would need to meet to be permitted. The criteria include the need for the design to be compatible with the scale, form, layout, appearance and materials of surrounding buildings; providing an environment that reasonably meets the needs of all potential users; reduces the potential for crime; helps to minimise water and energy consumption and reduces waste production and encourages recycling and reuse; minimises the environmental impact on neighbouring properties through appropriate mitigation measures; and that the design would not have a materially adverse effect on the reasonable occupation and enjoyment of a residential or other sensitive property.

5.14 **Policy GEN3 – Flood Protection** states that outside flood risk areas, development must not increase the risk of flooding through surface water run-off. The policy details that a flood risk assessment will be required to demonstrate this. Sustainable Drainage Systems should be considered as an appropriate flood mitigation measure in the first instance.

5.15 **Policy GEN4 – Good neighbourliness** identifies that developments will not be permitted if noise or vibrations generated, or smell, dust, fumes, electromagnetic radiation, or exposure to other pollutants would cause material disturbance or nuisance to occupiers of surrounding properties.

5.16 For developments that include a lighting scheme, **Policy GEN5 – Light Pollution** details the requirements for development to be permitted. The policy states that the level of lighting and its period of use is the minimum necessary to achieve its purpose, and glare and light spillage from the site is minimised.

5.17 **Policy GEN6 – Infrastructure Provision to Support Development** details that development will not be permitted unless it makes provision at the appropriate time for required infrastructure, including transport provision, drainage and other infrastructure made necessary by the proposed development. Furthermore, where the cumulative impacts of development necessitate such provision, the policy states that developers may be required to contribute to the costs of such provision.

5.18 **Policy GEN7 – Nature Conservation** states that development will not be permitted where it would have a harmful effect on wildlife or geological features, unless the need for the development outweighs the importance of the feature to nature conservation. The policy requires that a nature conservation survey is undertaken where the site includes protected species or habitats suitable for protected species. Mitigation and /or compensation measures for the potential impacts of development will be secured by planning condition or obligation.

5.19 **Policy ENV11 – Noise Generators** identifies that noise generating development will not be permitted if it would be liable to affect adversely the reasonable occupation of existing or proposed noise sensitive development nearby, unless the need for the development outweighs the degree of noise generated.

5.20 **Policy ENV12 – Protection of Water Resources** identifies that development will not be permitted where it would be liable to cause contamination of groundwater, particularly within protection zones.

5.21 With regard to transportation, the Local Plan refers to the Uttlesford Transport Strategy published in 2001 which highlights Stansted Airport as a key area that should be targeted for greater public transport use.

Uttlesford Withdrawn Local Plan (2014)

5.22 The adopted Local Plan will eventually be replaced by a new Uttlesford Local Plan. Uttlesford District Council consulted on a Pre-Submission version of a Local Plan between April and June 2014; with an Examination in Public of the Plan held in November 2014. The Plan was unable to be declared sound by the Inspector and the Examination was suspended, principally on the basis of housing need and site allocation. The Plan was subsequently withdrawn. Proposed policies relating to the airport, of the now withdrawn plan, were however examined and considered 'sound' by the Inspector.

5.23 The proposed 'District Vision' recognised Stansted Airport as a regional interchange centre for bus, coach and train, allowing people to change easily from one mode of transport to another. The Plan also stated that by 2031 the impact of the airport will have been minimised so that its presence is recognised as an asset to the District which attracts people to live, work and visit.

5.24 The Local Plan set an objective to accommodate development at the airport that equates to a passenger throughput of 35mppa and provide for the maximum number of connecting journeys by air passengers and workers to be made by public transport.

5.25 The Local Plan provided for the airport's growth in **Policy SP4**: **Land at the Airport**. This policy supported airport related development on land within the airport boundary, with the land to be used efficiently, whilst protecting the environmental assets of the site and avoiding unnecessarily prominent structures.

Uttlesford Emerging Local Plan (2017)

5.26 Since the withdrawal of the previous replacement Local Plan in January 2015, Uttlesford District Council commenced work on a new replacement Local Plan, with consultation taking place on an Issues and Options version of the Plan between October and December 2015.

5.27 The Local Plan Issues and Options Consultation Document (2015) sought views on the District Vision and Development Strategy to 2033. The consultation documents stated that the vision and development strategy should set a positive context for how growth and development will be managed over the plan period, and that appropriate items might include the role and function of Stansted Airport.

5.28 Consultation on the Regulation 18 Local Plan (the 'draft' version of the Local Plan) took place between 12 July 2017 and 4 September 2017. The Draft Local Plan builds on the 'Spatial Vision' set out in the Issues and Options consultation document (2015) and details that London Stansted Airport will *"form a pivotal part of the highly successful London Stansted Cambridge Corridor; the environmental impact of London Stansted Airport will be effectively managed".*[7] The Spatial Vision is supported by a series of Themes and Objectives. 'Theme 2 – Support Sustainable Business Growth' is particularly relevant to the airport and is supported by objectives to enable growth and investment (2a) and London Stansted Airport (2c) through the provision of opportunities for employment growth related to the airport and to accommodate development by:

- *"Utilising the permitted capacity of the existing runway and provide for the maximum number of connecting journeys by air passengers and workers to be made by public transport; and*
- *Ensuring that appropriate surface access infrastructure and service capacity will be provided without impacting on capacity to meet the demands of other network users".*[8]

5.29 The draft **Policy SP2 – The Spatial Strategy 2011-2033** specifies that the growth of London Stansted Airport will be *"supported subject to conformity with the environmental and transport framework set out in Policy SP11 – London Stansted Airport".*[9]

5.30 The Local Plan identifies London Stansted Airport as making "*a positive contribution to the delivery of the Spatial Strategy due to the continued expansion, economic growth and increase in passenger numbers".*[10] The draft **Policy SP11 – London Stansted Airport** details that the growth of the airport will be supported and it is designated as a Strategic Allocation in the Local Plan. The policy states that proposals for the development of the airport and its operation, together with any associated surface access improvements, will be assessed against the Local Plan policies as a whole. The policy includes a series of criteria which proposals for development will be assessed against and development will be supported where proposals:

"1. They are directly related to airport use of development;

2. They contribute to achieving the latest national aviation policies;

3. They are in accordance with the latest permission;

4. Do not result in a significant increase in Air Transport Movements that would adversely affect the amenities of surrounding occupiers or the local environment (in terms of noise, disturbance, air quality and climate change impacts);

5. Achieve further noise reduction or no increase in day or night time noise in accordance with any imposed planning condition or otherwise cause excessive noise including ground noise at any time of the day or night and in accordance with the airport's most recent Airport Noise Action Plan;

6. Include an effective noise control, monitoring and management scheme that ensures that current and future operations at the airport are fully in accordance with the policies of this Plan and any planning permission which has been granted;

7. Include proposals which will over time result in a significant diminution and betterment of the effects of aircraft operations on the amenity of local residents and occupiers and users of sensitive premises in the area, through measures to be taken to secure fleet modernisation or otherwise;

8. Incorporate sustainable transportation and surface access measures in particular which minimise use of the private car, maximise the use of sustainable transport modes and seek to meet modal shift targets, all in accordance with the London Stansted Sustainable Development Plan; and

9. Incorporate suitable road access for vehicles including any necessary improvements required as a result of the development."[11]

5.31 The policy goes on to state that development proposals at the London Stansted Airport Strategic Allocation will ensure that appropriate strategic landscaping will be provided both on and off site and that the height and design of buildings will reflect the site's setting and its visibility from the surrounding countryside.

5.32 The draft *Policy TA1 – Accessible Development* sets out that development and transport planning will work towards reducing the need to travel by car and increase the use of public transport and sustainable travel. All new development should:

- Be easily accessible to the main road network, without causing congestion;
- Improve road safety;
- Be located where it can be linked to services via public transport;
- Support and improve public transport; and
- Promote cycling rights of ways.

5.33 Draft *Policy TA2 – Sustainable Transport* provides that sustainable modes of transport should be facilitated though new developments to promote accessibility and integration into both the community and transport network. Developers should prioritise cycling, walking and public transport, whilst encouraging community transport schemes and facilitate charging facilities for plug-in and other ultra-low emission vehicles.

5.34 Draft *Policy EN16 – Air Quality* expands on this stating that development will only be permitted if it is demonstrated that it does not lead to significant adverse effects on health, the environment or amenity from polluting or malodorous emissions, or dust or smoke emissions to air. Additionally, where development is a sensitive end-use, it must be demonstrated that there will not be any significant adverse effects on health, the environment or amenity arising from existing poor air quality.

5.35 Draft *Policy EN18 – Noise Sensitive Development* of the draft Local Plan outlines that development will be permitted unless the occupiers of surrounding land or the historic and natural environment are exposed to adverse levels of noise and/or vibration (as defined within Uttlesford District Council's Noise Impact Technical Guidance – as detailed below). Potentially noisy developments will be located in areas where noise will not be a significant consideration or where its impact can be minimised by mitigation.

5.36 Draft *Policy SP12 – Sustainable Development Principles* details that development which ensures the prudent and sustainable management of the District's towns, villages and countryside will be supported. Schemes should achieve this by:

- Employing best practice in sustainable design and construction;
- Encouraging the redevelopment of previously-developed land which is unused or under-used for uses which are sustainable and protect the natural environment in that location;

- Minimising the amount of unallocated greenfield land that is developed;
- Retaining and enhancing the character, appearance and setting of those areas, settlements or buildings that are worthy of protection;
- Reducing, to an acceptable level, any pollution that may result from development;
- Reducing, to an acceptable level, any impacts arising from known or potential contamination both on development sites and on sites which affect development sites;
- Locating development on land identified as being at low risk of flooding and taking into account any potential increased risk of flooding from new development;
- Promoting development that minimises consumption of and protects natural resources including water;
- Promoting development that makes provision for waste recycling; and
- Promoting development which is located and designed to be energy efficient.

5.37 In addition to the airport specific objective on climate change, **Objective 3b** requires development "To minimise demand for resources and mitigate and adapt to climate change by: Promoting sustainable *design and construction in all development; Encouraging renewable energy production in appropriate locations; Ensuring development is located and designed to be resilient to future climate change and the risk of flooding; and ensuring new development promotes the use of sustainable travel".*[12]

5.38 The adopted Local Plan and emerging Local Plan are supported by a range of guidance documents developed at the district level that provide further detail on specific topic areas. The paragraphs below focus on those documents relevant to planning and land use; other specific policy and guidance documents are referred to in the accompanying ES chapters.

Uttlesford Statement of Community Involvement

5.39 Uttlesford adopted its Statement of Community Involvement (SCI) in May 2016, although a new SCI is currently under preparation by the Council with consultation having closed in November 2017.

5.40 The current adopted document sets out the Council's objectives for community involvement in the planning process. Specifically, it sets the Council's principles on the consultation process for planning applications and the Local Plan. The Council's key principle is to provide everyone with the opportunity to know what is going on and how they can get involved if they want to. The Council state they aim to achieve this by:

- *"involving people where the issue is relevant to them;*
- *at a time in the process where their views can influence outcomes;*

- *by a method appropriate for the purpose and issues being discussed and the people involved; and*
- *at a suitable and accessible venue*".[13]

5.41 The SCI identifies that the Council *"encourage community participation through effective consultation and engagement and improving community forums to reflect closer working with all sectors of the community".*[14]

Uttlesford Noise Assessment Technical Guidance

5.42 The Noise Assessment Technical Guidance (2017) has been prepared in relation to the Council's Local Plan policy on noise and is designed to take account of Planning Practice Guidance, British Standards, National Policy and other guidance to ensure "*developments achieve the highest possible standards without compromising the health and well-being of people that live and work within Uttlesford District Council".*[15] The document provides guidance for applicants, developers and acoustic consultants in relation to noise in a planning context to encourage good acoustic design. It is principally aimed at new residential development. The ES Chapter 7 Air Noise (Appendix 7.2) references it where appropriate to the assessment.

National Planning Policy

National Planning Policy Framework

5.43 The NPPF, issued in March 2012, replaced over 1,300 pages of planning guidance with a single concise document setting out the Government's planning policies for England and how these are expected to be applied when drawing up planning policy and determining planning applications. It sets out that the purpose of the planning system is to contribute to the achievement of sustainable development, which itself is clarified as being composed of three dimensions: economic, social and environmental. These dimensions should be considered jointly and simultaneously.

5.44 To achieve sustainable development, the NPPF sets out 12 core principles of the planning system. These include inter alia:

- a system that is genuinely plan-led;
- proactively driving and supporting sustainable economic development;
- allocating land for development that is of a lesser environmental value; and
- focusing significant development in locations that are or can be made sustainable.

5.45 In a specific reference to development at, and of airports, the NPPF states that local authorities should work with neighbouring authorities and transport providers to develop strategies for the provision of viable infrastructure necessary to support sustainable development, including large scale facilities or transport investment which support the growth of airports.[16] It explains that when planning for airports, plans should take account of their growth and role in serving business and the Government Framework for UK Aviation.

5.46 When planning for airports and airfields that are not subject to a separate national policy statement, the NPPF details that plans should take account of their growth and role in serving business, leisure, training and emergency service needs.[17] The NPPF specifies that such plans should take account of the principles set out in the relevant National Policy Statements and the Government's Aviation Policy Framework.

5.47 The following specific paragraphs of the NPPF are relevant to this application:

- Air Quality - Paragraph 124 of the NPPF refers to air quality and identifies that planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.
- Climate Change – The NPPF states that planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure (paragraph 93). Local Plans are required to take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity and landscape (paragraph 99).
- Ecology - Paragraph 109 states that the planning system should contribute to and enhance the natural and local environment by recognising the wider benefits of ecosystem services; minimising impacts on biodiversity and providing net gains to biodiversity where possible.
- Flood and Drainage - Paragraph 100 requires that development is directed away from areas at highest risk of flooding.
- Noise – Paragraph 109 states that the planning system should contribute to and enhance the natural and local environment by, inter alia, preventing both new and existing development from contributing to or being put at unacceptable risk from, or by being adversely affected by unacceptable levels of soil, air, water or noise pollution or land stability. More specifically, the NPPF states that planning policies and decisions should aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development; to mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions; and recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established (Paragraph 123).
- Health and Wellbeing – Paragraph 69 recognises that the planning system can play an important role in facilitating social interaction and creating healthy, inclusive communities.

- Transport – Paragraph 34 details that plans and decisions should ensure developments that generate significant movement are located where the need to travel will be minimised and the use of sustainable transport modes can be maximised.

5.48 The NPPF encourages community involvement in the planning process, with an emphasis on applicants engaging in pre-application consultation with local communities. Specifically, the NPPF states:

> *"Early engagement has significant potential to improve the efficiency and effectiveness of the planning application system for all parties. Good quality pre-application discussion enables better co-ordination between public and private resources and improved outcomes for the community".*[18]

5.49 This guidance has helped inform the consultation and engagement plan that has been embraced through a wide public consultation programme for this application.

5.50 The Department for Communities and Local Government (now the Ministry of Housing, Communities and Local Government) has indicated that consultation will take place in early 2018 on new policy measures alongside a draft of a new NPPF, with the revised NPPF to be published before the end of summer 2019.[19]

National Aviation Policy

Aviation Policy Framework

5.51 In 2003, the Government adopted the Future of Air Transport White Paper, updated by the 2006 Progress Report. Since the production of the 2003 White Paper much has changed in terms of Government policy, the economy, the aviation market and the needs of passengers and airlines.

5.52 Following the Coalition Agreement in 2010, the Secretary of State issued in March 2011 a Scoping Document that concluded that whilst there was widespread agreement regarding aviation's economic contribution and its local and global environmental impacts, there was still considerable uncertainty about where, or if, new capacity to retain the UK's aviation hub status should be provided. The Government withdrew its support for new runways in the South East and set up the independent Airports Commission in September 2012 to advise on future runway capacity (see para 5.58). The Aviation Policy Framework (APF) was issued in March 2013 and wholly replaced the 2003 Aviation White Paper as the formal statement of Government policy.

5.53 The measures set out in the APF aim to achieve a "*balanced approach to securing the benefits of aviation*". It clearly states that the role of aviation in supporting the long-term economic growth of the country is unequivocal, but recognises that it is essential that the aviation sector continues to make a significant and cost-effective contribution towards reducing global emissions.

5.54 The APF sets out a strategy for a vibrant aviation sector focusing on the short term to around 2020 and endorses making better use of existing runways at all UK airports. Specifically, the strategy is focussed on measures for:

- *"making best use of existing capacity to improve performance, resilience and the passenger experience;*
- *encouraging new routes and services; supporting airports outside the South East to grow and develop new routes; and*
- *better integrating airports into the wider transport network".*[20]

5.55 The Framework contains a chapter relating to planning; explaining its interaction with existing planning guidance and policies. It cites the NPPF's advice to local planning authorities to prepare local plans with regard to policies and advice issued by the Secretary of State, including the APF, which may also be a material consideration in planning decisions.

5.56 The Framework goes on to suggest that all proposals for airport development must be accompanied by clear surface access proposals which demonstrate how the airport will ensure safe and reliable access for passengers and minimise congestion and other local impacts.

Airports Commission

5.57 The Airports Commission was established in 2012 with a remit to examine the location, scale and timing of any requirements for additional capacity to maintain the UK's position as Europe's most important aviation hub and to identify and evaluate how any need for additional capacity should be met in the short, medium and long term. The intention of the Commission's work was to lead to a political consensus and overcome the previous obstacles to establishing a settled long-term plan for aviation.

5.58 The Commission published an interim report to Government in December 2013. It set out the evidence for the measures needed to maintain the UK's global hub status, its recommendations to improve the use of existing airport capacity, and a short-list for new runways in the London area in the period to 2030. The final report of the Commission, published in July 2015, recommended Heathrow as the preferred option for the location of a new runway. The report is clear that the "*position of the UK within the global aviation market is critical to its economy: it is central to ensuring increased productivity, growth and employment opportunities*".[21]

5.59 The Commission was also clear in its support for the necessary infrastructure development (including transport links) and spending to achieve the best use of current infrastructure. The Commission recognised the strategic importance of Stansted to the wider London airport system and considered that there would be a case for reviewing the Stansted planning cap, if and when, the airport moves closer to full capacity. The Final Report of the Commission notes that the airport has seen rapid growth since its purchase by MAG, which if sustained over a longer period, would bring the airport to full capacity in the 2020s.

Future Aviation Policy

5.60 The Government recognises that aviation is an important vehicle for driving economic growth and crucial to building a strong economy.[22] The high level of growth over the past five years is recognised as putting significant pressure on existing infrastructure, especially in the South East which is the busiest region in the UK aviation market.

5.61 Given the long lead-time for new runway capacity at Heathrow, the Government recognises that it is vital the UK continues to grow its domestic and international connectivity during the intervening period, and that this objective can only be achieved through more intensive use of existing airport capacity.

5.62 The Government is currently reviewing its wider aviation policies and is looking to update the overarching strategy for the sector, in order to better respond to future challenges and opportunities.

5.63 In a written statement to Parliament, The Rt Hon Chris Grayling (Secretary of State for Transport) announced plans in February 2017 for a new UK aviation strategy.[23] The statement detailed that the strategy:

> *"…will champion the success story of the UK's aviation sector. It will put the consumer back at the heart of our thinking. The strategy will also explore how we can maximise the positive role that our world class aviation sector plays in developing global trade links, providing vital connections to both the world's growing economies and more established trading partners. Connections that will only grow in importance as our trading network expands".*[24]

5.64 The Government issued a Call for Evidence on a new strategy in July 2017. The consultation document 'Beyond the Horizon - The future of UK aviation: A call for evidence on a new strategy' sought views on the approach the Government is proposing to take and the issues it has identified in relation to aviation.[25]

5.65 The Aviation Strategy will set out the Government's vision for the wider aviation sector and will eventually replace the 2013 APF. Over the course of 2018, the Government is expected to publish a series of Green Papers focused on specific topics, including airport safety, security, competitiveness, consumers, regulation and capacity. Subsequently, it is anticipated that Government will publish a final White Paper setting out a new Aviation Strategy. Taken together, the Aviation Strategy and the Airports NPS (see below) will provide Government's policy in respect of the aviation sector.

5.66 The Call for Evidence notes that strong growth in passengers over the past five years (including in the south east), is putting significant pressure on existing infrastructure. The Government acknowledge (para 7.20):

"We are aware that a number of airports have plans to invest further, allowing them to accommodate passenger growth over the next decade using their existing runways, which may need to be accompanied by applications to increase existing caps."

5.67 It goes on to accept the Airports Commission's recommendation of the need for more intensive use of existing airport capacity. Thus, as part of the preparation of the new Aviation Strategy, and in advance of it considering other topics, the Government is:

"minded to be supportive of all airports who wish to make best use of their existing runways including those in the South East. The exception to this is Heathrow, whose proposed expansion is proceeding through the draft Airports NPS process".[26]

5.68 The Government go on to advise that airports with planning restrictions that wish to take forward plans to develop their airport and increase the utilisation of existing runways beyond those restrictions will need to submit a planning application. Those applications should be judged on the application's individual merits. This will include considering environmental issues along with the other issues that led to the current restrictions. Evidence and views in relation to this policy were sought by the Government, which considers that *"Due to the recent rise in growth, the government believes that this issue cannot wait until the publication of a new Aviation Strategy".*[27] The Government's response to the Call for Evidence consultation is expected in February 2018.

Draft Airports National Policy Statement

5.69 Following the Government's announcement[28] that a Northwest Runway at Heathrow was its preferred scheme to deliver additional airport capacity in the South East, a draft Airports National Policy Statement (NPS) was published for consultation between February and May 2017. Ultimately, the Airports NPS will provide the primary basis for decision making on a DCO application(s) for a Northwest Runway at Heathrow Airport.

5.70 The consultation document stated that the Airports NPS "*does not have effect in relation to an application for development consent for an airport development not comprised in an application relating to: the Heathrow Northwest Runway*"[29] and other associated terminal capacity and reconfiguration of Heathrow Airport's central terminal area.

5.71 However, the draft NPS recognised the importance of aviation to the UK economy and states that the *"international connectivity, underpinned by strong airlines and airports, is important to the success of the UK economy".*[30] Furthermore, the draft NPS recognised that the sector benefits the UK economy through its direct contribution to Gross Domestic Product (around £20 billion of economic output in 2014) and employment (direct employment of c 230,000 in 2014), facilitating trade and investment, manufacturing supply chains, skills development, tourism and leisure.

5.72 The draft NPS is clear there is a need for new airport capacity and that the UK faces a significant capacity challenge, particularly in the South East, emphasising that all London airports will be full by 2040 unless action is taken now. Specifically, the NPS states that *"The Government believes* *that not increasing capacity will impose costs on passengers and on the wider economy".*[31] The draft Airports NPS was subsequently withdrawn on 24 October 2017 and superseded by the Revised Draft Airports NPS (October 2017).

5.73 A further period of consultation on a Revised Draft NPS[32] was undertaken between 24 October 2017 and 19 December 2017 to take into account revised Government aviation demand forecasts and the impact of the Government's final 2017 Air Quality Plan which were not published at the time of the initial consultation; broader government policy changes; and responses to the February consultation.

5.74 Since the publication of the initial Draft Airports NPS in February 2017, the Government has published the call for evidence on the new Aviation Strategy. This included a firm commitment to the development of a "*new policy framework for the sector which will provide clarity on the future of aviation policy across the whole of the UK*"[33] whilst also looking to address wider aviation policy to 2050. It was necessary therefore, for the Government to align both documents and the revised draft NPS makes references to the Aviation Strategy and recognises the complementary nature of the policies. Specifically, the revised draft NPS reiterates that the Government is minded to be "*supportive of all airports who wish to make best use of their existing runways, including those in the South East".*[34]

5.75 The revised draft NPS also provides clarity on the applicability of the NPS and how airports wishing to make more intensive use of existing runways are able to do so[35]. In particular, it identifies that with regard to the more intensive use of existing infrastructure, that it may be possible for existing airports to "*demonstrate sufficient need for their proposals, additional to (or different from) the need which is met by the provision of a Northwest Runway at Heathrow".*[36]

5.76 The final NPS is currently expected to be laid before in Parliament during the first half of 2018.

Airspace Policy Consultation

5.77 A Government consultation on UK Airspace Policy was undertaken between January and May 2017 in support of airspace modernisation to deliver benefits for the UK economy, passengers and communities. The proposed development, subject of this application, does not require an airspace change.

5.78 The aim of the consultation was to outline the policy principles that will guide such decisions and offering greater flexibility to three of London's major airports, including Stansted, to adapt their noise management to the needs of local communities. It is the noise management issues that are of relevance to this application.

5.79 A range of supporting documents were published in support of this consultation, of which the following are germane:

- Draft Air Navigation Guidance: Guidance on Airspace & Noise Management and Environmental Objectives; and

- Survey of Noise Attitudes (SoNA 2014).

5.80 The UK Airspace Policy and NPS consultations raised proposals to introduce an Independent Commission on Civil Aviation Noise (ICCAN) and changes to the night noise regime.

Night Flight Restrictions

5.81 The Secretary of State has the power to set night flight restrictions for designated airports under section 78 of the 1982 Civil Aviation Act. Since 1971 Stansted Airport has been designated, along with Heathrow and Gatwick. The previous night noise regime for these airports was set in July 2014 and ran from October 2014 to October 2017.

5.82 In January 2017, the Government published a consultation document on night flight restrictions at Heathrow, Gatwick and Stansted for 5 years commencing October 2017. It proposed modified controls on noise during the night quota period (23h30 to 06h00) which aimed to ensure that communities around the three controlled airports would not be subject to unlimited 'exempt' aircraft. In general terms this resulted in the creation of a new quota category to capture the majority of aircraft, but that even 'quota exempt' aircraft count in the movement limit. The proposed five-year regime to October 2022 therefore adjusted Stansted's movement limits but not the noise quota limit; the effect being that to utilise the movement limit, the average noise quota per movement would have to reduce.

5.83 Following the consultation period, the Government announced a continuation of controls for all three airports, subject to the changes originally proposed but with deferral of the quota category until October 2018. The Government recognised the need for continued intervention and acknowledged that night time operations involve a careful balancing of local environmental impacts and economic benefits that they bring.[37]

National Economic Policy

Industrial Strategy: Building a Britain Fit for the Future

5.84 The Government's white paper 'Industrial Strategy: Building a Britain Fit for the Future' (2017) sets out a long-term plan to boost productivity and the earning power of people throughout the UK. The Prime Minister's foreword states that a *"successful free-market economy must be built on firm foundations: the skills of its workers, the quality of the infrastructure, and a fair and predictable business environment".*[38] The Strategy establishes five foundations of productivity: ideas; people; infrastructure; business environment; and places.

5.85 With respect to infrastructure, the Government's approach is to invest in infrastructure to drive growth across the UK, and to create *"a new high-speed rail network that connects people to jobs and opportunities, regenerate our stations and airports, and progressively upgrade our road network".*[39] The Strategy seeks to provide the right infrastructure in the right places to boost the earning power of people, communities and businesses.

5.86 The Strategy outlines that with a more strategic approach to infrastructure investment, *"a priority will be to strengthen growth and accelerate the creation of economic opportunities throughout the UK".*[40] Key to this are the UK's international gateways, which the Strategy identifies as connecting markets and people and attracting inward investment, keeping the UK globally competitive.[41] The Strategy also states that the UK has the third largest aviation network in the world and points to the development of a new Aviation Strategy to *"build on our strengths to create a safe, secure and sustainable aviation sector for a global, outward-looking Britain".*[42]

5.87 The Strategy's approach to people is to ensure that *"everyone can improve their skills throughout their lives, increasing their earning power and opportunities for better jobs".*[43] Specifically, the Strategy recognises that people and the skills they have are a key driver of productivity, and furthermore that there are currently not enough skilled people in science, technology, engineering and maths. Reference is made in the strategy to the Government working with Harlow College to open a new Advanced Manufacturing Centre and a base at Stansted to train local workers in the skills required. The Strategy sets out a series of key policies to support the generation of good jobs and greater earning power for all.

National Transport Policy

Transport Investment Strategy: Moving Britain Ahead

5.88 The 'Transport Investment Strategy: Moving Britain Ahead' (2017) provides an overview of the Department for Transport's priorities and approach for future transport investment decisions. The Transport Investment Strategy identifies that high performing infrastructure can enable the delivery of the Industrial Strategy and that by *"maintaining and upgrading our transport infrastructure – an integrated network that underpins not only our daily lives but our economy too – we can connect communities and businesses and help deliver balanced growth across the country".*[44]

5.89 The Strategy identifies the importance of Britain's international gateways and that *"our success is closely tied to our connections with the rest of the world, made through our airports and seaports".*[45] It is recognised by the Strategy that the majority of airports are owned and operated in the private sector, but that Government has a responsibility for ensuring they are connected up to the existing national networks and that such networks can handle the road and rail traffic they generate.

5.90 A well-managed and maintained transport network is identified as a powerful national asset and a cornerstone of Britain's prosperity: this has informed the Government's approach to fundamental decisions about the future capability of the transport network, including taking steps to secure Britain's status in the global aviation market. The Strategy states that *"while we currently have the third largest aviation network in the world, London's airports are filling up fast and will all be full by 2040 unless we take action now, limiting the new international connections we can make".*[46] Furthermore, the Strategy suggests transport underpins effective international trade and that the ability to trade freely depends on the speed and reliability of the global connections made possible by airports and ports. In terms of the Government's role, the Strategy states:

"While the private sector invests to enhance our ports and airports, Government has a key role to play, working with industry, to assess the demand for and constraints around road and rail access to ports and airports. Around a quarter of businesses cite the quality of domestic connections to international gateways as a barrier to exporting".[47]

Strategic Road Network Initial Report

5.91 Highways England's Strategic Road Network Initial Report (2017) comprises the first stage of developing the Second Road Investment Strategy (RIS2) which will be delivered between 2020 and 2025. The First Road Investment Strategy (RIS1) covered investment in England's motorways and major roads (the strategic road network (SRN)) during the 2015 to 2020 period, outlining a multi-year investment plan for over 100 major road schemes.

5.92 The Initial Report sets out Highways England's views and recommendations on the key challenges and investment priorities for the SRN in Road Period 2.

5.93 The Initial Report identifies four economic roles that the SRN and Highways England can play in supporting the economy:

- Economic Role 1: Supporting business productivity and competitiveness, and enabling the performance of SRN-reliant sectors.
- Economic Role 2: Providing efficient routes to global markets through international gateways.
- Economic Role 3: Stimulating and supporting the sustainable development of homes and employment spaces.
- Economic Role 4: Providing employment, skills and business opportunities within our sector.

5.94 The report recognises that road improvements have a profound positive economic impact, particularly as UK businesses are dependent on the SRN to transport goods between sites, ports/airports and to clients.[48]

5.95 The Department for Transport undertook consultation on Highways England's Initial Report between December 2017 and February 2018.[49] Feedback on the consultation will inform the development of the RIS2 document which is due to be published in 2019.

Connecting People: A Strategic Vision for Rail

5.96 'Connecting People: A Strategic Vision for Rail' (November 2017) provides the Government's strategic vision for the railways and details how this is to be achieved, focusing on: investing in upgrades to the network to deliver faster journey times, more capacity and support economic growth; improving the customer experience; and bringing the organisations that run the track and trains closer together to deliver better services for passengers. In the near term, the document sets a vision for *"better customer service and delivering planned upgrades, with the industry getting a* *grip on cost".*[50] Looking forward, the vision for 2019-2024 (Control Period 6) is for a *"more reliable, efficient and modern railway delivered by joined up local teams".*[51] For the period 2024-2029, the vision is for a *"step change for rail, with current reforms and HS2 delivering better journeys, better services and support for the economy".*[52] Beyond 2030, the Government's vision is for a *"world-class railway, working as part of the wider transport network, bringing new opportunities for the nation".*[53]

5.97 The report recognises the potential for rail services to unlock housing growth as part of a wider transport network. In particular, reference is made to supporting housing in the Cambridge - Milton Keynes – Oxford corridor and also Cambridge South. An opportunity is recognised that a new station at Cambridge South could provide direct rail links between one of the largest bio-medical campuses in Europe which is being consolidated in Cambridge with Central London, Stansted Airport and regional housing development sites. The Government is committing £5m to develop proposals, working in partnership with local stakeholders.[54] Further to this, it is detailed that a new East West Rail company is being established to lead on the delivery of a new rail link along the strategically important Cambridge- Milton Keynes – Oxford corridor.[55]

5.98 On Crossrail 2, a proposed new railway stretching from Surrey to Hertfordshire through Central London, the report notes that it *"could relieve crowding and support the capital's growth. It could offer travellers on national rail lines a new route into London, helping free up capacity, and relieve pressure on the Tube network, while unlocking new homes along the route".*[56]

National Noise Policy

Noise Policy Statement for England

5.99 The Noise Policy Statement for England (NPSE, 2010) does not set out specific noise level guidelines for noise sensitive development; these are covered in other statutory documentation. The overall aim of the NPSE is to:

> *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".*[57]

5.100 The NPSE outlines three main aims:

- The first aim of the NPSE is to avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
- The second aim of the NPSE is to mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

- The third aim of the NPSE is where possible, contribute to the improvement of health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

5.101 The above aims of the NPSE should be interpreted in line with a set of shared UK principles that underpin the Government's sustainable development strategy, these being:

- Ensuring a Strong Healthy and Just Society
- Using Sound Science Responsibly
- Living Within Environmental Limits
- Achieving a Sustainable Economy
- Promoting Good Governance

5.102 The NPSE defines "significant adverse" and "adverse" impact in line with the World Health Organisation's definitions: NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. LOAEL – Lowest Observed Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected.

5.103 By extending these concepts for the purpose of the NPSE leads to a third category: SOAEL – Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur. However, it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

Regional Policy

Local Enterprise Partnerships

5.104 The airport is within two Local Enterprise Partnership (LEP) areas: The South East LEP and the Greater Cambridge/Greater Peterborough (GCGP) LEP. A key element of growth for both LEPs is to strengthen the competitive advantage of strategic growth locations within the LEP areas; Stansted Airport is one such location.

5.105 The 'South East LEP Strategic Economic Plan' (March 2014) set out proposals for the renewal of the physical and intellectual capital of the area. Alongside upgrades to infrastructure, the plan also put forward aims to raise educational and skills attainment to develop a workforce poised to grasp the new business and high-level job opportunities presented. The plan recognises that "*in Stansted Airport, the LSCC has a key economic asset with significant potential to catalyse growth areas across the corridor and beyond*".[58] Furthermore, the Plan recognises that the "*growth opportunities astride the A120 are in Braintree, Colchester and Tendring and are generated both from ready* *access to Stansted Airport and the ports of Harwich and Felixstowe*".[59] The plan recognises that there is a need to commit investment in infrastructure targeted at key sites within Essex's strategic growth corridors, including the West Essex M11 and A120.

5.106 The South East LEP is currently preparing for the next phase of funding and investment by refreshing the Strategic Economic Plan.

5.107 The 'Greater Cambridge and Greater Peterborough LEP Strategic Economic Plan' (2013) aims to release the area's significant potential for continued economic growth, through a targeted range of interventions. The plan promotes improvement to transport services and connections, and connectivity to improve economic growth. The Plan recognises Stansted as strategically important infrastructure giving access to Europe and the rest of the world and identifies that the airport contributes "*significantly to the LEP area and wider economy*".[60] In addition, the plan states that "*in the short term we know that London Stansted Airport has 50%*[i] *more capacity within its approved operating parameters. We want to ensure that maximum use of* [sic] *made of this potential to develop long-haul routes that support our businesses*".[61]

5.108 To the east of the airport lies the Hertfordshire LEP area. In 2017 the Hertfordshire LEP published a refreshed version of its Strategic Economic Plan. The 'Perfectly Placed for Business: The Refreshed Strategic Economic Plan: 2017-2030' (July 2017) sets out a 'route map' for Hertfordshire which has been refreshed to chart what the LEP and its partners are seeking to achieve along with the priority interventions that are needed to make this happen. The Plan identifies three radial corridors that cross the county which present substantial opportunities. This includes a key radial axis to the eastern boundary of Hertfordshire and connects London with Harlow, Stansted Airport and Cambridge. The Plan identifies that Stansted "*has growth capacity and, under the ownership of Manchester Airports Group, growth ambition*".[62]

Essex County Council - The Economic Plan for Essex (EPfE)

5.109 In April 2014, Essex County Council (ECC) published its Economic Plan, setting out its vision for the County's sustainable economic growth for the benefit of the local communities over the next seven years (2014-2021). This strategy is based on improving skills across Essex, establishing a pipeline of £1bn of infrastructure investment and enhancing productivity across five growth sectors.

5.110 The EPfE recognises that the development within this period will come from the private sector, with the public sector creating the right conditions for growth. The location of Stansted Airport is acknowledged as having a direct and substantial impact on the economic growth potential, indeed the plan recognises the airport as a "*key economic asset with significant potential to catalyse growth along the corridor [LSCC] and beyond*".[63] Furthermore, the Plan details that "*Essex supports Stansted to grow to its current capacity limit of 45m passengers per annum (45mppa)*"[64] and states that "*It is clear that Stansted is, and can continue to be, a major driver of growth in Essex*".[65]

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[i] At the time of the Strategic Economic Plan's publication, the airport was operating at around 17.5mppa.

5.111 Across the County, the EPfE poses key challenges: enhancing the workforce; unlocking growth on strategic corridors; enhancing productivity; developing the County's reputation; removing resistance to development and the capacity to support growth.

Essex Corporate Plan and Organisation Strategy

5.112 The Essex Works Corporate Plan 2012-2017 sets out ECC's vision, priorities and outcomes for the period. The plan details a number of priorities including: securing the highways, infrastructure and environment to enable businesses to grow; and enabling every individual to achieve their ambitions by supporting a world-class education and skills offer in the county.[66] The plan details that enabling business to grow matters because:

> *"private enterprise creates jobs, generates wealth and improves lives. In a time of austerity it is more important than ever that Essex is a place where business can flourish, providing employment opportunities for local residents and, by creating wealth, helping to fund the public services we use".*[67]

5.113 Further to this, the plan recognises that a *"highly skilled workforce provides a foundation upon which our future economic growth and prosperity can be built".*[68]

5.114 The Essex Organisation Strategy: Our Four Strategic Aims 2017-21 outlines ECC's areas of focus over the four year period and outlines how better outcomes will be achieved for Essex. The Strategy outlines four strategic aims:

- enable inclusive economic growth;
- help people get the best start and age well;
- help create great places to grow up, live and work; and
- transform the Council to achieve more with less.

5.115 To enable inclusive economic growth, the Strategy sets three Strategic Priorities: help people in Essex prosper by increasing their skills; enable Essex to attract and grow large firms in high growth industries; and target economic development to areas of opportunity. The strategy recognises the importance of the international gateways in Essex, such as Stansted, in enabling inclusive economic growth, alongside the *"major economic engines in Chelmsford, Harlow, Basildon and Colchester".*[69]

Essex Transport Strategy: The Local Transport Plan for Essex

5.116 The Essex Local Transport Plan (2011-2026) (LTP3) summarises the Highway Authority's transport strategy, outlining its approach to all travel modes for the period of 2011-2026. The LTP3 divides Essex into four areas, for which specific priorities will be identified via dedicated area plans. The transport priorities for West Essex are identified as:

- *"Improving access to and from the M11 corridor;*

- *Tackling congestion and improving the management of traffic in Harlow town centre;*
- *Providing the transport improvements needed to support housing and employment growth;*
- *Improving the attractiveness of bus services;*
- *Improving cycling networks and walking routes and encouraging their greater use;*
- *Improving the attractiveness of public spaces and their ease of use;*
- *Working with Transport for London to improve the journey experience of Essex residents using the Central Line underground services; and*
- *Improving access to Stansted Airport by low carbon forms of transport".*[70]

5.117 The LTP3 outlines 15 transport policies, many of which are relevant to the airport site and proposed development. These policies cover key issues such as integrating land-use and transport planning, public transport, connectivity, carbon reduction, promoting sustainable travel choices, the historic built environment, access to services, and cycling and walking.

East of England Route Strategy

5.118 Highways England's East of England Route Strategy (March 2017) provides a statement on the current performance, and perceived pressures on, the East of England's major A Roads (forming part of the SRN) to inform the planning of future investment. The East of England's route is formed of the A11, A12, A47 and A120. The A120 stretches from Puckeridge in Hertfordshire to the port of Harwich in Essex and passes to the south of Stansted, providing one of the main access points into the airport site.

5.119 The Strategy states that the A120 is *"strategically important to the local and regional economy, on account of its connection to the shipping industry"*[71] but the lack of capacity on the route can lead to longer trips, negatively affecting growth in the surrounding area.

5.120 The Route Strategies (18 in total, plus 6 strategic studies) will inform the development of Highways England's RIS2 Investment Plan.

Hertfordshire Local Transport Plan

5.121 The current Hertfordshire County Council (HCC) Local Transport Plan 2011-2031 (LTP3) sets the framework for achieving a vision for better transport for all. The plan is built on the foundations of LTP1 and LTP2 and focuses on delivering the shared priorities of tackling congestion, improving accessibility, providing safer roads, improving air quality and improving the quality of life for residents.

5.122 HCC consulted on the Local Transport Plan (LTP4) for Hertfordshire between October 2017 and January 2018. The new LTP4 will provide a framework to guide future transport planning and investment and is due to be adopted in Spring 2018. The draft Plan identifies that Hertfordshire benefits from a good level of connectivity, with particularly good connections to London and international airports, but that *"passenger transport access to airports at Luton and Stansted requires improvement".*[72] As such, one of the objectives of the Plan is to "*Improve access to international gateways and regional centres outside Hertfordshire".*[73]

5.123 The Plan recognises that Stansted has the highest proportion of passenger transport trips of any airport in the UK using alternatives to the car and includes a policy specific to airports. Policy 11: Airports states:

> "*The county council, working in partnership with neighbouring local authorities and airport operators, will seek improvements to surface access to Luton and Stansted Airports and promote and where possible facilitate a modal shift of both airport passengers and employees towards sustainable modes of transport".*[74]

5.124 Overall, the policy seeks the delivery of sustainable airport growth with negative impacts on the local road network, environment and quality of life minimised.

London Stansted Cambridge Corridor (LSCC)

5.125 The London Stansted Cambridge Consortium (LSCC) was launched in June 2013 as a strategic partnership of public and private organisations covering the London-Stansted-Cambridge-Peterborough Corridor. The Consortium subsequently set up the LSCC Growth Commission.

5.126 The London Plan (March 2016) defines the London Stansted Cambridge Corridor regional growth areas as a *"development corridor to the east and west of the Lee Valley through north London and Harlow and north to Stansted, Cambridge and Peterborough".*[75] London Plan Policy 2.3 (Growth Areas and Co-ordination Corridors) states that the Mayor of London will engage with relevant agencies beyond London to identify and develop capacity and linkages across nationally recognised growth areas which include parts of London, such as the London Stansted Cambridge Corridor.

5.127 In July 2016, the LSCC Growth Commission published a report titled 'Findings and Recommendations of the London Stansted Cambridge Corridor Growth Commission'[76], which outlines a 20-year vision for the Corridor to become one of the top 'knowledge regions' in the world and identified the growth of Stansted Airport as being crucial to the economic development of the corridor. Specifically, the final report identifies that *"London Stansted Airport has the capacity to expand and could be a big part of the solution to the aviation needs of the Corridor, London and the Greater South East".*[77] The report also recognises the importance of Stansted as an employment centre, with improvements to transport services providing opportunities for job creation as well as benefiting international passengers.[78]

Harlow Enterprise Zone

5.128 Harlow Enterprise Zone occupies a strategically significant site along the LSCC, with its proximity to Stansted making it a premier business location. The 51 hectares site is divided into three specific areas that focus on providing high quality, modern business space for the information communications technologies, advanced manufacturing and life science sectors. It will be the home of Anglia Ruskin University Med Tech Campus – one of the world's largest health innovation spaces, delivering research and development services to businesses working in the health and life sciences sectors.

5.129 Over the next decade the Enterprise Zone is looking to attract over 100 businesses and create 2,500 jobs with the potential to create more than 5,000 jobs over a 25-year period, driving inward investment along the corridor and West Essex sub region.

North London Boroughs - Upper Lee Valley Opportunity Area Planning Framework

5.130 The Upper Lee Valley Opportunity Area covers 3,884 hectares shared between the London Boroughs of Enfield, Haringey, Waltham Forest and Hackney. The planning framework, adopted in July 2013, sets the goals of the regeneration plan which includes development and redevelopment opportunities along the A10/A1010 Corridor, in particular the Tottenham High Road Corridor and Northumberland Park in North East London; the creation of over 15,000 new jobs by 2031 across a range of industries; a green industrial hub creating greater learning and employment opportunities and over 20,100 new homes by 2031.

5.131 In June 2014, the Mayor of London also announced that Tottenham Hale – a key gateway to Stansted Airport – will become one of 20 new housing zones and benefit from additional funding to help kick-start housing on brownfield sites across London.

Haven Gateway Partnership

5.132 Stansted Airport is a key member of the Partnership, formed to drive economic growth along the A120 corridor between the airport and the ports of Harwich and Felixstowe. The corridor has the potential to attract significant housing and business growth over the next decade and is highlighted as a key growth area in the South East LEP Strategic Economic Plan. The Partnership's A120 campaign to dual key sections of the A120, will dramatically improve road access between the airport and ports to unlock wider growth in the region.

Cambridge - Milton Keynes – Oxford Arc

5.133 'Partnering for Prosperity: A new deal for the Cambridge – Milton Keynes – Oxford Arc' (2017) sets out the National Infrastructure Commission's recommendations for securing the long-term economic success of the Arc, delivering improved infrastructure and new homes to create places where people will want to live and work. The report suggests the Cambridge-Milton Keynes-Oxford

Arc must be a national priority so that its *"world-class research, innovation and technology can help the UK prosper in a changing global economy".*[79] It is suggested that a new deal is required between central and local government to align public and private interests behind *"delivery of significant east-west infrastructure and major new settlements, and which seeks commitment to faster growth through a joined-up plan for jobs, homes and infrastructure".*[80]

5.134 The report suggests that the arc could provide a *"strategic economic and transport link, connecting towns and cities in East Anglia to the west of England and South Wales"*[81], and sets out a series of recommendations to achieve the potential of the Arc.

The London Plan

5.135 The London Plan (March 2016) sets out the spatial development strategy for London and provides a consolidated version of the plan to include alterations made since the publication of the 2011 plan. Support is provided by The London Plan for the development of the London-Stansted-Cambridge-Peterborough growth area which is recognised as a nationally important growth corridor.

5.136 **Policy 2.3 Growth Areas and Co-Ordination Corridors** identifies that the Mayor will, along with other partners, engage with relevant agencies beyond London to identify and develop (inter-alia) *"linkages across, and capacity of, nationally recognised growth areas which include parts of London (the Thames Gateway and London-Stansted-Cambridge-Peterborough)".*[82]

Local Policy

Uttlesford District - Economic Development Strategy 2016-2018

5.137 The airport sits within Uttlesford District. The Council's Economic Development Strategy 2016-2018 sets its intention to increase the percentage of Uttlesford businesses exporting; to promote and attract inward investment, including foreign direct investment and expansion of existing businesses; and increase tourism in Uttlesford. The Strategy acknowledges that the locational benefits of the airport in relation to the district are vital in meeting these aims and is fully supportive of this objective.

5.138 The District's Strategy recognises that there is a local work force with high-level skills, a high employment rate, excellent connectivity and that the airport employs around 1 in 12 residents. Despite this, there is a comparatively low enterprise culture, economy size and businesses that trade internationally, which are threats to the district's economic future. In addition, an imbalance in the range and mix of skills, as well as rural geography limiting access to employment, provide distinct local challenges.

East Hertfordshire Local Plan

5.139 To the east of the airport lies the area of East Hertfordshire Council. The East Herts Local Plan Second Review was adopted in April 2007. The majority of policies in the Local Plan were 'saved' by the Secretary of State in 2010 and form part of the Development Plan for East Herts. The Local Plan aims to *"ensure that development in East Hertfordshire is the most sustainable in form as current knowledge and practicalities permit".*[83]

5.140 The Local Plan identifies that whilst Stansted is located in Essex, the airport has an impact on East Hertfordshire, in particular on transport, environment and economic development and employment.

5.141 The emerging East Herts District Plan Pre-Submission Consultation (2016) is currently at examination and once adopted will replace the saved policies of the adopted Local Plan (2007). Whilst outside the district, Stansted is recognised by the Plan as having *"strategic implications for the area".*[84] The District Plan incorporates the Vision for the London Stansted Cambridge Corridor Core Area and states that *"together with Stansted Airport, the local authorities [The Councils of Broxbourne, East Herts, Epping Forest, Harlow and Uttlesford] will deliver sustainable growth which supports the economic ambitions of the LSCC and UK".*[85] Further to this, the vision states:

> "*The Core Area supports the development and sustainable growth of Greater Harlow and key growth locations at Broxbourne, Brookfield and Bishop's Stortford together with Stansted Airport growing to its full permitted capacity and as a business growth hub. These centres, with proportionate growth throughout the wide area, and the right investment, would create an economic powerhouse".*[86]

5.142 The District Plan recognises that the proximity of Bishop's Stortford to Stansted Airport and the M11 makes it an attractive place for businesses and new employment opportunities in the town. With regards to economic development, the plan identifies that East Herts *"is not a self-contained economy and in economic terms it plays a supporting role in relation to the adjacent urban centres and Stansted Airport, particularly in terms of labour supply".*[87] In addition, the plan identifies that the district's business base of predominantly small and medium sized firms has links to companies in the sub-region, to London or with Stansted.

5.143 With respect to noise pollution and air quality, the District Plan identifies that any increase in activity associated with the airport combined with the existing road network may exacerbate the potential for traffic related noise pollution and impact air quality.

East Hertfordshire Council Economic Development Vision

5.144 Stansted Airport is located immediately adjacent to East Hertfordshire District. The Council's 2016, Economic Development Vision sets out the economic priorities for the coming years. This includes, the identification of Bishop's Stortford as a key area for future growth nationally, linked to Stansted Airport and the LSCC.

Stansted Airport Policy

MAG Corporate Responsibility Strategy

5.145 Stansted Airport reports on progress against the MAG Corporate Responsibility Strategy (2015)[88] on an annual basis as part of the London Stansted Airport Corporate Social Responsibility Report.[89] The Corporate Responsibility Strategy details the vision for the Group and sets out a series of strategic objectives to achieve this:

- **Our Environment**: We will make best use of natural resources and minimise the environmental impact of our operations.
- **Our Community**: By building enduring relationships with our local communities, we will seek to understand the issues that are important and to use our combined skills and resources to work together for our mutual benefit.
- **Our Colleagues**: Keeping them safe at all times, we will support and develop our people so that they can consistently deliver high performance.
- **Our Business**: Working in a spirit of partnership, we will maximise our social and economic contribution in the regions we serve.

5.146 The strategy recognises the importance of responsible growth and the airport's desire to be a trusted neighbour. It is founded on sustained engagement with the whole community, focusing on growing the business at the same time as supporting job creation and prosperity.

Stansted Airport Sustainable Development Plan

5.147 Government policy[90] requires airport operators regularly to publish long term masterplans. These are intended to set out the nature of future growth and development and measures to deal with the consequences and impacts of that growth. Such masterplans will be given greater weight if they are prepared in consultation with all those having an interest in the airport. In 2014, the airport consulted widely on a draft masterplan – the Sustainable Development Plan (SDP) - which was to replace the previous 2007 BAA Masterplan. The final SDP was published in 2015 and sets out a series of guiding principles, which are to:

- support Stansted in becoming the best London airport;
- proactively plan for growth to make best use of existing capacity;
- support prosperity and economic growth in the region;
- actively manage and contain environmental impacts;
- be active and supportive partners in the local community; and
- maintain Stansted's position as the best airport in the UK for public transport.

5.148 In relation to making best use of Stansted's existing capacity, the Land Use Plan identifies:

> "*the land, the uses and the facilities required to support the maximum capacity of the airport's single runway, up to annual throughput of between 40-45 million passengers and over 400,000 tonnes of cargo. It identifies the principal elements of airport infrastructure required, the sequencing of development, and sets out a policy for the use and the development of airport land*".[91]

5.149 The SDP identifies that the airport can grow within the current boundaries and physical constraints as a result of improvements to the way in which the airport operates and facilities are now used, and states:

> "*The exact capacity will be a product of our route network, aircraft size, the spread of traffic through the day and year and the capacity drivers described in our Land Use Plan*".[92]

5.150 In terms of future airfield requirements to support the best use of the single runway, the SDP Land Use Plan states:

> "*Improvements can be made to the taxiway network, assisting the efficiency of aircraft queuing and sequencing and taking into account the different spacing required from aircraft types. The envisaged future improvements to the taxiway network are minor in scale and have limited potential impact as development would only involve some removal of airfield grassland which has limited ecological value*".[93]

5.151 The extent of improvements required to the taxiway network to support the best use of the single runway are the subject of this application and details are set out in section 4 of this statement.

Stansted Noise Strategy and Action Plan 2013-2018

5.152 In line with the Environmental Noise Directive, Stansted Airport developed and consulted upon its first Noise Action Plan in 2009, which has since been updated to cover the period 2013-2018 (Adopted 2014). The Building on a Sound Foundation: Stansted Airport Noise Strategy and Action Plan Revised for 2013-2018 (2014)[94] includes actions which relate to developing the airport within its current planning permission and in line with the guidance provided by DEFRA.

5.153 Nine key themes are identified which the Noise Strategy and Action Plan seeks to address over the lifetime of the Plan. These are:

- Control of noise generated from departing aircraft;
- Control of noise generated from arriving aircraft;
- Control of aircraft noise generated by ground operations;
- Night noise restrictions;

- Mitigation schemes;
- Monitoring and reporting;
- Policy and planning;
- Continuous improvement; and
- Communication.[95]

5.154 The Noise Strategy and Action Plan for Stansted will be updated later this year in line with DEFRA timescales.

Summary

5.155 The above review demonstrates that there is a wide range of policies, both general and specific, nationally and locally, that apply to the proposed works. The above policies have been given due regard in the planning assessment of the proposed works, and are discussed in the following section.

6 Planning Appraisal

6.1 The approach to any planning appraisal is provided for and required by Section 70(2) of the Town and Country Planning Act and Section 38(6) of the Planning and Compulsory Purchase Act 2004. These state that, for the purpose of determining a planning application, the determination must be made in accordance with the Development Plan unless material considerations indicate otherwise. The plan-led system for the determination of applications is further supported by paragraph 14 of the NPPF.

6.2 The NPPF describes, in paragraphs 215 and 216, the weight that should be afforded, in the decision-making process for planning applications, to a Local Plan that has been adopted since 2004, to the NPPF and to any emerging replacement plan. Uttlesford's Local Plan was adopted in 2005 and therefore, a judgement is required by the decision maker as to the weight afforded to policies, 'according to the degree of consistency' with the NPPF[ii]. Furthermore, emerging plans may have weight in the decision-making process, depending on their stage of preparation and the extent of unresolved objections[iii].

6.3 This section of the planning statement examines the extent to which the proposal is in accordance with the Development Plan and, given their importance as 'material considerations', the NPPF and the emerging Draft Local Plan (Regulation 18) for Uttlesford. The following section of this statement (Section 7) sets out those benefits arising from the proposal which are material to any decision.

Fall Back Position

6.4 In 2008 planning permission was granted to enable Stansted to grow up to a new planning cap of 35mppa and 274,000 air transport movements. This was a variation to an earlier permission (in 2003) which permitted large scale built development at the airport (in line with the original masterplan) but with a cap on passenger numbers of 25mppa. The limit for air transport movements was 241,000. Details are set out in Chapter 3. The 2008 permission has been commenced, and Stansted is currently operating under its terms, along with the attendant S106 obligations. An important further limit is that the size of the daytime 57 LAeq 16hr noise 'footprint' shall not exceed 33.9sqkm.

6.5 This existing planning permission thus enables Stansted to grow until it reaches the passenger, air transport and noise limits. On current forecasts, the passenger limit would be reached in 2023, beyond which operations would continue but within the relevant cap.

[ii] Consideration has been given to the report *'Uttlesford Local Plan 2005 - National Planning Policy Framework Compatibility Assessment (Ann Skippers Planning, July 2012).*

[iii] At the time of writing this statement the Regulation 18 Draft Local Plan for Uttlesford has unresolved objections, as is reasonably expected given the stage of its preparation. This Planning Statement addresses compliance with the draft policies as published in July 2017, unless specifically stated otherwise.

6.6 There is, therefore, an important 'fall back' position, which is a relevant material consideration in respect of the current application. Firstly, the previous planning permissions grant consent for various pieces of airfield infrastructure, which, while approved, have not yet been built. Secondly, even without the proposed development, Stansted has permission to grow from its current throughput of 25.9mppa to a figure of 35mppa; from 189,921 air transport movements (2017 figures) to 274,000 movements and to a noise footprint of 33.9sqkm. As already noted, this application does not seek to change the total number of air transport movements that are allowed; nor will the 33.9sqkm noise footprint be exceeded. Thus, an important comparison when judging this current application is between the planning impacts and benefits that arise from the 35mppa already permitted and those from the new cap of 43mppa: an increase of 8 million passengers a year.

The Environmental Statement

6.7 The planning application is accompanied by an Environmental Impact Assessment (EIA) which has been undertaken in accordance with the requirements of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations). The results of this assessment are reported in the accompanying Environmental Statement (ES) and summarised in the Non-Technical Summary (NTS). The assessment of the proposed development's accordance with Development Plan policy and other material considerations draws substantively from the assessment and conclusions within the ES.

6.8 The EIA process is intended to be an iterative process starting at the project inception stage and continuing through to the final operational stage. This ensures that any likely significant environmental effects are either 'designed-out' at the planning stage or can be mitigated, managed and controlled to acceptable levels.

6.9 The operational effects of the proposed development (the increase in annual passenger throughput and associated effects) are the most relevant to the application. For this reason, the focus of the ES is on changes in surface access traffic, air noise, ground noise, air quality, socio-economic conditions and human health. The ES also considers other secondary effects such as surface access noise, carbon, climate change and water resources. The ES has been written in consideration of a Scoping Report and the Council's formal 'Scoping Opinion' received on 22 December 2017.

6.10 In accordance with established practice for EIA, the assessment of environmental effects from the proposed development is based on measuring the difference between how the airport would develop in the future under its existing planning permission (termed the 'Do Minimum' scenario in the ES) and how it would grow with the new infrastructure in place, together with the 8mppa uplift for which planning permission is sought (termed the 'Development case' in the ES). As detailed in the accompanying ES and NTS of the ES, the technical chapters within the ES use the following forecasts to develop a baseline and assessment scenarios:

- 2016 – Baseline conditions;

- 2021/2022 – Construction Year;
- 2023 – Do Minimum 35mppa full capacity;
- 2023 – Development Case 36mppa;
- 2028 – Do Minimum 35mppa full capacity; and
- 2028 – Development Case 43mppa full capacity.

6.11 The ES identifies the environmental effects, both positive and negative, of the proposed development that would be brought about by its construction and operation in terms of the level of significance expressed as major, moderate, minor or negligible.

6.12 Further detail of the EIA Methodology adopted is provided in *Chapter 3: EIA Methodology* of the ES.

Principle of Development

6.13 The principle of development is determined in the first instance, by the proposed development's compliance with the main provisions of the Development Plan.

6.14 As set out in the planning history section of this Statement (Section 3), the airport has been established in its current form since the early 1990's. The core infrastructure, land boundary and landscape masterplan that created the extent of the present airport (i.e. the operational area) date from this time. The 'red line boundary' of this application is consistent with that original and enduring boundary and the development proposed will all be accommodated within the current airfield.

6.15 The Development Plan does not specify any particular policies for the airfield, unlike some of the landside areas of the airport in AIR1-5. However, it is covered by Policy S4 which defines the extent of the airport site, in line with the original masterplan. Airport related development is permitted within this designated site. The emerging draft Local Plan sets out a more detailed airport policy in SP11. This draft policy supports development of the airport subject to a number of criteria, of which the first element is where proposals 'directly relate to the airport use of development'.

6.16 The infrastructure proposed would lie within the current airfield, replacing airfield grass and some existing hard surface, and therefore its development, as a matter of principle, is an acceptable use of land, in compliance with Policy S4 and the first criterion of draft Policy SP11.

6.17 Insofar as compliance with draft Policy SP11 is concerned as a whole, all criteria are required to be met. The remainder of this section addresses those criteria where appropriate.

Socio-Economic Impacts

6.18 Access to air services provides global connectivity which creates economic and social benefits through encouraging business investment, including from overseas; supporting business growth and increased productivity; facilitating trade in goods and services and supporting tourism. These benefits are a constant thread presented and endorsed throughout successive national policy documents, both aviation (e.g. APF) and planning (e.g. NPPF).

6.19 Socio-economic benefits are also a long-standing, underpinning theme of the policy debates around aviation and are to the fore in the Airports Commission's recommendations, the Government's draft Airports NPS and the recent Call for Evidence for the new aviation strategy.

6.20 The proposed development, by enabling best use of Stansted, will create such benefits and the socio-economic effects of the proposed development will extend not only to the users of the airport, but will also be felt across the region and beyond, through the airport's role as a driver of economic activity. The growth of Stansted to the proposed new passenger limit will also generate a higher level of employment and economic impact than would otherwise be the case, creating significant additional benefits for the regional and local economy.

6.21 A full assessment of the Socio-Economic Impact of the proposed development is detailed in *Chapter 11 (Socio Economic Impacts)* of the accompanying ES. This details that by 2028, at 43 mppa, there will be 6.3 million business passengers and 36.7 million leisure passengers using Stansted, compared to 3.6 million and 22.3 million respectively today. Of the additional UK passengers, where the place of residence is known, it is forecast that 79% will live in the East of England and London.

6.22 Additional passenger capacity and increased connectivity would be brought about by the proposed development. Such benefits align directly with two of the three dimensions of sustainable development as defined by the NPPF: economic and social benefits. The planning system, through the NPPF, encourages the provision of infrastructure to underpin '*thriving local places that the country needs*' and '*respond positively to the wider opportunities for growth*'[96].

6.23 The proposed development will deliver these objectives through:

- improved access to overseas markets;
- meeting a higher share of local/regional aviation demand;
- improved potential for attracting inward investment and productivity growth;
- promoting trade and tourism;
- providing increased numbers of jobs; and
- improving skills and opportunities in the local labour market.

6.24 **Improved access to overseas markets** occurs through the additional passenger capacity (i.e. 43mppa) providing potential for greater frequency of flights, a greater choice of the times of day that passengers wish to fly and through an expanded route network and a wider range of destinations (both direct and through new routes to large connecting hubs such as Dubai with the new Emirates service). Increased competition between airlines will also lead to flights being made available at competitive prices and at the quality of service demanded by passengers.

6.25 **Meeting a higher share of local & regional demand** can be achieved through increased capacity thereby reducing the need for passengers and business to use other less convenient airports. This will save passengers time and money, something which will be of real value to business passengers. The key interrelated benefit of reduced travel time for users, and the environmental benefits associated with avoiding longer travel distances to Heathrow and Gatwick for flights to destinations not presently served by Stansted, also results from the proposed development.

6.26 **Inward investment and productivity**. The proposed development will enable an additional 1.2million business passengers to travel through the airport, with the majority having an origin or destination in the study area[iv]. This will enable the airport to directly contribute to the attractiveness of the region and its sustainable growth. This is in line with the growth strategies, in particular, for the LSCC, the Greater Cambridge and Greater Peterborough LEP and A120 Haven Gateway growth corridor. Furthermore, the wider impacts on business efficiency and productivity from the proposed expansion at Stansted would produce an increase in annual UK GVA of between £1.2bn[v] and £5.6bn[vi]. At the London and East of England levels, this ranges between £0.95bn and £4.4bn. On this basis, the proposed development is considered to have a major beneficial socio-economic impact.

6.27 **International tourism** is a major worldwide industry and air travel is a key facilitator of the UK tourism industry. The proposed development will enable more leisure trips to be made through Stansted, both inbound and outbound. The additional foreign leisure visitors using Stansted in 2028 as a result of the proposed development will be of significant benefit to the UK economy. We estimate that an additional 2.2 million foreign leisure passengers per year will be attracted as a result of the increased capacity, resulting in an estimated 1.1million additional foreign visits to the UK via Stansted in 2028. This is an increase of 2.9% compared to the level in 2016. Applying the average spend of overseas visitors to the UK by air (around £700 per visit), this equates to an estimated spend by the additional visitors of £779million in 2028. Further to this, an additional 4.6million UK leisure passengers will be able to make international trips in 2028 enabled by the proposed development, equating to around 2.3million additional trips. Consequently, the proposed development has the potential to have a major beneficial impact on international tourism.

6.28 **International trade** is an important mechanism for promoting economic growth and in raising standards of living. Access to air services is a key factor in encouraging business investment and facilitating trade, including inward investment from overseas. Stansted supports regional manufacturing and service sectors by moving people travelling on business, and high value and time critical goods, across the world. In 2016, goods with a value £6.3bn were exported through Stansted to non-EU destinations, while goods with a value of £6bn were imported. Aviation plays an important role in the export of UK services. Much of the service sector operating out of the UK is made up of highly globalised firms that work with clients throughout the world. This includes financial services, insurance and the creative industries, many of which are located within Stansted's

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[iv] As defined in *Chapter 11: Socio Economic Impacts*
[v] Based on Oxford Economic Forecasting as detailed in *Chapter 11: Socio Economic Impacts*
[vi] Based on Oxera forecasts as detailed in *Chapter 11: Socio Economic Impacts*

catchment area. The proposed development would enable an additional 800 tonnes of cargo to be carried through the airport. This would reinforce Stansted's role in the London airports system as a base for the main logistics operators and integrators. This represents a 0.2% increase compared to the 'Do Minimum' scenario and as such is assessed as a minor beneficial effect.

6.29 The proposed development will result in a series of direct, indirect and induced **employment** benefits. During the twelve-month (2021-22) construction period of the new airfield infrastructure, it is estimated that a total of almost 300 jobs will be created (200 direct and 100 indirect or induced) supporting a GVA of £23.4million. Relative to the number of people working in the construction industry in the study area, the construction employment associated with the proposed development is very small and as such it is considered the effect of the proposed development would be negligible.

6.30 In terms of employment effects associated with the operation of the airport, the proposed development is estimated to support additional employment of 5,400 and GVA of £357million in the operational study area in 2028 when compared to the 'Do Minimum' scenario. Within the study area, it is forecast that in 2028 there will be 269,600 more people available for work than there will be jobs. The proposed development will therefore contribute to reducing this shortfall in jobs, and reduce the need for out-commuting and also contribute to the achievement of the jobs target set out in the Economic Plan for Essex[97].

6.31 Overall, the operational employment effect of the proposed development is assessed as beneficial. The additional jobs would represent 3.4% of the forecast increase in labour supply in the study area between 2015 and 2028 and would reduce the growth of the shortfall of jobs by 21%. Therefore the employment effects are considered to be moderate beneficial.

6.32 Whilst the ES has not identified any significant adverse effects requiring mitigation, the airport will continue to develop and enhance the existing skills, education, training and community initiatives to maximise the socio-economic benefits of the proposed development. Such initiatives include the Stansted Airport Employment and Skills Academy, with a focus on attracting employees from disadvantaged areas such as Harlow, Braintree and other parts of Essex and London. By 2028, the aim is to increase employment of local people by 700 per year, as part of wider airport employment growth. Furthermore, the new on-site Stansted Airport College will provide a purpose-built training facility for 500 young people to gain industry recognised qualifications and work experience around the airport, ensuring that students have the skills needed to take advantage of the employment opportunities at the airport and the growth sectors in the local economy. This can reduce the need for commuting outside the area by local people.

6.33 The airport's surface access strategy (as set out in the SDP) provides the framework for promoting sustainable employee travel alongside a focus on improved connections to target workforce areas, such as the North London Boroughs. Initiatives such as the Airport Travelcard, providing significant savings on standard fares, encourage employees to access the airport by public transport.

6.34 The proposed development will generate economic and social benefits through encouraging business investment and growth, tourism, trade and jobs growth and directly contributing to a strong, responsive and competitive economy. As a consequence, it is considered that the development aligns with the economic and social principles defined by the NPPF. The proposed development supports the socio-economic aims of the emerging Uttlesford Local Plan, in particular the Spatial Vision Theme 2(a) (reflected in turn in policy SP11) in supporting the local economy and growth corridors like the LSCC. These benefits also align with current and emerging national aviation policy and the Government's Industrial Strategy.

Noise: Air, Ground and Surface Access

6.35 The accompanying ES undertakes a full assessment of the proposed development and the effects of noise arising from the air, ground and surface access. The following section summarises each of the effects in turn.

Air Noise

6.36 Air noise is associated with the flight phase of an aircraft, namely from start of roll (when the aircraft produces maximum thrust for take-off), the onward flight, and the landing at the airport until the point of exiting the runway.

6.37 Air noise is already controlled at Stansted, both by a limit on the total number of aircraft movements and by a planning condition limiting the size of the 'noise envelope'. These controls arise from the 2008 Permission and work independently of each other. Specifically, the limit on the total number of aircraft movements is set at 274,000 per annum and the maximum extent of the noise envelope is set at 33.9sqkm (for 57dB $L_{Aeq,16hr}$).

6.38 This application proposes to retain both the current overall cap on aircraft movements and the current limit on the size of the noise envelope, while enabling the airport to handle a larger number of passengers (43mppa). Further, Stansted will still be subject to the night time noise controls which are set by the Government.

6.39 Under the ES 'Do Minimum' scenario, the passenger throughput constraint of 35 mppa is reached first and at this point it is forecast that the combined number of aircraft movements would be 249,000. On this basis, the primary ES assessment case is a comparison of the noise generated if the airport was limited to 35mppa (with fewer aircraft in operation than is currently permitted), and 43mppa, when the current aircraft movement limit will be reached.

6.40 A key feature of this application is that the main noise controls that are currently imposed (aircraft movement limit and noise contour area limit) remain in place as the airport grows beyond 35 mppa.

6.41 A second key feature that arises from all the noise assessments is that significant adverse noise impacts do not arise for any properties as a result of the development. The technical measurement of noise uses decibels (dB). A change of 3dB is necessary in order to be discernible to the human ear. The technical assessments, using various metrics, show that any change in noise levels are small - less than 1dB. Thus while this minor change in noise (1dB or less) may be enough to move a property from one noise zone (e.g. 56.5dB) to the next (e.g. 57.5dB), the change in noise levels that is experienced would be indiscernible to the human ear.

6.42 The ES concludes that the proposed development does not result in significant adverse noise impacts. However, we recognise that aircraft noise is the single environmental issue that most concerns people living around airports. For that reason, we have carried out a detailed assessment of the air noise impacts associated with the proposed development and the growth of the airport from 35 mppa to 43 mppa.

Average Noise (LAeq Contours)

6.43 A range of noise metrics are used to measure and describe air noise impacts and these are addressed and described in detail within the ES, Chapter 7. Longstanding convention has been to use the average noise energy (L_{Aeq}) noise contours as the primary metric for assessment.

6.44 This approach has been reinforced by the findings of recently published research *SoNA 2014: Aircraft Noise*. A key conclusion is that evidence-based decisions about aircraft noise should continue to use the $L_{Aeq,16h}$ metric for operations on a typical summer day. Whilst there is an acceptance that sensitivity to aircraft noise has increased in recent years, and some people will experience disturbance at lower noise levels, the Government's Aviation Policy Framework (paragraph 3.17) still places emphasis on the 57dB $L_{Aeq,16hr}$ contour.

6.45 The ES considers how this noise contour is influenced by the proposed development. By using this particular metric, a direct comparison can be made between the outcome of the proposed development, the Do Minimum scenario and the current operational restrictions set by the 2008 permission.

6.46 The assessment of growth to 43 mppa, in respect of average daytime noise exposure, results in an area of 28.7sqkm within the 57dB $L_{Aeq,16hr}$ contour. By comparison, the currently permitted noise contour, judged acceptable as a result of the granting of the 25+ permission, extends to 33.9sqkm with the airport operating at 35mppa. Therefore, the proposed development represents a reduction of 5.2sqkm against the currently agreed noise limit, despite the proposed increase in the number of passengers to 43mppa.

6.47 For comparison purposes, the 25+ ES Assessment undertook a sensitivity test which predicted that the 54dB $L_{Aeq,16hr}$ contour would extend to 58.3sqkm with the airport operating at 35mppa. With the proposed development, the same contour area would be 53sqkm, representing a reduction of 5.3sqkm.

Evolving Attitudes to Noise

6.48 As noted above, the proposed development would lead to a smaller area within the 57dB $L_{Aeq,16hr}$ contour than previously predicted for 35mppa. However, the findings presented in *SoNA 2014:*

Aircraft Noise found an increased sensitivity to aircraft noise, with a significant proportion of people reporting annoyance at noise levels of 54dB $L_{Aeq,16hr}$.

6.49 The results of SoNA are influencing recent aviation policies which now supplement those in the APF. In light of this, there is additional benefit in considering a range of noise metrics that address different aspects of air noise. The ES therefore assesses a number of supplementary metrics that address additional aspects of noise, including frequency of operations. This is intended to provide as comprehensive a picture as possible of the noise impact of the proposed development. The outcomes are summarised below.

6.50 One of the concerns raised by some stakeholders in the consultation process was the possibility that removing the 35mppa cap would give rise to a greater noise impact on local communities and a large increase in overflights. The ES explains that the L_{Aeq} noise contour has two main inputs, which determine the size of the contour:

- the noise made by each individual aircraft (as a single event): the measurement of this is by use of Sound Exposure Level (SEL) or 'single event' contours; and
- the number of flights or noise events: aircraft movements comprise both arrivals and departures, and they are spread across different departure routes. As a result, a helpful measure is the use of 'Nx' (number above) noise contours.

6.51 The key factors driving a reduction in the noise envelope in 2028 are:

- the noise footprint of the typical aircraft at Stansted in the future is roughly half that of today; because the new generation aircraft are generally between 3db and 5db quieter on departure than today's version of the same type;
- the current overall cap on aircraft movements of 274,000 will remain. In 2028, with the development, there will be around 712 daily aircraft movements in the summer peaks; compared to 640 daily movements without the development. These extra 72 daily movements comprise 36 departures and 36 arrivals. These additional movements will operate across a range of departures routes. For the most intensively used flight path, it would mean a maximum of 25 extra departures between 07.00 and 23.00 – between one and two per hour in the summer peak.

6.52 Taking both measures together, a small increase in the number of aircraft movements is more than outweighed by the substantial benefits arising from aircraft fleet modernisation. Both of these metrics are explained in more detail below.

6.53 The ICF forecasts show that operations at Stansted will continue to be dominated by smaller, modern and more efficient aircraft that are capable of flying both short and long-haul routes. This reduces the likelihood of operations by heavier and noisier aircraft that were historically required to fly long-haul routes. The ES summarises the noise benefits of fleet modernisation in Table 7.6 of Chapter 7. It shows an aggregate reduction in air noise level of between 3dB and 5dB compared to current versions of the same aircraft. This is a material positive change.

6.54 These next generation aircraft are already beginning to enter service at Stansted and fleet modernisation will take place progressively over the course of the next decade. With the proposed development, the ES predicts that the highest noise levels are expected to occur around 2024 and that noise levels will then decline as fleet replacement continues. For 2024, the 57dB L_{Aeq} 16hr daytime noise envelope is forecast to be 32.0sqkm; still below the current permitted limit of 33.9sqkm.

Single Event Noise / SEL Footprints

6.55 In addition to the use of average energy, or L_{Aeq} noise contours, one of the noise metrics presented in Chapter 7 of the ES is the noise 'footprint' of the single operation of a number of different aircraft types. The single event, or Sound Exposure Level (SEL), contours clearly demonstrate the significant noise reduction from new generation aircraft.

6.56 For Stansted's fleet, the most prominent and important comparison is between today's widely used Boeing 737-800 and the future variant of this aircraft. Currently 69% of operations at Stansted are by this aircraft and it is forecast that in 2028 it reduces to 23%. Chapter 7 of the ES presents a comparison between the noise 'footprint' of the current version, the B737-800 and the new variant, the 737-Max8, which is now beginning to enter service and will progressively increase. The ES Chapter 7 (Tables 7.18 – 7.21) demonstrates that the area of the noise 'footprint' is halved, which significantly reduces the number of people experiencing higher levels of noise from each aircraft movement. This highlights the contribution that improvements in aircraft technology are making to reduce air noise impacts.

6.57 With regard to night-time operations, the long-standing convention has been that an SEL contour for 90 decibels (90 dB(A) SEL) is the threshold within which there is a discernible risk of sleep disturbance. It is notable that the new variant of the Boeing 737-Max8 does not expose any houses to this noise level around Stansted with the proposed development.

Frequency of Overflight

6.58 As noted above, an input to the average (LAeq) noise contours is the number of flights. For a relevant time period (daytime or night-time) the number above contours (Nx contours) describe how many times air noise will exceed a specified value, and show how many aircraft, over this noise level, overfly a specific location or area. This metric is therefore a good descriptor of the frequency with which elevated levels of aircraft noise will be experienced, as they can potentially demonstrate some changes that might be not be discernible from average energy, or L_{Aeq} contours.

6.59 However, there are some limitations to their use because they do not fully describe the actual noise levels experienced at any given location. For example, the day time N65 and night time N60 contours show the number of movements exceeding 65dB and 60dB L_{Amax} respectively, but they do not show by how much the 65dB or 60dB levels are exceeded. As a result, such contours have limited value on their own and are best used in conjunction with the average noise exposure contours as described above.

6.60 Nx contours are plotted for the number of events above the chosen threshold value, usually 65dB daytime and 60dB night-time. In line with the approach used by the CAA in their 2014 study of community attitudes to aircraft noise, the assessment uses frequencies of 25, 50, 100 and 200 on a typical summer day. For daytime, this represents flights at 40, 20, 10 and 5-minute intervals respectively and for the night time, it represents one flight every 20, 10, 5 and 2.5-minutes. The night time intervals are shorter than the daytime intervals because the night-time period is half the number of hours of the daytime.

6.61 The ES presents 'number above' contours for a range of different frequencies and noise thresholds. The ES assessment demonstrates that, using a noise threshold of 65dB(A) for daytime operations (an N65 contour), similar conditions will exist with the proposed development compared to both today's baseline conditions and for the previously permitted 35mppa. In all these scenarios the overall shape of the contours is similar, reflecting the most intensively used flightpaths, which remain unchanged from today.

6.62 The overall conclusion is that the proposed development is unlikely to result in residents experiencing a material difference in the number of daytime overflights at 65dB(A) or above.

6.63 For the night-time period, the 'number above' contours show no discernible change. As set out in Section 5 of this statement, night-time operations will continue to be controlled by the Government and the ES assumes that the current night-time controls are maintained. On a typical summer night, there may be three extra flights per night in 2028.

Population and Households: Difference Contours

6.64 As identified in paragraphs 5.97 to 5.104 above, the NPSE describes categories of noise exposure. The Lowest and Significant Observable Adverse Effect Levels (LOAEL) and (SOAEL) are the most relevant to this application. The NPSE's first and second aims, reflected in paragraph 123 of the NPPF, seek to avoid development being exposed to or causing noise above the SOAEL and to mitigate and minimise the effects of noise for development exposed to levels above the LOAEL. The LOAEL and SOAEL are expressed using an average energy, or L_{Aeq} contour. In the context of this application, households exposed to levels above 63dB $L_{Aeq,16hr}$ (day) and 54dB $L_{Aeq,8hr}$ (night) are within SOAEL; while for LOAEL the thresholds, in line with Government policy, are 51dB $L_{Aeq,16hr}$ (daytime) and 45dB $L_{Aeq,8hr}$ (night).

6.65 The number of people exposed to noise within these categories is set out for both the proposed development and the 'do minimum' scenario. With the proposed development, we expect aircraft to continue to use the same flight paths, and thus overfly the same areas as today. These households are already experiencing aircraft overflight and aircraft noise at levels at or close to the threshold. Thus, while the assessment tables (ES Chapter 7 Table 7.14 and 7.15) show an increase in the number of households exposed to noise levels above both the SOAEL and LOAEL during the daytime, the change in noise level that would be experienced at any of the households is less than 1 dB; and being less than 3dB, this degree of change is not discernible to the human ear. The impact assessment using this metric is therefore 'negligible'.

6.66 For the night-time assessment, a similar effect is seen. The assessment tables in ES Chapter 7 show an increase in the number of households exposed to noise levels above the SOAEL, and a reduction in the number exposed to noise levels above the LOAEL area. As with the daytime assessment, these properties are already subject to aircraft noise. There is a very small change in night time activity and, again, the technical measurement of the change in noise levels that would be experienced at any of the households in question would be indiscernible to the human ear. Therefore, the impact assessment is 'minor'.

6.67 The figures now forecast for 2028, with growth to 43mppa, are lower for both LOAEL and SOEAL than the numbers of people in both these categories assessed as part of the previous planning permission for growth to 35mppa.

Noise Level Change and Summary

6.68 The ES considers all sensitive receptors including community and care facilities. The study area is described in Chapter 7. Residential and non-residential receptors are considered separately, but the degree of change in noise exposure is location rather than receptor specific and therefore it is reasonable to consider changes across the entire community. In 2028, the total assessed difference between the proposed development and operations limited at 35mppa in the daytime, is an increase of between 0.5 to 0.6dB and at night it ranges from a decrease of 0.2dB to an increase of 0.4dB, depending on location (Table 7.21 ES Chapter 7).

6.69 Given that a change of 3dB is recognised as being necessary in order to be discernible to the human ear, the overall change in noise levels (using average noise contours) experienced as a consequence of the proposed development would be negligible. As a result, the proposed development would comply with the Local Plan Policy ENV11, and draft Policy EN18, as it would not give rise to adverse effects on the occupation of sensitive noise receptors.

Further Mitigation

6.70 The NPPF and the NPSE aim to reduce noise effects through mitigating and minimising any adverse impacts on health and quality of life. The APF sets out the Government's aim to minimise and, where possible, reduce the number of people significantly affected by noise. Consistent with this national guidance, the emerging local plan for Uttlesford contains similar aims in draft Policy SP11.

6.71 While the noise assessment set out in the ES shows that there will be no significant effects requiring specific mitigation, the proposed enhanced measures set out in Section 7 of this statement demonstrates compliance with NPPF, national guidance and the emerging development plan policies.

Ground Noise

6.72 The area around the airport is largely rural where the noise environment is mostly dominated by road traffic noise (for example the M11) and aircraft noise. The main sources of ground noise at the airport include aircraft taxiing or holding, the use of auxiliary and mobile ground power units and fixed plant and equipment.

6.73 *Chapter 8: Ground Noise* of the ES undertakes an assessment of Ground Noise and identifies those locations close to the airport where it may be audible. The level and character of ground noise depends on the proximity of the receptors to the airport and the degree of screening provided by buildings and local topography. Noise from ground operations is typically heard as a relatively steady background noise, and quite often noise levels from reasonably busy nearby roads are high enough to mask airport ground noise, to the point that it is not easy to distinguish it above the general noise climate.

6.74 The ES includes a full assessment of the effects of ground noise taking into account the degree of change, how the level compares to the existing background noise and how it relates to appropriate threshold values. For the Development Case scenario, the analysis shows that at all receptor locations assessed, with the exception of Molehill Green, the proposed development is forecast to give rise to no adverse effects during the daytime (07:00 to 23:00) at either 2023 or 2028. At Molehill Green, the change in noise levels resulting from the proposed development is forecast to be indiscernible, but the background noise and the relevant threshold are forecast to be exceeded by the small margin of 1dB. As such the forecast increase in noise levels in 2028 exceeds the 'no impact' thresholds by the smallest of margins, 0.1dB, and a minor adverse effect is determined for this location.

6.75 At night-time, no adverse ground noise effects are forecast to arise from the proposed development in either 2023 or 2028 at all locations assessed.

6.76 During construction, it is forecast there will be a negligible impact in all assessment cases due to the location of the development, the distance to local receptors and the expectation that construction noise levels will not exceed prevailing background noise levels by a significant margin.

6.77 There is currently a significant amount of mitigation in place, including bunds, landscaping and buildings, which all combine to limit the impacts of ground noise from the airport.

Surface Access Noise

6.78 The assessment of Surface Access Noise in *Chapter 9: Surface Access* of the ES focuses on noise from road traffic. This includes existing roads and the effect of the proposed mitigation works to J8 M11. It is assumed for the purposes of the assessment, that the works currently proposed by the HE and ECC for J8 (the 'improvement works') are in place. Growth of both airport and background traffic are included in the assessment. There is no assessment of noise associated with rail as there is no increase in rail movements that would result from the proposed development.

6.79 The ES predicts that changes in noise level, occurring as a result of the proposed development, for growth beyond 35mppa are either zero or less than 1dB at the sensitive receptors. At these levels, the change would be imperceptible and the impact of road traffic noise would be negligible.

6.80 Over the long term (i.e. from 2016 to 2028) road traffic noise is expected to increase; but by less than 3dB. This is not perceptible, will be gradual and is therefore 'negligible'.

6.81 There is one exception, in that the assessment has shown an increase of 3.8dB on Round Coppice Road (part of the airport's internal road network). This is defined as a 'minor' impact. Again, this is a long-term effect (2016 to 2028) and arises from a combination of growth to 35 mppa and the potential cumulative effects of traffic from the proposed employment at Northside allocated in the draft Regulation 18 Local Plan. The addition of growth from 35mppa to 43mppa makes a negligible difference.

6.82 Over a long-term period, such a change does not warrant mitigation. Moreover, the Stansted Airport College building (currently under construction) is located close to Round Coppice Road and includes high performance glazing and mechanical ventilation, due to the building's proximity to the runway. The Novotel hotel sits more than 150m from the road and actual changes in noise level at the hotel, due to road traffic on Round Coppice Road, would be well below 3dBA. Neither receptor would be impacted by this long-term change in surface access noise levels.

Conclusion on Noise

6.83 Overall, none of the noise impacts associated with the proposed development would be sufficient to give rise to significant adverse impacts. Specifically, there is proposed enhanced mitigation for aircraft noise (Section 7) that further aims to reduce the impact of noise associated with the airport's operations. The proposed development is therefore in compliance with NPPF paragraph 123, adopted Local Plan Policy EN11 and draft Policy EN18 of the Regulation 18 Local Plan.

Air Quality

6.84 Aircraft, vehicle traffic and on-airport infrastructure can all influence local air quality. In order to understand the impact of the proposed development, a study has been undertaken to predict the impacts of oxides of nitrogen (NOx), including nitrogen dioxide (NO2), and particulate matter (PM_{10} and $PM_{2.5}$) ('the pollutants'). This is set out in Chapter 10 of the ES.

6.85 Air quality and its management has legal status at European level and has done so since 1996, when the European Commission (EC) published the Air Quality Directive. Since then, and through further Directives, air quality limit values have been set and the UK is required to comply with them. These 'standards' are expressed as annual average concentrations where their impact is due to prolonged exposure, or shorter 24hr or 1hr time based concentration where their impact is more acute, on human health or the natural environment.

6.86 Concentrations of the assessed emissions are modelled using the ADMS-Airport (version 4.1) atmospheric dispersion model. This software is widely used for air quality assessments in the UK. Stansted has continuously monitored and reported on air quality around the airport since 2006. Airport data, combined with local authority, DEFRA and weather station data has been used in the modelling to create a detailed understanding of local air quality.

6.87 The ES describes the air quality assessment study area of 225sqkm. It includes 'human receptors' (houses, schools, care homes and hospitals) and ecological sites (Site of Special Scientific Interest and National Nature Reserve sites, such as Hatfield Forest and Elsenham Woods) that could be at risk from changes in emission concentrations. The study also considers the long standing local air quality issue in Bishop's Stortford and the existing Air Quality Management Area (AQMA) in the town centre.

6.88 Baseline local air quality around Stansted is heavily dominated by the M11 and A120 road corridors and vehicle emissions. Aircraft and airport emissions are very localised and are largely confined within the airport boundary. The collated local monitoring data shows that across the study area, the concentrations of pollutants are well below the relevant standards. Only at one site at Burton End adjacent to the M11, and in Bishop's Stortford AQMA, are annual NO_2 levels exceeded, and these are clearly a result of road traffic. On a wider basis, the rural background concentrations have been calculated using DEFRA data over a 3000sqkm area, and these similarly are well below air quality standards.

6.89 To ensure a robust assessment, a full range of potential emission sources have been considered. These include the full landing and take-off (LTO) cycle for aircraft and their Auxiliary Power Unit (APU) usage when on stand; airfield equipment (e.g. ground power units, ground support vehicles), airport infrastructure (e.g. heating plant, fire training facility) and road traffic (both airport and non-airport). A full inventory of sources and qualifying emissions data is set out in the ES Chapter and Appendices.

6.90 The first stage of the modelling process calculates the total estimated emissions over a year and the results are set out in tables 10.4 and 10.5 of the ES Chapter 10. In the 2028 43mppa scenario it is predicted that there would be an increase in total NOx, PM_{10} and $PM_{2.5}$ emissions in comparison to the lower passenger throughput scenario of 35mppa in the same year. This is an expected outcome given the increase in activity between the scenarios.

6.91 A more useful comparison to the measured 2016 levels reveals that for the 2028 43mppa scenario only predicted PM10 levels would be higher, but NOx and $PM_{2.5}$ levels would be lower. Localised particulate matter increases due to brake and tyre wear from aircraft are proportionate to aircraft numbers increasing. But the changes are small and the effects are very localised within the area of the runway Improvements in aircraft engine technology over this time will have considerable positive impacts on the aircraft NOx emissions. The same is true of vehicle engine technology, which has benefits for airport and non-airport traffic in the local area.

6.92 Absolute emissions levels are produced to provide input into the ADMS dispersion model that is used to calculate concentrations in the local area, which in turn are measured against EU and UK limits.

6.93 The ES concludes that, as a result of the proposed development, for all NO_2, PM_{10} and $PM_{2.5}$ emissions there would be marginal increases at isolated receptors. Importantly there are no exceedances of legal limits, and forecast levels are well below air quality standards for human receptors.

6.94 With the proposed development in 2028, for all ecological receptors, NOx emissions are predicted to remain below the air quality standard and no significant effects are predicted. Predicted change to lower critical load is less than 1% for Elsenham Woods and Hatfield Forest.

6.95 Therefore, in respect of local air quality the proposed development will not have any unacceptable impact on health, the natural environment or general amenity, and therefore is compliant with paragraph 120 of the NPPF, Local Plan Policy GEN 7, and draft Local Plan Policy EN16.

Highway Safety and Accessibility

6.96 The application is supported by a full Transport Assessment (TA) which considers the potential effects of the proposed development on all relevant modes of transport (road, rail, bus, coach, walking and cycling) used to access the airport by both passengers and staff. In addition, the environmental impact of the proposed development on the airport's surface access network and surrounding environment is set out in *Chapter 6: Surface Access* of the ES and draws on the conclusions of the TA.

6.97 Stansted Airport has the highest public transport mode share for passengers of any major airport in the UK; the most recent surveys indicate that around 52% of passengers travel to the airport using public transport.[98] In the SDP, the future target is to maintain public transport use above 50%. Thus, the TA assumes this same modal split of air passengers in the assessment years.

6.98 In addition to air passenger access to Stansted, STAL also actively manages staff travel through various initiatives and a Travel Plan which promotes the use of sustainable modes of transport by staff. For example, the Stansted SDP outlines a target to reduce the number of single car occupancy trips to no more than 65% by the end of 2019.

6.99 The profile of surface access trips to the airport for air passengers reflects the daily flight schedule. Typically, passengers arrive up to two hours before a flight departs and leave the airport from one hour after landing. Current demands on the surface access network therefore currently exist at 04:00-05:00hrs for passenger arrival at the airport, 00:00-01:00hrs for passenger departure from the airport and a combined peak at 17:00-18:00hrs. For staff at the airport, there are a variety of shift patterns as well as typical '9-5' working. Staff travel demand on the surface access network is therefore spread across the day.

6.100 As the airport grows, the pattern of flights will change and become more evenly spread across the day and less well-defined peaks and troughs. For air passenger demand this results in a corresponding impact on the surface access network. As the airport grows to 35mppa, there will be limited growth in peak demand but greater demand occurs throughout the day instead.

6.101 Staff numbers are forecast to increase in the future. Over the period 2002-2015, private car usage by staff has reduced by 23% and it is anticipated that this would reduce by a further 10% by 2028 as a result of the continued effects of the airport's travel planning initiatives. Public transport mode share will increase as a result. The full data analysis of future demand and travel patterns is set out in Section 7 of the TA.

Accessibility: Road Network

6.102 Section 8 of the TA describes the detailed modelling of the local highway network in order to understand the potential impacts of the proposed development. Background growth (which incorporates housing and economic growth) and airport traffic growth (passengers and staff) have been considered together, in conjunction with planned highway improvements. For completeness, the TA also includes traffic associated with development of the anticipated employment land allocation at 'Northside' (emerging local plan policies SP11 and EMP1).

6.103 Since planning permission and appropriate mitigation have already been secured by S106 agreements for airport growth to 35mppa, it is the impact of growth from 35mppa to 43mppa that is the key focus of the analysis, and if necessary, further mitigation.

6.104 To enable a comparison of the additional growth to 43mppa, a comparable scenario for the same forecast year (2028) has to be generated for 35mppa. In this respect, the TA shows that for 35mppa the cumulative road traffic growth represents a 'moderate' increase in traffic from the 2016 baseline across the whole study area. This is defined as growth in excess of 10% of daily flows.

6.105 In this scenario, traffic growth is at its highest around Priory Wood roundabout primarily as a result of the allocation of employment land in the draft Local Plan.

6.106 The average annual daily traffic growth associated with the uplift in demand from passenger growth from 35mppa to 43mppa is modest and is limited to an impact of less than 3% on local roads and no more than 5% on trunk roads. This level of impact is considered to be minimal.

6.107 Levels of growth exceeding 10% would only be seen only on Thremhall Avenue, the A120 between the airport and M11, and the short link between Thremhall Avenue to the A120 east bound. In addition, a minor impact is expected on the operation of Junction 8 of the M11. However, in totality, the traffic impacts associated with the proposed development are localised to the airport site and immediate road network.

6.108 The traffic impact of 43mppa has also been assessed for the highway network peak hours and the airport surface access peak hour on the local and strategic road junctions and links. This analysis shows that the impact of the proposed development to 43mppa, compared to the already approved 35mppa scenario, is not anticipated to cause any significant change in operational conditions. Similar to the average daily traffic, the main growth of traffic is experienced between the 2016 baseline and the consented 2028 'Do Minimum' (35mppa) scenario.

Road and Junction Capacity

6.109 Road capacity assessment shows the impact of traffic growth upon the highway network, and where that additional traffic may lead to congestion. The TA undertakes junction analysis at M11 Junction 8; Priory Wood roundabout; and Round Coppice Road roundabout.

6.110 The results show that even in the modelled 35mppa scenario, with all the associated background traffic growth and the planned 'Interim Works', that M11 J8 will be well over capacity with significant levels of congestion. Additional junction mitigation will still be required, regardless of the proposed development and airport growth to 43mppa. The addition of traffic associated with the proposed development to 43mppa contributes further to this situation.

6.111 The additional enhancement of J8 necessary to minimise excessive delays caused by road traffic congestion, particularly during peak commuting hours, has already been identified by the relevant highway authorities. Joint working on modelling a long-term comprehensive scheme is underway and a scheme is likely to be necessary beyond 2025, the details of which are presently being developed by the highway authorities.

6.112 The airport traffic growth to 43mppa could be mitigated to required 'nil-detriment' levels through smaller scale interventions to J8 (following the construction of the 'Interim Works'), principally involving the slip roads. This is set out in the TA in Section 8 and the appendix.

6.113 In addition to the main access points from the Strategic Road Network, the airport is served by two access points from local minor roads via Parsonage Road to the east and Bury Lodge Lane to the west. The data shows that a notable proportion of traffic on some local roads is associated with the airport and the expansion of airport operations will be expected to increase traffic on these roads. The total volume of traffic however will remain low and well within capacity, and any increase would be below the 10% impact threshold. No specific mitigation is identified necessary at this time to address capacity demands.

6.114 It is acknowledged that small scale traffic increases will occur and that localised improvements may be required over time as the airport grows. To mitigate any such impacts, it is proposed to establish a Local Road Fund to contribute towards local infrastructure schemes. The allocation of these funds will be determined by the Highways Working Group of the Airport Transport Forum, in conjunction with ECC and HCC (as local highway authorities).

Accessibility: Public Transport

6.115 The effect on rail services associated with the 'Do Something' scenario compared with 'Do Minimum' is considered to be negligible on the Stansted Express. With the development, there will be spare seating capacity on Stansted Express in both directions. The increase in seating demand to capacity ratio is below 8% in both directions for all time periods. On the Greater Anglia services to Cambridge, with the development, there will be an additional 177 passengers each way per day which is within the capacity of the service and of a negligible scale.

6.116 For most CrossCountry services, in 2028, with the development, the largest increase in demand to Stansted is 12% in the morning peak, and an 11% increase leaving Stansted in the evening peak. Some Stansted to Cambridge PM peak services are likely to operate just above seating capacity; although there will be spare standing capacity. CrossCountry have however consulted on plans to enhance passenger services to meet increasing demands, including an extra 1,800 seats a day on its Birmingham services. Growth at Stansted is likely to be a driver for improved rail connectivity, which would be a positive benefit.

6.117 Given that existing and planned services will have sufficient capacity to meet airport demand, with the development, no infrastructure mitigation is required to address the impacts on rail capacity. The airport will continue to commit to and implement Travel Plan initiatives and work with the train operators and the Airport Transport Forum to improve rail connectivity.

6.118 Given the level of service currently provided by bus and coach operators, and their ability to respond quickly to new and potential demand to provide new and improved services (in line with the Stansted Bus and Coach Strategy), it is considered that additional demand in the 'Do Something' scenario is likely to stimulate new services and thus be a positive impact.

Accessibility: Cycling and Walking

6.119 Opportunities for staff and passengers to access the airport by cycling and walking are limited by the rural location, however the airport is committed to promoting this means of access where viable with some notable improvements in recent years. Given the current relatively low walk and cycle mode share (0.6% and 0.4% respectively), the effect of the proposed development is considered negligible, with any improvement to infrastructure and access likely to occur gradually in line with the airport's Walking and Cycling Strategy.

Highway Safety

6.120 Accident data has been analysed as part of the TA. Over the five-year period July 2012- June 2017 some 73 accidents were recorded; 62 of which were 'slight' and 11 'serious'. No fatalities were recorded. It is judged that both the rate and prominent causes (namely, failed to look properly; careless/reckless/in a hurry; and failed to judge other person's path or speed) are consistent with typical UK statistics. There is no data to illustrate an identified safety problem on the road network.

Travel Planning

6.121 A travel plan already exists for the airport, its implementation is overseen by the established Airport Transport Forum. The development will be incorporated into this existing approach to sustainable travel and will be maintained through two yearly updates to the travel plan in line with existing Section 106 commitments.

Summary of Highway Safety and Accessibility

6.122 Overall, the assessment detailed in the ES concludes that the impact of the proposed development is minor negative effects on surface access, but that these can be addressed through suitable mitigation measures. Combined with the ambitious mode share targets set out in the SDP, and continued strong performance in public transport use, the application encourages movement by means other than private cars and is therefore in accordance with Policy GEN1 of the Uttlesford Local Plan, Policy TA1 of the emerging Local Plan, paragraph 32 of the NPPF and paragraph 5.11 of the APF.

Water Supply, Flood Risk & Drainage

6.123 This application is supported by a Flood Risk Assessment (FRA) and drainage strategy which together inform Chapter 15 of the ES, *Water Resources and Flood Risk.* This addresses the impact of the development on flood risk, hydrology, foul drainage, surface and ground water quality, and potable water supply.

6.124 The potential impacts of the proposed development are two-fold: the drainage and water quality associated with the physical airfield works and the potential for increased demand on water consumption and foul drainage because of increased passenger numbers. These are addressed in turn, below.

Airfield Works

6.125 The development comprises airfield pavement that would result in a 7ha (net) addition to the impermeable area at the airport. It is the duty of the planning system, as defined by the NPPF, that flood risk is taken into account in planning processes and that climate change allowances are factored into the consideration of new development.

6.126 The airport is located within Flood Zone 1 with a generally low risk of flooding across the site. Nevertheless, the increase in impermeable area will generate additional surface water run-off and this requires management to ensure that increased risk of flooding and ground water pollution does not occur.

6.127 The airport is served by over 80km of drainage pipes and four balancing ponds. The private surface water system is designed to manage both clean and contaminated water and is divided into five distinct catchments: one such catchment is the airfield which includes surface water that contains the glycol based de-icing fluids used on the aircraft.

6.128 The airfield works proposed in this application, will be connected to the existing airfield drainage system in order to manage the additional run-off. This increased discharge, including the appropriate allowance for climate change impact, has been calculated in the hydraulic drainage model for the airport and the results set out in both the FRA and Drainage Strategy (appended to the ES Chapter 15). The model indicates that the modest additional discharge can be accommodated within the airport's current systems subject to some minor capacity enhancements. In turn, the accommodation of the additional discharge within the airport's drainage system will ensure that contaminated water is managed on site, before being pumped to the TTWL system.

6.129 The additional airfield works can be effectively drained and would not lead to a risk of flooding or groundwater pollution risk. Therefore, the proposed development would be in compliance with the NPPF paragraph 103 and Local Plan Policy GEN 3, ENV 12 and draft Local Plan Policy SP12.

Water Usage and Foul Drainage Network

6.130 It is anticipated that water consumption will rise with the increased number of passengers utilising the airport. The consumption of water however is not anticipated to be a linear relationship with the rise in passengers, as there are water efficiency measures already in place and more will be introduced as the airport grows. Current measures include low use washroom technology, while water pipework repairs in 2011 reduced the airport's consumption by 33%. STAL is committed to prudent use of resources and water efficiency measures and leakage prevention are contained within current asset plans as part of the airport's mitigation measures.

6.131 Scenarios for water consumption, including a worst case linear case, are considered in the ES. Consultation with Affinity Water (the airports' supplier) has revealed that the supplier is more concerned with rate of supply and the resultant peak demands on its water network, as opposed to total volume of consumption. The airport's supply is managed by on-site tanks which self-balance so as to reduce direct mains network supply demands. Current discussions with Affinity Water and STAL are in progress to reinforce the on-site tanks and network to further reduce the peak demands on the mains network. On this basis, the ES concludes a negligible impact on water supply.

6.132 Foul water drainage is managed through two private systems on site; both discharge into the Thames Water Utilities Limited (TWUL) system for onward pumping to the Bishop's Stortford Waste Water Treatment Plant (WWTP). The ES describes the potential for increased foul water discharge and although some increase in capacity may occur, like water consumption, it is not a linear relationship to passenger growth. Other sources of foul water exist on site that are not affected by the proposed development and there are also efficiency programmes in place across the airport to reduce foul water flows.

6.133 A hydraulic impact assessment is currently being undertaken in conjunction with TTWL, which will assist in further understanding of the likely increase in system capacity requirements. No new connections to the network are likely to be required. From April 2018, it will become TWUL's responsibility to reinforce the network to accommodate demand and charges will be incurred through Infrastructure Charges (i.e. utility billing). This is a change from current practice where new connections and network reinforcement (off-site infrastructure) can be subject of S106 Planning Obligations. If any reinforcement is required, it would be capable of being addressed directly between TTWL and STAL.

6.134 In consideration of the likely demands on the supply and foul drainage networks and taking into account the existing and future mitigation, the proposed development would not have any detrimental impact on water resources; is capable of being adequately drained and will not give rise to any pollution risk. The development would therefore be in compliance with the NPPF, Local Plan Policy GEN6 and ENV 12 and draft Local Plan Policy SP12.

Environment

6.135 This section considers the assessments undertaken with respect to the proposed development and the environment focusing on the topics of Climate Change; Carbon Emissions; Natural Habitat and Construction Environmental Management.

Climate Change

6.136 *Chapter 13: Climate Change* of the ES provides detail of the full assessments undertaken to consider, firstly, the in-combination climate change impacts of the proposed development and secondly a climate change resilience assessment.

6.137 The assessment of in-combination climate change impacts considers: surface access and transport; noise; air quality; socio-economic effects; and public health and well-being. The main in-combination climate change impacts relate to the operation of the proposed development, with effects identified for the construction stage. Further to this, no in-combination effects were identified for noise or public health and wellbeing as part of the operational stage. Thus the assessment focuses on the remaining topic areas, namely surface access, air quality and socio-economic effects.

6.138 The key in-combination effects for surface access and socio-economic issues relate to the adverse effects that would arise from increased stress on the existing road and rail network combined with increase in the frequency of extreme weather events impacting surface access and the resultant impacts on direct and indirect job creation during operation. Existing mitigation is outlined in the airport's Climate Change Adaptation Progress Report which includes emergency contingency plans and co-ordination with road and rail operators. In-combination effects on air quality arise from the adverse effects from increased prevalence of hotter and drier weather conditions combined with vehicle and aircraft emissions. These effects are mitigated through the introduction of new, cleaner aircraft fleets and, where air quality targets are not met, an action plan has to be put in place by local authorities. Regular monitoring of the airport's climate change resilience plans, and continued monitoring of trends in weather events, are therefore recommended.

6.139 The climate change resilience assessment considers the hazards associated with high and low precipitation and temperature and strong winds and lightning. During construction, it is not anticipated that the frequency or intensity of the climate hazards will change significantly when compared to the baseline climate. In terms of the operational stage, the airport's Climate Change

Adaptation Report and Works Contract ensures that adequate mitigation is in place to provide resilience, similarly such measures are also applicable to the construction programme.

6.140 To maintain resilience, additional mitigation measures in relation to high temperatures, strong winds and high precipitation are detailed in Chapter 13 of the ES. Subject to continued monitoring of trends in weather events, and the level of risk associated with such trends, there are no residual effects to be addressed. As such, the proposed development is in line with the environmental role of planning as identified in the NPPF to 'mitigate and adapt to Climate Change'[99] and take account of climate change over the longer term (paragraph 99) and the emerging policy SP11 and objective 3b of the draft Uttlesford Local Plan (there are no specific adopted policies in the 2005 ULP for climate change adaptation).

Carbon Emissions

6.141 A full assessment of the overall effects on carbon emissions forms *Chapter 12: Carbon Emissions* of the ES. It considers those associated with operations (flights, surface access, airport energy plant, and airside) - by far the largest contributor, and construction related effects.

6.142 Total carbon emissions from Stansted for the 'Development Case' scenario are projected to be 4.4 metric tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2028 compared with 4.0 $MtCO_2e$ for the 'Do Minimum' scenario. The majority of the increase is associated with flights (94%), with surface access and energy use accounting for 5% and 1% respectively. Whilst there is an increase in total emissions, there will be an improvement in carbon density (carbon emission per passenger). This reduces from 184kg carbon dioxide equivalent (CO_2e) per passenger to 176kgCO_2e per passenger in 2028. This 4% improvement in carbon intensity is largely due to an increasing number of passengers being handled by the same airport infrastructure.

6.143 Between 2028 and 2050, flight emissions are projected to reduce due to improvements in aircraft and engine efficiency; air traffic procedures and the use of sustainable aviation fuels. The annual carbon emissions from flights are projected to fall within the range between 2.5 $MtCO_2e$ and 3.4 $MtCO_2e$. In terms of the carbon footprint, it is projected that under both the 'Do Minimum' and 'Development Case' scenario the footprint would increase between 2016 and 2023, with the 'Development Case' scenario experiencing a steeper increase without the restriction of the 35mppa operating limit. Thereafter, the 'Development Case' would see an increase in carbon emissions, whereas the 'Do Minimum Scenario' would see a slight decrease.

6.144 It is projected that for the 'Do Minimum' scenario, the calculated cumulative emissions between 2016 and 2028 are 47.4 $MtCO_2e$ compared to the cumulative emissions for the 'Development Case' of 49.2 $MtCO_2e$; a difference of 1.8 $MtCO_2e$ between the two scenarios. The additional emissions would largely occur between 2023 and 2028.

6.145 The construction of the new airfield infrastructure is estimated to contribute 0.021 $MtCO_2e$. This includes emissions associated with the manufacture of concrete and steel and the fuel used by construction plant and equipment. This represents 0.5% of Stansted's total annual emissions for

2022 (year of construction) and would only account for approximately 0.001% of the UK's total 3rd carbon budget (2018 to 2022).

6.146 STAL is committed to minimising construction-related carbon emissions and reducing operational carbon emissions wherever reasonable. Our carbon plan includes a wide range of activities such as achieving carbon neutral status; investment in low energy and low carbon technology; smart metering; reporting on the airport's emissions annually; and influencing activities such as surface access trips and aircraft movements. The SDP Environment Plan contains a range of targets to reduce energy demand, target BREEAM 'Excellent' rating, and maintain compliance with the Carbon Trust Standard (or equivalent). Given these measures and targets, no further mitigation is required. The construction and operational emissions are compatible with the UK meeting its targets for greenhouse gas emissions and CO_2 from aviation in 2050. Thus, the proposed development aligns with the NPPF core principle of supporting the transition to a low carbon future (paragraph 17).

Natural Habitat

6.147 Recent surveys of the airfield have identified very limited ecological value for the hardstanding and airfield grassland areas which will be affected by the proposed construction works. However, Common Lizard and one specimen of Great Crested Newt (both protected species) were recorded in a small area of rough grassland.

6.148 Accordingly, mitigation measures will be put in place prior to the commencement of construction in order to avoid harming these species. This will comprise a further reptile survey and, where reptiles are recorded, these will be captured and relocated; and reptile fencing will be erected around the work site area. Adopting this mitigation strategy will ensure there will be no adverse effects on reptiles or any other species due to the construction works.

6.149 As a result, it can be concluded that the development would not cause harm to protected species and therefore the proposed development is compliant with GEN7 of the adopted Local Plan, EN9 of the draft Local Plan and is consistent with the aims of the NPPF (paragraph 118).

Construction Environmental Management

6.150 The construction of the new airfield infrastructure will be sequenced over an approximate 12-month period, with construction works timetabled to start in 2021 and be completed by mid-2022. *Chapter 5: Development Programme and Construction Environmental Management* of the ES provides further detail of the assessment of effects and details the approach to Construction Environmental Management.

6.151 The detailed construction phasing plan and associated method statement(s) will be developed if permission is granted, and will set out the sequence of works and adherence to the airport's operational requirements and applicable aviation safety standards.

6.152 The environmental effects (such as noise, traffic, dust etc.) associated with construction would be temporary in nature and therefore differ from the 'operational effects' of the new airfield infrastructure. The impact of the construction works on environmental receptors, such as archaeology, ground conditions and landscape, are unlikely to be significant due to the location of the works within the existing airfield and also the relatively minor scale and extent of proposed excavations.

6.153 It is anticipated that a Construction Environmental Management Plan (CEMP) would be a condition of any consent and require approval of the Local Planning Authority prior to the commencement of construction activities. As a result, and in light of the negligible environmental effects, the proposed development would accord with the draft local plan policy SP12.

Community Well-being and Health Impacts

6.154 Consistent with the latest EIA Regulations, the ES contains a Health Impact Assessment (HIA) of the proposed development's impact on human health, through socio-economic and environmental pathways. The NPPF recognises the role of the planning system in creating healthy communities, and is reflective of the World Health Organisation (WHO) definition that includes social well-being and not just the absence of disease or infirmity.

6.155 The HIA follows a source-pathway-receptor approach to identify and assess health impacts. This methodology is designed to identify links between hazards and receptors, as well as magnitude, to understand what level of health impact may exist.

6.156 The 'health pathways' of the proposed development are set out in detail in table 14.1 of the ES. The main pathways can be summarised as:

- aircraft and surface access noise;
- air pollution; and
- socio-economic benefits, which include increased connectivity, education and employment opportunities and supply chain benefits.

6.157 The impacts of the proposed development on air quality are negligible (summarised above) and it is judged highly unlikely that any consequential impacts on respiratory disease will occur as a result of increased passenger throughput.

6.158 Noise resulting from the proposed development is assessed in the ES Chapter as being a negligible change. The change in noise is up to 0.6dB in the day and 0.1dB at night. As these are below discernible levels to the human ear, any corresponding impacts on health are negligible. The HIA finds that changes to health outcomes (i.e. ischemic heart disease, stroke or dementia) are for the most part barely measurable. Hypertension, depression or anxiety caused by sleep disturbance is also predicted to be a very small impact. The proposed development will not bring about new night flights, and these are constrained by Government imposed limits. There will be a slight reduction to the Lnight contours resulting from quieter aircraft entering service, and a small decrease in those 'highly' sleep disturbed is predicted.

6.159 Assessment of air noise at community and care noise-sensitive receptors shows little measurable change in average day- or night-time noise at any of these locations. There would be a 13% increase in the number of daytime noise events above the assessment threshold at the most-affected school, Howe Green; the most-affected church, St Giles in Great Hallingbury; and the most-affected healthcare facility, Falcon House residential care home in Little Hallingbury. Depending on the actual noise levels experienced, the building fabric (including any existing sound insulation) and degree of external noise attenuation, there may be minor potential for increased disruption to learning, to the care environment at Falcon House, or an impact on the quality of life for worshippers at the affected churches.

6.160 Some minor impact on footpaths in the local countryside and parts of Hatfield Forest, would be a consequence of the proposed development through overflights; this could affect the enjoyment of amenity and green spaces, potentially impacting on levels of physical activity in the community.

6.161 Although some of these impacts on health are predicted to be adverse in the ES Chapter, the scale and magnitude of the impacts are 'minor' and 'negligible' and effective mitigation can be secured to counteract them. Mitigation is discussed in Section 7 of this statement, and is proposed so as to reduce and offset any harm to public health.

6.162 Any negative effects also need to be viewed in the balance with the socio-economic benefits arising from the proposed development. These include increased opportunities for employment and stabilisation of employment which provide direct links to healthier lifestyles. Increases in GVA per annum, generated by the airport's impact on the economy, can lead indirectly to increased personal wealth and in turn, facilitate healthier lifestyles. GVA increases can also impact positively on increased public revenues, allowing spending on public health services.

6.163 The increased opportunities for leisure trips, as a result of the proposed development, would enable local and regional passengers to maintain social and family connections both domestically (for example longer distances to Scotland) as well as outside the UK. There are also the cultural, recreational or educational experiences that can be gained through travel abroad. In both cases, there are substantial benefits including life satisfaction, happiness, self-reported general health and mental health, all of which contribute to quality of life.

6.164 The negative impacts can be mitigated effectively and there are positive health benefits linked to socio-economic impacts. As a consequence, the proposed development is compliant with the aims and objectives of paragraph 69 of the NPPF, Local Plan Policy ENV10 and 13 draft Local Plan policies INF3 and SP11.

6.165 The health assessment demonstrates that the application is in accordance with all the relevant policies at a national and local level as well as material technical guidance on specialist topics. As such, there is no conflict with the Development Plan, or emerging plans that would have material weight in the decision-making process. And the positive health outcomes would support NPPF policy objectives.

Summary

6.166 The Development Plan for Uttlesford is the adopted 2005 Local Plan. It does however precede the NPPF and a new replacement Local Plan is being prepared. As set out in 6.1-6.3 above, the judgement of weight given to the emerging plan and the existing Local Plan's compliance with the NPPF needs to be taken by the decision maker.

6.167 Irrespective of the potentially complex Development Plan position; drawing from the conclusions of the Environmental Statement, the above assessment has demonstrated that the proposed development of airfield works to optimise operations and facilitate 43mppa, is in compliance with the relevant polices contained in the Development Plan, the NPPF and the emerging Local Plan.

7 Mitigation

7.1 Section 106 (S106) of the Town and Country Planning Act 1990 allows a developer to enter into legally-binding agreements or provide unilateral planning obligations to a Local Planning Authority (LPA) in association with the granting of planning permission. Government advice on the nature and scope of S106 Agreements is set out within the Government's online *Planning Practice Guidance*[100]. The legal regulations on the use of S106 are provided in the Community Infrastructure Levy Regulations 2010 in Sections 122 and 123. Section 122(2) states:

> *"A planning obligation may only constitute a reason for granting planning permission for the development if the obligation is—*
>
> *(a) necessary to make the development acceptable in planning terms;*
>
> *(b) directly related to the development; and*
>
> *(c) fairly and reasonably related in scale and kind to the development."*

7.2 These agreements are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They sit alongside the conditions imposed on a planning permission. They can cover a wide range of matters, including contributions to one-off infrastructure works and public transport services, to controlling the way approved development is managed and operated.

7.3 As part of the "2003 Permission" and "2008 Permission" and the associated planning conditions, the airport is subject to three S106 agreements and a Unilateral Undertaking. The S106 obligations and commitments include a range of measures to mitigate and/or control the impacts of the development granted under the 2003 and 2008 permissions. The matters covered by the obligations include:

- Air and Ground Noise;
- Noise Insulation Scheme;
- Air Quality Monitoring;
- Surface Access, Rail Infrastructure and Train Capacity, and Local Road Network Improvements;
- Economic Performance;
- Employment and Business Forums;
- Community Fund;
- Waste, Energy, Water Efficiency and Nature Conservation;
- Visitor and Archaeological Resources;
- Design and Construction;

- Health; and
- Monitoring.

7.4 Compliance is monitored by Uttlesford District Council as the LPA. All of the obligations have been, or continue to be, complied with.

7.5 However, the multiple layers of agreements, some overlapping provisions and the addition of two sets of planning conditions make for a complex arrangement which makes it more difficult to manage and not easy to understand. Moreover, some of the obligations originate from negotiations and impacts dating from nearly 20 years ago. There is therefore, a case for simplifying, consolidating and updating these measures and controls to produce an up to date package of measures governing Stansted's operations and impacts.

The Approach to Mitigation

7.6 The approach to mitigation has been informed by:

- reviewing past and current obligations and planning conditions;
- the measures and policies in Stansted's SDP 2015;
- STAL & MAG's corporate policies;
- the feedback from extensive public consultation events and meetings;
- the views of statutory consultees and stakeholders; and
- the conclusions and recommendations of the EIA.

7.7 From this process, a number of mitigation topics have been identified. These have then been considered in the light of the legal requirements governing S106 agreements and Government advice and policy on their scope and extent. The process to arrive at the proposed mitigation package is shown below (Figure 2):

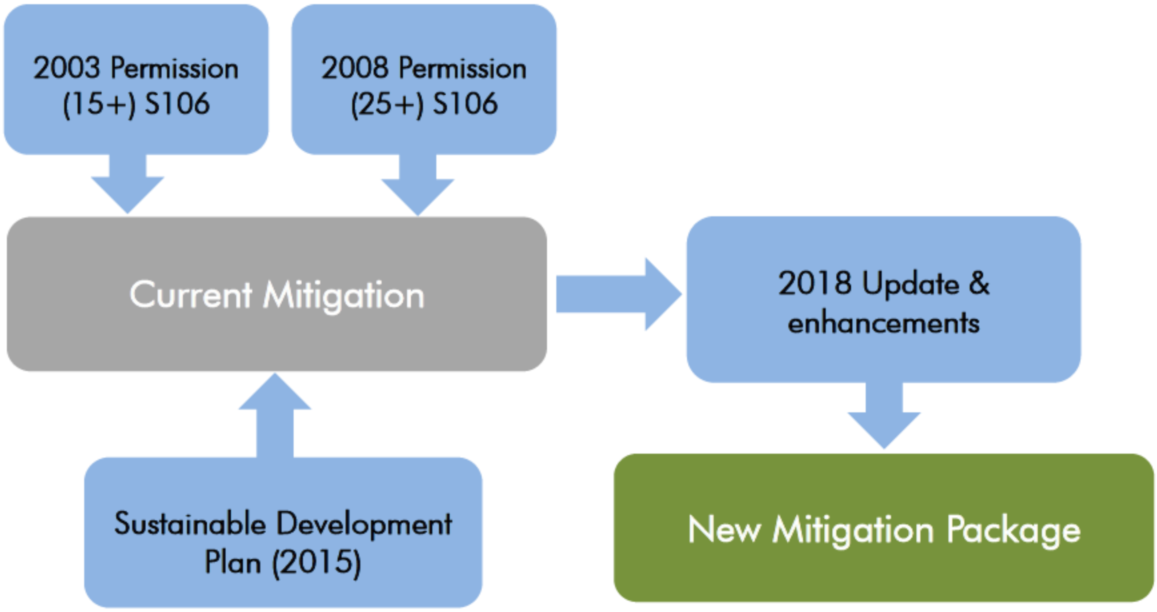


Figure 2: Process for developing the proposed mitigation package

7.8 Details of community engagement and the outputs and methodology of the public consultation process and stakeholder engagement are set out in the accompanying SCI.

7.9 The key themes and community issues raised through consultation are summarised below. More detail is provided in the SCI:

Theme	Key Issues
Aircraft Noise and Night Flights	• Some stakeholders wanted to see an improvement in the way the airport handles noise complaints, both in terms of process and time taken to respond and the usability of the website and information provided. • Some stakeholders expressed concern regarding the potential for aircraft noise to increase, in particular night noise associated with cargo flights. • For some stakeholders, the benefits of an international airport outweigh noise disturbance.
Road Transport	• Stakeholders recognised that the airport has the highest public transport mode share of airports in the UK. • Some stakeholders expressed concern that the development may result in more road congestion, especially M11 Junction 8.

	• Where improvements are required to the road network, some stakeholders expect the airport to pay its fair share towards mitigation. • Whilst the number of people cycling and walking to the airport has increased over recent years, some stakeholders suggested that improvements could be made to the existing provision. • The strong public transport offer was welcomed and recognised by stakeholders, however some did identify that bus services to some local areas could be improved. • Some concerns raised regarding fly-parking cars being parked on residential roads near the airport.
Economic Benefits and Community Engagement	• Strong stakeholder support for more destinations, especially long haul. • Some stakeholders welcomed the possibility of thousands of jobs being created of all types. • Stansted's commitment to providing apprenticeships was recognised, with some stakeholders supporting the creation of more apprenticeships. • The importance and benefits of the Aerozone and Airport Academy were recognised, but some stakeholders felt such facilities could be better promoted. • Some stakeholders expressed a desire to see a greater variety and choice of airlines at Stansted.
Passenger Experience	• Many stakeholders make use of the Parking and Express Set Down facilities at Stansted, but some raised concern regarding the fees charged. • A number of stakeholders were aware of the Residents' Discount card, but some felt this could be better promoted so more residents could make use of the benefits. • At Stansted's busiest times, some stakeholders identified that queues in the terminal were an issue and that the provision of additional seating would provide an improved passenger experience.

Proposed Mitigation

7.10 The mitigation measures forming part of this application fall in to two main categories:

a) A consolidation and continuation of existing S106 obligations, updated to reflect current measures / targets; and

b) New measures arising from the process described at paragraphs 7.5 - 7.6 above.

Current Section 106 Obligations

7.11 The current S106 obligations cover an extensive range of topics. A new S106 agreement will reflect the relevant existing obligations, with updates and modifications to reflect changes since the grant of the 2003 and 2008 permissions. The existing agreements have resulted in many positive benefits for the airport, local community and other key stakeholders. Some key successes include:

- the investment and improvements in public transport services and facilities and roads;
- mitigation measures e.g. Sound Insulation Grant Scheme (SIGS);
- community benefits e.g. Community Trust Fund and community activity; and
- economic benefits e.g. job creation and local business support.

7.12 The key topics where existing obligations are to be carried forward are:

- monitoring of a range of environmental impacts;
- operational restrictions designed to mitigate air and ground noise;
- penalties for off track aircraft;
- surface access management; staff travel card; public transport levy; and
- measures to protect sensitive environmental sites and reduce waste, water and energy consumption.

7.13 During the consultation process, stakeholders also identified other issues associated with the operation of the airport which STAL is committed to addressing but which do not form part of the application's mitigation package. One such example relates to the noise complaints process. In response, STAL has committed to undertaking a review of the process and response times and will report back on progress to the Stansted Airport Consultative Committee.

7.14 Increasing the choice of destinations (in particular long-haul destinations) and airlines was supported through the consultation process; STAL has and continues to work with airlines to grow the route network and bring new operators to the airport (further detail of this is provided in Section 2 of this Statement).

7.15 STAL welcomes feedback from passengers on their experience of using the airport and accepts that at peak times queues can be experienced in the core processing areas of check-in, security, departure lounge and through border control. STAL has invested significantly in facilities in recent years, with major improvements to the security area, the departure lounge and transformation of Satellite 1, and remains committed to meeting the evolving needs of passengers and airlines. As part of the Stansted Transformation and Investment Programme, further investment in infrastructure and facilities is planned to improve the passenger experience (as detailed further in Section 2 of this Statement).

New Mitigation Measures

7.16 STAL has developed a package of new mitigation measures which are relevant and related to this development, which recognise key community concerns raised during the consultation process particularly around noise and surface access, but also ensuring benefits are felt locally. In response to the key issues raised by stakeholders, as detailed further in the SCI, additional measures are now proposed, which fall under four broad headings and address key issues raised during consultation (as set out in paragraph 7.9):

- Skills and Economy;
- Noise;
- Surface Access; and
- Community.

7.17 The consolidation of the current mitigation and the proposed additions combine to form a new mitigation package as shown below (Figure 3):

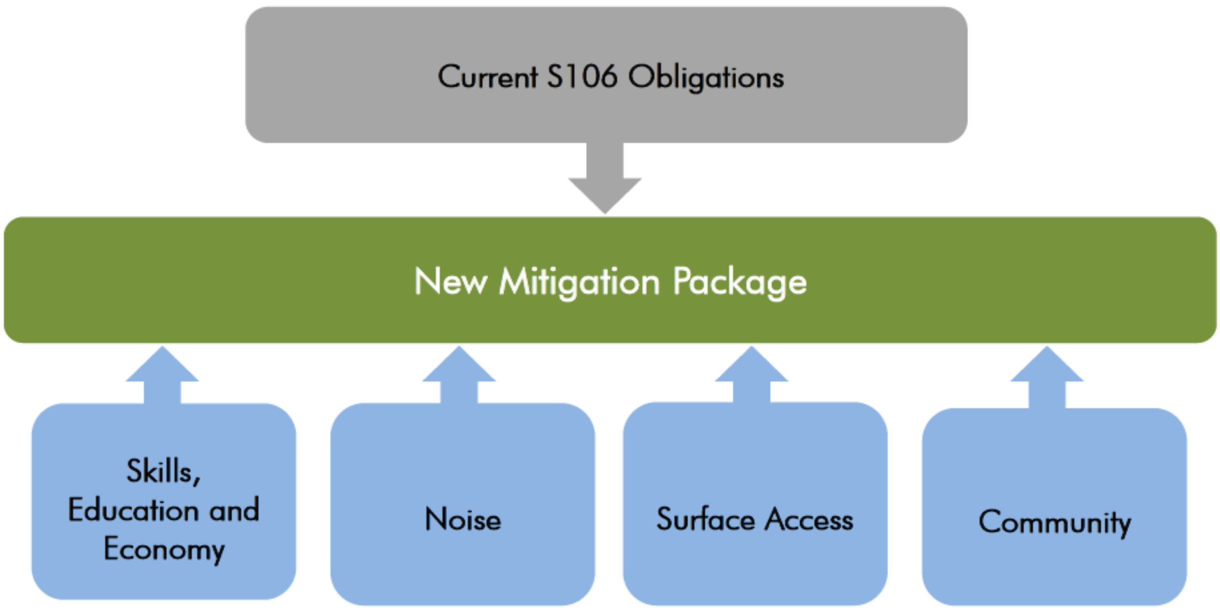


Figure 3: Combined mitigation package diagram

Skills, Education and Economy

7.18 The Socio-Economic chapter of the ES describes the impact of Stansted's growth on the local economy, employment and labour markets. The airport is a major employer in the locality and therefore measures are proposed which build on the success of the existing S106 agreements and new initiatives to support education and skills development and economic growth. These are designed to help capture the employment benefits for the local area.

7.19 Proposed measures include:

- **Airport Employment Academy:** funding and support for an on-site skills and employment centre to enable more jobseekers to choose to work at Stansted;
- **Aerozone:** funding and operation of an on-site education centre for local children to raise standards and attainment;
- **Stansted Airport College:** funding and support of an on-site Further Education college to ensure a supply of suitably skilled labour; and
- **Local Supply Chain Support:** including 'Meet the Buyers' events to increase the number of contracts awarded to local businesses.

Noise

7.20 The principal noise mitigation measures stem from the type and specification of aircraft operating at Stansted, along with the operational and air traffic control procedures in force. The ES (Air Noise, Chapter 7) contains details of the existing and future position.

7.21 STAL has offered a SIGS since 2005. This provides households subject to the highest levels of noise, financial assistance with the cost of moving. For other households within certain noise levels, the existing SIGS can cover 50% of the total cost of acoustic insulation. To date, over half of all properties eligible for the scheme have taken up the grant offer.

7.22 STAL has undertaken a review of schemes at other UK and international airports to establish current best practice. The findings of this review have been taken into account in developing a new and enhanced scheme which forms part of the proposed mitigation package.

7.23 A modified and improved scheme is proposed; the main features of which are:

- a larger geographic area of coverage, increasing the number of eligible properties;
- a scheme now based on meeting one of three different noise metrics: a combined 57dB LAeq (16hr), N65 200 (number above) and the 90 dBA SEL (single event) contour; 55 dB LAeq (16 hour) ground noise contour and being within 600m of the runway.
- a higher rate of grant, which would not require any matched funding by the home-owner;

- a tiered system which provides the highest funding for the noisiest areas;
- the addition of roof insulation to the scheme; and
- a free home insulation survey and report to establish the most suitable measures.

7.24 This much improved package of measures should prove more attractive, thus increasing the likelihood of local residents taking advantage of the scheme. This will ensure more houses have better protection against aircraft noise, reducing the amount of disturbance felt within properties. Improved noise insulation also brings better insulation in terms of energy loss and thus utility cost savings.

7.25 Feedback from the community has emphasised the need for transparency and better information with respect to aircraft noise. STAL will maintain an on-line aircraft track keeping and noise information system and report on progress against Noise Action Plan targets in the annual Corporate Social Responsibility Report.

Surface Access

7.26 The Transport Assessment sets out the impacts of the development on surface access networks and services. It shows the likely change in road traffic volumes on the strategic network and local roads. It also describes how Stansted is expected to maintain or improve its current high levels of public transport use for passengers and staff and measures to encourage more sustainable travel. Public consultation has highlighted community concerns about increased traffic and congestion.

7.27 No significant impacts are predicted as a result of the proposed development and, therefore, the view could be taken that no further mitigation is required. This section sets out some of the ways STAL manages the impacts that arise from its operations. This includes existing planning obligations and SDP commitments. In addition to summarising the current control and mitigation measures, the following sets out how they may be enhanced.

7.28 The existing S106 obligations require STAL to fund a range of measures. These have largely been delivered; but the following are outstanding:

- M11 J8 / A120 junction improvements
- contribution to Little Hadham by-pass

7.29 Based on the conclusions of the Transport Assessment, the following additional mitigation measures are proposed in relation to the development:

- **Off-airport Highway Improvements:** focussed intervention on capacity solutions for J8, M11. It is proposed that funding will be provided and works carried out by the Local Highway Authorities;

- **Walking and Cycling Improvements**: this includes the extension of footways and cycleways linking the key areas of the airport with the public transport interchange and off-airport networks;
- **A Local Roads Fund:** this will be set up to deliver localised improvements, traffic management and enforcement measures in conjunction with the Local Highway Authorities; and
- **Local Bus Network Development Fund**: further funding towards supporting new services in the local area.

Community

7.30 The impacts of the development, and Stansted's growth, on local communities are addressed in a number of ES Chapters: for example, noise, air quality, public health and well-being, and socio-economic. Further, public and stakeholder consultation has raised issues which could be described generally as having an impact on quality of life.

7.31 The existing obligations provide for a number of measures designed to improve local communities' social and economic well-being and mitigate the adverse impacts which result from Stansted's operations.

7.32 Alongside the continuation of some existing measures (some of which are to be updated), it is proposed to introduce additional measures as set out below:

- **Community and Well-being Fund:** a new Trust Fund set up with greater breadth and funding ambitions to provide financial sponsorship towards local community projects that improve cultural and social well-being and healthy lifestyles;
- **Airport Community Volunteer Network:** provision of volunteering, mentoring and coaching of local young people and practical support for community projects;
- **Express Drop-Off Discount**: improved discount scheme for use of the airport forecourt by local residents, modified to benefit residents most affected by aircraft noise; and
- **Rail Commuter Parking Scheme:** reduced costs and updated to reflect and respond to modern commuting patterns.

Heads of Terms

7.22 In accordance with best practice, and the Council's Scoping Opinion for the ES, an outline of the main provisions of a proposed S106 Agreement are included as Appendix D to this Statement.

8 Planning Benefits and Other Relevant Policies

8.1 A key consideration in any planning judgment, in addition to matters of Development Plan compliance, is an understanding of the material benefits that are delivered by the proposed development and which need to be assessed in the overall balance. Having regard to the proposed works, and growth to 43mppa, the main benefits can be summarised as follows:

a) delivering on national aviation policy objectives through making best use of existing airport capacity and being able to accommodate growth in South East demand across the London system;

b) delivering the economic growth aspirations and improved regional competitiveness through better connectivity for the East of England, London and the UK;

c) the increased economic impact and employment at Stansted itself, including improving skills and education;

d) greater choice, competition and the consumer benefits that result, including consumer and environmental benefits of avoiding trips to Heathrow and Gatwick;

e) substantial benefits can be delivered within a well-established planning framework and with no significant adverse environmental impacts (e.g. on noise or air quality) and the addition of new mitigation measures; and

f) planning for the future - the benefits of long term certainty and timing in relation to supporting wider policy preparation.

8.2 These planning benefits are reflected and recognised in other policies that do not form part of the Development Plan; they are however capable of being material planning considerations. The following sections describe the planning benefits of this application and how they are aligned to the aims and objectives of other key policies at a national and local level.

Delivering on Aviation Objectives: Best Use of Existing Airport Capacity

8.3 It will be at least 10-15 years before a new runway at Heathrow is available, and effective utilisation of existing airport capacity will be vital in the intervening period for the benefit of the UK economy. The need to make best use of existing capacity was recognised by Government in its recent Call for Evidence for a new aviation strategy. The Government's proposal to support airports seeking to make best use of existing capacity takes forward the Airport's Commission recommendation on the need to recognise the "crucial importance" of making better use of capacity and the "imperative" of growing the UK's connectivity in the period before a new runway is delivered at Heathrow.

8.4 Stansted is the only major airport capable of making a significant contribution to meeting demand locally and across the London system over the next 10 years. It has spare runway capacity, and the supporting infrastructure to handle that growth is in place or committed. Growth from 35mppa to

43mppa can also be accommodated within existing agreed limits on aircraft movements and the airport's noise footprint.

Delivering Economic Growth Aspirations and Regional Competitiveness through Improved Connectivity for the East of England, London and UK

8.5 Paragraph 7 of the NPPF defines the economic role of the planning system as "contributing to building a strong, responsive and competitive economy by [...] identifying and coordinating development requirements, including the provision of infrastructure". Paragraph 19 explicitly requires that 'significant weight' be attached to supporting economic growth. As above, the best use of Stansted will deliver on UK-wide aviation objectives, and the increased potential of the airport can unlock economic growth and deliver on identified priorities at the sub-regional and local levels.

8.6 Section 5 has outlined the wide range of plans and policies which together provide a compelling and consistent aspiration to deliver sustained growth and prosperity. It is widely recognised that improved connectivity, be it road, rail or air is a fundamental driver of wider economic growth. Successful regions are well connected regions. Stansted has a crucial role to play in this respect. Air travel provides the ability to easily access international and domestic destinations. Stansted's growing route network, with an increasing number of long haul destinations, directly leads to improved connectivity, easing the movement of people and goods, and attracting inward investment and visitors. This improves the competitiveness of the region and its businesses.

8.7 The regional strategies and policies that will be assisted by this application are:

- national strategies to increase wealth and prosperity, and securing sustainable economic growth;
- the LEP driven strategies for the London – Stansted – Cambridge Corridor and the Haven Gateway. The LSCC envisages 400,000 new jobs to be created between 2016 and 2036;
- Economic Plan for Essex – supports the growth of single runway capacity at Stansted and targets investment aimed at securing over 117,745 new jobs in Essex;
- Hertfordshire LEP Economic Plan - aims to address productivity performance with a target to increase GVA per hour in line with London's productivity growth;
- Harlow Enterprise Zone – new investment to broaden the economic base and provide employment in an area of need; and
- Upper Lee Valley Opportunity Area Planning Framework – appropriate investment could deliver cumulative additional GVA of around £10billion by 2031.

Economic Impact and Employment at Stansted including Skills and Education

8.8 Stansted is already the largest employment site in the East of England. It provides direct employment for around 12,000 people, 75% of whom live in Essex and Hertfordshire. There is a well-established relationship between the growth of Stansted and the growth in jobs on site. This application will enable a growth in employment of over 5,000 jobs over 10 years, at a sustainable location in line with NPPF paragraph 17. This will make a major contribution to the employment needs of the local population and the employment targets of Uttlesford District Council and neighbouring local authorities. These are set out at paragraphs 5.139 and 5.146 in Section 5.

8.9 The scale of activity at Stansted also provides a significant stimulus to the local economy through its indirect and 'multiplier' effects. A large number, and wide range, of local businesses and jobs are dependent on Stansted through the provision of goods and services to airport companies. As Stansted grows, so this employment and economic impact will increase. Local people employed at Stansted spend locally, thus indirectly supporting further numbers of jobs and local businesses.

8.10 Airports are unusual in the range and breadth of jobs that they support. These range from unskilled to highly skilled; include full time and part time jobs, and seasonal and permanent positions. Stansted therefore meets the diverse employment needs of a very wide range of the local population.

Greater Choice, Competition and Consumer Benefits & Wider Transport Objectives

8.11 The Competition Commission enforced sale of Stansted in 2013 was designed to offer greater choice and introduce more competition into the London market. It was envisaged that this would directly benefit consumers by lowering prices and increasing the likelihood of passengers being able to fly from their local airport. These wider public policy objectives have clearly been met given the evidence of the last five years, with an increasing number of destinations served from Stansted, the introduction of new airlines and new products and growing success in attracting long haul services.

8.12 One particular benefit has been the ability of more local passengers to be able to use their local airport rather than making surface access journeys to Heathrow and Gatwick. Destinations such as the USA and the Middle East will now be available from Stansted. This added convenience is not only time saving for passengers and businesses, but also reduces the volume and length of surface access trips to other airports. There is an environmental benefit where this has led to reduced car journeys.

8.13 Public consultation has shown that the more that Stansted can meet the travel needs of local people, so there is a more balanced view between the impacts of aviation e.g. aircraft noise and the benefits it brings. Local businesses benefit from improved choice and competition. More direct services from Stansted can reduce the time and cost of business travel, and enable easier access to international markets and customers. The forecasts show 6.3m business passengers using Stansted in 2028 in the 'With Development' scenario. This is an additional 1.2m business passengers compared to the 'Do Minimum' scenario. Most of these have an origin or destination in the local area. The use of Stansted for moving air cargo can also save time and cost and make the region more attractive for inward investment.

8.14 There is a clear and well evidenced link between economic success, growth and transport connectivity. Thus, alongside its role as an economic driver and employment hub in its own right, Stansted also performs a role as a key part of the UK and regional transport networks. As a major public transport facility, it provides domestic and international air connections and also acts as a major regional transport hub for local people as well as air passengers and staff. Its near 24-hour rail services to London, Cambridge and beyond is matched by high frequency coach services to key destinations in London and links to other UK cities. Local bus routes have been sustained, and have grown, due to financial support and the increase in passenger demand generated by Stansted. For rural communities this brings social and economic benefits in accessing services.

8.15 These represent significant benefits to the local area, and confirm Stansted as a sustainable location for growth and new development, in line with NPPF paragraph 34. In compliance with the Aviation Policy Framework's requirements, a comprehensive Surface Access Strategy has been put in place at Stansted.

8.16 The regional growth agenda seeks to exploit the region's key transport corridors and gateways – notably the M11, A120, West Anglia main line railway, the Haven ports and Stansted. The airport is in a unique position, being at the geographical heart of these strategic road and rail corridors. Airport growth strengthens the case for the major investment in transport that is a crucial enabler for the delivery of new housing, new employment and the realisation of the regional growth agenda. This is clear from the regional policies outlined in Section 5. On the rail network, improved journey times, greater reliability and new rolling stock are shared objectives for the regional partners as an important prelude to major infrastructure upgrades such as four--tracking on the West Anglia mainline. This would directly improve Stansted's connectivity from London, reduce journey times and bring benefits to the wider region.

An Established Planning Framework

8.17 As explained in earlier sections, Stansted's growth has taken place in a carefully planned manner, in distinct phases. The original masterplan was designed to provide a well defined reservoir of land, capable of meeting the region's long-term aviation needs. Stansted today operates within well-established boundaries, with substantial landscape screening. The current application fits comfortably within that framework. The environmental impacts of Stansted's operations have also been managed within a well-established and comprehensive system of environmental controls and policies, which are, in many respects, best practice within the industry. These have been reviewed, updated and improved at each stage of Stansted's growth.

8.18 The growth now forecast for the next 10 years, and the proposed small addition to the airfield infrastructure, can take place with only modest or minor impacts beyond the site. A comprehensive EIA shows that there will be no substantial adverse environmental impacts beyond the airport's permitted growth to 35 mppa. Indeed, a 43mppa throughput can be achieved with a smaller noise footprint than that currently permitted for 35mppa and with no exceedance of environmental limits.

The proposed development does not conflict with national or local environmental policies, including the national Air Quality Plan 2017. This is a major benefit of meeting the growth in demand for air travel at Stansted.

Planning for the Future

8.19 Airports are long term infrastructure businesses. Successful airports need to plan and invest for the future. This, in turn, requires clarity and a confidence in the long-term prospects of the airport and the regions that they serve.

8.20 At the UK level, this requires a clear national policy for aviation. The Airports Commission confirmed the merits of making the best use of the UK's aviation assets and the Government has recently endorsed this view. The suggested national policy support for making the best use of existing airport assets and runway capacity is welcome and complements the Government's support for an additional runway at Heathrow. Moreover, the Government's acknowledgement that air connectivity is a vital component of the UK's future after leaving the EU, confirms the need to plan beyond the short term.

8.21 At the regional level, there are plans for substantial long term economic growth and investment, especially along the London – Stansted – Cambridge and other growth corridors. Local authorities, LEPs and other stakeholders have developed a shared long-term vision, part of which relies on, and benefits from, the continued growth and success of Stansted and the connectivity that it provides. This vision both needs, and can help attract, sustained investment in the region's transport infrastructure. Major improvements to the West Anglia rail network and the strategic highway network are shared priorities; the case for which needs to be reflected in the long-term plans of Highways England and Network Rail. Both of those bodies plan and invest over 10 to15 year periods.

8.22 At the local level, Uttlesford District Council and surrounding local authorities are preparing their own vision and strategies. These are ambitious, and set out a strong agenda for growth and to create more prosperous local communities. These plans have a 15 to 25-year horizon and require an assessment of the need for jobs, housing and infrastructure. The future for Stansted, the part it can play, and the impact it will have, is an important component in this strategic planning.

8.23 It is against this backdrop of long term planning, that STAL believes it is necessary and helpful to establish Stansted's role and its own 10-year plan. This is in line with Government's advice about the benefits of long term airport masterplans. The 2015 SDP sets out how Stansted could develop and the impacts of that growth. Clarity, certainty and confidence in Stansted's long-term future is especially important given its key role in helping to deliver wider economic growth. This all builds confidence in the region, creating the environment and conditions that make it more likely that both public and private sector investment can be attracted and be successful.

8.24 This approach is consistent with the way that Stansted has operated and evolved since the mid-1980s. A long term masterplan provided a clear framework for the development of the airport, within a well-established landscaped boundary, to provide the facilities and services to support a major international airport. The scale of operation, and the impacts that result, have then been managed through a series of planning permissions with attendant controls and mitigation measures. It is now appropriate to consider the next chapter in that history with a review of Stansted's prospects for the next 10 years.

8.25 Stansted can grow to 35mppa without the need for any further permissions. The rate of growth that has been experienced in recent years means that this limit will be reached by around 2023. This application is made in order to provide a clear and up to date regulatory framework for the airport's growth beyond 35mppa. This application is timely, in the context of the long lead times and major infrastructure activities, to plan, build and deliver the necessary investment. MAG's vision for Stansted requires substantial further investment, building on the £150m that has been invested since 2013. This further investment will transform and extend the terminal facilities, with complementary investment in the airfield, site infrastructure and utilities and supporting facilities such as car parking.

8.26 It is not just the airport's infrastructure that needs planning ahead. Existing and prospective airlines also need certainty and time to plan, to negotiate longer term agreements for new routes and ensure that those routes are aligned to the needs of the region. They need to plan and invest in aircraft, facilities and staff. In a liberalised market place, airlines need confidence that their investment in new commercial agreements with airports will be sustainable and offer the opportunity for future growth.

8.27 Knowing that the airport has the ability to grow to make best use of its capacity for the next 10 years, would increase the prospect of fleet replacement at Stansted, with Ryanair in particular planning to invest heavily to introduce the most modern and therefore quieter new generation aircraft. This will deliver noticeable improvements in the noise climate and enable a growth in passenger numbers to be contained within existing agreed limits on aircraft noise and aircraft movements.

8.28 Stansted is targeting further new long-haul routes, building on the launch of the Dubai route – with China, the Middle East and North America being key markets. These routes can take some time to become established and move into profit, due to their higher start-up and operating costs. With the confidence that Stansted can grow beyond 35 mppa, it is far more likely that a larger and more diverse route network will develop, compared to if the airport were constrained, where route development would slow if not cease.

8.29 The greater degree of confidence and certainty, the more likely that the airport, the region and the UK are seen as 'open for business'. The ability for Stansted to grow beyond 35 mppa is a more attractive proposition for airlines, as they will feel more confident about their ability to realise market potential. Headroom in the limits also helps competition as it provides scope for new airlines to enter the market; unlike the position at constrained airports where growth rarely continues at a linear rate, but instead is more likely to plateau out as the limit is reached.

Summary

8.30 These benefits associated with the application are material considerations in the determination of the planning application. Although their weight must be ultimately judged by the decision maker, the NPPF describes economic matters as a dimension of sustainable development and one to be judged alongside environmental and social issues. Furthermore, the NPPF promotes the need to build a strong and competitive economy, and achieve sustainable economic growth. The ability to access employment and the creation of jobs, further supports the social role that the planning system should undertake.

9 Planning Judgement and Conclusion

9.1 Any assessment of the planning acceptability of the 35+ planning application needs to have regard to:

a) the degree of Development Plan support;

b) the extent of any conflict with the Development Plan; and

c) other material planning considerations.

9.2 This statement has undertaken this exercise in detail, assessing each of the individual elements and thus providing the basis for a planning judgement to be taken. The outcome of this exercise is that the proposed development:

a) is in compliance with the policies of the adopted Uttlesford Local Plan, emerging draft Local Plan and the NPPF in respect of employment and economy; climate change, flood risk and drainage; carbon emissions and air quality; noise; bio-diversity, ecological impact; and sustainable transport; and

b) has no areas of conflict with the Development Plan when the material fall-back position of the existing 2008 planning permission is taken into account; and

c) has material benefits in the form of:

- delivering on national aviation policy objectives through making best use of existing airport capacity and being able to accommodate growth in demand;
- delivering economic growth and regional competitiveness through improved connectivity;
- increased economic impact and employment, including skills and education;
- greater choice, competition and consumer benefits, including consumer and environmental benefits of avoiding trips to Heathrow and Gatwick;
- growth being delivered within a well-established planning framework and with no significant adverse environmental impacts and the addition of new mitigation measures;
- giving clarity about Stansted's future to inform wider policy preparation and investment.

In conclusion, the 35+ planning application is in overall accordance with the Development Plan and represents a form of sustainable development that will bring significant economic and social benefits without causing unacceptable environmental harm.

9.3 A grant of planning permission for the proposed works would therefore be appropriate.

Appendices

Appendix A: Glossary

APF	Aviation Policy Framework
APU	Auxiliary Power Unit
AQMA	Air Quality Management Area
ATM	Air Transport Movement
BAA	former British Airports Authority and BAA plc
Bn	Billion
CAA	Civil Aviation Authority
CEMP	Construction Environmental Management Plan
CSR	Corporate Social Responsibility
CTMP	Construction Transport Management Plan
dB	Decibel
DEFRA	Department for Environment, Food & Rural Affairs
DCO	Development Consent Order
ECC	Essex County Council
EIA	Environmental Impact Assessment
EPfE	Economic Plan for Essex
ES	Environmental Statement
EU	European Union
FEGP	Fixed Electrical Ground Power
GCGP	Greater Cambridge / Greater Peterborough
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GVA	Gross Value Added
Ha	Hectare
HCC	Hertfordshire County Council
HGV	Heavy Goods Vehicle
ICCAN	Independent Commission on Civil Aviation Noise
ICAO	International Civil Aviation Organization
Km	Kilometres
LEP	Local Enterprise Partnership
LOAEL	Lowest Observed Adverse Effect Level
LSCC	London Stansted Cambridge Consortium

LTO Landing and take-off

LTP Local Transport Plan

MAG Manchester Airports Group

MPPA Million passengers per annum

$MtCO_2e$ Metric tonnes of carbon dioxide equivalent

NOEL No Observed Effect Level

NPPF National Planning Policy Framework

NPS National Policy Statement

NPSE Noise Policy Statement for England

NSIP Nationally Significant Infrastructure Project

NTS Non-Technical Summary

PATM Passenger Air Transport Movement

PAX Passenger

PD Permitted Development

RAT Rapid Access Taxiway

RET Rapid Exit Taxiway

RIS Road Investment Strategy

SCI Statement of Community Involvement

SDP Sustainable Development Plan

SPD Supplementary Planning Document

SRN Strategic Road Network

SOAEL Significant Observed Adverse Effect Level

STACC Stansted Airport Consultative Committee

STAL Stansted Airport Limited

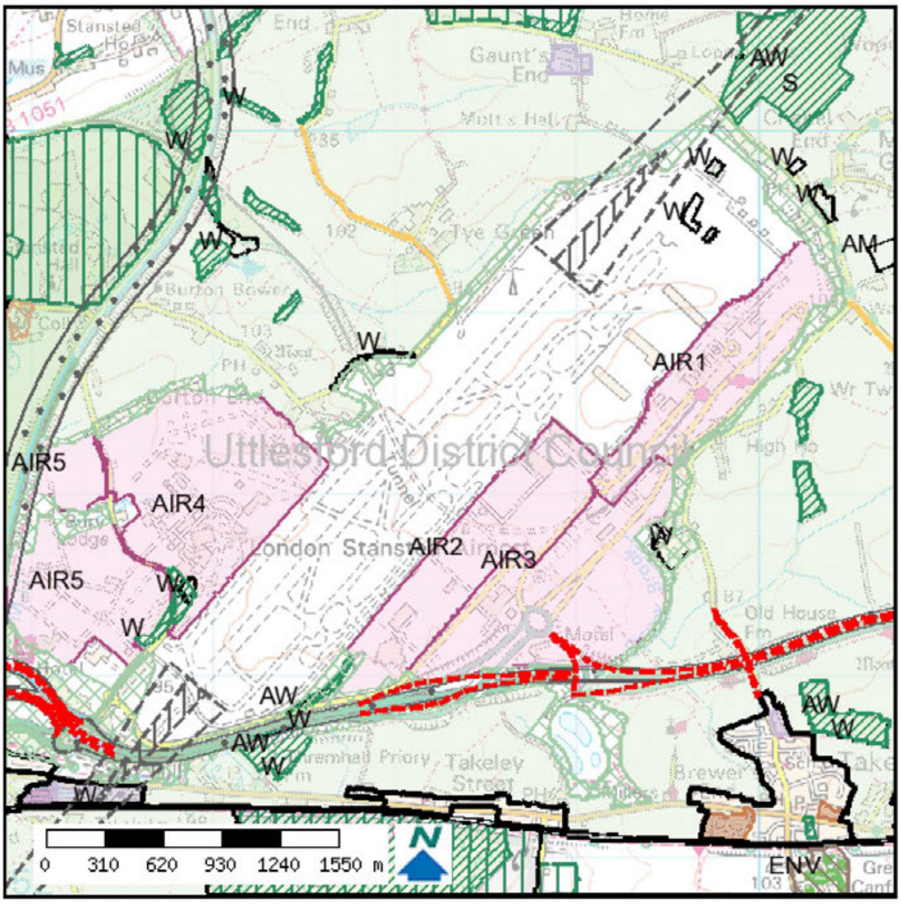
STEM Science, Technology, Engineering and Maths

S106 Section 106 of the Town and Country Planning Act 1990 (as amended)

TA Transport Assessment

UDC Uttlesford District Council

Appendix B: Extract of the Uttlesford Proposals Map



Uttlesford District Council

Legend

- Urban/Settlement Expansions
- Employment Land
- Residential Land
- Metropolitan Green Belt
- Countryside Protection Zone
- Employment Land to be Safeguarded
- Special Verge
- Protected Lane
- Town or Local Centre
- AIR1 Terminal Support Area
- AIR2 Cargo Handling/Aircraft Maintenance Area
- AIR3 Southern Ancillary Area
- AIR4 Northern Ancillary Area
- AIR5 Long Term Car Park
- ENV Protected Open Space of Environmental Value
- Lower Street and Church Road, Stansted Mountfitchet
- Development Limits
- S Site of Special Scientific Interest (SSSI)
- W County Wildlife Site
- AW Ancient Woodland
- HL Historic Landscape
- Important Woodland
- Historic Parks and Gardens
- Major Developed Site in Green Belt
- Mobile Home Park, Takeley
- Landscaped Areas
- Public Safety Zone 1:100,000 risk
- Public Safety Zone 1:10,000 risk
- Parsonage Farm, Stansted Mountfitchet
- Conservation Area
- Ground Water Protection Zone
- Poor Air Quality Zone
- N National Nature Reserve
- AM Ancient Monument
- Route of New Road to be Safeguarded

Appendix C: Policy Compliance Overview

		Development Plan Policy		National Planning Policy
	35+ Planning Statement	Adopted Uttlesford Local Plan (2005)	Emerging Uttlesford Plan (Regulation 18, 2017)	National Planning Policy Framework (2012)
Policy Compliance	**Principle of Development** Refer to paragraphs 6.13 to 6.17	Policy S4	Policies SP11, SP1, SP2, SP12	
	Socio Economic Impacts Refer to paragraphs 6.18 to 6.34		Spatial Vision, Objective 21a, PoliciesSP11, SP4	Paragraphs 17, 19
	Noise (air, ground and surface access) Refer to paragraphs 6.35 to 6.83	Policies ENV11, GEN 4	Policies EN18, SP11, SP2	Paragraphs 109, 123
	Air Quality Refer to paragraphs 6.84 to 6.95	Policies GEN7, GEN4, ENV13	Policy EN16	Paragraphs 109, 120
	Highway Safety and Accessibility Refer to paragraphs 6.96 to 6.122	Policies GEN1, E3, GEN6	Objective 2c, Policies TA1, TA2	Paragraphs 32, 34, 35, 36
	Water Supply, Flood Risk and Drainage Refer to paragraphs 6.123 to 6.134	Policies GEN3, ENV12, GEN6	Policies SP12, EN11, EN12, EN13	Paragraph 103
	Climate Change Refer to paragraphs 6.135 to 6.140		Objective 3b, Policy SP11.	Paragraphs 7, 93
	Carbon Emissions Refer to paragraphs 6.141 to 6.146			Paragraphs 7, 17, 18
	Natural Habitat Refer to paragraphs 6.147 to 6.149	Policy GEN7	Policy EN9	Paragraph 118
	Construction Environmental Management Refer to paragraphs 6.150 to 6.153		Policy SP12	Paragraph 17
	Community Well-being and Health Impacts Refer to paragraphs 6.154 to 6.165	Policies ENV11, ENV13	Policies INF3, SP11	Paragraph 69

Appendix D: S.106 Draft Heads of Terms

Existing S106 Obligation[7]	Content
Air Noise	*Continue:* - Adopt operational procedures and practices aimed at achieving ongoing improvements in the levels of, and the minimisation of impacts of, air noise. - Monitoring of the performance of airlines. - Voluntary incentives and controls to reduce aircraft noise. - Pay off-track flying penalties to the Trust Fund. - Noise insulation programme for domestic dwellings and Home Relocation Assistance Scheme [refer to Addition below]. *Addition:* - Enhanced Sound Insulation Grant Scheme. *Exclude:* - Restriction on lobbying for any relaxation of night flight restrictions.
Ground Noise	*Continue:* - Carry out ground run testing of aircraft engines in the ground run facilities. - Review the Stansted Ground Noise Management Strategy every five years (as part of the Sustainable Development Plan). - Echo Apron restrictions.
Air Quality	*Continue:* - Monitor air quality in the vicinity of the airport, including monitoring (a fixed monitor and diffusion tube monitoring) within Hatfield Forest (subject to agreement with The National Trust), and associated reporting.
Surface Access	*Continue:* - Charging a levy for any public or communal use staff car parking. Income from the levy to finance initiatives in accordance with the Surface Access Strategy to promote sustainable travel. - Preparation of a Surface Access Strategy (as part of the Sustainable Development Plan) and monitoring arrangement (including two yearly report on staff travel patterns). - Maintain Airport Travel Plan and Airport Travelcard Scheme. - Reasonable endeavours to reduce the proportion of staff travelling by car and consider means to increase public transport mode share for (non-transferring) passengers. - Maintain Stansted Surface Access Transport Forum. - Contributions to local road schemes [refer to Addition below].

[7] 2003 and 2008 Section 106 agreements.

	- Contributions to further develop public transport links to and from the airport [refer to Addition below]. *Addition:* - Off-airport Highway Improvements: focussed intervention on capacity solution of junction 8 of the M11. - Walking and Cycling Improvements: including extension of footways and cycleways. - Local Roads Fund: this will be set up to deliver localised improvements, traffic management and enforcement measures in conjunction with the Local Highway Authorities. - Local Bus Network Development Fund: further funding towards supporting new services in the local area.
Rail	*Continue:* - Monitoring rail patronage. *Exclude:* - Requirement for the provision of rail platform extension land and construction. - Improve waiting facilities for rail passengers.
Passenger Pick Up	*Continue:* - Provide a suitable area for collection by car of air passengers arriving at the terminal building and limit parking in the area to a maximum of 15 minutes [refer to Addition below]. *Addition:* - Express Drop-Off Discount: improved discount scheme for use of the airport forecourt by local residents, modified to benefit residents most affected by aircraft noise. - Rail Commuter Parking Scheme: reduced costs and updated to reflect and respond to modern commuting patterns. *Exclude:* - Provision of a rail car park for season ticket holders [refer to Addition above].
Nature Conservation	*Continue:* - Scheme for management and maintenance of the airport's biodiversity. *Exclude:* - Baseline study at about 160,000 PATMS of current condition of flora and fauna within Hatfield Forest, East End Wood and the Fenn Site. - (2003 Agreement) Within 12 months of terminal extension authorised by the permission being used by 185,000 PATMS t submit to UDC a proposal for a study of the effects of noise, air and light pollution on flora and fauna in Hatfield Forest; and appropriate measures to mitigate any significant effects of the development. - (2008 Agreement) Undertake a study om the effects of noise, air and light pollution on the flora and fauna in Hatfield Forest at 230,000 PATMS; and consider schemes of appropriate measures to compensate for material adverse effects.
Employment and Education	*Continue:* - Maintain and support the Stansted Airport Employment Forum. - Fund initiatives to support training and employment [refer to Additions below].

	- Review the Stansted Employment Strategy (every four years). - Undertake an employment survey (every five years). *Addition:* - Airport Employment Academy: funding and support for an on-site employment centre to enable more jobseekers to choose to work at Stansted. - Aerozone: funding and operation of an on-site centre for local children to raise standards and attainment. - Stansted Airport College: funding and support of an on-site Further Education college to ensure a supply of suitably skilled labour.
Economic Performance	*Continue:* - Maintain and support the Stansted Airport Business Forum. - Support and facilitate the annual 'Meet the Buyers' event [refer to Addition below]. *Addition:* - Support the local supply chain, including the 'Meet the Buyers' event.
Community	*Continue:* - Pay monies annually into a Trust Fund [refer to Addition below]. *Addition:* - Community and Well-being Fund: a new Trust Fund set up with greater breadth and funding ambitions to provide financial sponsorship towards local community projects that improve cultural and social well-being and healthy lifestyles. - Airport Community Volunteer Network: provision of volunteering, mentoring and coaching of local young people and practical support for community projects.
Visitors and Archaeological Resource	*Continue:* - Make all archaeological finds discovered during works available to the Saffron Walden Museum for inspection. *Exclude:* - Provision of a visitor's centre and aircraft viewing facility.
Design and Construction	*Continue:* - Using reasonable endeavours to ensure construction practices and the suppliers for goods and services are environmentally responsible and sustainable.
Waste Management	*Continue:* - Review the Stansted Waste Management Strategy every five years (as part of the Sustainable Development Plan) and report progress. *Exclude:* - Provision of a waste recycling facility.
Energy	*Continue:* - Review the Stansted Energy Management Strategy every five years (as part of the Sustainable Development Plan) and report progress.
Monitoring	*Continue:*

	- Commission studies at agreed intervals of the impact on: air noise contours; ground noise measurements; air quality; traffic flows; transport mode shares; employment levels; patterns of the places of residence of persons employed at the Airport; visual impact; waste; water; and energy. - Publish an annual Corporate Responsibility Report. - Reasonable endeavours to implement any reasonable and proportionate measures to mitigate any adverse effects of the Development on the environment.
Health	***Addition:*** - [As also detailed under Community] Community and Well-being Fund: a new Trust Fund set up with greater breadth and funding ambitions to provide financial sponsorship towards local community projects that improve cultural and social well-being and healthy lifestyles ***Exclude:*** - Consultation with the Primary Care Trust on the appropriateness of undertaking a study on effects on public health. - Take reasonable and proportionate steps to mitigate in accordance with Government guidance regarding noise and air quality any proven adverse effects upon public health being a direct result of the Development as identified by studies carried out.
Water efficiency	***Continue:*** - Agree detail of water efficiency measures that should be incorporated into the detailed design of Satellite 4.
Landscape mounding and planting	***Addition:*** - Submission of a scheme for additional planting or mounding to the existing Molehill Green mound. ***Exclude:*** - Planting on the grassed area of Molehill Green mound.

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[100] Planning obligations (reviewed 11 January 2018), Planning Practice Guidance, Department for Communities and Local Government: https://www.gov.uk/government/collections/planning-practice-guidance.

From: committee
To: Manston Airport
Cc: dr.beauwebber@gmail.com
Subject: Re: SMAa representation Matter 2
Date: 30 June 2021 18:19:38
Attachments: SMAa representation to the Secretary of State - Matter 2 - part 2.pdf

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For the attention of the Manston Airport Case Team :

TR020002 – SMAa representation to the Secretary of State for Transport – Matter 2 Part 2

Re-determination of the Application by RiverOak Strategic Partners Limited ("the Applicant") for an Order granting Development Consent for the reopening and development of Manston Airport in Kent.

SMAa has over 3,700 members who are in full support of the Development Consent Order to reopen Manston Airport, many wanting jobs for themselves, their family or other Kentish people. Thus, we wish to make further representations to assist in the re-determination of the DCO.

Statement of Matters

In the Department for Transport's Statement of Matters letter dated 11th June 2021 it invited Interested Parties to make further representations on 4 matters. This representation will look at:

"whether the quantitative need for the Development has been affected by any changes since 9 July 2019, and if so, a description of any such changes and the impacts on the level of need from those changes (such as, but not limited to, changes in demand for air freight, changes of capacity at other airports, locational requirements for air freight and the effects of Brexit and/or Covid)"

Please see below web file :

SMAa representation to the Secretary of State for Transport - Matter 1.pdf

From the SMAa Committee on behalf of the 3,700 members

Dr Beau Webber (Chairman)

Liam Coyle (Vice-Chairman & Chief Moderator)

David Stevens (Vice-Chairman)

Margaret Sole (Treasurer)

Gregory Nocentini (Treasurer)

Angela Stevens (Secretary)

Ex-officio members:

Bryan Girdler

Garry Dumigan

Email: committee@savemanstonairport.org.uk

Department for Transport

Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England

Presented to Parliament pursuant to Section 9(8) of the Planning Act 2008

Moving Britain Ahead

June 2018

The Department for Transport has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the Department's website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact the Department.

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Contents

1. Introduction

Background

1.1 The UK aviation sector plays an important role in the modern economy, contributing around £20 billion per year[1] and directly supporting approximately 230,000 jobs.[2] The positive impacts of the aviation sector extend beyond its direct contribution to the economy by also enabling activity in other important sectors like business services, financial services, and the creative industries. The UK has the third largest aviation network in the world, and London's airports serve more routes than the airports of any other European city.

1.2 However, London and the South East are now facing longer term capacity problems. Heathrow Airport is operating at capacity today, Gatwick Airport is operating at capacity at peak times, and the whole London airports system is forecast to be full by the mid-2030s.[3] There is still spare capacity elsewhere in the South East for point to point and especially low cost flights. However, with very limited capability at London's major airports, London is beginning to find that new routes to important long haul destinations are being set up elsewhere in Europe. This is having an adverse impact on the UK economy, and affecting the country's global competitiveness.[4]

1.3 In September 2012, the Coalition Government established the independent Airports Commission to examine the scale and timing of any requirement for additional capacity to maintain the UK's position as Europe's most important aviation hub, and identify and evaluate how any need for additional capacity should be met in the short, medium and long term.[5]

1.4 In its Interim Report in December 2013, the independent Airports Commission concluded that there was a need for one additional runway to be in operation in the South East of England by 2030.[6] It also confirmed three shortlisted capacity schemes for further analysis: a Second Runway at Gatwick Airport (proposed by Gatwick Airport Ltd.), a Northwest Runway at Heathrow Airport (proposed by Heathrow Airport Ltd.), and an Extended Northern Runway at Heathrow Airport (proposed by Heathrow Hub Ltd.). The Airports Commission then consulted further on the three shortlisted schemes, plus proposals for a new airport in the inner Thames Estuary. In September 2014, the Airports Commission concluded not to consider further an inner Thames Estuary scheme.[7]

1.5 In its Final Report in July 2015, the Airports Commission unanimously concluded that the proposal for a Northwest Runway at Heathrow Airport, combined with a significant

[1] ONS, Input-Output Supply and Use tables, 2014
[2] ONS, Business Register and Employment Survey, 2014
[3] *https://www.gov.uk/government/publications/airport-expansion-updated-cost-and-benefits-appraisal Updated Appraisal Report,* p11
[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf *Airports Commission: Final Report*, p3
[5] https://www.gov.uk/government/organisations/airports-commission
[6] https://www.gov.uk/government/publications/airports-commission-interim-report
[7] https://www.gov.uk/government/publications/inner-thames-estuary-airport-summary-and-decision

package of measures to address its environmental and community impacts, presented the strongest case and offered the greatest strategic and economic benefits.

1.6 The Airports Commission's remit also required it to look at how to make best use of existing airport infrastructure, before new capacity becomes operational.[8] The Commission noted in its final report that a new runway will not open for at least 10 years. It therefore considered it imperative that the UK continues to grow its domestic and international connectivity in this period, which it considered would require the more intensive use of existing airports other than Heathrow and Gatwick.[9]

1.7 On 14 December 2015, the Government accepted the Airports Commission's recommendation for increased capacity in the South East of England, and its shortlisted scheme options. The Government also confirmed that it would begin work on the building blocks of an Airports National Policy Statement ('Airports NPS'), and this is what happened.[10]

1.8 The Government believes that an NPS is the most appropriate method to put in place the planning framework for a new runway in the South East of England.[11] All three shortlisted airport schemes would have been classed as nationally significant infrastructure projects under the Planning Act 2008, and the Government's view is that an Airports NPS, and a development consent application made under the Planning Act 2008, is the most appropriate route to deliver the Government's preferred scheme.

1.9 In its announcement on 14 December 2015, the Government made clear that it would be important to undertake further work regarding the final location of the preferred scheme. This included additional work on air quality, noise, carbon, and mitigating impacts on affected local communities.

1.10 On 25 October 2016 the Government announced that a Northwest Runway at Heathrow Airport, combined with a significant package of supporting measures, was its preferred scheme to deliver additional airport capacity in the South East of England. It also confirmed that this would be included in a draft Airports NPS, to be the subject of consultation according to the procedures laid down in the Planning Act 2008.[12]

1.11 The draft Airports NPS and supporting Appraisal of Sustainability were published on 2 February 2017 and a 16 week public consultation was launched. On publishing the draft Airports NPS, the Government made a commitment to continue updating its evidence base on airport capacity, including revised passenger demand forecasts and the impact of the publication of the final Air Quality Plan (the UK plan for tackling roadside nitrogen dioxide concentrations). On 24 October 2017, the Government published and conducted an 8 week public consultation on a revised draft Airports NPS and other documents which were published alongside it. The revisions were made on the basis of changes to the evidence base and as a result of initial consideration of the responses to the February consultation and other broader government policy changes. Having considered the responses to both the February and October consultations, and the report published by the Transport Committee on 23 March 2018, the Government has made some further changes, principally to provide greater clarity and reflect updates to wider Government policies.

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[8] *Airports Commission: Interim Report*, paragraph 5.2
[9] *Airports Commission: Final Report*, paragraph 16.40
[10] https://www.gov.uk/government/speeches/aviation-capacity
[11] Throughout this document, unless specified otherwise, the term "NPS" refers to the Airports NPS. Other NPSs, for example the National Networks NPS, are referred to in full as required
[12] https://www.gov.uk/government/speeches/airport-capacity

Purpose and scope of the Airports NPS

1.12 The Airports NPS provides the primary basis for decision making on development consent applications for a Northwest Runway at Heathrow Airport, and will be an important and relevant consideration in respect of applications for new runway capacity and other airport infrastructure in London and the South East of England. Other NPSs may also be relevant to decisions on airport capacity in this geographical area.

1.13 The Airports NPS sets out:

- The Government's policy on the need for new airport capacity in the South East of England;
- The Government's preferred location and scheme to deliver new capacity; and
- Particular considerations relevant to a development consent application to which the Airports NPS relates.

1.14 It sets out planning policy in relation to applications for any airport nationally significant infrastructure project in the South East of England, and its policies will be important and relevant for the examination by the Examining Authority, and decisions by the Secretary of State, in relation to such applications.

1.15 In particular, the Secretary of State will use the Airports NPS as the primary basis for making decisions on any development consent application for a new Northwest Runway at Heathrow Airport, which is the Government's preferred scheme. The policies in the Airports NPS will have effect in relation to the Government's preferred scheme, having a runway length of at least 3,500m and enabling at least 260,000 additional air transport movements per annum.[13] It will also have effect in relation to terminal infrastructure associated with the Heathrow Northwest Runway scheme and the reconfiguration of terminal facilities in the area between the two existing runways at Heathrow Airport. For the avoidance of doubt, the Airports NPS does not identify any statutory undertaker as the appropriate person or appropriate persons to carry out the preferred scheme.

1.16 It is possible that an applicant for development consent in respect of the preferred scheme will promote more than one application for development consent, dealing with different components individually. To the extent that this is the case, the Secretary of State will apply the Airports NPS to such applications to the extent that he or she determines to be appropriate in the circumstances.

1.17 For a scheme to be compliant with the Airports NPS, the Secretary of State would expect to see these elements comprised in its design, and their implementation and delivery secured, particularly with regard to runway length and increased capacity of air transport movements. Other NPSs may also be relevant to decisions on nationally significant infrastructure projects at airports but, if there is conflict between the Airports NPS and other NPSs, the conflict should be resolved in favour of the NPS that has been most recently designated.

1.18 Under section 104 of the Planning Act 2008, the Secretary of State must decide any application in accordance with any relevant NPS unless he or she is satisfied that to do so would:

[13] The Airports NPS stipulates the length of the new runway to ensure that the new infrastructure can accommodate the largest commercial aircraft, as they operate many of the long haul flights that support the UK's position as a major aviation hub

- Lead to the UK being in breach of its international obligations;
- Be unlawful;
- Lead to the Secretary of State being in breach of any duty imposed by or under any legislation;
- Result in adverse impacts of the development outweighing its benefits; or
- Be contrary to legislation about how the decisions are to be taken.[14]

1.19 The Airports NPS refers in some places to other relevant documents. These other documents may be replaced, updated or amended over the lifetime of the Airports NPS, and so successor documents should be referred to when this is the case.

1.20 Unlike the regime for the granting of planning permission under the Town and Country Planning Act 1990, there is no provision in the Planning Act 2008 for the making of an 'outline' application for development consent, followed by 'reserved matters' approval. This does not mean, however, that development cannot be phased, so that particular parts are brought forward at different times, or that the details of a proposal cannot be reserved for determination later. Guidance by the Ministry of Housing, Communities and Local Government recognises that development projects advanced through the development consent order process may be phased, but emphasises that every phase of the project contained in a development consent application must be considered in the application for the order and the order itself.[15]

Duration

1.21 The Airports NPS covers development that is anticipated to be required by 2030 as well as other development required to support it. It will remain in place until it is withdrawn, amended or replaced. It will be reviewed, in accordance with the Planning Act 2008, when the Secretary of State considers it appropriate to do so. When considering whether to review the Airports NPS, the Secretary of State will look at whether there has been a significant change in any circumstances on which the policy was based and whether such change was anticipated when the Airports NPS was designated.

Territorial extent

1.22 The Airports NPS covers England only. Some aspects of aviation noise policy are devolved but others are reserved.[16]

1.23 Aviation policy is largely a reserved matter, though planning policy is not. Specifically:

- The National Assembly for Wales has devolved powers relating to airports in terms of land use planning and surface access policy;
- The Scottish Parliament has competence for planning in Scotland, and some powers in relation to aerodromes are also devolved to the Scottish Parliament; and
- The Northern Ireland Executive and Assembly have devolved powers relating to airports in terms of regional land use planning, surface access policy and funding,

[14] Planning Act 2008, section 104 – decisions in cases where an NPS has effect
[15] https://www.gov.uk/government/publications/guidance-on-the-pre-application-process-for-major-infrastructure-projects
[16] For the avoidance of doubt, references to matters which are "reserved" in this section refer to those matters of legislative responsibility reserved to the Westminster Parliament under the UK's devolution arrangements

and environmental policy. The Northern Ireland Executive also has responsibility for airport economic regulation, has powers over land in relation to aviation safety, has the ability to grant aid for airports infrastructure, and may exercise certain controls relating to the management of airports.

European Union

1.24 On 29 March 2017 the Government formally notified the European Council of its intention to withdraw from the European Union, as provided for under Article 50 of the Treaty on European Union. Until the UK has left the EU, it remains a full Member of the European Union and all the rights and obligations of EU membership remain in force. Therefore, for the time being, European Union legislation applies to the development of this policy and to decision making in relation to the preferred scheme.

1.25 The UK and EU negotiating teams reached agreement in March 2018 on the terms of a transition or implementation period that will start on 30 March 2019, when the UK formally ceases to be a member of the EU, and last until 31 December 2020. The agreed text states that “Union law shall be applicable to and in the United Kingdom during the transition period”. The limited exceptions to this are set out in the published text.

1.26 The Government has also introduced legislation to ensure that the UK exits the EU with maximum certainty and continuity. The EU Withdrawal Bill ends the supremacy of European Union (EU) law in UK law and converts EU law as it stands at the moment of exit into domestic law. The same rules and laws will apply on the day after exit as on the day before. It will then be for democratically elected representatives in the UK to decide on any changes to that law, after full scrutiny and proper debate.

Appraisal of Sustainability

1.27 An Appraisal of Sustainability is required by the Planning Act 2008 in relation to any NPS. An Appraisal of Sustainability, which describes the analysis of reasonable alternatives to the preferred scheme, has been carried out to inform the Airports NPS. The Appraisal of Sustainability informs the development of the Airports NPS by assessing the potential economic, social and environmental impacts of options to increase airport capacity.

1.28 The Appraisal of Sustainability also incorporates a strategic environmental assessment (pursuant to Directive 2001/42/EC as transposed by SI 2004/1633).[17] The Appraisal of Sustainability was published alongside the Airports NPS.

1.29 The overall conclusions of the Appraisal of Sustainability show that (provided any scheme remains within the parameters and boundaries in this policy), whilst there will be inevitable harm caused by a new Northwest Runway at Heathrow Airport in relation to some topics, the need for such a scheme, the obligation to mitigate such harm as far as possible, and the benefits that such a scheme will deliver, outweigh such harm. However, this is subject to the assessment of the effects of the preferred scheme, identification of suitable mitigation, and measures to secure and deliver the relevant mitigation.

[17] Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programmes on the environment

1.30 The preferred scheme has been subject to further refinement by Heathrow Airport since the conclusion of the work of the Airports Commission. These refinements were not captured within the Airports Commission's appraisals and are not expected to significantly alter the key appraisal findings. The Government expects any applicant to carry out a further and more detailed study, and to secure appropriate mitigation measures, ahead of seeking development consent.

Habitats Regulations Assessment

1.31 The Airports NPS has also been assessed under the Habitats and Wild Birds Directive and Regulations.[18] A Habitats Regulations Assessment has been undertaken at a strategic level, and was published alongside the Airports NPS.

1.32 The strategic level Habitats Regulations Assessment, conducted in accordance with the Conservation of Habitats and Species Regulations 2010,[19] concluded that the potential for the preferred scheme to have adverse effects on the integrity of European sites for the purposes of Article 6(3) of the Habitats Directive could not be ruled out. This is because more detailed project design information and detailed proposals for mitigation are not presently available and inherent uncertainties exist at this stage. The Airports NPS has thus been considered in accordance with Article 6(4) of the Habitats Directive. Consideration has been given to alternative solutions to the preferred scheme, and the conclusion has been reached that there are no alternatives that would deliver the objectives of the Airports NPS in relation to increasing airport capacity in the South East and maintaining the UK's hub status. In line with Article 6(4) of the Directive, the Government considers that meeting the overall needs case for increased capacity and maintaining the UK's hub status, as set out in chapter two, amount to imperative reasons of overriding public interest supporting its rationale for the designation of the Airports NPS. At detailed design stage, and in so far as it may be necessary, the matters set out in the Airports NPS will be relevant to determining whether there are alternative solutions and imperative reasons of overriding public interest, provided that the design remains consistent with the objectives of the Airports NPS.

1.33 Any development brought forward through an Airports NPS that was likely to have a significant effect on a European site, either alone or in combination with other plans or projects, would be subject to a project-level Habitats Regulations Assessment at the detailed design stage. If it could not be concluded that there would be no adverse effects on site integrity, the project would not receive development consent on this basis, unless (a) there were no alternative solutions, (b) there were imperative reasons of overriding public interest in support, and (c) the necessary compensatory measures to protect the site were secured.

Equality Assessment

1.34 The Airports NPS has been informed by an Equality Assessment, which was published alongside the Airports NPS.

1.35 Under the Equality Act 2010, public bodies have a statutory duty to ensure race, disability and equality are considered in the exercise of their functions. The Equality

[18] Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna; and Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds

[19] http://www.legislation.gov.uk/uksi/2010/490/contents/made Since the revised draft Airports National Policy Statement was published, the Conservation of Habitats and Species Regulations 2017 have come into force

Assessment considered the potential equalities implications of airport expansion, including the effect on persons or groups of persons who share certain characteristics protected by the Equality Act 2010. The Equality Assessment concludes that all of the shortlisted schemes will have effects on these groups, but that such effects can be managed and can ultimately be within appropriate limits. The Airports NPS requires that final impacts on affected groups should be the subject of a detailed review, carefully designed through engagement with the local community, and approved by the Secretary of State. It should be possible to fully or partially mitigate negative equalities impacts through good design, operations and mitigation plans.

Health Impact Analysis

1.36 The Airports NPS has been subject to a Health Impact Analysis, which was published alongside the Airports NPS.

1.37 The Health Impact Analysis identified impacts which would affect the population's health, including noise, air quality and socio-economic impacts. In order to be compliant with the Airports NPS, a further project level Health Impact Assessment is required. The application should include and propose health mitigation, which seeks to maximise the health benefits of the scheme and mitigate any negative health impacts.

Relationship between the Airports NPS and the Aviation Policy Framework

1.38 The Airports NPS sets out Government policy on expanding airport capacity in the South East of England, in particular by developing a Northwest Runway at Heathrow Airport. Any application for a new Northwest Runway development at Heathrow will be considered under the Airports NPS. Other Government policy on airport capacity has been set out in the Aviation Policy Framework, published in 2013.[20] The Airports NPS does not affect Government policy on wider aviation issues, for which the 2013 Aviation Policy Framework and any subsequent policy statements still apply.[21]

1.39 On 21 July 2017, the Government issued a call for evidence on a new Aviation Strategy.[22] Having analysed the responses, the Government has confirmed that it is supportive of airports beyond Heathrow making best use of their existing runways. However, we recognise that the development of airports can have positive and negative impacts, including on noise levels. We consider that any proposals should be judged on their individual merits by the relevant planning authority, taking careful account of all relevant considerations, particularly economic and environmental impacts.

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[20] https://www.gov.uk/government/publications/aviation-policy-framework

[21] This includes changes to the UK airspace policy published in the Government's response to the consultation, *UK Airspace policy: a framework for balanced decisions on the design and use of airspace*

[22] *Beyond the Horizon: The Future of Aviation* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/636625/aviation-strategy-call-for-evidence.pdf - see paragraphs 7.19 to 7.21

Development covered by the Airports NPS

1.40 The Airports NPS has effect in relation to the delivery of additional airport capacity through the provision of a Northwest Runway at Heathrow Airport. It also applies to proposals for new terminal capacity located between the new Northwest Runway and the existing Northern Runway at Heathrow Airport, as well as the reconfiguration of terminal facilities in the area between the two existing runways at Heathrow Airport. Each of these elements is also capable of constituting a nationally significant infrastructure project.

1.41 The Airports NPS does not have effect in relation to an application for development consent for an airport development not comprised in an application relating to the Heathrow Northwest Runway, and proposals for new terminal capacity located between the Northwest Runway at Heathrow Airport and the existing Northern Runway and reconfiguration of terminal facilities between the two existing runways at Heathrow Airport. Nevertheless, the Secretary of State considers that the contents of the Airports NPS will be both important and relevant considerations in the determination of such an application, particularly where it relates to London or the South East of England. Among the considerations that will be important and relevant are the findings in the Airports NPS as to the need for new airport capacity and that the preferred scheme is the most appropriate means of meeting that need.

1.42 As indicated in paragraph 1.39 above, airports wishing to make more intensive use of existing runways will still need to submit an application for planning permission or development consent to the relevant authority, which should be judged on the application's individual merits. However, in light of the findings of the Airports Commission on the need for more intensive use of existing infrastructure as described at paragraph 1.6 above, the Government accepts that it may well be possible for existing airports to demonstrate sufficient need for their proposals, additional to (or different from) the need which is met by the provision of a Northwest Runway at Heathrow. As indicated in paragraph 1.39 above, the Government's policy on this issue will continue to be considered in the context of developing a new Aviation Strategy.

2. The need for additional airport capacity

The importance of aviation to the UK economy

2.1 International connectivity, underpinned by strong airports and airlines, is important to the success of the UK economy. It is essential to allow domestic and foreign companies to access existing and new markets, and to help deliver trade and investment, linking us to valuable international markets and ensuring that the UK is open for business. It facilitates trade in goods and services, enables the movement of workers and tourists, and drives business innovation and investment, being particularly important for many of the fastest growing sectors of the economy.

2.2 International connectivity attracts businesses to cluster round airports, and helps to improve the productivity of the wider UK economy. Large and small UK businesses rely on air travel, while our airports are the primary gateway for vital time-sensitive freight services. Air travel also allows us ever greater freedom to travel and visit family and friends across the globe, and brings millions of people to the UK to do business or enjoy the best the country has to offer.

2.3 The UK benefits from a strong and substantially privatised airport sector, with a regulatory system that supports growth while ensuring the interests of passengers are at its heart. The Government believes that this is the right approach for the airport sector, but that Government has an important role to play in strategic decisions like planning future airport capacity.

2.4 The UK has the third largest aviation network in the world after the USA and China,[23] and London's airports serve more routes than any other European city.[24] The UK's airports handled over 268 million passengers in 2016, a 6.7% increase from the previous year.[25] The sector benefits the UK economy through its direct contribution to GDP and employment, and by facilitating trade and investment, manufacturing supply chains, skills development, and tourism.

2.5 In 2014 the UK aviation sector generated around £20 billion[26] of economic output, and directly employed around 230,000 workers,[27] supporting many more jobs indirectly. The UK has the second largest aircraft manufacturing industry in the world after the USA, and will benefit economically from growth in employment and exports from future aviation growth.[28] Air Passenger Duty remains an important contributor to Government revenue, raising over £3 billion in2015/16.[29] Heathrow Airport directly supports around 75,000 jobs on site.[30]

[23] *The Global Competitiveness Report 2014-2015*, World Economic Forum, 2015, based on available airline seat kilometres
[24] *Airports Commission: Final Report*, p55
[25] https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-Airport-data/Airport-data-2016/
[26] ONS, Input-Output Supply and Use tables, 2014
[27] ONS, Business Register and Employment Survey, 2014
[28] UK Aerospace Industry Survey, Aerospace, Defence, Security Trade Association, 2010
[29] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/691309/Feb18_Receipts_NS_Bulletin_Final.pdf
[30] https://www.heathrowexpansion.com/local-community/local-benefits/

2.6 Businesses from across the UK utilise our aviation network to access markets worldwide. The UK's strong services sector, which provides significant export earnings for the country, is particularly reliant on aviation. The sector includes, among others, financial services, insurance, creative industries, education, and health – all of which rely on face-to-face engagement with customers for success.

2.7 Air freight is also important to the UK economy. Although only a small proportion of UK trade by weight is carried by air, it is particularly important for supporting export-led growth in sectors where goods are of high value or time critical. Heathrow Airport is the UK's biggest freight port by value.[31] Over £178 billion of air freight was sent between UK and non-European Union countries in 2016, representing over 45% of the UK's extra-European Union trade by value.[32] This is especially important in the advanced manufacturing sector, where air freight is a key element of the time-critical supply chain. By 2030, advanced manufacturing industries such as pharmaceuticals or chemicals, whose components and products are predominantly moved by air, are expected to be among the top five UK export markets by their share of value.[33] In the future, UK manufacturing competitiveness and a successful and diverse UK economy will drive the need for quicker air freight.

2.8 Aviation also brings many wider benefits to society and individuals, including travel for leisure and visiting family and friends. This drives further economic activity. In 2013, for example, the direct gross value added of the tourism sector, one of the important beneficiaries of a strong UK aviation sector, was £59 billion.[34] Likewise, 2015 saw the value of inbound tourism rise to over £22 billion,[35] with the wider UK tourism industry forecast to grow significantly over the coming decades.

2.9 The importance of aviation to the UK economy, and in particular the UK's hub status, has only increased following the country's decision to leave the European Union. As the UK develops its new trading relationships with the rest of the world, it will be essential that increased airport capacity is delivered, in particular to support development of long haul routes to and from the UK, especially to emerging and developing economies.

The need for new airport capacity

2.10 However, challenges exist in the UK's aviation sector, stemming in particular from capacity constraints. These constraints are affecting our ability to travel conveniently and to a broader range of destinations than in the past. They create negative impacts on the UK through increased risk of flight delays and unreliability, restricted scope for competition and lower fares, declining domestic connectivity, erosion of the UK's hub status[36] relative to foreign competitors, and constraining the scope of the aviation sector to deliver wider economic benefits.

2.11 The UK now faces a significant capacity challenge. Heathrow Airport is currently the busiest two-runway airport in the world, while Gatwick Airport is the busiest single runway airport in the world. London's airports are filling up fast, and will all be full by the mid-2030s if we do not take action now.[37]

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[31] https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx
[32] https://www.uktradeinfo.com/Statistics/Pages/Statistics.aspx
[33] HSBC Trade Forecast Tool, Accessed 2015
[34] Estimates of the Economic Importance of Tourism 2008-2013, Office for National Statistics, December 2014
[35] https://www.visitbritain.org/2015-snapshot. This figure represents tourism by all modes of transport. The equivalent figure for inbound tourists by air is £19 billion in 2015
[36] Defined as the frequency of flights and the density of a route network
[37] *Updated Appraisal Report*, p11

2.12 Aviation demand is likely to increase significantly between now and 2050.[38] All major airports in the South East of England[39] are expected to be full by the mid-2030s, with four out of five full by the mid-2020s. By 2050 demand at these airports is expected to outstrip capacity by at least 34%, even on the department's low demand forecast.[40] There is relatively little scope to redistribute demand away from the region to less heavily utilised capacity elsewhere in the country.[41]

2.13 The UK's hub status, stemming from the convenience and variety of its direct connections across the world, is already being challenged by restricted connectivity.[42] Hub airports at Paris, Frankfurt and Amsterdam have spare capacity and are able to attract new flights to growth markets in China and South America.[43] These competitors have benefited from the capacity constraints at Heathrow Airport, and have seen faster growth over the past few years. The UK's airports also face growing competition from hubs in the Middle East like Dubai, Abu Dhabi, Doha and Istanbul. Heathrow Airport was overtaken by Dubai in 2015 as the world's busiest international passenger airport.[44]

2.14 The consequences of not increasing airport capacity in the South East of England – the 'do nothing' or 'do minimum scenarios' – are detrimental to the UK economy and the UK's hub status. International connectivity will be restricted as capacity restrictions mean airlines prioritise their routes, seeking to maximise their profits. Capacity constraints therefore lead to trade-offs in destinations, and while there is scope to respond to changing demand patterns, this necessarily comes at the expense of other connections. Domestic connectivity into the largest London airports will also decline as competition for slots encourages airlines to prioritise more profitable routes.

2.15 Operating existing capacity at its limits means there will be little resilience to unforeseen disruptions, leading to delays. Fares are likely to rise as demand outstrips supply, and the lack of available slots makes it more difficult for new competitors to enter the market.

2.16 The Government believes that not increasing capacity will impose costs on passengers and on the wider economy. The Airports Commission estimated that direct negative impacts to passengers, such as fare increases and delays, would range from £21 billion to £23 billion over 60 years.[45] Without expansion, capacity constraints would impose increasing costs on the rest of the economy over time, lowering economic output by making aviation more expensive and less convenient to use, with knock-on effects in lost trade, tourism and foreign direct investment.

2.17 It is very challenging to put a precise figure on these impacts, but using alternative approaches the Airports Commission estimated these costs to be between £30 billion and £45 billion over 60 years.[46] The Airports Commission urged caution interpreting these figures, which overlap with the direct passenger costs reported above and so are not wholly additional. But they do illustrate that not increasing airport capacity carries real economic costs to the whole economy beyond aviation passengers. Having reviewed this further, the Government accepts this analysis and considers that

[38] *Updated Appraisal Report*, p8
[39] Defined as Gatwick, Heathrow, London City, Luton and Stansted
[40] *Updated Appraisal Report*, p11
[41] *Airports Commission: Interim Report*, pp117-126
[42] For more analysis on the UK's hub status, see *Airports Commission: Interim Report*, pp90-92
[43] *Airports Commission: Final Report*, p249
[44] http://www.aci.aero/News/Releases/Most-Recent/2016/09/09/Airports-Council-International-releases-2015-World-Airport-Traffic-Report-The-busiest-become-busier-the-year-of-the-international-hub-airport
[45] *Airports Commission: Final Report*, p81; present value over 60 years
[46] *Airports Commission: Final Report*, p81

recent demand growth in the South East suggests an even greater possible cost if expansion is not undertaken.[47]

2.18 The Government also acknowledges the local and national environmental impacts of airports and aviation, for example noise and emissions, and believes that capacity expansion should take place in a way that satisfactorily mitigates these impacts wherever possible. Expansion must be deliverable within national targets on greenhouse gas emissions and in accordance with legal obligations on air quality.

The Airports Commission

2.19 To address these issues, in September 2012, the Coalition Government established the independent Airports Commission, led by Sir Howard Davies. The Airports Commission had two objectives:

- To produce an Interim Report, setting out the nature, scale and timing of steps needed to maintain the UK's global hub status alongside recommendations for making better use of the UK's existing runway capacity over the next five years; and
- To produce a Final Report, setting out recommendations on how to meet any need for additional airport capacity in the longer term.[48]

2.20 The Airports Commission was asked to take appropriate account of the national, regional and local implications of any expansion. As well as seven discussion papers and an appraisal framework, the Airports Commission delivered its recommendations to Government in its Interim Report in December 2013 and its Final Report in July 2015. It also published a summary and decision paper in September 2014 on whether to add an inner Thames Estuary airport proposal to a shortlist for further appraisal.[49]

Alternatives to additional runway capacity

2.21 The Airports Commission explored potential alternatives to additional runway capacity, which included:

- Doing nothing;
- A 'do minimum' set of alternatives with very limited provision for additional capacity;
- Redistribution methods, for example changing the rate of Air Passenger Duty, changing slot allocation regimes, traffic distribution rules, and prohibiting certain types of flights;
- Investment in high speed rail and improved surface access options; and
- New technologies.[50]

2.22 The Airports Commission found that none of these options delivered a sufficient increase in capacity, and that many required investment far in excess of the cost of runway expansion. However, the Airports Commission did note that the need to make best use of existing infrastructure would remain.[51]

[47] *Updated Appraisal Report*, p11
[48] https://www.gov.uk/government/organisations/airports-commission/about/terms-of-reference
[49] https://www.gov.uk/government/publications/inner-thames-estuary-airport-summary-and-decision
[50] *Airports Commission: Final Report*, p84
[51] *Airports Commission: Final Report*, paragraph 16.1 and 16.40

The Airports Commission's shortlisting process

2.23 The Airports Commission consulted widely on its appraisal framework, which contained its criteria for sifting proposed schemes,[52] and the Government is satisfied that the appraisal framework was appropriate. The Airports Commission received 52 proposals, with three options developed by the Airports Commission itself. The Airports Commission took advice from a number of relevant stakeholders, including NATS Holdings, the Civil Aviation Authority, Network Rail, and the Highways Agency (as it then was). The Government believes that the Airports Commission has analysed all the options put forward to the appropriate degree of detail, and discounted non-shortlisted schemes fairly and objectively according to the sift criteria. The Government does not consider that any of the non-shortlisted schemes represents a reasonable alternative to its preferred scheme.

2.24 The three shortlisted schemes were:

- Gatwick Second Runway scheme;
- Heathrow Northwest Runway scheme (which the Airports Commission recommended and is the Government's preferred scheme); and
- Heathrow Extended Northern Runway scheme.

2.25 The Government has made clear in its announcement of 14 December 2015 that it agrees with the Airports Commission's three shortlisted schemes for expansion, and has taken forward its further work on this basis. As set out at paragraph 1.40 of this document, the Airports NPS will only have effect in relation to a scheme located at Heathrow Airport for the provision of a Northwest Runway, and not the other shortlisted schemes.

The Airports Commission's conclusions

2.26 In its Interim Report in December 2013,[53] the Airports Commission concluded that there was a need for one additional runway to be in operation in the South East of England by 2030. It also set in train a period of further consultation on three shortlisted schemes (Gatwick Second Runway scheme, Heathrow Northwest Runway scheme, and Heathrow Extended Northern Runway scheme), as well as the option of a new airport in the inner Thames Estuary. In September 2014, the Airports Commission concluded that a new airport in the inner Thames Estuary did not perform sufficiently well to warrant consideration alongside the three schemes that it decided to shortlist.

2.27 In its Final Report in July 2015, the Airports Commission concluded that the proposed Northwest Runway at Heathrow Airport presented the strongest case for expansion and would offer the greatest strategic and economic benefits to the UK. A copy of the illustrative Heathrow Northwest Runway scheme masterplan is included at Annex B. The Airports Commission also made clear that expansion would have to involve a significant package of supporting measures to address the environmental and community impacts of the new runway.

2.28 The Commission's remit also required it to look at how to make best use of existing airport infrastructure, before new capacity becomes operational.[54] The Commission noted in its final report that a new runway will not open for at least 10 years. It

[52] https://www.gov.uk/government/publications/sift-criteria-for-long-term-capacity-options-at-uk-airports
[53] *Airports Commission: Interim Report*, p11
[54] *Airports Commission: Interim Report*, paragraph 5.2

therefore considered it imperative that the UK continues to grow its domestic and international connectivity in this period, which it considered would require more intensive use of existing airports other than Heathrow and Gatwick.[55]

The Government's work

2.29 The Government has reviewed the Airports Commission's work and the representations Government has received on the issue of airport capacity, and is confident that the Airports Commission's arguments and reasoning are clear and thorough.

2.30 The Airports Commission undertook an extensive appraisal over two and a half years, consulting widely and analysing all the evidence before making its final recommendations. Since then, the Government has reviewed the Airports Commission's work and concluded that its evidence base on the case for expansion and its use of this evidence are both sound.[56] This has given the Government the assurance required to use the evidence to inform its further work, which is set out in more detail later. The Government has therefore considered the Airports Commission data in great depth and also carried out its own further work, all of which informs the Airports NPS.

2.31 In coming to these decisions, the Government has fully considered the Airports Commission's Interim and Final Reports, as well as the inner Thames Estuary summary and decision paper. The Government also received a range of information from a variety of stakeholders in response to those reports, which was taken into account by the Government in reaching its preference.

2.32 Having reviewed the work of the Airports Commission and considered the evidence put forward on the issue of airport capacity, the Government believes that there is clear and strong evidence that there is a need to increase capacity in the South East of England by 2030 by constructing one new runway. The Government also agrees with the Airports Commission that this can be delivered within the UK's obligations under the Climate Change Act 2008.[57] The Government considers that following the country's decision to leave the European Union the country will increasingly look beyond Europe to the rest of the world, and so the importance of maintaining the UK's hub status, and in that context long haul connectivity in particular, has only increased.

2.33 The next chapter of the Airports NPS sets out how the Government has identified the most effective and appropriate way to address the overall need for increased airport capacity, and maintain the UK's hub status, while meeting air quality and carbon obligations and identifies that the Northwest Runway at Heathrow is the Government's preferred scheme.

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[55] *Airports Commission: Final Report*, paragraph 16.40
[56] https://www.gov.uk/government/publications/airport-expansion-further-review-and-sensitivities-report
[57] https://www.gov.uk/government/publications/airport-expansion-dft-review-of-the-airports-commissions-final-report *Review of the Airports Commission Final Report*, p19

3. The Government's preferred scheme: Heathrow Northwest Runway

Overview

3.1 While the previous chapter of the Airports NPS sets out the Government's underlying policy and evidence on the need to expand airport capacity in the South East of England, this chapter sets out why the Government has stated its preference for the Heathrow Northwest Runway scheme.

3.2 As set out in the previous chapter, the Airports Commission undertook a detailed shortlisting process, which resulted in three shortlisted schemes being considered by the Government for additional airport capacity:

- Gatwick Second Runway scheme;
- Heathrow Northwest Runway scheme (which the Airports Commission recommended and is the Government's preferred scheme);
- Heathrow Extended Northern Runway scheme.

3.3 The Government accepted the Airports Commission's three shortlisted schemes on 14 December 2015, agreeing with the Airports Commission's conclusion that one new runway in the South East of England by 2030 would be required to meet the need for additional capacity.

3.4 Following the publication of the Airports Commission's Final Report, the Government undertook further work on:

- Air quality;
- Noise;
- Carbon emissions; and
- Impacts on local communities.

3.5 The Government has carried out additional sensitivities, which show the worst case scenarios on noise, carbon and the economy, within the Appraisal of Sustainability.

3.6 The work on air quality, which demonstrated that expansion (with mitigation) is capable of taking place within legal limits, is outlined in the Government's air quality re-analysis[58] and the Appraisal of Sustainability. Both documents contain a worst case scenario.

3.7 The Government agrees with the Airports Commission's assessment that a new runway is deliverable within the UK's climate change obligations.[59]

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[58] https://www.gov.uk/government/publications/airport-expansion-further-updated-air-quality-re-analysis

[59] https://www.gov.uk/government/publications/airport-expansion-dft-review-of-the-airports-commissions-final-report *Review of the Airports Commission Final Report*, p19

3.8 Following engagement with all three shortlisted scheme promoters, the Government has recommended a package of community supporting measures.

3.9 The Government also carried out additional work in relation to surface access, and further economic analysis. This work has allowed the Government to consider carefully the effectiveness of each of the three schemes to meet the need for additional capacity.

3.10 The detailed results of this work can be found in a number of reports published by the Government on 25 October 2016:

- A formal review by the Department for Transport of the Airports Commission's Final Report;[60]
- An air quality re-analysis to test the Airports Commission's work against the Government's air quality plan;[61]
- A further review of the Airports Commission's analytical approach, providing greater assurance in those areas where needed;[62]
- A comparison of the originally shortlisted schemes' compensation packages against other expansion projects around the world;[63]
- An assurance report by Highways England on the schemes' road surface access proposals;[64] and
- A non-binding statement of principles between Heathrow Airport and the Secretary of State for Transport on the Heathrow Northwest Runway scheme.[65]

3.11 On 25 October 2016, the Government announced that its preferred scheme to meet the need for new airport capacity in the South East of England was a Northwest Runway at Heathrow Airport.[66] It also confirmed that this would be included in a draft Airports NPS, which would be subject to consultation in accordance with the procedures laid down in the Planning Act 2008.

3.12 The draft Airports NPS and supporting Appraisal of Sustainability were published on 2 February 2017 and a 16 week public consultation was launched. On publishing the draft Airports NPS, the Government made a commitment to continue updating its evidence base on airport capacity, including revised passenger demand forecasts and the impact of the publication of the final Air Quality Plan (the UK plan for tackling roadside nitrogen dioxide concentrations). On 24 October 2017, the Government published and conducted an 8 week public consultation on a revised draft Airports NPS and other documents which were published alongside it. The revisions were made on the basis of changes to the evidence base and as a result of initial consideration of the responses to the February consultation and other broader government policy changes. Having considered the responses to both the February and October consultations, and the report published by the Transport Committee on 23 March 2018, the Government has made some further changes, principally to provide greater clarity and reflect updates to wider Government policies. The Government believes that the Heathrow Northwest Runway scheme, of all the three shortlisted schemes, is the most effective and most appropriate way of meeting the

[60] https://www.gov.uk/government/publications/airport-expansion-dft-review-of-the-airports-commissions-final-report
[61] https://www.gov.uk/government/publications/airport-expansion-further-analysis-of-air-quality-data
[62] https://www.gov.uk/government/publications/airport-expansion-further-review-and-sensitivities-report
[63] https://www.gov.uk/government/publications/airport-expansion-global-comparison-of-airport-mitigation-measures
[64] https://www.gov.uk/government/publications/airport-expansion-highways-england-assurance-report
[65] https://www.gov.uk/government/publications/heathrow-airport-limited-statement-of-principles
[66] https://www.gov.uk/government/speeches/airport-capacity

needs case set out in chapter 2. As such, the Government has also concluded that the other shortlisted schemes do not represent true alternatives to the preferred scheme.

3.13 The remainder of this chapter is broken down into two distinct sections. The first section focuses on why the Government prefers the Heathrow Northwest Runway Scheme to the Gatwick Second Runway scheme in terms of delivering additional airport capacity by 2030. The second section focuses on why the Government prefers the Heathrow Northwest Runway scheme to the Heathrow Extended Northern Runway scheme.

3.14 Increasing airport capacity in the South East of England and maintaining the UK's hub status can be expected to result in both positive and negative impacts, as would be the case for any major infrastructure project. Important positive impacts are expected to include better international connectivity and providing benefits to passengers and the UK economy as a whole (for example for the freight industry). The negative impacts are expected to include environmental impacts, for example on air quality and affected local communities.

3.15 In its considerations on a preferred scheme, the Government has fully taken into account the work of the Airports Commission, information provided by a variety of stakeholders, and the results of the Government's further work outlined in paragraphs 3.4-3.10 above. As set out below, the Government has considered the positive and negative effects from each of the three shortlisted schemes, and reached its conclusion by weighing these expected effects, along with considering how positive effects can be enhanced and negative effects mitigated.

Heathrow Northwest Runway and Gatwick Second Runway

3.16 In identifying the preferred scheme, a wide range of factors has been taken into account, including:

- International connectivity and strategic benefits;
- Passenger and wider economic benefits;
- Domestic connectivity and regional impacts;
- Surface access links;
- Views of airlines, regional airports and the business community;
- Financeability;
- Deliverability; and
- Local environmental impacts.

3.17 While the Government acknowledges the differences between the three shortlisted schemes, carbon impacts (unlike the factors above) have not been considered as a differentiating factor between schemes due to the Airports Commission's overarching assessment that all three are deliverable within the UK's climate change obligations.

International connectivity and strategic benefits, including freight

3.18 Heathrow Airport is best placed to address this need by providing the biggest boost to the UK's international connectivity. Heathrow Airport is one of the world's major hub airports, serving around 180 destinations worldwide with at least a weekly service, including a diverse network of onward flights across the UK and Europe.[67] Building on this base, expansion at Heathrow Airport will mean it will continue to attract a growing number of transfer passengers, providing the added demand to make more routes viable. In particular, this is expected to lead to more long haul flights and connections to fast-growing economies, helping to secure the UK's status as a global aviation hub, and enabling it to play a crucial role in the global economy.

3.19 By contrast, expansion at Gatwick Airport would not enhance, and would consequently threaten, the UK's global aviation hub status. Gatwick Airport would largely remain a point to point airport, attracting very few transfer passengers. Heathrow Airport would continue to be constrained, outcompeted by competitor hubs which lure away transfer passengers, further weakening the range and frequency of viable routes. At the UK level, there would be significantly fewer long haul flights in comparison to the preferred scheme, with long haul destinations served less frequently. Expansion at Heathrow Airport is the better option to ensure the number of services on existing routes increases and allows airlines to offer more frequent new routes to vital emerging markets.

3.20 This was demonstrated by the forecasts produced by the Airports Commission, and continues to be found in the department's 2017 forecasts.[68] Compared to no expansion, the Government estimate that a Northwest Runway at Heathrow Airport by 2040 would result in 113,000 additional flights a year across the UK as a whole (including 43,000 long haul), and 28 million additional passengers a year. By way of comparison, the Heathrow Extended Northern Runway would add 85,000 more flights and 22 million additional passengers.[69] [70]

3.21 Compared to no expansion, the Second Runway scheme at Gatwick would add 15,000 flights and 10 million passengers by 2040, across the UK as a whole, increasing to 77,000 and 23 million respectively in 2050. The Government project that 8,000 of these additional flights would be long haul in 2040, rising to 17,000 in 2050.[71] Gatwick Airport has recently been successful in securing a number of long haul routes to the USA and Canada from low cost carriers, a new market segment.

3.22 As set out above, the ease with which businesses can move staff around the globe is an important facilitator of trade and for businesses locating and remaining in the UK. The broader range and greater frequency of long haul flights at Heathrow Airport best meets this need. It would deliver benefits for UK passengers (both business and leisure) by allowing them to travel to more destinations flexibly. These benefits include the additional frequency of flights, for example connecting the UK to long haul destinations daily instead of weekly, or several times a day instead of daily. Businesses from across the UK currently take advantage of Heathrow Airport's international connections, and will continue to benefit from these following expansion. In particular, the additional capacity delivered at Heathrow Airport will support growth

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[67] CAA, 2016

[68] An important uncertainty to the central estimates concerns the forecasts of future aviation demand and allocation across UK airports. The Airports Commission reflected this uncertainty using five demand scenarios, as well as two carbon policy regimes. The Department for Transport has further considered uncertainty through the use of low, central and high demand scenarios. Further uncertainty arises from the choice of individual modelling assumptions. More information on the Airports Commission's scenarios and sensitivity analysis, can be found in the *Further Review and Sensitivities Report.* More information on the department's 2017 scenarios and sensitivity analysis can be found in the Updated Appraisal Report

[69] *Updated Appraisal Report,* p14 and 17.This number includes all point to point and transfer passengers at UK airports, and refers to terminal passengers who are counted each time they land or take off at a UK airport. Further disaggregation is provided in the Updated Appraisal Report

[70] Due to the expected use of larger planes with higher load factors, the department's 2017 forecasts find smaller increases in ATMs are needed to deliver similar increases in passenger numbers. This is particularly evident for Gatwick, where load factors have increased notably over the past few years. Further information is provided in the Updated Appraisal Report

[71] *Updated Appraisal Report,* p 14 and 17

in important sectors of the UK economy, including tourism, financial services, and the creative industries.

3.23 The aviation sector can also boost the wider economy by providing more opportunities for trade through air freight. The time-sensitive air freight industry, and those industries that use air freight, benefit from greater quantity and frequency of services, especially long haul. By providing more space for cargo, lowering costs, and by the greater frequency of services, this should in turn provide a boost to trade and GDP benefits.[72]

3.24 As set out above, expansion at Heathrow Airport delivers the biggest boost in long haul flights, and the greatest benefit therefore to air freight. This is further facilitated by the existing and proposed airport development of freight facilities as part of the Northwest Runway scheme. Heathrow Airport currently has a substantial freight handling operation, around 20 times larger by tonnage[73] than that at Gatwick Airport, and accounting for 34% of the UK's non-European Union trade by value – around 170 times more than Gatwick Airport.[74] Expansion at Heathrow Airport will further strengthen the connections of firms from across the UK to international markets.

Passenger and wider economic benefits

3.25 Without expansion, passengers and other users of airports are likely to suffer from higher fares and more delays. High demand for air travel at airports with limited or no scope for increased capacity could weaken competition, allowing airlines to charge higher fares. As airports fill up and operate at full capacity, there is little resilience to deal with any disruption, leading to delays.

3.26 Expansion via the Heathrow Northwest Runway scheme is best placed to address this need. Heathrow Airport is currently the busiest two runway airport in the world, already operating at full capacity, with substantial pent up demand from passengers and airlines. Expansion at Heathrow Airport would increase the availability of services, and increase competition between airlines. This would lower fares that passengers can expect to face relative to no expansion, leading to significant benefits to business and leisure passengers and the wider economy. Crucially, the extent of the pent up demand at Heathrow Airport means that these benefits will be experienced more rapidly once the new capacity is operational, with both Heathrow schemes providing more passenger benefits by 2050 than the Gatwick Second Runway scheme, and with total benefits (not including wider trade benefits) of up to £74 billion over 60 years for the Northwest Runway scheme.[75] [76] These benefits are expected to be realised by passengers across the UK as they make use of the additional services provided by the expanded airport. Cumulative benefits delivered by a Northwest Runway scheme remain highest throughout most of the appraisal period, until the mid-2070s, although total benefits are slightly lower than would be delivered by Gatwick expansion over the full 60 year assessment.[77]

3.27 The Government also recognises the role airports can play in supporting wider economic growth in the local community. Expansion at Heathrow Airport is expected to result in larger benefits to the wider economy than expansion at Gatwick Airport. These additional benefits come from workers moving to more productive jobs around the expanded airport as well as the productivity benefits from firms who will enjoy lower aviation transport costs. Heathrow Airport already has a more developed cluster

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[72] *Updated Appraisal Report*, p16
[73] https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-airport-data/Airport-data-2016/
[74] HMRC, 2016, https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx
[75] For clarity of presentation, only the central demand scenario estimate is presented here. This value is the same for the department's carbon-traded and carbon-capped scenarios – see the Updated Appraisal Report for further details
[76] This includes passenger benefits to UK residents, non-UK residents and international-to-international interliners
[77] *Updated Appraisal Report*, p45

of businesses in its surrounding area, which should enable an even larger economic boost from expansion in the local economy.[78]

3.28 Expansion via the Heathrow Northwest Runway scheme should deliver additional jobs at the airport, through its supply chain and in the local community. The Heathrow Northwest Runway scheme is expected to generate up to 114,000 additional jobs in the local area by 2030,[79] with Heathrow Airport also pledging to provide 5,000 additional apprenticeships by this time. The number of local jobs created at an expanded Heathrow Airport is predicted to be much greater than at Gatwick Airport (up to 21,000 by 2030 and 60,000 by 2050),[80] and the jobs would also be created more quickly. The numbers are higher at Heathrow Airport because the additional capacity is forecast to be used more quickly following expansion and, importantly, because the types of services offered at an expanded Heathrow Airport are likely to be more complex, particularly with the greater number of full service airlines operating there.

3.29 Expansion brings a wide set of non-monetised benefits such as local job creation, trade, and freight benefits, which indicate a stronger case for a Heathrow scheme than for the Gatwick Second Runway scheme.[81]

Domestic connectivity

3.30 The Government recognises the importance that the nations and regions of the UK attach to domestic connectivity, particularly connections into Heathrow Airport. Airports across the UK provide a vital contribution to the economic wellbeing of the whole of the UK. Without expansion, there is a risk that, as airlines react to limited capacity, they could prioritise routes away from domestic connections. The Government therefore sees expansion at Heathrow Airport as an opportunity to not only protect and strengthen the frequency of existing domestic routes, but to secure new domestic routes to the benefit of passengers and businesses across the UK.

3.31 Passengers from across the UK are likely to benefit from the improved international connectivity provided by expansion. In 2040, 5.9 million additional passengers from outside of London and the South East are forecast to make one way international journeys[82] from Heathrow Airport. Under a Gatwick Second Runway scheme, 3.8 million additional passengers from outside London and the South East would be forecast to make one way international journeys from Gatwick Airport in 2040. By way of comparison, under a Heathrow Extended Northern Runway scheme, 4.6 million additional passengers from outside London and the South East would be forecast to make one way international journeys from Heathrow Airport in 2040. While expansion will also see some displacement of passengers from regional airports to the London system, overall regional airports are expected to continue displaying strong growth in passenger numbers by 2050.[83]

3.32 An expanded Heathrow Airport should therefore mean that more passengers from across the UK are likely to benefit from lower fares and access to important international markets from the airport.

3.33 The Government expects to see expansion at Heathrow Airport driving an increase in the number of UK airports with connections specifically into the airport. Heathrow

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[78] *Updated Appraisal Report*, p27
[79] *Updated Appraisal Report*, p29
[80] *Ibid*.
[81] *Updated Appraisal Report*, p42
[82] Defined as any passenger who travels to (or from) an international destination from a region outside of London and the South East, and uses the expanded airport as part of this journey. A one-way journey is counted as either an outbound or an inbound journey. Return passengers are therefore counted twice.
[83] *Updated Appraisal Report*, p20

Airport and Gatwick Airport set out plans on domestic connectivity which they say they could deliver by 2030:

- at least 14 domestic routes for Heathrow Airport, compared to the eight routes currently in operation; and
- at least 12 domestic routes for Gatwick Airport, compared to the six currently offered.[84]

The following table provides examples of potential domestic routes:[85]

Heathrow Airport under expansion in 2030[86]	Gatwick Airport under expansion in 2030
8 domestic routes operating today (Aberdeen, Belfast City, Edinburgh, Glasgow, Inverness, Leeds Bradford, Manchester, Newcastle) **plus** Belfast International, Durham Tees Valley, Humberside, Liverpool, Newquay, Prestwick **Total: 14**	**6 domestic routes operating today** (Aberdeen, Belfast International, Edinburgh, Glasgow, Inverness, Newquay) **plus** Belfast City, Derry-Londonderry, Dundee, Leeds Bradford, Manchester, Newcastle **Total: 12**

Government expectation on domestic connectivity

3.34 The Government recognises that air routes are in the first instance a commercial decision for airlines and are not in the gift of an airport operator. But the Government is determined that new routes will be secured, and will hold Heathrow Airport to account on this. The Government requires Heathrow Airport to demonstrate it has worked constructively with its airline customers to protect and strengthen existing domestic routes, and to develop new domestic connections, including to regions currently unserved.

Surface access links

3.35 To realise the benefits of expansion, passengers and users must have good access to the airport. On this basis Heathrow Airport has the advantage, because of its more accessible location and more varied surface access links.

3.36 Heathrow Airport already has good surface transport links to the rest of the UK. It enjoys road links via the M25, M4, M40 and M3, and rail links via the London Underground Piccadilly Line, Heathrow Connect, and Heathrow Express. In the future, it will connect to Crossrail, and link to HS2 at Old Oak Common. Plans are being developed for improved rail access: the proposed Western Rail Access could link the airport to the Great Western Main Line, and Southern Rail Access could join routes to the South Western Railway network and London Waterloo Station. This varied choice of road and rail connections makes Heathrow Airport accessible to both passengers

[84] The DfT 2017 aviation forecasts do not take account of the ability of airport levers to strengthen specific routes. Domestic routes proposed by promoters are therefore not included in the updated forecasts

[85] Table excludes UK Crown Dependencies

[86] Taken from promoter plans for domestic connections at Heathrow Airport and Gatwick Airport, compared to existing domestic connections at both airports. The Government would expect Heathrow Airport's plan to be broadly equivalent for the Extended Northern Runway proposal if it was taken forward

and freight operators in much of the UK, and provides significant resilience to any disruption.

3.37 Access to Gatwick relies on the M23 and the Brighton Main Line, which means it serves London well but makes it less convenient for onward travel to the rest of the UK. It is also less resilient than Heathrow Airport. Heathrow Airport has advantages over Gatwick Airport with its greater integration into the national transport network, benefitting both passengers and freight operators. It also currently has significantly larger freight operations than Gatwick Airport, around 20 times larger in terms of total tonnage[87] and around 170 times larger in terms of value.[88]

3.38 The airport scheme promoters have pledged to meet the cost of surface access schemes required to enable a runway to open. For Gatwick Airport, this covers the full cost of the works (including the M23 and A23) needed to support expansion. The two Heathrow schemes would pay for the full cost of M25, A4 and A3044 works, as well as other local road works. They would make a contribution towards the cost of the proposed Western Rail Access and Southern Rail Access schemes. Improvements which are already underway, such as Thameslink and Crossrail, will be completed, and the Government has not assumed any change to these schemes' existing funding.

3.39 The majority of the surface access costs where a split of beneficiaries is expected (for example, where multiple businesses and the public at large benefit from a new road junction or rail scheme) are likely to be borne by Government, where the schemes provide greater benefits for non-airport users. The airport contribution would be subject to a negotiation, and review by regulators.

3.40 Because of the early stages of development, there is some variability of surface access costs, which are subject to more detailed development and, for example, choices over precise routes. The additional public expenditure effects of the options would likely be as follows:

- For both Heathrow proposals, there is no Government road spend directly linked to expansion; the promoter would pay for changes to the M25, A4 and A3044 and any local roads. The Western and Southern Rail schemes are at different levels of development and the cost estimates will change as these schemes are developed. The Government would expect the costs of the schemes to be partly offset by airport contributions, which would be negotiated when the schemes reach an appropriate level of development.
- For the Gatwick proposal, there would be no additional public expenditure solely because of expansion, as all road enhancement costs for airport expansion would be met by the scheme promoter. The Government has assumed that any improvements to the Brighton Main Line that may be required would take place regardless of expansion and would be publicly funded.

Views and support of airlines, regional airports and the business community

3.41 The benefits of expansion will be delivered only if airlines and the industry choose to use the new capacity, and pay for it via airport charges. There is much greater airline support for expansion via the Heathrow Northwest Runway scheme than the other two schemes, subject to various concerns being met, for example on costs.

3.42 The majority of regional airports who have stated a public preference support expanding Heathrow Airport, on the basis of its current status as the UK's hub (though

[87] https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-airport-data/Airport-data-2016/
[88] https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx

Birmingham Airport has supported expansion at Gatwick Airport). This support is driven by airports' considerations on connectivity and other commercial issues.

3.43 Expansion is critical for business confidence in the UK. The Heathrow Northwest Runway scheme has strong support from the wider business community across the whole of the UK, including from the Confederation of British Industry,[89] the British Chambers of Commerce,[90] the Federation of Small Businesses,[91] the manufacturers' organisation EEF,[92] and regional business groups across the UK. 61% of the directors asked by the Institute of Directors stated that their preference was for expansion at Heathrow Airport, compared to 39% who favoured expansion at Gatwick Airport.[93]

Financeability

3.44 While the Gatwick Second Runway scheme would be significantly cheaper than the two schemes at Heathrow, with the Heathrow Northwest Runway the most expensive of the three shortlisted schemes, all three are private sector schemes which the Government believes could be financeable without Government support.[94]

3.45 The level of debt and equity required for the Gatwick Second Runway scheme would be significantly lower than for the Heathrow schemes, but the Airports Commission noted that the Gatwick Second Runway scheme would have comparatively higher demand risk, which is harder for Government to mitigate compared to the Heathrow schemes.[95] Both Heathrow schemes build on a strong track record of proven demand that has proven resistant to economic downturns. Independent financial advisers have undertaken further work for the Government, and agree that all three schemes are financeable without Government support.

Deliverability and safety

3.46 The three shortlisted schemes involve different levels of delivery risk. Gatwick Airport said its Second Runway scheme is capable of being delivered by 2025, while Heathrow Airport said its Northwest Runway scheme is capable of being delivered by 2026. The Gatwick Second Runway scheme would be much simpler to build. The process for delivering powers for the Heathrow schemes will be more complex because the schemes themselves are more complex. The delivery dates for both Heathrow schemes are therefore likely to be more risky than that for the scheme at Gatwick.

3.47 The Airports Commission worked with the Civil Aviation Authority and NATS Holdings to review the operational and airspace implications of all three shortlisted schemes, including conducting fast-time simulation modelling of the proposed airspace routes. This work concluded that, while safely managing the expected increase in air traffic for any scheme will be challenging, it should nevertheless be achievable given modernisation of airspace in the South East of England and taking advantage of new technologies – changes which will be necessary with or without expansion.

3.48 The Airports Commission also asked the Health and Safety Laboratory (HSL) to review the scale of increase in crash risk associated with each of the schemes. This review considered two risks: the background risk, which accounts for aircraft cruising in UK airspace, and an airfield crash rate, relating to aircraft taking off and landing at a

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[89] http://mediacentre.heathrow.com/pressrelease/details/81/Expansion-News-23/4789
[90] http://www.britishchambers.org.uk/press-office/press-releases/bcc-while-britain-dithers-on-aviation,-others-do.html
[91] https://www.fsb.org.uk/media-centre/press-releases/heathrow-s-third-runway-sends-clear-signal-britain-is-open-for-business
[92] https://www.eef.org.uk/about-eef/media-news-and-insights/media-releases/2016/oct/eef-comment-on-heathrow-expansion
[93] https://www.iod.com/news-campaigns/news/articles/Business-leaders-welcome-Airports-Commission-recommendations
[94] The Airports Commission estimated capital costs at £9 billion for the Gatwick Second Runway scheme, £14.4 billion for the Heathrow Extended Northern Runway Scheme, and £17.6 billion for the Heathrow Northwest Runway scheme, not including surface access costs
[95] *Airports Commission: Final Report*, p270

specific airfield.[96] This review concluded that "the changes to the background crash risk are minimal regardless of whether or not expansion takes place at the airports."[97] In addition the increase in airfield crash risks for both airports was proportionate to the additional number of flights anticipated, meaning that the "scenario for Heathrow with the highest crash rates represents an increase of 60% in the crash rate compared to 2013. At Gatwick Airport, the crash rate is more than doubled in the scenario with the highest rates."[98] As noted by HSL, "there is a high level of uncertainty in the calculated crash rates" due to the limited number of previous incidents to assess. Of the over 36 million aircraft movements examined by HSL that are of relevance to either Heathrow or Gatwick's airfield crash risk, only three resulted in accidents.[99] The Civil Aviation Authority conducted a preliminary safety assessment of the schemes and concluded that the schemes were feasible in principle from a safety perspective.[100]

Local environmental, health and community impacts

3.49 Decisions on airport capacity must rightly balance local, environmental and social considerations against the national and local benefits stemming from expansion. As set out above, in terms of economic and strategic benefits, expansion via the Heathrow Northwest Runway scheme best meets the need for additional capacity in the South East of England. However, set against these positive impacts, airport expansion can also have negative impacts. For example, all three schemes will have significant impacts on the environment and local communities.

3.50 The Appraisal of Sustainability presents an assessment of the likely environmental, social and economic impacts of all three schemes. The Health Impact Analysis also presents an assessment of the health impacts. The following discussion of assessments of the three schemes considers the impacts of expansion without the benefits of the mitigation package put forward by scheme promoters or required by the Government under this NPS. The *Updated Appraisal Report* monetises, where possible, the air quality, noise and carbon impacts affecting people from each of the three schemes. These monetised values are small relative to the size of the monetised economic benefits of each scheme over the 60-year appraisal period. The Appraisal of Sustainability shows that, while all three schemes are expected to lead to a reduction in air quality and increased noise (without consideration of potential mitigations of the three schemes), the Gatwick Second Runway scheme would have a lower level of adverse effects relating to noise and air quality than either scheme at Heathrow. All three schemes will have an impact on the natural environment, including biodiversity, water and landscape. Negative effects upon quality of life, health and amenity were assessed, when unmitigated, to be of a greater magnitude for the two Heathrow expansion schemes and of a lower magnitude for the Gatwick Second Runway scheme. This is primarily because Gatwick Airport is in a more rural location, with fewer people impacted by the airport. The Appraisal of Sustainability also outlines measures to mitigate these local impacts to ensure that legal obligations will be met.

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[96] *Operational Efficiency: Ground Risk Analysis*, Health and Safety Laboratory, p3
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/437269/operational-efficiency-ground-risk-analysis.pdf
[97] *Operational Efficiency: Ground Risk Analysis*, Health and Safety Laboratory, pvi
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/437269/operational-efficiency-ground-risk-analysis.pdf
[98] *Operational Efficiency: Ground Risk Analysis*, Health and Safety Laboratory, p15
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/437269/operational-efficiency-ground-risk-analysis.pdf
[99] *Operational Efficiency: Ground Risk Analysis,* Health and Safety Laboratory, p9
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/437269/operational-efficiency-ground-risk-analysis.pdf
[100] *Airports Commission: Final report*, p243

As set out below, the Government believes this demonstrates how the commitment to ensure that local impacts of expansion will be mitigated satisfactorily can be met.

3.51 Heathrow Airport has committed to ensuring its landside airport-related traffic is no greater than today. The airport will be expected to achieve a public transport mode share of at least 50% by 2030, and at least 55% by 2040, for passengers.

3.52 The Government agrees with the evidence set out by the Airports Commission that expansion at Heathrow Airport is consistent with the UK's climate change obligations.[101]

3.53 The Appraisal of Sustainability identifies that, in addition to changes due to local noise and air quality impacts, communities may be affected by airport expansion through loss of, and/or additional demand for housing, community facilities or services, including recreational facilities. In addition, there will be effects on parks, open spaces and the historic environment, which will affect the quality of life of local communities which benefit from access to these facilities and features. These effects will be of a higher magnitude for the two Heathrow expansion schemes and a lower magnitude for Gatwick Second Runway. Overall, each of the three schemes is expected to have negative impacts on local communities, with more severe impacts expected from the Heathrow schemes. Impacts of all three schemes will not be felt equally across social groups. Equality impacts are set out in chapter four.

3.54 The Heathrow Northwest Runway scheme will be accompanied by a package of measures to mitigate the impact of airport expansion on the environment and affected communities.[102] The Government agrees with the Airports Commission's conclusion that "to make expansion possible…a comprehensive package of accompanying measures [should be recommended to] make the airport's expansion more acceptable to its local community, and to Londoners generally".[103] This is expected to include a highly valued scheduled night flight ban of six and a half hours between 11pm and 7am (with the exact start and finish times to be determined following consultation), and the offer of a predictable, though reduced, period of respite for local communities.

3.55 To mitigate environmental and social impacts, Heathrow Airport and Gatwick Airport both announced compensation packages (covering residential property acquisition, noise insulation, and other community measures like funding for schools), of more than £1 billion at Heathrow Airport and more than £200 million at Gatwick Airport (over 15-20 years from 2020). Heathrow Airport's package reflects the much greater number of people affected in the local area.

Heathrow Northwest Runway and Heathrow Extended Northern Runway

3.56 The Heathrow Extended Northern runway scheme has two advantages over the Heathrow Northwest Runway scheme: lower capital costs (£14.4 billion for the Extended Northern Runway scheme compared to £17.6 billion for the Northwest Runway scheme), and significantly fewer houses being demolished (242 rather than 783), as well as avoiding impacts on a number of commercial properties.

[101] https://www.gov.uk/government/publications/airport-expansion-dft-review-of-the-airports-commissions-final-report *Review of the Airports Commission Final Report*, p19

[102] By way of comparison, the Government engaged Ernst & Young to prepare a report on the approaches taken by other international airports in addressing the local impacts of the airport - https://www.gov.uk/government/publications/airport-expansion-global-comparison-of-airport-mitigation-measures

[103] *Airports Commission: Final Report*, p4

3.57 However, the Government made a preference for the Heathrow Northwest Runway based on a number of factors:

- Resilience;
- Respite from noise for local communities; and
- Deliverability.

3.58 The Heathrow Northwest Runway scheme would provide respite by altering the pattern of arrivals and departures across the runways over the course of the day to give communities breaks from noise. However, respite would decrease from one half to one third of the day. The Heathrow Extended Northern Runway scheme has much less potential for respite. It would use both runways for arrivals and departures for most of the day, although it may be able to 'switch off' one runway for a short time during non-peak periods with a corresponding reduction in capacity.[104]

3.59 The Heathrow Northwest Runway scheme should provide greater resilience than the Heathrow Extended Northern Runway scheme because of the way the three separate runways could operate more flexibly when needed to reduce delays, and the less congested airfield. It delivers greater capacity (estimated on a like for like basis by the Airports Commission at 740,000 flights departing and arriving per annum compared to the Extended Northern Runway scheme at 700,000),[105] accordingly higher economic benefits, and a broader route network. It also provides greater space for commercial development, which could be used to enhance onsite freight capacity.

3.60 The Airports Commission assessed the Heathrow Extended Northern Runway scheme to be deliverable.[106] However, the Extended Northern Runway scheme has no direct global precedent. As such, there is greater uncertainty as to what measures may be required to ensure that the airport can operate safely, and what the impact of those measures may be, including the restriction on runway capacity.

Carbon emissions

3.61 Although not a differentiating factor between the three shortlisted schemes, the Government has considered the issue of carbon emissions, given the Government's commitment to tackle climate change, and its legal obligations under the Climate Change Act 2008.

3.62 The Airports Commission identified carbon impacts from expansion in four areas: a net increase in air travel; airside ground movements and airport operations; changes in travel patterns as a result of the scheme's surface access arrangements; and construction of new infrastructure. Emissions from air travel, specifically international flights, are by far the largest of these impacts.[107]

3.63 To address uncertainties over the future policy treatment of international aviation emissions,[108] the Airports Commission used two carbon policy scenarios in its analysis.

3.64 The first was a 'carbon capped' scenario, in which emissions from the UK aviation sector are limited to the Committee on Climate Change's planning assumption for the

[104] *Airports Commission: Final Report*, pp180-184
[105] *Airports Commission: Final Report*, p29
[106] *Airports Commission: Final Report*, p236
[107] Intra-UK flights account for approximately 6% of the total emissions from all flights departing UK airports. These emissions are included in the UK's carbon budgets
[108] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/186683/aviation-and-climate-change-paper.pdf *Airports Commission: discussion paper 03: aviation and climate change*, pp12-16

sector of 37.5 million tonnes of carbon dioxide in 2050. The second was a 'carbon traded' scenario, in which emissions are traded as part of a global carbon market, allowing reductions to be made where they are most efficient across the global economy.

3.65 The Airports Commission then assessed whether the needs case could be met under each of these scenarios, that is whether expansion would still deliver the necessary improvements and provide benefits to passengers and the wider economy. The Government has updated this analysis to take account of the latest passenger demand forecasts.

3.66 This further analysis reinforces the conclusion that any one of the three shortlisted schemes could be delivered within the UK's climate change obligations, as well as showing that a mix of policy measures and technologies could be employed to meet the Committee of Climate Change's planning assumption.[109]

3.67 Of the three shortlisted schemes, the Heathrow Northwest Runway scheme produces the highest carbon emissions in absolute terms. However, this is in part due to the greater additional connectivity provided by the scheme, and, in relation to the increase in emissions caused by expansion under any of the schemes, the differences between the schemes are small. Both of the carbon policy scenarios incorporated measures to ensure that the increased emissions from any of the shortlisted schemes were not additional overall either at the global level (in the carbon traded case) or at the UK level (in the carbon capped case).

3.68 The further analysis also shows that, in both carbon policy scenarios, the Heathrow Northwest Runway scheme would deliver significant benefits to passengers and the wider economy (such as lower fares, improved frequency and higher productivity), and would do so more quickly than the Gatwick Second Runway scheme. Both Heathrow schemes provide more passenger benefits by 2050 than the Gatwick Second Runway scheme.

3.69 The Government has considered this further analysis, and concludes both that expansion via a Northwest Runway at Heathrow Airport (as its preferred scheme) can be delivered within the UK's carbon obligations, and that the scheme is the right choice on economic and strategic grounds regardless of the future regime to deal with emissions from international aviation.[110]

Strategic environmental assessment

3.70 Strategic environmental assessments are required by the law. A strategic environmental assessment is set out in full in the Appraisal of Sustainability.[111] It demonstrates that airport expansion will attract additional air traffic, which impacts upon quality of life and wellbeing, in particular through noise, air quality, housing, community facilities, and access to nature and cultural heritage. Negative impacts upon quality of life were of a greater scale within the two Heathrow schemes and of lower magnitude for the Gatwick Second Runway scheme. However, when assessing against the objective of maximising economic benefits and improving competitiveness and employment, the Heathrow Northwest Runway scheme generates the most benefits, as well as producing the highest direct benefits to passengers.

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[109] *Updated Appraisal Report,* p36
[110] *Updated Appraisal Report*, p35 and p42
[111] https://www.gov.uk/government/publications/appraisal-of-sustainability-for-the-revised-draft-airports-national-policy-statement

Conclusion

3.71 This section summarises the factors the Government considered when evaluating each of the three schemes shortlisted by the Airports Commission against the needs case presented in chapter 2. As part of this, the Government identified where schemes could have negative impacts, for example on the local environment. It considered the predicted beneficial effects of the three schemes, particularly in relation to the needs case and economic considerations. It also assessed how the schemes could conform to wider Government strategic objectives and meet legal obligations, for example on air quality. Bringing these considerations together, the Government's decision on a preferred scheme balances this range of factors, enabling it to determine which scheme, overall, is the most effective and appropriate means of meeting the needs case and maintaining the UK's hub status in particular.

3.72 The Appraisal of Sustainability provides an assessment of the schemes against a number of the factors considered in this chapter. It concludes that the Heathrow Northwest Runway scheme is best placed to maximise the monetised economic benefits that the provision of additional airport capacity could deliver in the short term, although this scheme is likely to do so with the greatest negative impact on local communities. However, the Appraisal of Sustainability also identifies measures which can help to mitigate these impacts, for example by reducing noise, ensuring that the development is in accordance with legal obligations on air quality, showing how future carbon targets could be met, and assessing future demand scenarios.

3.73 Building on this assessment, the Government has identified a number of attributes in the manner of strategic effects, which it believes only the preferred scheme is likely to deliver to meet the overall needs case for increased capacity in the South East of England and to maintain the UK's hub status. The Government has afforded particular weight to these:

- Expansion via the Heathrow Northwest Runway scheme would provide the biggest boost to connectivity, particularly in terms of long haul flights. This is important to a range of high value sectors across the economy in the UK which depend on air travel, as well as for air freight. It will enable more passengers to fly where they need to, when they need to.
- Expansion via the Heathrow Northwest Runway scheme would provide benefits to passengers and to the wider economy sooner than the other schemes. This is regardless of the technical challenges to its delivery. It would also provide the greatest boost to local jobs.
- Heathrow Airport is better connected to the rest of the UK by road and rail. Heathrow Airport already has good road links via the M25, M4, M40 and M3, and rail links via the London Underground Piccadilly Line, Heathrow Connect and Heathrow Express. In the future, it will be connected to Crossrail, and linked to HS2 at Old Oak Common. The number of such links provides resilience.
- The Heathrow Northwest Runway scheme delivers the greatest support for freight. The plans for the scheme include a doubling of freight capacity at the airport. Heathrow Airport already handles more freight by value than all other UK airports combined, and twice as much as the UK's two largest container ports.

3.74 The needs case has shown the importance of developing more capacity more quickly, and in a form which passengers and businesses want to use. The Heathrow Northwest Runway scheme is best placed to deliver this capacity, delivering the greatest benefits soonest as well as providing the biggest boost to the UK's international connectivity, doing so in the 2020s at a point when without the scheme 4 out of 5 London airports would be full, with all the problems to passengers this could entail. Taken together, benefits to passengers and the wider economy are substantial, even having regard to the proportionally greater environmental disbenefits estimated for the Heathrow Northwest Runway. Even though the preferred scheme's environmental disbenefits are larger than those of the Gatwick Second Runway scheme, when all benefits and disbenefits are considered together,[112] overall the Heathrow Northwest Runway scheme is considered to deliver the greatest net benefits to the UK.

3.75 A number of mitigation measures will need to be applied to reduce the impacts of the Heathrow Northwest Runway scheme felt by the local community and the environment. Airport expansion is also expected to be accompanied by an extensive and appropriate compensation package for affected parties. With these safeguards in place, the Government considers that the Heathrow Northwest Runway scheme delivers the greatest strategic and economic benefits, and is therefore the most effective and appropriate way of meeting the needs case.

[112] *Updated Appraisal Report*, p44

4. Assessment principles

General principles of assessment

4.1 The statutory framework for deciding applications for development consent is contained in the Planning Act 2008. This chapter of the Airports NPS sets out general policies in accordance with which applications relating to a Northwest Runway at Heathrow Airport are to be decided. This chapter is specific to assessments necessary for the Heathrow Northwest Runway scheme, but is not exhaustive as to the assessments that may be applicable to that scheme.

4.2 The Airports NPS covering the Heathrow Northwest Runway scheme establishes the needs case for that proposed development, provided it adheres to the detailed policies and protections set out in the Airports NPS, and the legal constraints contained within the Planning Act 2008. The statutory framework for deciding nationally significant infrastructure project applications where there is a relevant designated NPS is set out in section 104 of the Planning Act 2008.[113]

4.3 The Airports NPS applies to schemes at Heathrow Airport (in the area shown, for this purpose, illustratively, within the scheme boundary map at Annex A) that include a runway of at least 3,500m in length and that are capable of delivering additional capacity of at least 260,000 air transport movements per annum, and associated infrastructure and surface access facilities. In particular, it also applies to the reconfiguration of and provision of new terminal capacity to be located between the two existing runways at Heathrow Airport. The Secretary of State's policy in relation to other airport infrastructure in the South East of England is set out at paragraph 1.41 above.

4.4 In considering any proposed development, and in particular when weighing its adverse impacts against its benefits, the Examining Authority and the Secretary of State will take into account:

- Its potential benefits, including the facilitation of economic development (including job creation) and environmental improvement, and any long term or wider benefits; and
- Its potential adverse impacts (including any longer term and cumulative adverse impacts) as well as any measures to avoid, reduce or compensate for any adverse impacts.

4.5 In this context, environmental, safety, social and economic benefits and adverse impacts should be considered at national, regional and local levels. These may be identified in the Airports NPS, or elsewhere. The Secretary of State will also have regard to the manner in which such benefits are secured, and the level of confidence in their delivery.

[113] Planning Act 2008, section 104 – decisions in cases where an NPS has effect

4.6 The National Networks NPS sets out the Government's policies to deliver development of nationally significant infrastructure projects on the national road and rail networks and strategic rail freight interchanges. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.

4.7 Where the applicant's proposals in relation to surface access meet the thresholds to qualify as nationally significant infrastructure projects under the Planning Act 2008, or is associated development under section 115 of the Planning Act 2008, the Secretary of State will consider those aspects by reference to both the National Networks NPS and the Airports NPS, as appropriate. To the extent that discrete aspects of the surface access proposals do not qualify as nationally significant and cannot be included in a development consent application as associated development (for example), the applicant will be expected to pursue or secure necessary consent(s) through the most appropriate alternative consenting regime. This might include, for example, the Town and Country Planning Act 1990, the Highways Act 1980, or the Transport and Works Act 1992, promoted by a third party if need be.

4.8 The Secretary of State will consider any relevant nationally significant road and rail elements of the applicant's proposals in accordance with the National Networks NPS and with the Airports NPS. If there is conflict between the Airports NPS and other NPSs, the conflict should be resolved in favour of the NPS that has been most recently designated. The Airports NPS and the National Networks NPS may also be a material consideration in decision making on applications for road and rail schemes associated with or related to the preferred scheme that fall under the Town and Country Planning Act 1990, the Transport and Works Act 1992, or other legislation relating to planning. Whether, and to what extent, the Airports NPS and the National Networks NPS are a material consideration will be judged on a case by case basis by the relevant decision makers.

4.9 The Examining Authority should only recommend, and the Secretary of State will only impose, requirements in relation to a development consent, that are necessary, relevant to planning, relevant to the development to be consented, enforceable, precise, and reasonable in all other respects.[114] The need for requirements in respect of the phasing of the scheme is likely to be an important consideration, so that effects of construction and operational phases are properly mitigated, as well as any changes in the operations of the airport that may occur in line with the phasing of physical works and commencement of operations. Guidance on the use of planning conditions or any successor to it should be taken into account where requirements are proposed.

4.10 Obligations under section 106 of the Town and Country Planning Act 1990 should only be sought where they are necessary to make the development acceptable in planning terms, (including where necessary to ensure compliance with the Airports NPS), directly related to the proposed development, and fairly and reasonably related in scale and kind to the development.[115]

Scheme variation

4.11 While the Government has decided that a Northwest Runway at Heathrow Airport is its preferred scheme to deliver additional airport capacity (an illustrative masterplan is at

[114] National Planning Policy Framework, March 2012, paragraph 206, or any successor document

[115] Town and Country Planning Act 1990, section 106; Regulation 122(2) Community Infrastructure Levy Regulations 2010; National Planning Policy Framework, March 2012, paragraph 204

Annex B of the Airports NPS), this does not limit variations resulting in the final scheme for which development consent is sought. To benefit from the full support of policy within the Airports NPS, any application(s) will have to fall within the boundaries and parameters set out in the Airports NPS. However, the form of a development for which an application is made is a matter for the applicant. The Airports NPS does not prejudice the viability or merits of any particular application, detailed scheme or applicant. It governs the location, limits and nature of such schemes. It will be for an Examining Authority, and ultimately the Secretary of State, to determine whether any future application is compliant with the Airports NPS, meets the need for additional capacity, and is of benefit to the UK, whilst minimising any harm caused.

Environmental Impact Assessment

4.12 All proposals for projects that are subject to the European Union's Environmental Impact Assessment Directive,[116] and are likely to have significant effects on the environment, must be accompanied by an environmental statement, describing the aspects of the environment likely to be significantly affected by the project.[117] The Directive specifically requires an Environmental Impact Assessment to identify, describe and assess effects on human beings, fauna and flora, soil, water, air, climate, the landscape, material assets and cultural heritage, and the interaction between them. Schedule 4 to the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017[118] sets out the information that should be included in the environmental statement. This includes a description of the likely significant effects of the proposed project on the environment, covering the direct effects and any indirect, secondary, cumulative, short-, medium- and long-term, permanent and temporary, positive and negative effects of the project, and also the measures envisaged for avoiding or mitigating significant adverse effects.

4.13 When examining a proposal to which the Airports NPS applies, the Examining Authority should ensure that likely significant effects at all stages of the project have been adequately assessed. The effects of any changes in operations, including the number of air traffic movements, during the construction and operational phases must be properly assessed and appropriate mitigation secured for any significant effects. Any requests for environmental information not included in the original environmental statement should be proportionate and focus only on likely significant effects. In the Airports NPS, the terms 'effects', 'impacts' or 'benefits' should accordingly be understood to mean likely significant effects, impacts or benefits.

4.14 When considering significant cumulative effects, any environmental statement should provide information on how the effects of an applicant's proposal would combine and interact with the effects of other development (including projects for which consent has been granted, as well as those already in existence if they are not part of the baseline).[119]

4.15 The Examining Authority should consider how significant cumulative effects, and the interrelationship between effects, might as a whole affect the environment, even

[116] Directive 2014/52/EU of the European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. The amendments to Directive 2011/92/EU made by Directive 2014/52/EU have been transposed into domestic legislation. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 have, subject to transitional arrangements, with amendments, consolidated the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 and various amending regulations
[117] http://www.legislation.gov.uk/uksi/2017/572/contents/made
[118] Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (S.I. 2017/572)
[119] The applicant should refer to the Planning Inspectorate's advice on assessing cumulative effects https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/12/Advice-note-17V4.pdf

though they may be acceptable when considered on an individual basis or with mitigation measures in place.

4.16 In some instances it may not be possible at the time of the application for development consent for all aspects of the proposal to have been settled in precise detail. Where this is the case, the applicant should explain in its application which elements of the proposal have yet to be finalised, and the reasons why this is the case.

4.17 Effort should be made to refine the detail of the proposed development. However, where details are still to be finalised, such as in respect of the phasing of the development and operational changes at the airport, the applicant is advised to set out in the environmental statement the relevant design parameters used for the assessment. The environmental statement should explain, with reference to the parameters, what the maximum extent of the proposed development may be (for example in terms of site area) or the extent of change in respect of operational impacts, and assess the potential adverse effects which the project could have, to ensure that the impacts of the project as it may be constructed have been properly assessed.

4.18 Should the Secretary of State decide to grant development consent for an application where details are still to be finalised, this will need to be reflected in appropriate development consent requirements in the development consent order. It may be the case that development consent is granted for a proposal and, at a later stage, the applicant wishes (for technical or commercial reasons) to construct it in such a way that it is outside the terms of what has been consented, for example because its extent will be greater than has been provided for in terms of the consent. In this situation, it will be necessary for the applicant to apply for a change to be made to the development consent provided under the Planning Act 2008.

Habitats Regulations Assessment

4.19 Prior to granting development consent, the Secretary of State as competent authority must comply with the duties under the Conservation of Habitats and Species Regulations 2017. Under these regulations, if the competent authority considers that the proposed development is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and is not connected with or necessary to the management of that site, it must make an Appropriate Assessment of the implications for the site in view of the site's conservation objectives.[120] [121] The applicant should also refer to the Airports NPS sections on biodiversity, land use, and air quality. The competent authority must consult Natural England to ensure that impacts on European sites are adequately considered.

4.20 The applicant is required to provide sufficient information with their applications for development consent to enable the Secretary of State to carry out an Appropriate Assessment if required. This information should include details of any measures that are proposed to minimise or avoid any likely significant effects on a European site. The information provided may also assist the Secretary of State in concluding that an Appropriate Assessment is not required because significant effects on European sites

[120] This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in Regulation 8 of the Conservation of Habitats and Species Regulations 2017

[121] Directive 2011/92/EU was amended in 2014 by Directive 2014/52/EU. As amended, Article 2(3) of the Directive provides that, where an obligation to assess environmental effects arises simultaneously from the EIA Directive and the Habitats Directive (Directive 92/43/EU) and/or the Wild Birds Directive (Directive 2009/147/EC), Member States "shall, where appropriate, ensure that coordinated and/or joint procedures" are provided for

are sufficiently unlikely that they can be excluded. If it is concluded there is likely to be a significant effect, or such effects cannot be ruled out (alone or in combination), an Appropriate Assessment is required.

4.21 If an Appropriate Assessment for a proposed airport development concludes that it is not possible to rule out an adverse effect on the integrity of a European site, the Habitats Directive permits a derogation, subject to the proposal meeting three tests. These tests are (a) that there are no less damaging alternative solutions, (b) that there are imperative reasons of overriding public interest for the proposal going ahead, and (c) that adequate and timely compensation measures will be put in place to ensure the overall coherence of the network of protected sites is maintained. At detailed design stage, and in so far as it may be necessary, the matters set out in the Airports NPS will be relevant to determining whether there are alternative solutions and imperative reasons of overriding public interest, provided that the design remains consistent with the objectives of the Airports NPS.

4.22 Where a development may negatively affect any priority natural habitat type or priority species,[122] any imperative reasons of overriding public interest case would need to be established solely on one or more of the grounds relating to human health, public safety or beneficial consequences of primary importance to the environment. The competent authority may only rely on other (i.e. social or economic) imperative reasons of overriding public interest if it has first obtained an opinion from the European Commission.

Equalities

4.23 The Airports Commission's stated objective on equalities was "to reduce or avoid disproportionate impacts on any social group".[123] At consultation stage, the Airports Commission carried out a high level Equality Impact Assessment.

4.24 The Appraisal of Sustainability to the Airports NPS sets out an assessment of equalities impacts, informed by the work of the Airports Commission. The Airports Commission was clear that its assessment was based upon current scheme design, and that a more detailed Equality Impact Assessment would likely be necessary as design, supporting measures and operational plans were developed.

4.25 The Airports Commission's assessment identified different types of equalities impacts for each of its shortlisted schemes, but no substantial difference in the overall extent of equalities impacts. The Airports Commission's assessment, and the assessment carried out for the Appraisal of Sustainability that informs the Airports NPS, both concluded that negative equalities impacts could be well mitigated through good design and operation, and supporting measures and plans.

4.26 The Department for Transport has reviewed the Airports Commission's work, informed by the Equality Assessment carried out as part of the Appraisal of Sustainability. The Government is satisfied that the scope of the Airports Commission's work was appropriate at this stage of scheme development, that the Airports Commission's approach was consistent with the Equality Act 2010, and that its conclusion is consistent with the evidence produced.

4.27 For any application to be considered compliant with the Airports NPS, it must be accompanied by a project level Equality Impact Assessment examining the potential impact of that project on groups of people with protected characteristics. In order to

[122] As listed in Annex I and II of the Habitats Directive
[123] *Airports Commission: Appraisal Framework*, p98

benefit from the support of the Airports NPS, the results of that project level Equality Impact Assessment must be within the legal limits and parameters of acceptability outlined in the Appraisal of Sustainability that informs the Airports NPS.

Assessing alternatives

4.28 The applicant should comply with all legal obligations and policy set out in the Airports NPS on the assessment of alternatives. In particular:

- The Environmental Impact Assessment Directive requires projects with significant environmental effects to include a description of the reasonable alternatives studied by the applicant which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the significant effects of the project on the environmental effects;
- There may also be other specific legal obligations requiring the consideration of alternatives, for example, under the Habitats and Water Framework Directives; and
- There may be policies in the Airports NPS requiring consideration of alternatives, for example the flood risk sequential test.

Criteria for 'good design' for airports infrastructure

4.29 The applicant should include design as an integral consideration from the outset of a proposal.

4.30 Visual appearance should be an important factor in considering the scheme design, as well as functionality, fitness for purpose, sustainability and cost. Applying 'good design' to airports projects should therefore produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction, and matched by an appearance that demonstrates good aesthetics as far as possible.

4.31 A good design should meet the principal objectives of the scheme by eliminating or substantially mitigating the adverse impacts of the development, for example by improving operational conditions. It should also mitigate any existing adverse impacts wherever possible, for example in relation to safety or the environment. A good design will also be one that sustains the improvements to operational efficiency for as many years as is practicable, taking into account capital cost, economics and environmental impacts.

4.32 Scheme design will be an important and relevant consideration in decision making. The Secretary of State will need to be satisfied that projects are sustainable and as aesthetically sensitive, durable, adaptable and resilient as they can reasonably be, having regard to regulatory and other constraints and including accounting for natural hazards such as flooding. The Secretary of State will also need to be satisfied that extant security, customs and immigration measures are maintained or reprovided.

4.33 The scheme should take into account, as far as possible, both functionality, including fitness for purpose and sustainability, and aesthetics, including the scheme's contribution to the quality of the area in which it would be located. The applicant will want to consider the role of technology in delivering new airports projects. Professional, independent advice on the design aspects of a proposal should be undertaken to ensure good design principles are embedded into infrastructure proposals.

4.34 There may be opportunities for the applicant to demonstrate good design in terms of siting and design measures relative to existing landscape and historical character and function, landscape permeability, landform, and vegetation.

4.35 The applicant should be able to demonstrate in its application how the design process was conducted and how the proposed design evolved. Where a number of different designs were considered, the applicant should set out the reasons why the favoured choice has been selected. The Examining Authority and Secretary of State will take into account the ultimate purpose of the infrastructure and bear in mind the operational, safety and security standards which the design has to satisfy.

Costs

4.36 The relationship between cost and affordability for a scheme is governed by the regulated funding of the airport and funding from other sources, and the need to comply with the Government's guidance on compulsory acquisition of land under the Planning Act 2008.[124] This guidance is relevant to any scheme that will require the compulsory acquisition of land, which is expected in relation to any scheme to which this NPS applies which would include any application for development consent for a Northwest Runway at Heathrow Airport. That guidance sets out what a promoter must demonstrate if it is to be granted powers of compulsory acquisition - including in relation to impediments to a scheme and financial resources.

4.37 Heathrow Airport is subject to economic regulation by the Civil Aviation Authority (CAA) under the Civil Aviation Act 2012. As part of the CAA's discharge of its duty under the Civil Aviation Act 2012 to further the interests of users of air transport services (passengers and cargo owners), the CAA has granted an economic licence to the operator of Heathrow Airport to levy airport charges. This licence sets a maximum yield per passenger that can be recovered by the operator of Heathrow Airport through airport charges (the "maximum yield"). This maximum yield is set by the CAA having conducted a process that scrutinises, among other things, the business plan submitted by the licence holder and developed through constructive engagement with the airlines, as well as other submissions from airlines and stakeholders. This process of scrutiny of costs will include benchmarking exercises from industry professionals and assessments by an Independent Fund Surveyor as well as by the CAA. Expansion will also be subject to specific gateway reviews by airlines and stakeholders. The final business plan will include details of the future capital expenditure that the licensee proposes to incur.

4.38 For the development of new capacity at Heathrow, the CAA will set the maximum yield having regard to the matters required by the Civil Aviation Act 2012. The CAA will consider, among other things:

- the need to secure that the licence holder is able to finance its provision of airport operation services; and
- the economy and efficiency of the proposals set out in any business plan (including such capital expenditure proposals as are contained in it),

as part of its process of setting the maximum yield per passenger in the period covered by the price control.

[124] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/236454/Planning_Act_2008_-_Guidance_related_to_procedures_for_the_compulsory_acquisition_of_land.pdf

4.39 The applicant should demonstrate in its application for development consent that its scheme is cost-efficient and sustainable, and seeks to minimise costs to airlines, passengers and freight owners over its lifetime.

4.40 Detailed scrutiny of any business plan put forward by the licence holder will fall under the CAA's regulatory process under the Civil Aviation Act 2012, and the detailed matters considered under that process are not expected to be scrutinised in the same way during the examination and determination of an application for development consent. The CAA is a statutory consultee for all proposed applications relating to airports or which are likely to affect an airport or its current or future operation. The applicant is expected to provide the CAA with the information it needs to enable it to assist the Examining Authority in considering whether any impediments to the applicant's development proposals, insofar as they relate to the CAA's economic regulatory and other functions, are capable of being properly managed.

Climate change adaptation

4.41 The Planning Act 2008 requires the Secretary of State to have regard to the desirability of mitigating, and adapting to, climate change in designating an NPS.[125]

4.42 This section sets out how the Airports NPS puts Government policy on climate change adaptation into practice, and in particular how the applicant and the Secretary of State will take into account the effects of climate change when developing and considering airports infrastructure applications. Climate change mitigation is essential to minimise the most dangerous impacts of climate change, as previous global greenhouse gas emissions will already mean some degree of continued climate change for at least the next 30 years. Climate change is likely to mean that the UK will experience on average hotter, drier summers and warmer, wetter winters. There is potentially an increased risk of flooding, drought, heatwaves, intense rainfall events and other extreme events such as storms and wildfires, as well as rising sea levels.

4.43 Adaptation is therefore necessary to deal with the potential impacts of these changes that are already happening. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the provision of green infrastructure.

4.44 The Government has published a set of UK Climate Projections, and every five years prepares a statutory UK Climate Change Risk Assessment and National Adaptation Programme.[126] In addition, the Climate Change Act 2008 adaptation reporting power has been used by Government to invite reporting authorities (a defined list of public bodies and statutory undertakers, including airports) to consider the impact on them of current and predicted climate change, and to report on progress implementing adaptation actions.[127] Successive strategies for adaptation reporting will be laid alongside five yearly updates to the National Adaptation Programme.

4.45 New airports infrastructure will typically be a long-term investment which will need to remain operational over many decades, in the face of a changing climate. Consequently, the applicant must consider the impacts of climate change when planning design, build and operation. Any accompanying environmental statement

[125] Planning Act 2008, section 10(3)(a)
[126] Climate Change Act 2008, section 58
[127] Climate Change Act 2008, section 62

should set out how the proposal will take account of the projected impacts of climate change.

4.46 Detailed consideration must be given to the range of potential impacts of climate change using the latest UK Climate Projections available at the time, and to ensuring any environmental statement that is prepared identifies appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. Should a new set of UK Climate Projections become available after the preparation of any environmental statement, the Examining Authority should consider whether it needs to request additional information from the applicant.

4.47 Where transport infrastructure has safety-critical elements, and the design life of the asset is 60 years or greater, the applicant should apply the latest available UK Climate Projections, considering at least a scenario that reflects a high level of greenhouse gas emissions at the 10%, 50% and 90% probability levels, to assess the impacts of climate change over the lifetime of the development.

4.48 The applicant should demonstrate that there are no critical features of infrastructure design which may be seriously affected by more radical changes to the climate beyond those projected in the latest set of UK Climate Projections. Any potential critical features should be assessed, taking account of the latest credible scientific evidence on, for example, sea level rise, and on the basis that necessary action can be taken to ensure the operation of the infrastructure over its estimated lifetime through potential further mitigation or adaptation.

4.49 Any adaptation measures should be based on the latest set of UK Climate Projections,[128] the most recent UK Climate Change Risk Assessment,[129] consultation with statutory consultation bodies, and any other appropriate climate projection data. Any adaptation measures must themselves also be assessed as part of any Environmental Impact Assessment and included in the environmental statement, which should set out how and where such measures are proposed to be secured.

4.50 If any proposed adaptation measures themselves give rise to consequential impacts, the Secretary of State will consider the impact in relation to the application as a whole and the assessment principles set out in the Airports NPS.

4.51 Adaptation measures can be required to be implemented at the time of construction where necessary and appropriate to do so.

4.52 Where adaptation measures are necessary to deal with the impact of climate change, and that measure would have an adverse effect on other aspects of the project or the surrounding environment, the Secretary of State may consider requiring the applicant to ensure that the adaptation measure could be implemented should the need arise, rather than at the outset of the development.

Pollution control and other environmental protection regimes

4.53 Issues relating to discharges or emissions from a proposed project which affect air quality, water quality, land quality or the marine environment, or which include noise, may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes. Relevant permissions will need to be obtained for any activities within the development that are regulated under those regimes before the activities can be operated.

[128] http://ukclimateprojections.metoffice.gov.uk/

[129] https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report

4.54 In deciding an application, the Secretary of State should focus on whether the development is an acceptable use of the land, and on the impacts of that use, rather than the control of processes, emissions or discharges themselves. The Secretary of State should assess the potential impacts of processes, emissions or discharges to inform decision making, but should work on the assumption that, in terms of the control and enforcement, the relevant pollution control regime will be properly applied and enforced. Decisions under the Planning Act 2008 should complement but not duplicate those taken under the relevant pollution control regime.

4.55 These considerations apply in an analogous way to other environmental regulatory regimes, including those on land drainage, flood defence, and biodiversity.

4.56 When an applicant applies for an environmental permit, the relevant regulator (in this case the Environment Agency) requires that processes are in place that are sufficient for the grant of the permit and to ensure compliance with conditions attached to any permit. In examining the impacts of the project, the Examining Authority may wish to seek the views of the regulator on the scope of the permit or consent and any management plans (such as any produced for noise) that would be included in an environmental permit application.

4.57 The applicant should begin pre-application discussions with the Environment Agency as early as possible. It is expected, however, that an applicant will have first considered what the Environment Agency is likely to require as a starting point for discussion. Some consents require a significant amount of preparation: as an example, the Environment Agency strongly recommends the applicant should start work towards submitting the permit application at least six months prior to the submission of a development consent order application, where it wishes to parallel track the applications. This will help ensure that applications take account of all relevant environmental considerations and that the relevant regulators are able to provide timely advice and assurance to the Examining Authority and the Secretary of State.

4.58 The Secretary of State will be satisfied that development consent can be granted taking full account of environmental impacts. This will require close cooperation with the Environment Agency, the local planning authority and pollution control authority, and other relevant bodies, such as Natural England, Drainage Boards, and water and sewerage undertakers, to ensure that, in the case of potentially polluting developments:

- The relevant pollution control authority is satisfied that potential releases can be adequately regulated under the pollution control framework; and
- The effects of existing sources of pollution in and around the project are not such that the cumulative effects of pollution when the proposed development is added would make that development unacceptable, particularly in relation to statutory environmental quality limits.

4.59 The Secretary of State should not refuse consent on the basis of regulated impacts unless there is good reason to believe that any relevant necessary operational pollution control permits or licences or other consents will not subsequently be granted.

Common law nuisance and statutory nuisance

4.60 Section 158 of the Planning Act 2008 provides a defence of statutory authority in civil or criminal proceedings for nuisance. Such a defence is also available in respect of anything else authorised by an order granting development consent. The defence does not extinguish the local authority's duties under Part III of the Environmental Protection Act 1990 to inspect its area and take reasonable steps to investigate complaints of statutory nuisance and to serve an abatement notice where satisfied of its existence, likely occurrence or recurrence.

4.61 During the examination of an application for development consent for infrastructure covered under the Airports NPS, possible sources of nuisance under section 79(1) of the Environmental Protection Act 1990 and under sections 76 and 77 of the Civil Aviation Act 1982 should be considered by the Examining Authority. The Examining Authority should also consider how those sources of nuisance might be mitigated or limited so they can recommend appropriate requirements that the Secretary of State might include in any subsequent order granting development consent.

4.62 The defence of statutory authority is subject to any contrary provision made by the Secretary of State in any particular case by an order granting development consent.[130]

Security and safety considerations

4.63 National security considerations apply across all national infrastructure sectors. The Department for Transport acts as the sector sponsor department for the aviation sector, and in this capacity has lead responsibility for security matters and for directing the security approach to be taken, working with the Civil Aviation Authority. The Department for Transport works closely with Government agencies, including the Centre for the Protection of National Infrastructure, to reduce the vulnerability of the aviation sector to terrorism and other national security threats.

4.64 Government policy is to ensure that, where possible, proportionate protective security measures are designed into new infrastructure projects at an early stage in the project development. The nature of the aviation sector as a target for terrorism means that security considerations will likely apply in the case of the infrastructure project for which development consent may be sought under the Airports NPS.

4.65 Where national security implications have been identified, the applicant should consult with relevant security experts from the Centre for the Protection of National Infrastructure and the Department for Transport to ensure that physical, procedural and personnel security measures have been adequately considered in the design process, and that adequate consideration has been given to the management of security risks. If the Department for Transport, taking advice from the Civil Aviation Authority, Centre for the Protection of National Infrastructure and others it considers appropriate, forms the opinion that it is satisfied that current and potential future security needs are adequately addressed in the project and that relevant guidance on these matters has been appropriately taken into account in the application, it will provide confirmation of this to the Secretary of State, and the Examining Authority should not need to give any further consideration to the details of the security measures during the examination.

[130] Planning Act 2008, section 158(3)

4.66 The applicant should only include such security-related information in the application as is necessary to enable the Examining Authority to examine the development consent issues and make a properly informed recommendation on the application.

4.67 In exceptional cases where examination of an application would involve public disclosure of information about defence or national security which would not be in the national interest, the Secretary of State can intervene and may appoint an examiner to consider evidence in closed session.

4.68 Air transport is one of the safest forms of travel, and the UK is a world leader in aviation safety. Maintaining and improving that record, while ensuring that regulation is proportionate and cost-effective, remains of primary importance to the UK. Since 2003, rules and standards for aviation safety in Europe have increasingly been set by the European Aviation Safety Agency. The UK will continue to work closely with the European Aviation Safety Agency to ensure that a high and uniform level of civil aviation safety is maintained across Europe. The preferred scheme at Heathrow must comply with the UK's civil aviation safety regime, regulated by the Civil Aviation Authority.

4.69 There remains a considerable threat to aviation security from terrorism. The UK meets this threat with a multi-layered aviation security regime built on intelligence, effective risk management and robust, proportionate measures, brought together under the National Aviation Security Programme. The regulations governing aviation security in the UK have their basis in UK and European law, and are enforced by the Civil Aviation Authority on behalf of the Secretary of State. The design and operation of the Heathrow Northwest Runway scheme, to which the Airports NPS relates, must comply with aviation security regulations and guidance in the same way as existing airports. There may also be other security considerations linked to any application for development consent under the Airports NPS.

Health

4.70 The construction and use of airports infrastructure has the potential to affect people's health, wellbeing and quality of life. Infrastructure can have direct impacts on health because of traffic, noise, vibration, air quality and emissions, light pollution, community severance, dust, odour, polluting water, hazardous waste and pests.

4.71 New or enhanced airports infrastructure may also have indirect health impacts, for example if they affect access to key public services, local transport, opportunities for cycling and walking, or the use of open space for recreation and physical activity. It should also be noted, however, that the increased employment stemming from airport expansion may have indirect positive health impacts.

4.72 As described elsewhere in the Airports NPS, where the proposed project has likely significant environmental impacts that would have an effect on human beings, any environmental statement should identify and set out the assessment of any likely significant health impacts.

4.73 The applicant should identify measures to avoid, reduce or compensate for adverse health impacts as appropriate. These impacts may affect people simultaneously, so the applicant, the Examining Authority and the Secretary of State (in determining an application for development consent) should consider the cumulative impact on health.

Accessibility

4.74 The Government is committed to creating a more accessible and inclusive transport network that provides a range of opportunities and choices for all people to connect with jobs, services and leisure opportunities. This commitment extends to all the users of new airports infrastructure, and to the associated surface access facilities.

4.75 In 2008, the Department for Transport published *Access to Air Travel for Disabled Persons and Persons with Reduced Mobility – Code of Practice*,[131] which sets out the legal framework and gives advice and information. Since then, the Equality Act 2010 has updated and extended the legal framework for accessibility.[132]

4.76 In accordance with legal and best practice in relation to accessibility:

- The Government requires the applicant to include clear details of how plans will improve access on and around the airport by designing and delivering schemes (both new construction and upgrade or refurbishment) that address the accessibility needs of all those who use, or are affected by, surface access infrastructure, including those with physical and/or mental impairments as well as older users. Every opportunity to deliver improvements in accessibility on and to the existing national road network should also be taken;
- The Government will continue to work to ensure that all bus and train fleets comply with legal access standards by 2020, and to improve rail station access for those with impairments in accordance with legislation and best practice; and
- The car will continue to play an important role, providing disabled people with independence where other forms of transport are not accessible or available. Easy access and car parking provision at the airports is essential to this goal and must meet standards set down in guidance (such as the Department for Transport's *Inclusive Mobility*).[133]

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131 http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/transportforyou/access/aviationshipping/accesstoairtravelfordisabled.pdf
132 http://www.legislation.gov.uk/ukpga/2010/15/contents
133 https://www.gov.uk/government/publications/inclusive-mobility

5. Assessment of impacts

Introduction

5.1 This chapter focuses on the potential impacts of the Heathrow Northwest Runway scheme, the assessments that any applicant will need to carry out, and the specific planning requirements that they will need to meet, in order to gain development consent.

5.2 In its Final Report, the Airports Commission recommended that "to make expansion possible…a comprehensive package of accompanying measures [should be recommended to] make the airport's expansion more acceptable to its local community, and to Londoners generally".[134]

5.3 When the Government stated in December 2015 that it agreed with the Airports Commission that one additional runway was required in the South East of England by 2030, it also emphasised the importance of securing the best possible deal for communities affected by the preferred scheme to increase airport capacity. The Government undertook further work, including through engagement with all three shortlisted scheme promoters, during 2016 to develop a package of location-specific measures to mitigate the impacts of increased capacity, and to enhance beneficial effects.

5.4 The Government announced on 25 October 2016 that its preferred scheme to deliver additional airport capacity in the South East of England was a Northwest Runway at Heathrow Airport. Alongside this, it set out a number of supporting measures that any application for development consent will be required to demonstrate and secure in order to mitigate the impacts of expansion on the environment and affected communities.

Surface access

Introduction

5.5 The Government's objective for surface access is to ensure that access to the airport by road, rail and public transport is high quality, efficient and reliable for passengers, freight operators and airport workers who use transport on a daily basis. The Government also wishes to see the number of journeys made to airports by sustainable modes of transport maximised as much as possible. This should be delivered in a way that minimises congestion and environmental impacts, for example on air quality.

5.6 A Northwest Runway at Heathrow Airport will have a range of impacts on local and national transport networks serving the airport, during both the construction and operational phases. Passengers, freight operators and airport workers share the

[134] *Airports Commission: Final Report*, p4

routes to and from the airport with other road and rail users, including commuters, leisure travellers and business users. Without effective mitigation, expansion is likely to increase congestion on existing routes and have environmental impacts such as increased noise and emissions.

5.7 The Airports Commission identified three major rail improvements which would support a new Northwest Runway at Heathrow Airport. These were Crossrail, a Western Rail Link to Heathrow and Southern Rail Access to the airport. Notwithstanding the requirements for the applicant's assessment set out below, Government has supported, or is supporting, all three of these schemes subject to a satisfactory business case and the agreement of acceptable terms with the Heathrow aviation industry. Crossrail is in construction and full services are anticipated to commence in 2019. The Western Rail Link to Heathrow was one of the schemes named as being in the 'develop' phase in the Rail Network Enhancements Pipeline, published in March 2018 and, subject to obtaining planning consent, it is expected to commence operations before 2030. Any Southern Rail Access to Heathrow is at an earlier stage of development and, subject to an acceptable business case and obtaining planning consent, should commence operations as soon as reasonably practicable after a new runway has opened.

5.8 It is important that improvements are made to Heathrow Airport's transport links to be able to support the increased numbers of people and freight traffic which will need to access the expanded airport, should development consent be granted.

Applicant's assessment

5.9 The applicant must prepare an airport surface access strategy in conjunction with its Airport Transport Forum, in accordance with the guidance contained in the Aviation Policy Framework.[135] The airport surface access strategy must reflect the needs of the scheme contained in the application for development consent, including any phasing over its development, implementation and operational stages, reflecting the changing number of passengers, freight operators and airport workers attributable to the number of air traffic movements. The strategy should reference the role of surface transport in relation to air quality and carbon. The airport surface access strategy must contain specific targets for maximising the proportion of journeys made to the airport by public transport, cycling or walking. The strategy should also contain actions, policies and defined performance indicators for delivering against targets, and should include a mechanism whereby the Airport Transport Forum can oversee implementation of the strategy and monitor progress against targets alongside the implementation and operation of the preferred scheme.

5.10 The applicant should assess the implications of airport expansion on surface access network capacity using the WebTAG methodology stipulated in the Department for Transport guidance,[136] or any successor to such methodology. The applicant should consult Highways England, Network Rail and highway and transport authorities, as appropriate, on the assessment and proposed mitigation measures. The assessment should distinguish between the construction and operational project stages for the development comprised in the application.

5.11 The applicant should also consult with Highways England, Network Rail and relevant highway and transport authorities, and transport operators, to understand the target completion dates of any third party or external schemes included in existing rail, road or other transport investment plans. It will need to assess the effects of the preferred

[135] https://www.gov.uk/government/publications/aviation-policy-framework, paragraphs 4.20-4.21
[136] https://www.gov.uk/guidance/transport-analysis-guidance-webtag

scheme as influenced by such schemes and plans. Such consultation and assessment, both of third party schemes on which the preferred scheme depends, and others which interact with it, all of which may be subject to their own planning, funding and approval processes, must be understood in terms of implications of the timings for the applicant's own surface access proposals.

5.12 The applicant will need to demonstrate that Highways England, Network Rail and any relevant highway and transport authorities and transport providers have been consulted, and are content with the deliverability of any new transport schemes or other changes required to existing links to allow expansion within the timescales required for the preferred scheme as a whole, the requirements of the Airports NPS and other statutory requirements. This includes changes to the M25 to allow a new runway to cross the motorway, local road changes, and improvements including the diversion of the A4 and A3044, changes to the Colnbrook Freight branch railway and on-airport station works and safeguarding. On the strategic road network, it will be important to ensure that any changes to the M25 which the applicant proposes will be implemented consistently with the Secretary of State's statutory directions and guidance set out in Highways England's licence. This includes ensuring that sufficient provision is made to accommodate flexibility and future-proofing in planning the long-term development, improvement and operation of Highways England's network.

5.13 For schemes and related surface access proposals or other works impacting on the strategic road network, the applicant should have regard to DfT Circular 02/2013, *The Strategic Road Network and the delivery of sustainable development*[137] (or prevailing policy), and the National Networks NPS. This sets out the way in which the highway authority for the strategic road network will engage with communities and the development industry to deliver sustainable development and economic growth, whilst safeguarding the primary function and purpose of the network.

5.14 The surface access systems and proposed airport infrastructure may have the potential to result in severance in some locations. Where appropriate, the applicant should seek to deliver improvements or mitigation measures that reduce community severance and improve accessibility.

Mitigation

5.15 In its application, the applicant should set out the mitigation measures that it considers are required to minimise and mitigate the effect of expansion on existing surface access arrangements.

5.16 The applicant should demonstrate in its assessment that the proposed surface access strategy will support the additional transport demands generated by airport expansion. This should be appropriately secured.

5.17 Any application for development consent and accompanying airport surface access strategy must include details of how the applicant will increase the proportion of journeys made to the airport by public transport, cycling and walking to achieve a public transport mode share of at least 50% by 2030, and at least 55% by 2040 for passengers. The applicant should also include details of how, from a 2013 baseline level, it will achieve a 25% reduction of all staff car trips by 2030, and a reduction of 50% by 2040.[138]

5.18 The applicant should commit to annual public reporting on performance against these specific targets. The airport surface access strategy should consider measures and

[137] https://www.gov.uk/government/publications/strategic-road-network-and-the-delivery-of-sustainable-development
[138] These mode share targets are derived from *Heathrow Airport Ltd. Statement of Principles*, part 5, paragraph 1.6 https://www.gov.uk/government/publications/heathrow-airport-limited-statement-of-principles

incentives which could help to manage demand by car users travelling to and from the airport, as well as physical infrastructure interventions, having at all times due regard to the effect of its strategy on the surrounding area and transport networks. The strategy should also include an assessment of the feasibility of the measures proposed as well as the benefits and disbenefits related to those measures, including any implications for Highways England, Network Rail and affected relevant highway authorities and transport providers. These measures could be used to help achieve mode share targets and should be considered in conjunction with measures to mitigate air quality impacts as described in the Airports NPS.

5.19 The Government expects the applicant to secure the upgrading or enhancing of road, rail or other transport networks or services which are physically needed to be completed to enable the Northwest Runway to operate. This includes works to the M25, local road changes and improvements including the diversion of the A4 and A3044, and on-airport station works and safeguarding, as set out in more detail in paragraph 5.12.

5.20 Where a surface transport scheme is not solely required to deliver airport capacity and has a wider range of beneficiaries, the Government, along with relevant stakeholders, will consider the need for a public funding contribution alongside an appropriate contribution from the airport on a case by case basis. The Government recognises that there may be some works which may not be required at the time the additional runway opens, but will be needed as the additional capacity becomes fully utilised. The same principle applies that, where a transport scheme is not solely required to deliver airport capacity, the Government, along with relevant stakeholders, will consider the need for a public funding contribution alongside an appropriate contribution from the airport on a case by case basis.

Decision making

5.21 The applicant's proposals will give rise to impacts on the existing and surrounding transport infrastructure. The Secretary of State will consider whether the applicant has taken all reasonable steps to mitigate these impacts during both the development and construction phase and the operational phase. Where the proposed mitigation measures are insufficient to effectively offset or reduce the impact on the transport network, arising from expansion, of additional passengers, freight operators and airport workers, the Secretary of State will impose requirements on the applicant to accept requirements and / or obligations to fund infrastructure or implement other measures to mitigate the adverse impacts, including air quality.

5.22 Provided the applicant is willing to commit to transport planning obligations to satisfactorily mitigate transport impacts identified in the transport assessment (including environment and social impacts), with costs being considered in accordance with the Department for Transport's policy on the funding of surface access schemes, development consent should not be withheld on surface access grounds.

Air quality

Introduction

5.23 Increases in emissions of pollutants during the construction or operational phases of the scheme could result in the worsening of local air quality. Increased emissions can contribute to adverse impacts on human health and on the natural environment.

5.24 The European Union has established common, health-based and ecosystem based ambient concentration limit values for the main pollutants in the Ambient Air Quality Directive (2008/50/EC) ('the Air Quality Directive'),[139] which member states are required to meet by specified dates.

5.25 Where compliance by those dates has not been achieved, the member state is required to put in place an action plan showing how the period of exceedance in each non-compliant area will be kept as short as possible. In December 2015, the UK submitted its national air quality plan for nitrogen dioxide, including a zonal plan for Greater London and the South East, for the approval of the European Commission.

5.26 In November 2016 the High Court ordered the Government to produce a modified air quality plan that delivers compliance in the shortest possible time. The Government published a final, modified air quality plan on 26 July 2017. The European Commission were notified of this plan on 31 July 2017.[140]

5.27 Other relevant legislation includes the fourth daughter Air Quality Directive (2004/107/EC), which sets targets for levels in outdoor air of certain toxic heavy metals and polycyclic aromatic hydrocarbons, and the National Emission Ceilings Directive (2016/2284/EU),[141] which sets national emission limits for a range of atmospheric pollutants.

5.28 Air quality impacts are generated by all types of infrastructure development to varying degrees, and the geographical extent and distribution can cover a large area. At Heathrow Airport in 2015, aircraft movements were modelled to have contributed 17% on average to local NOx concentrations at nearby roadside locations. Road transport, by comparison, accounted for 64% of NOx concentrations in the same areas. Off-road transport and mobile machinery (a category which would include airside vehicles) contributed 5%[142].

5.29 The Airports Commission identified (and in some cases quantified the impact of) a number of measures that would help mitigate any negative impacts on air quality.[143] In addition, for the Heathrow Northwest Runway scheme, the Airports Commission recommended the following supporting measures:

- That Heathrow Airport should be held to performance targets to increase the percentage of employees and passengers accessing the airport by public transport; and
- That the introduction of a congestion or access charge for road vehicles should be considered.

5.30 The Airports Commission undertook extensive analysis on air quality and concluded that expansion could take place within legal obligations (including in a high demand growth scenario). The Department for Transport conducted a study of the implications of the Government's 2015 national air quality plan on the conclusions of the Airports Commission's air quality assessment.[144]

5.31 Since this work was completed in June 2016, updated international evidence on vehicle emission forecasts was published at the end of September 2016. The Department for Transport has conducted further analysis to assess the impact that this updated evidence base would have on estimated compliance with EU limit values of

[139] The Ambient Air Quality Directive (2008/50/EC) was brought into law in England through the Air Quality Standards Regulations 2010
[140] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633270/air-quality-plan-detail.pdf
[141] This Directive succeeds an earlier National Emissions Ceilings Directive (2001/81/EC) and contains transitional provisions
[142] Based on 2015 data from the Pollution Climate Mapping Model for roads affected by Heathrow emissions
[143] https://www.gov.uk/government/consultations/airports-commission-air-quality-assessment
[144] https://www.gov.uk/government/publications/airport-expansion-further-analysis-of-air-quality-data

expansion options at Heathrow Airport and Gatwick Airport. This analysis has been updated to take account of the revised aviation demand forecasts and the Government's final air quality plan. The result of this analysis helped inform the Government's view that, with a suitable package of policy and mitigation measures, including the Government's modified air quality plan, the Heathrow Northwest Runway scheme would be capable of being delivered without impacting the UK's compliance with air quality limit values.

Applicant's assessment

5.32 The applicant should undertake an assessment of the project, to be included as part of the environmental statement, demonstrating to the Secretary of State that the construction and operation of the Northwest Runway will not affect the UK's ability to comply with legal obligations. Failure to demonstrate this will result in refusal of development consent.

5.33 The environmental statement should assess:

- Existing air quality levels for all relevant pollutants referred to in the Air Quality Standards Regulations 2010 and the National Emission Ceilings Regulations 2002 (as amended) or referred to in any successor regulations;
- Forecasts of levels for all relevant air quality pollutants at the time of opening, (a) assuming that the scheme is not built (the 'future baseline'), and (b) taking account of the impact of the scheme, including when at full capacity; and
- Any likely significant air quality effects of the scheme, their mitigation and any residual likely significant effects, distinguishing between those applicable to the construction and operation of the scheme including any interaction between construction and operational changes and taking account of the impact that the scheme is likely to cause on air quality arising from road and other surface access traffic.

5.34 Defra publishes future national projections of air quality based on evidence of future emissions. Projections may be updated as the evidence base changes. The applicant's assessment should, in so far as practicable, be based on the latest available projections.

Mitigation

5.35 The Secretary of State will need to be satisfied that the mitigation measures put forward by the applicant are acceptable, including at the construction stage. A management / project plan may help record and secure mitigation measures.

5.36 Mitigation measures may affect the project design, layout, construction and operation, and / or may comprise measures to improve air quality in pollution hotspots beyond the immediate locality of the scheme.

5.37 While the precise package of mitigations should be subject to consultation with local communities and relevant stakeholders to ensure the most effective measures are taken forward, an extensive range of mitigation measures is likely to be required.

5.38 In addition, Heathrow Airport should continue to strive to meet its public pledge to have landside airport-related traffic no greater than today. To achieve this, it should set out and regularly review its plans to meet the mode share targets set at paragraph 5.17 above. Heathrow Airport should also develop and keep under review plans to improve the impact of road freight serving the airport.

5.39 Other mitigation measures which may be put forward by the applicant could include, but are not limited to:

- Landing charges structured to reward airlines for operating cleaner flights (for example NOx emissions charging);
- Zero- or low-emission hybrid or electric vehicle use (ultra-low emission vehicles), charging and fuel facilities;
- Reduced or single engine taxiing (improved taxiing efficiency);
- Reducing emissions from aircraft at the gate (for example installation of fixed electrical ground power and preconditioned air to aircraft stands to reduce the use of auxiliary power unit);
- Modernised heating supplies in airport buildings;
- Changes to the layout of surface access arrangements;
- Traffic restrictions and / or traffic relocation around sensitive areas;
- An emissions-based access charge; and
- Physical means, including barriers to trap or better disperse emissions and speed control on roads.

5.40 Mitigation measures at the construction stage should also be provided and draw on best practice from other major construction schemes, including during the procurement of contractors. Specific measures could include but are not limited to:

- Development of a construction traffic management plan (which may include the possible use of rail and consolidation sites or waterways);
- The use of low emission construction plant / fleet, fitting of diesel particulate filters, and use of cleaner engines;
- The use of freight consolidation sites;
- Active workforce management / a worker transport scheme;
- Construction site connection to grid electricity to avoid use of mobile generation; and
- Selection of construction material to minimise distance of transport and increase recycling percentages of the material where appropriate.

5.41 The implementation of mitigation measures may require working with partners to support their delivery.

Decision making

5.42 The Secretary of State will consider air quality impacts over the wider area likely to be affected, as well as in the vicinity of the scheme. In order to grant development consent, the Secretary of State will need to be satisfied that, with mitigation, the scheme would be compliant with legal obligations that provide for the protection of human health and the environment.

5.43 Air quality considerations are likely to be particularly relevant where the proposed scheme:

- is within or adjacent to Air Quality Management Areas,[145] roads identified as being above limit values, or nature conservation sites (including Natura 2000 sites and Sites of Special Scientific Interest);
- would have effects sufficient to bring about the need for new Air Quality Management Areas or change the size of an existing Air Quality Management Area, or bring about changes to exceedances of the limit values, or have the potential to have an impact on nature conservation sites; and
- after taking into account mitigation, would lead to a significant air quality impact in relation to Environmental Impact Assessment and / or to a deterioration in air quality in a zone or agglomeration.

Noise

Introduction

5.44 The impact of noise from airport expansion is a key concern for communities affected, and the Government takes this issue very seriously. High exposure to noise is an annoyance, can disturb sleep, and can also affect people's health. Aircraft operations are by far the largest source of noise emissions from an airport, although noise will also be generated from ground operations and surface transport, and during the construction phase of a scheme.

5.45 Aircraft noise is not only determined by the number of aircraft overhead, but also by engine technologies and airframe design, the paths the aircraft take when approaching and departing from the airport, and the way in which the aircraft are flown.

5.46 Over recent decades, there have been reductions in aviation noise due to technological and operational improvements, and this trend is expected to continue.[146] New technology is already making aircraft quieter. Newer generation aircraft coming into service have a noise footprint typically 50% smaller on departure than the ones they are replacing, and at least 30% smaller on arrival. In addition, further opportunities for noise reductions are expected in the next decade as part of the UK airspace modernisation programme. One of the key benefits of this programme is expected to be "reduced noise from aircraft overflying communities, with less 'holding' at lower altitudes".[147] However, evidence has shown that people's sensitivity to noise has increased in recent years, and there has been growing evidence that exposure to high levels of aircraft noise can adversely affect people's health.[148] Expansion will lead to a rise in the number of flights in the local area compared to a no expansion scenario.

5.47 The Government wants to strike a fair balance between the negative impacts of noise (on health, amenity, quality of life and productivity) and the positive impacts of flights. There is no European or national legislation which sets legally binding limits on aviation noise emissions. Major airports are, however, under a legal obligation[149] to

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[145] https://uk-air.defra.gov.uk/aqma/

[146] *The Sustainable Aviation Noise Roadmap, A Blueprint for Managing Noise from Aviation Sources to 2050*: http://www.sustainableaviation.co.uk/road-maps/

[147] UK Airspace Policy: A framework for balanced decisions on the design and use of airspace, p21, para 3.9, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/588186/uk-airspace-policy-a-framework-for-balanced-decisions-on-the-design-and-use-of-airspace-web-version.pdf

[148] *CAP 1164, Aircraft noise, sleep disturbance and health effects 2014*: http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=6275
CAP 1506, Survey of noise attitudes 2014: Aircraft
http://www.gov.uk/government/publications/survey-of-attitudes-to-aviation-noise

[149] The EU Environmental Noise Directive 2002/49 which is implemented in England by the Environmental Noise (England) Regulations 2006 (S.I. 2006/2238 as amended)

develop strategic noise maps and produce Noise Action Plans based on those maps, on a five yearly basis. They are also required to review and, if necessary, revise action plans when a major development occurs affecting the existing noise situation. In addition, the Government already expects the noise-designated airports (Heathrow, Gatwick and Stansted) to produce noise exposure maps on an annual basis.

5.48 The International Civil Aviation Organisation introduced the concept of a 'Balanced Approach' to noise management (resolution A33/7). This is given legal effect in the UK through EU Regulation 598/2014.[150]

5.49 The Airports Commission undertook a thorough assessment of the noise impacts of the proposed development. The Airports Commission used a "noise scorecard" to assess the noise impacts of the scheme in 2030, 2040 and 2050.[151] The noise scorecard included both conventional metrics, which assess noise levels over a period of time (daytime, night time and 24-hour), and more innovative metrics that assess the number of times a location is overflown by aircraft whose noise impacts exceed a specified level.

5.50 The Airports Commission's assessment was based on 'indicative' flight path designs, which the Government considers to be a reasonable approach at this stage in the process. Precise flight path designs can only be defined at a later stage after detailed airspace design work has taken place. This work will need to consider the various options available to ensure a safe and efficient airspace which also mitigates the level of noise disturbance. Once the design work has been completed, the airspace proposal will be subject to extensive consultation as part of the separate airspace decision making process established by the Civil Aviation Authority.

5.51 The Airports Commission concluded that "expansion at Heathrow must be taken forward with a firm guarantee that the airport and its airlines will be held to the very highest standards of noise performance". In addition, the Airports Commission stated that "the airport should not be allowed to expand without appropriate conditions being put in place in respect of its noise impacts".[152]

Applicant's assessment

5.52 Pursuant to the terms of the Environmental Impact Assessment Regulations,[153] the applicant should undertake a noise assessment for any period of change in air traffic movements prior to opening, for the time of opening, and at the time the airport is forecast to reach full capacity, and (if applicable, being different to either of the other assessment periods) at a point when the airport's noise impact is forecast to be highest. This should form part of the environmental statement. The noise assessment should include the following:

- A description of the noise sources;
- An assessment of the likely significant effect of predicted changes in the noise environment on any noise sensitive premises (including schools and hospitals) and noise sensitive areas (including National Parks and Areas of Outstanding Natural Beauty);
- The characteristics of the existing noise environment, including noise from aircraft, using noise exposure maps, and from surface transport and ground operations

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[150] Regulation (EU) No 598/2014 of the European Parliament and of the Council on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC
[151] *Airports Commission: Final Report*, p170-171
[152] *Airports Commission: Final Report*, p276
[153] Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (S.I. 2017/572)

associated with the project, the latter during both the construction and operational phases of the project;

- A prediction on how the noise environment will change with the proposed project; and
- Measures to be employed in mitigating the effects of noise.

These should take into account construction and operational noise (including from surface access arrangements) and aircraft noise. The applicant's assessment of aircraft noise should be undertaken in accordance with the developing indicative airspace design. This may involve the use of appropriate design parameters and scenarios based on indicative flightpaths.

5.53 Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. For the prediction, assessment and management of construction noise, reference should be made to any British Standards and other guidance which give examples of mitigation strategies. In assessing the likely significant impacts of aircraft noise, the applicant should have regard to the noise assessment principles, including noise metrics, set out in the national policy on airspace.

Mitigation

5.54 Noise management at airports where a noise problem has been identified is subject to the concept of a 'Balanced Approach', referred to above. EU Regulation 598/2014, which adopts the Balanced Approach,[154] also lays down a procedure for the adoption of noise-related operating restrictions, in particular a requirement for prior consultation.

5.55 The Government recognises that aircraft noise is a significant concern to communities affected and that, as a result of additional runway capacity, noise- related action will need to be taken. Such action should strike a fair balance between the negative impacts of noise and positive impacts of flights.

5.56 The Government also recognises that predictable periods of relief from aircraft noise (known as respite) are important for communities affected, and that noise at night is widely regarded as the least acceptable aspect of aviation noise for those communities, with the costs on communities of aircraft noise during the night (particularly the health costs associated with sleep disturbance) being higher.

5.57 While the package and detail of noise mitigation measures should be subject to consultation with local communities and other stakeholders to ensure the most appropriate and effective measures are taken forward, in the context of Government policy on sustainable development, the Government expects the applicant to make particular efforts to avoid significant adverse noise impacts and mitigate other adverse noise impacts as a result of the Northwest Runway scheme and Heathrow Airport as a whole.

5.58 The Secretary of State will consider whether the mitigation measures put forward by the applicant following consultation are acceptable. The noise mitigation measures should ensure the impact of aircraft noise is limited and, where possible, reduced compared to the 2013 baseline assessed by the Airports Commission.[155]

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[154] For the purposes of EU Regulation 598/2014, an airport means an airport which has more than 50,000 civil aircraft movements per calendar year (a movement being a take-off or landing), on the basis of the average number of movements in the last three calendar years before the noise assessment

[155] With reference to the 2013 baseline for the 54 decibel LAeq, 16h noise contour assessed by the Airports Commission. LAeq,16h indicates the annual average noise levels for the 16-hour period between 0700 – 2300

5.59 The applicant should specifically seek to deliver the mitigation measures set out in paragraphs 5.60-5.62 below.

5.60 The applicant should put forward plans for a noise envelope. Such an envelope should be tailored to local priorities and include clear noise performance targets. As such, the design of the envelope should be defined in consultation with local communities and relevant stakeholders, and take account of any independent guidance such as from the Independent Commission on Civil Aviation Noise. The benefits of future technological improvements should be shared between the applicant and its local communities, hence helping to achieve a balance between growth and noise reduction. Suitable review periods should be set in consultation with the parties mentioned above to ensure the noise envelope's framework remains relevant.

5.61 The applicant should put forward plans for a runway alternation scheme that provides communities affected with predictable periods of respite (though the Government acknowledges that the duration of periods of respite that currently apply will be reduced). Predictability should be afforded to the extent that this is within the airport operator's control.[156] The details of any such scheme, including timings, duration and scheduling, should be defined in consultation with local communities and relevant stakeholders, and take account of any independent guidance such as from the Independent Commission on Civil Aviation Noise.

5.62 The Government also expects a ban on scheduled night flights for a period of six and a half hours, between the hours of 11pm and 7am, to be implemented.[157] The rules around its operation, including the exact timings of such a ban, should be defined in consultation with local communities and relevant stakeholders, in line with EU Regulation 598/2014. In addition, outside the hours of a ban, the Government expects the applicant to make particular efforts to incentivise the use of the quietest aircraft at night.

5.63 It is recognised that Heathrow Airport already supports a number of initiatives to mitigate aircraft noise, such as developing quieter operating procedures (like steeper descent approaches) and keeping landing gear up as long as possible. The applicant is expected to continue to do so, and to explore all opportunities to mitigate operational noise in line with best practice. The implementation of such measures may require working with partners to support their delivery.

5.64 Noise mitigation measures at the construction stage should also be provided. These should draw on best practice from other major construction schemes, with due regard given to any relevant British Standards and other guidance, and should be taken into account during the procurement of contractors.

5.65 Other measures to mitigate noise during the construction and operation of the development may include one or more of the following:

- Reducing noise at point of generation and containment of noise generated;
- Where possible, optimising the distance between source and noise-sensitive receptors, and incorporating good design to minimise noise transmission through screening by natural barriers or other buildings; and
- Restricting activities allowed on the site.

5.66 The Secretary of State will expect the applicant to put forward proposals as to how these measures may be secured and enforced, including the bodies who may enforce

[156] Examples of circumstances outside of an airport operator's control might be severe weather disruption and similar events

[157] 11pm to 7am is the standard night period used in noise measurement, and is used in World Health Organisation guidelines and the Environmental Noise Directive

the measures. These bodies might include the Secretary of State, local authorities (including those over a wider area), and / or the Civil Aviation Authority.

Decision making

5.67 The proposed development must be undertaken in accordance with statutory obligations for noise.[158] Due regard must have been given to national policy on aviation noise, and the relevant sections of the Noise Policy Statement for England,[159] the National Planning Policy Framework,[160] and the Government's associated planning guidance on noise.[161] However, the Airports NPS must be used as the primary policy on noise when considering the Heathrow Northwest Runway scheme, and has primacy over other wider noise policy sources.

5.68 Development consent should not be granted unless the Secretary of State is satisfied that the proposals will meet the following aims for the effective management and control of noise, within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life from noise;
- Mitigate and minimise adverse impacts on health and quality of life from noise; and
- Where possible, contribute to improvements to health and quality of life.

Carbon emissions

Introduction

5.69 The Planning Act 2008 requires that a national policy statement must give reasons for the policy set out in the statement and an explanation of how the policy set out in the statement takes account of Government policy relating to the mitigation of, and adaptation to, climate change.[162] The Government has a number of international and domestic obligations to limit carbon emissions. Emissions from both the construction and operational phases of the project will be relevant to meeting these obligations.

5.70 The Government's key objective on aviation emissions, as outlined in the Aviation Policy Framework, is to ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions.[163] This must be achieved while minimising the risk of putting UK businesses at a competitive international disadvantage. The development of the Heathrow Northwest Runway scheme being considered under the Airports NPS does not override this objective.

5.71 The UK's obligations on greenhouse gas emissions are set under the 2008 Climate Change Act. Under this framework, the UK has a 2050 target to reduce its greenhouse gas emissions by at least 80% on 1990 levels, and has a series of five year carbon budgets on the way to 2050.

Coverage of aviation emissions under the UK's Climate Change Act

5.72 Whilst UK domestic aviation emissions are included in the 2050 target, international aviation emissions are not currently formally included within the UK's 'net carbon account' for greenhouse gas emissions and are therefore not included in the 2050 target as defined by the Climate Change Act, nor within the first five carbon budgets. The Climate Change Act says that the Government must "take into account" the

[158] EU Regulation 598/2014; The Environmental Noise (England) Regulations 2006
[159] Noise policy statement for England, March 2010, https://www.gov.uk/government/publications/noise-policy-statement-for-england
[160] National Planning Policy Framework, March 2012, paragraph 123, or any successor document
[161] https://www.gov.uk/guidance/noise--2
[162] Planning Act 2008, section 5(8)
[163] *Aviation Policy Framework*, paragraph 12

"estimated amount of reportable emissions from international aviation for the budgetary period or periods in question" when setting carbon budgets. The Committee on Climate Change has interpreted the requirement to take these emissions into account as requiring the UK to aim to meet a 2050 target which includes these emissions, and has made its recommendations for the levels of the existing carbon budgets on this basis.

5.73 The Government has accepted the Committee on Climate Change's recommendations on the first five carbon budgets. The fifth carbon budget, for the period 2028-2032, was set in July 2016 in line with the Committee on Climate Change's advice. In effect, this means that carbon budgets for other sectors of the UK economy have been set at a level which the Committee on Climate Change considers is consistent with meeting the overall 2050 target when international aviation emissions are included.

Impacts

5.74 The carbon impact of the proposed development falls into four areas: increased emissions from air transport movements (both international and domestic) as a result of increased demand, emissions from airport buildings and ground operations, emissions from surface transport accessing the expanded airport, and emissions caused by construction. The first is by far the largest of these impacts.

5.75 The Airports Commission used two sets of carbon scenarios: one in which a cap is imposed on UK aviation emissions in line with the Committee on Climate Change's planning assumption of 37.5 million tonnes of CO_2 in 2050; and another in which an international trading mechanism allows carbon emissions from aviation to be offset by paying for emissions reductions in other sectors of the global economy. The analysis also assumed certain carbon-limiting developments largely outside the applicant's control. These include growth in numbers of more fuel-efficient aircraft, increasing use of biofuels, and other airline operational measures.

Applicant's assessment

5.76 Pursuant to the terms of the Environmental Impact Assessment Regulations,[164] the applicant should undertake an assessment of the project as part of the environmental statement, to include an assessment of any likely significant climate factors. The applicant should provide evidence of the carbon impact of the project (including embodied carbon), both from construction and operation, such that it can be assessed against the Government's carbon obligations, including but not limited to carbon budgets. The applicant should quantify the greenhouse gas impacts before and after mitigation to show the impacts of the proposed mitigation. This will require emissions to be split into traded sector and non-traded sector emissions, and for a distinction to be made between international and domestic aviation emissions.

5.77 As far as possible, the applicant's assessment should also seek to quantify impacts including:

- Emissions from surface access due to airport and construction staff;
- Emissions from surface access due to freight and retail operations and construction site traffic.
- Emissions from surface access due to airport passengers / visitors; and
- Emissions from airport operations including energy and fuel use.

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[164] Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (S.I. 2017/572). Regulation 5(2)(c) refers to the significant effects of the proposed development on, among other factors, climate.

This should be undertaken in both a ‘do minimum’ and also in the ‘do something’ scenario for the opening, peak operation, and worst case scenarios.

Mitigation

5.78 The Secretary of State will need to be satisfied that the mitigation measures put forward by the applicant are acceptable, including at the construction stage. A management / project plan may help clarify and secure mitigation at this stage. The applicant is expected to take measures to limit the carbon impact of the project, which may include, but are not limited to:

- Zero or low-emission hybrid or electric vehicle use (ultra-low emission vehicles), charging and fuel facilities;
- Reduced engine taxiing (improved taxiing efficiency);
- Reducing emissions from aircraft at the gate;
- Reduced emissions from airport buildings (for example from lower carbon heating);
- Changes to the layout of surface access arrangements; and
- Encouraging increased use of public transport by staff and passengers.

5.79 Aircraft are expected to become cleaner as technology and standards improve and fleets evolve. It is recognised that the applicant already supports a number of initiatives to reduce the carbon emissions from flights, such as reduced-engine taxiing and ground-towing, and airspace and navigational reform.

5.80 Mitigation measures at the construction stage should also be provided and draw on best practice from other major construction schemes, including during the procurement of contractors. Specific measures could include but are not limited to:

- Development of a construction traffic management plan (which may include the possible use of rail and consolidation sites);
- Transport of materials to site by alternative modes to road (for example by rail or water);
- Increased efficiency in use of construction plant;
- Use of energy efficient site accommodation;
- Reduction of waste, and the transport of waste;
- Construction site connection to grid electricity to avoid use of mobile generation;
- Selection of construction material to utilise low carbon options; and
- Selection of construction material to minimise distance of transport.

5.81 The implementation of mitigation measures may require working with partners to support their delivery.

Decision making

5.82 Any increase in carbon emissions alone is not a reason to refuse development consent, unless the increase in carbon emissions resulting from the project is so significant that it would have a material impact on the ability of Government to meet its carbon reduction targets, including carbon budgets.

5.83 Evidence of appropriate mitigation measures (incorporating engineering plans on configuration and layout, and use of materials) in both design and construction should be presented as part of any application for development consent. The Secretary of

State will consider the effectiveness of such mitigation measures in order to ensure that, in relation to design and construction, the carbon footprint is not unnecessarily high. The Secretary of State's view of the adequacy of the mitigation measures relating to design, construction and operational phases will be a material factor in the decision making process.

Biodiversity and ecological conservation

Introduction

5.84 Biodiversity is the variety of plant and animal life in the world or in a particular habitat, and encompasses all species of plants and animals and the complex ecosystems of which they are a part. Government policy for the natural environment, including on biodiversity, is set out in the *Natural Environment White Paper*.[165] The biodiversity section in the *Natural Environment White Paper* sets out a vision of moving progressively from new biodiversity loss to net gain, by supporting healthy, well-functioning ecosystems and establishing more coherent ecological networks that are more resilient to current and future pressures. It is also a requirement of the Water Framework Directive to protect and enhance biodiversity associated with the water environment. Geological conservation relates to the sites that are designated for their geology and / or geomorphological importance.[166]

5.85 The Government's biodiversity strategy is set out in *Biodiversity 2020: A Strategy for England's wildlife and ecosystem services*.[167] Its aim is to halt overall biodiversity loss, support healthy, well-functioning ecosystems, and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people. The contribution that the planning system should make to enhancing the local and natural environment, including establishing coherent ecological networks, is set out in the National Planning Policy Framework, to which the applicant should also refer.[168]

5.86 The National Planning Policy Framework states that pursuing sustainable development involves seeking positive improvements in the quality of the built, natural and historic environment, as well as in people's quality of life. This includes moving from a net loss of biodiversity to achieving net gains for nature.[169]

5.87 The wide range of legislative provisions at the international and national level that can impact on planning decisions affecting biodiversity and ecological conservation is set out in the Planning Practice Guidance on biodiversity and ecosystems.[170] This includes a description of the potential impacts on internationally, nationally and locally protected sites which may arise through development, and should therefore be considered through further assessment.

5.88 Airport development may require the netting of open watercourses to manage the risk of bird strike, which may have a detrimental impact on water environment and biodiversity.

Applicant's assessment

5.89 The applicant should ensure that the environmental statement submitted with its application for development consent clearly sets out any likely significant effects on

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165 https://www.gov.uk/government/publications/the-natural-choice-securing-the-value-of-nature
166 A list of designated sites is included in the Geological Conservation Review held by the Joint Nature Conservation Committee
167 https://www.gov.uk/government/publications/biodiversity-2020-a-strategy-for-england-s-wildlife-and-ecosystem-services
168 National Planning Policy Framework, March 2012, paragraph 109, or any successor document
169 National Planning Policy Framework, March 2012, paragraph 9, or any successor document
170 http://planningguidance.communities.gov.uk/blog/guidance/natural-environment/biodiversity-ecosystems-and-green-infrastructure/

internationally, nationally and locally designated sites of ecological or geological importance, protected species, and habitats and other species identified as being of principal importance for the conservation of biodiversity.

5.90 The Environmental Impact Assessment should reflect the principles of *Biodiversity 2020* and identify how the effects on the natural environment will be influenced by climate change, and how ecological networks and their physical and biological process will be maintained.

5.91 The applicant should show how the project has taken advantage of and maximised opportunities to conserve biodiversity and geological conservation interests.

Mitigation

5.92 The Secretary of State will consider what requirements should be attached to any consent and / or in any planning obligations entered into in order to ensure that mitigation measures are delivered and monitored for their effectiveness.

5.93 The Secretary of State will take account of any mitigation measures agreed between the applicant and Natural England, and whether Natural England has granted or refused, or intends to grant or refuse, any relevant licences, including protected species mitigation licences.

5.94 The applicant's proposal should address the mitigation hierarchy (which supports efforts to conserve and enhance biodiversity), which is set out in the National Planning Policy Framework.[171]

5.95 Compensation ratios relating to the effects of the preferred scheme should be considered in more detail during the design. The application of 2:1 compensation ratio is considered to represent the minimum requirement. However, there are other mechanisms for establishing compensation ratios, such as Defra's biodiversity offsetting metric. Equally, it is important to note that habitat ratios form only one part of potential compensation which should be considered, and the location and quality of any compensation land is of key importance. In this regard, habitat creation, where required, should be focused on areas where the most ecological and ecosystems services benefits can be realised.

Decision making

5.96 As a general principle, and subject to the specific policies set out below and the Infrastructure Planning (Decisions) Regulations 2010,[172] development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives. The applicant may also wish to make use of biodiversity offsetting in devising compensation proposals to counteract any impacts on biodiversity which cannot be avoided or mitigated.[173] Where significant harm cannot be avoided or mitigated, as a last resort appropriate compensation measures should be sought. The development consent order, or any associated planning obligations, will need to make provision for the long term management of such measures.

5.97 In taking decisions, the Secretary of State will ensure that appropriate weight is attached to designated sites of international, national and local importance, protected

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[171] National Planning Policy Framework, March 2012, paragraph 118, or any successor document

[172] http://www.legislation.gov.uk/uksi/2010/305/regulation/7/made

[173] https://www.gov.uk/government/collections/biodiversity-offsetting Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for residual adverse biodiversity impacts arising from a development after mitigating measures have been taken. The goal of biodiversity offsets is to achieve no net loss and, preferably, a net gain of biodiversity

species, habitats and other species of principal importance for the conservation of biodiversity, and to biodiversity and geological interests within the wider environment.

International sites

5.98 The most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Regulations provide statutory protection for European sites and require an assessment of impacts upon such sites.[174] The Government considers that the following wildlife sites should have the same protection as European sites:

- Potential Special Protection Areas and possible Special Areas of Conservation;
- Listed or proposed Ramsar sites;[175] and
- Sites identified or required as compensatory measures for adverse effects on European sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.

5.99 At this stage, it is not possible to rule out adverse effects of the Heathrow Northwest Runway scheme, given that more detailed project design information, and detailed proposals for mitigation, are not presently available. However, the applicant will need to demonstrate that Article 6(3) or 6(4) of the Habitats Directive are complied with in order to satisfy the competent authority that development consent can be granted on that basis.

Sites of Special Scientific Interest

5.100 Many Sites of Special Scientific Interest are also designated as sites of international importance and will be protected accordingly. Those that are not, or those features of Sites of Special Scientific Interest that are not covered by an international designation, will be given a high degree of protection. All National Nature Reserves are notified as Sites of Special Scientific Interest.

5.101 Where a proposed development on land within or outside a Site of Special Scientific Interest is likely to have an adverse effect on the site (either individually or in combination with other developments), development consent should not normally be granted. Where an adverse effect on the site's notified special interest features is likely, an exception should be made only where the benefits of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest. The Secretary of State will ensure that the applicant's proposals to mitigate the harmful aspects of the development and, where possible, to ensure the conservation and enhancement of the site's biodiversity or geological interest, are acceptable. Where necessary, requirements and / or planning obligations should be used to ensure these proposals are delivered.

Regional and local sites

5.102 Sites of regional and local biodiversity interest (which include Local Nature Reserves, Local Wildlife Sites and Nature Improvement Areas) have a fundamental role to play in meeting overall national biodiversity targets, contributing to the quality of life and the wellbeing of the community, and supporting research and education. The Secretary of State will give due consideration to such regional or local designations. However,

[174] This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in Regulation 8 of the Conservation of Habitats and Species Regulations 2010

[175] Potential Special Protection Areas, possible Special Areas of Conservation and proposed Ramsar sites are sites on which Government has initiated public consultation on the scientific case for designation as a Special Protection Area, candidate Special Area of Conservation or Ramsar site

given the need for new infrastructure, these designations should not be used in themselves to refuse development consent, although adequate compensation should always be considered, and ecological corridors and their physical processes should be maintained as a priority to mitigate widespread impacts.

Irreplaceable habitats including ancient woodland and veteran trees

5.103 Ancient woodland is a valuable biodiversity resource both for its diversity of species and for its longevity as woodland. Once lost, it cannot be recreated. The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss. Aged or veteran trees found outside ancient woodland are also particularly valuable for biodiversity and their loss should be avoided.[176] Where such trees would be affected by development proposals, the applicant should set out proposals for their conservation or, where their loss is unavoidable, the reasons for this.

Biodiversity within and around developments

5.104 The proposed development comprised in the preferred scheme should provide many opportunities for building in beneficial biodiversity as part of good design. When considering proposals, the Secretary of State will consider whether the applicant has maximised such opportunities in and around developments, and particularly to establishing and enhancing green infrastructure. The Secretary of State may use requirements or planning obligations where appropriate in order to ensure that such beneficial features are delivered.

Protection of other habitats and species

5.105 In addition to the habitats and species that are subject to statutory protection or international, regional or local designation, other habitats and species have been identified as being of principal importance for the conservation of biodiversity in England and Wales and therefore requiring conservation action. The Secretary of State will ensure that the applicant has taken measures to ensure that these other habitats and species are protected from the adverse effects of development. Where appropriate, requirements or planning obligations may be used in order to deliver this protection. The Secretary of State will refuse consent where harm to these other habitats, or species and their habitats, would result, unless the benefits of the development (including need) clearly outweigh that harm. In such cases, compensation will generally be expected to be included in the design proposals.

Land use including open space, green infrastructure and Green Belt

Introduction

5.106 Access to high quality open spaces and the countryside[177] and opportunities for sport and recreation can be a means of providing necessary mitigation and / or compensation requirements. Green infrastructure can enable developments to provide positive environmental and economic benefits.

[176] This does not prevent the loss of such trees where the decision maker is satisfied that their loss is unavoidable

[177] All open space of public value, including not just land but also areas of water (such as rivers, canals, lakes and reservoirs) which offer important opportunities for sport and recreation and can act as a visual amenity

5.107 Green Belts, defined in a development plan,[178] are situated around certain cities and built up areas, including London. The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open. The essential characteristics of Green Belts are their openness and their permanence. Further information on the purposes and protection of Green Belt is set out in the National Planning Policy Framework.[179]

5.108 Best and most versatile agricultural land is land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses such as biomass, fibres and pharmaceuticals. The National Planning Policy Framework sets out how local planning authorities should take into account the economic and other benefits of best and most versatile agricultural land.[180] Planning practice guidance for the natural environment provides additional guidance on best and most versatile agricultural land and soil issues.

5.109 Development of land will affect soil resources, including physical loss of and damage to soil resources, through land contamination and structural damage. Indirect impacts may also arise from changes in the local water regime, organic matter content, soil biodiversity and soil process.

5.110 Construction and operation of airport facilities is a potential source of contaminative substances (for example, through de-icing or leaks and spills of fuel). Where pre-existing land contamination is being considered through development, the objective is to ensure that the site is suitable for its intended use. Risks would require consideration in accordance with the contaminated land statutory guidance as a minimum.[181]

Applicant's assessment

5.111 The applicant should identify existing and proposed land uses[182] near the project, including any effects of replacing an existing development or use of the site with the proposed project or preventing a development or use on a neighbouring site from continuing. The applicant should also assess any effects of precluding a new development or use proposed in the development plan. The assessment should be proportionate to the scale of the preferred scheme and its likely impacts on such receptors.

5.112 Existing open space, sports and recreational buildings and land should not be developed unless the land is no longer needed or the loss would be replaced by equivalent or better provision in terms of quantity and quality in a suitable location. If the applicant is considering proposals which would involve developing such land, it should have regard to any local authority's assessment of need for such types of land and buildings.

5.113 During any pre-application discussions with the applicant, the local planning authority should identify any concerns it has about the impacts of the application on land use, having regard to the development plan and relevant applications and including, where relevant, whether it agrees with any independent assessment that the land is no longer needed. These are also matters that local authorities may wish to include in their Local Impact Report which can be submitted after an application for development consent has been accepted.

[178] Or else so designated under the Green Belt (London and Home Counties) Act 1938
[179] National Planning Policy Framework, March 2012, paragraphs 79-92, or any successor document
[180] National Planning Policy Framework, March 2012, paragraph 112, or any successor document
[181] https://www.gov.uk/government/publications/contaminated-land-statutory-guidance
[182] For example, where a planning application has been submitted

5.114 The general policies controlling development in the countryside apply with equal force in Green Belts but there is, in addition, a general presumption against inappropriate development within them. Such development should not be approved except in very special circumstances which are already the subject of Government guidance.[183] The applicant should therefore determine whether the proposal, or any part of it, is within an established Green Belt and, if so, whether its proposal may be considered inappropriate development within the meaning of Green Belt policy. Metropolitan Open Land and land designated a Local Green Space in a local or neighbourhood plan are subject to the same policies of protection as Green Belt, and inappropriate development should not be approved except in very special circumstances.

5.115 The applicant should take into account the economic and other benefits of best and most versatile agricultural land. Where significant development of agricultural land is demonstrated to be necessary, the applicant should seek to use areas of poorer quality land in preference to that of a higher quality. The applicant should also identify any effects, and seek to minimise impacts, on soil quality, taking into account any mitigation measures proposed.

5.116 For developments where land may be affected by contamination, or existing mitigation is in place in respect of historic contamination, the applicant should have regard to the statutory regime contained in Part IIA of the Environmental Protection Act 1990 and relevant Government guidance relating to or dealing with contaminated land.[184]

5.117 The applicant should safeguard any mineral resources on the proposed site for the preferred scheme as far as possible.

Mitigation

5.118 The applicant can minimise the direct effects of a project on the existing use of the proposed site, or proposed uses near the site, by the application of good design principles, including the layout of the project and the protection of soils during construction.[185]

5.119 Where green infrastructure is affected, the applicant should aim to ensure the functionality and connectivity of the green infrastructure network is maintained and any necessary works are undertaken, where possible, to mitigate any adverse impact and, where appropriate, to improve that network and other areas of open space, including appropriate access to National Trails and other public rights of way.

5.120 The Secretary of State must also consider whether mitigation of any adverse effects on green infrastructure or open space is adequately provided for by means of requirements, planning obligations, or any other means, for example to provide exchange land and provide for appropriate management and maintenance agreements. Any exchange land should be at least as good in terms of size, usefulness, attractiveness, quality and accessibility. Alternatively, where sections 131 and 132 of the Planning Act 2008 apply,[186] any replacement land provided under those sections will need to conform to the requirements of those sections.

5.121 Where the preferred scheme has an impact on a mineral safeguarding area, the Secretary of State must ensure that the applicant has put forward appropriate mitigation measures to safeguard mineral resources.

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[183] https://www.gov.uk/guidance/housing-and-economic-land-availability-assessment#paragraph_044
[184] https://www.gov.uk/government/collections/land-contamination-technical-guidance
[185] https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites
[186] http://www.legislation.gov.uk/ukpga/2008/29/section/131 and http://www.legislation.gov.uk/ukpga/2008/29/section/132

5.122 Where a project has a sterilising effect on land use, there may be scope for this to be mitigated through, for example, using the land for nature conservation or wildlife corridors.

5.123 Public rights of way, National Trails and other rights of access to land are important recreational facilities for walkers, cyclists and equestrians. The applicant is expected to take appropriate mitigation measures to address adverse effects on National Trails, other public rights of way and open access land and, where appropriate, to consider what opportunities there may be to improve access. In considering revisions to an existing right of way, consideration needs to be given to the use, character, attractiveness and convenience of the right of way. The Secretary of State should consider whether the mitigation measures put forward by an applicant are acceptable and whether requirements or other provisions in respect of these measures might be attached to any grant of development consent.

Decision making

5.124 The Secretary of State should not grant consent for development on existing open space, sports and recreational buildings and land, including playing fields, unless an assessment has been undertaken either by the local authority or independently, which has shown the open space or the buildings and land to be no longer needed, or the Secretary of State determines that the benefits of the project (including need) outweigh the potential loss of such facilities, taking into account any positive proposals made by the applicant to provide new, improved or compensatory land or facilities.

5.125 Where networks of green infrastructure have been identified in development plans, they should normally be protected from development and, where, possible, strengthened by or integrated within it. The Secretary of State will also have regard to the effect of the development upon and resulting from existing land contamination, as well as the mitigation proposed.

5.126 The Secretary of State will take into account the economic and other benefits of the best and most versatile agricultural land, and ensure the applicant has put forward appropriate mitigation measures to minimise impacts on soils or soil resources.

5.127 When located in the Green Belt, projects may comprise inappropriate development. Inappropriate development is by definition harmful to the Green Belt and there is a presumption against it except in very special circumstances. The Secretary of State will need to assess whether there are very special circumstances to justify inappropriate development. Very special circumstances will not exist unless the potential harm to the Green Belt by reason of inappropriateness, and any other harm, is clearly outweighed by other considerations. In view of the presumption against inappropriate development, the Secretary of State will attach substantial weight to the harm to the Green Belt, when considering any application for such development. In exchange for, or so as to ensure the reprovision of, lost Green Belt land,[187] the Secretary of State may require the provision of other land by the applicant, to be declared as Green Belt under the Green Belt (London and the Home Counties) Act 1938. The provision of such land should be in accordance with the National Planning Policy Framework or any successor document, and take into account relevant development plan policies.

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[187] The term “Green Belt land” refers to land designated as Green Belt land under a local development plan and/or land declared as Green Belt under the 1938 Act.

Home Office assets

Introduction

5.128 There are two Immigration Removal Centres (IRCs) to the north-west of Heathrow Airport, run as one facility, within the land shown inside the red line on the scheme boundary map (at Annex A). Detention at immigration removal centres plays a vital role as part of the infrastructure which allows the Government to maintain effective immigration control and secure the UK's borders. The IRCs are Harmondsworth IRC and the Colnbrook IRC.

5.129 Continuous service provision of the IRCs at Heathrow is necessary. This consideration extends to the need to provide appropriate road access to the IRCs.

Assessment

5.130 The applicant should show how it has considered the impacts of the project upon the existing IRCs. This should include the process in identifying alternative means of addressing the impact of the project on the IRCs, including the means by which they will be reprovided.

5.131 The applicant should discuss the provision to be made in substitution for the existing IRCs with the Home Office and any local authority whose area is likely to be affected by a replacement facility.

5.132 The applicant's assessment should also set out how a replacement IRC would function in relation to neighbouring land uses, as well as how it can best be accommodated without adversely affecting such uses. These are also matters which local authorities may wish to address in their local impact report, which can be submitted after an application for development consent has been submitted.

Decision making

5.133 The Secretary of State considers that replacement facilities in substitution for the affected IRCs should be provided prior to any works which may significantly interfere with the service and facilities provided by the existing IRCs. The Secretary of State will consider whether the applicant has taken all reasonable steps to mitigate impacts of the project on the existing IRCs. Where necessary, the Secretary of State will impose requirements or obligations upon the applicant to deliver suitable replacement facilities.

5.134 Provided that the applicant is willing to commit to appropriate provision of such facilities on a continuous service basis and with constant road access, and to mitigate the effect of the project on the existing and replacement IRCs, development consent should not be withheld on the grounds of its effects on the existing IRCs.

Resource and waste management

Introduction

5.135 Government policy on hazardous and non-hazardous waste is intended to protect human health and the environment by producing less waste and by using it as a resource wherever possible. Where this is not possible, waste management regulation ensures that waste is disposed of in a way that is least damaging to the environment and to human health.

5.136 Sustainable waste management is implemented through the waste hierarchy:

- Waste prevention;
- Preparing for reuse;
- Recycling;
- Other recovery, including energy recovery; and
- Disposal.

5.137 The targets for preparation for re-use and recycling of municipal waste (50%), and for construction and demolition waste (70%) set out by the Waste Framework Directive (2008/98/EC)[188] should be considered 'minimum acceptable practice' for the construction and operation of any new airport infrastructure. Exceeding these targets if possible by aiming for exemplar performance in resource efficiency and waste management is recommended, to align with the principles of the EU Action Plan for the Circular Economy.[189]

5.138 Large airport infrastructure projects may generate hazardous and non-hazardous waste during construction and operation. The Environment Agency's environmental permitting regime incorporates operational waste management controls for certain activities. When the applicant applies to the Environment Agency for an environmental permit, the Environment Agency will require the application to demonstrate that processes are in place to meet all relevant conditions.

5.139 In addition, the Heathrow Northwest Runway scheme would involve the removal of the Lakeside energy from waste plant.

5.140 Waste generated and sent to landfill during construction and operation will be an ongoing management issue, and will continue to have adverse effects on the environment into and beyond the operational phase. The principal adverse effects of sending waste to landfill include:

- Permanent loss of materials from potential use higher up the waste management hierarchy;
- Reduction of local and regional landfill capacity;
- Visual, noise, health and other nuisance impacts on local communities;
- Environmental degradation and pollution;
- Greenhouse gas emissions; and
- Environmental implications of transporting waste to landfill sites.

Applicant's assessment

5.141 The applicant should set out the arrangements that are proposed for managing any waste produced in the application for development consent. The arrangements described should include information on the proposed waste recovery and disposal system for all waste generated by the development. The applicant should seek to minimise the volume of waste sent for disposal unless it can be demonstrated that the alternative is the best overall environmental, social and economic outcome when considered over the whole lifetime of the project.

5.142 The effects of removing the Lakeside energy from waste plant upon capacity for treatment of waste will require assessment.

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188 http://ec.europa.eu/environment/waste/framework/
189 http://ec.europa.eu/environment/circular-economy/index_en.htm

Mitigation

5.143 The applicant should set out a comprehensive suite of mitigations to eliminate or significantly reduce the risk of adverse impacts associated with resource and waste management.

5.144 The Government recognises the role of the Lakeside Energy from Waste plant in local waste management plans. The applicant should make reasonable endeavours to ensure that sufficient provision is made to address the reduction in waste treatment capacity caused by the loss of the Lakeside Energy from Waste plant.

Decision making

5.145 The Secretary of State will consider the extent to which the applicant has proposed an effective process that will be followed to ensure effective management of hazardous and non-hazardous waste arising from all stages of the lifetime of the development. The Secretary of State should be satisfied that the process set out provides assurance that:

- Waste produced will be properly managed, both onsite and offsite;
- The waste from the proposed development can be dealt with appropriately by the waste infrastructure which is, or is likely to be, available. Such waste arising should not have an adverse effect on the capacity of existing waste management facilities to deal with other waste arising in the area; and
- Adequate steps have been taken to ensure that all waste arising from the site is subject to the principles of the waste hierarchy[190] and are dealt with at the highest possible level within the hierarchy.

5.146 Where necessary, the Secretary of State will require the applicant to develop a resource management plan to ensure that appropriate measures for sustainable resource and waste management are secured.

Flood risk

Introduction

5.147 Climate change over future decades is likely to result in milder, wetter winters and hotter, drier summers in the UK, while sea levels will continue to rise. Within the lifetime of the proposed development, these factors will lead to increased flood risk in areas susceptible to flooding, and to an increased risk of flooding in some areas not currently thought of as being at risk. In addition to increasing flood risk, longer term climate change will result in changes to weather-related disruption, most often caused by wind, rain, snow and ice. The applicant, the Examining Authority and the Secretary of State in taking decisions should take account of the policy on climate change adaptation as set out in the National Planning Policy Framework[191] and other supporting guidance.[192]

5.148 The National Planning Policy Framework sets out that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk.[193] But where development is necessary, it should be made safe without

[190] Article 4 of the revised EU Waste Framework Directive (Directive 2008/98/EC) sets out the ‘waste hierarchy’ with five steps for dealing with waste, ranked according to environmental impact

[191] National Planning Policy Framework, March 2012, paragraph 99, or any successor document

[192] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances and https://www.gov.uk/government/publications/adapting-to-climate-change-for-risk-management-authorities

[193] National Planning Policy Framework, March 2012, paragraphs 100-104, or any successor document

increasing flood risk elsewhere. Supporting guidance[194] explains that essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk is permissible in areas of high flood risk, subject to the Exception Test. In addition, as set out in the National Planning Policy Framework, new development should be planned to avoid increased vulnerability to the range of impacts arising from climate change.[195]

5.149 Loss of flood plain storage may increase the overall flood risk for the catchment. The extent of any impact will depend on the ability of the development to manage storage of water on or off-site.

5.150 There is the potential for airport expansion to result in increased risk from climate change effects, particularly to increased surface water runoff rate and pressure on potable water supply. There may also be effects on groundwater.

5.151 Where the Airports NPS mentions the UK Climate Change Risk Assessment, the reader should refer to the most recent version of the document.

Applicant's assessment

5.152 Applications for projects in the following locations should be accompanied by a flood risk assessment:

- Flood Zones 2 and 3 (medium and high probability of river and sea flooding);
- Flood Zone 1 (low probability of river and sea flooding) for projects of 1 hectare or greater, or projects which may be subject to other sources of flooding (local watercourses, surface water, groundwater or reservoirs), or where the Environment Agency has notified the local planning authority that there are critical drainage problems.

5.153 The applicant should identify and assess the risks of all forms of flooding to and from the preferred scheme, and demonstrate how these flood risks will be managed, taking climate change into account.[196]

5.154 In preparing a flood risk assessment the applicant should:

- Consider the risk of all forms of flooding arising from the development comprised in the preferred scheme, in addition to the risk of flooding to the project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe throughout its lifetime;[197]
- Take into account the impacts of climate change, clearly stating the development lifetime over which the assessment has been made;
- Consider the need for safe access and exit arrangements;
- Include the assessment of residual risk after risk reduction measures have been taken into account, and demonstrate that this is acceptable for the development;
- Consider if there is a need to remain operational during a worst case flood event over the preferred scheme's lifetime; and
- Provide evidence for the Secretary of State to apply the Sequential Test and Exception Test,[198] as appropriate.

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194 http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/
195 National Planning Policy Framework, March 2012, paragraph 99, or any successor document
196 https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications
197 Updated flood maps are available on the Environment Agency's website
198 National Planning Policy Framework, March 2012, paragraphs 100-104, or any successor document

5.155 Where the preferred scheme may be affected by, or may add to, flood risk, the applicant is advised to seek early pre-application discussions with the Environment Agency, and, where relevant, other flood risk management bodies such as lead local flood authorities, Internal Drainage Boards, sewerage undertakers, highways authorities and reservoir owners and operators. These discussions can be used to identify the likelihood and possible extent and nature of the flood risk, help scope the flood risk assessment, and identify the information that may be required by the Secretary of State to reach a decision on the application. If the Environment Agency has concerns about proposals on flood risk grounds, the applicant is encouraged to discuss these concerns at a sufficiently early stage with the Environment Agency and explore ways in which the proposal might be amended, or additional information provided, which would satisfy the Environment Agency's concerns, before the application for development consent is submitted.

5.156 For local flood risk (surface water, groundwater and ordinary watercourse flooding), local flood risk management strategies and surface water management plans provide useful sources of information for consideration in a flood risk assessment. Surface water flood issues need to be understood to allow them to be taken into account, for example by clearly identifying and managing flow routes.

5.157 When assessing the potential impacts of climate change on airports which can be wider than flooding impacts, such as implications from heat and water availability and the potential adaptation strategies for them, the applicant should take into account the latest UK Climate Change Risk Assessment, the latest set of UK Climate Projections, and other relevant sources of climate change evidence.

Mitigation

5.158 The applicant should ensure that the preferred scheme design takes into account flood risk, and should put forward measures to mitigate the impact of flooding.

5.159 Mitigation measures will need to be developed as part of the applicant's application for development consent to ensure that it is safe from flooding, and will not increase flood risk elsewhere for the proposed development's lifetime, taking into account climate change.

5.160 To satisfactorily manage flood risk and the impact of the natural water cycle on people, property and ecosystems, good design and infrastructure may need to be secured using requirements or planning obligations. This may include the use of sustainable drainage systems but could also include vegetation to help to slow runoff, hold back peak flows, and make landscapes more able to absorb the impact of severe weather events.

5.161 In the Airports NPS, the term sustainable drainage systems is used and taken to cover the whole range of sustainable approaches to surface water drainage management including:

- Source control measures including rainwater recycling and drainage;
- Infiltration devices to allow water to soak into the ground, that can include individual soakaways and communal facilities;
- Filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns;
- Filter drains and porous pavements to allow rainwater and runoff to infiltrate into permeable material below ground and provide storage if needed;

- Basins and ponds to hold excess water after rain and allow controlled discharge that avoids flooding; and
- Flood routes to carry and direct excess water through developments to minimise the impact of severe rainfall flooding.

5.162 Site layout and surface water drainage systems should be able to cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts.

5.163 The surface water drainage arrangements for any project should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, taking into account climate change, unless specific off-site arrangements are made and result in the same net effect.

5.164 It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the main application site. There may be circumstances where it is appropriate for infiltration attenuation storage to be provided outside the project site, if necessary through the use of a planning obligation or a development consent order requirement.

5.165 The sequential approach should be applied to the layout and design of the project. Vulnerable uses should be located on parts of the site at lower probability and residual risk of flooding. The applicant should seek opportunities where appropriate to use open space for multiple purposes such as amenity, wildlife habitat, and flood storage uses. Opportunities can be taken to lower flood risk by improving flow routes, flood storage capacity and using sustainable drainage systems.

Decision making

5.166 Where flood risk is a factor in determining an application for development consent, the Secretary of State will need to be satisfied that, where relevant:

- The application is supported by an appropriate flood risk assessment; and
- The Sequential Test[199] has been applied as part of site selection and, if required, the Exception Test.[200]

5.167 When determining an application, the Secretary of State will need to be satisfied that flood risk will not be increased elsewhere, and will only consider development appropriate in areas at risk of flooding where, informed by a flood risk assessment, following the Sequential Test and, if required, the Exception Test, it can be demonstrated that:

- Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and
- Over its lifetime, development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning, and that priority is given to the use of sustainable drainage systems.

5.168 The applicant should take into account the potential impacts of climate change using the latest UK Climate Change Risk Assessment, the latest set of UK Climate Projections, and other relevant sources of climate change evidence. The applicant should also ensure any environment statement that is prepared identifies appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new

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[199] National Planning Policy Framework, March 2012, paragraph 101, or any successor document
[200] National Planning Policy Framework, March 2012, paragraph 102, or any successor document

infrastructure. Should a new set of UK Climate Projections become available after the preparation of an environmental statement, the Examining Authority or the Secretary of State will consider whether they need to request additional information from the applicant as part of the development consent application.

5.169 When determining an application, the Secretary of State will need to be satisfied that the potential effects of climate change on the development have been considered as part of the design.

5.170 For construction work which has drainage implications, approval for the preferred scheme's overall approach to drainage systems will form part of any development consent issued by the Secretary of State.[201] The Secretary of State will therefore need to be satisfied that the proposed drainage system complies with any technical standards issued by the Government[202] or to any National Standards[203] issued under Schedule 3 to the Flood and Water Management Act 2010.[204] In addition, the development consent order, or any associated planning obligations, will need to make provision for the adoption and maintenance of any sustainable drainage systems, including any necessary access rights to property. The Secretary of State will need to be satisfied that the most appropriate body would be given the responsibility for maintaining any sustainable drainage systems, taking into account the nature and security of the infrastructure on the proposed site. The responsible body could include, for example, the applicant, the landowner, the relevant local authority, or another body such as the Internal Drainage Board.

5.171 If the Environment Agency continues to have concerns, and therefore objects to the grant of development consent on the grounds of flood risk, the Secretary of State can grant consent, but would need to be satisfied that all reasonable steps have been taken by the applicant and the Environment Agency to attempt to resolve the concerns. Similarly, if the lead local flood authority objects to the development consent on the grounds of surface or other local sources of flooding, the Secretary of State can grant consent, but would need to be satisfied that all reasonable steps have been taken by the applicant and the lead local flood authority to attempt to resolve the concerns.

Water quality and resources

Introduction

5.172 Airport infrastructure projects can have adverse effects on the water environment, including groundwater, inland surface water and transitional waters.[205] During construction and operation, it can lead to increased demand for water, involve discharges to water, and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected and other species and habitats, and could, in

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[201] Drainage implications as defined in Paragraph 7(2) of Schedule 3 to the Flood and Water Management Act 2010 http://www.legislation.gov.uk/ukpga/2010/29/schedule/3/crossheading/requirement-for-approval

[202] https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

[203] The National Standards set out requirements for the design, construction, operation and maintenance of sustainable drainage systems, and may include guidance to which the Secretary of State will have regard

[204] http://www.legislation.gov.uk/ukpga/2010/29/contents

[205] As defined in the Water Framework Directive (2000/60/EC), transitional waters are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters by which are substantially influenced by freshwater flows

particular, result in surface waters, groundwaters or protected areas[206] failing to meet environmental objectives established under the Water Framework Directive.[207]

5.173 The Government's planning policies make clear that the planning system should contribute to and enhance the natural and local environment by, among other things, preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, water pollution. The Government has issued guidance on water supply, wastewater and water quality considerations in the planning system.[208] Where applicable, an application for development consent has to contain a plan with accompanying information identifying water bodies in a river basin management plan.[209]

5.174 Development may result in an increased potential for impacts on the water environment, especially the quality of the surface and groundwater through the discharge of waters contaminated with de-icer along with hydrocarbons and other pollutants.

Applicant's assessment

5.175 The applicant should make sufficiently early contact with the relevant regulators, including the Environment Agency, for abstraction licensing and environmental permitting, and with the water supply company likely to supply the water. Where the proposed development is subject to an Environmental Impact Assessment and the development is likely to have significant adverse effects on the water environment, the applicant should ascertain the existing status of, and carry out an assessment of, the impacts of the proposed project on water quality, water resources and physical characteristics as part of the environmental statement.

5.176 Any environmental statement should describe:

- The existing quality of water affected by the proposed project;
- Existing water resources affected by the proposed project and the impacts of the proposed project on water resources;
- Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project, and any impact of physical modifications to these characteristics;
- Any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones around potable groundwater abstractions; and
- Any cumulative effects.

5.177 The applicant should assess the effects on the surrounding water and wastewater treatment network in cooperation with the relevant water and sewerage undertaker(s). It should also address any future water infrastructure needed for the preferred scheme, including for supplies and sewerage treatment, and the effects on the surrounding water and wastewater treatment network. This assessment would be based on the additional wastewater flows which would need to be treated at sewage treatment works and should be developed through liaison with the relevant water and sewerage undertaker(s).

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[206] Protected areas are areas which have been designated as requiring special protection under specific community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water
[207] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy
[208] http://planningguidance.communities.gov.uk/blog/guidance/water-supply-wastewater-and-water-quality/
[209] http://www.legislation.gov.uk/uksi/2009/2264/made

Mitigation

5.178 The impact on local water resources can be minimised through planning and design for the efficient use of water, including water recycling.

5.179 The Secretary of State will need to consider whether the mitigation measures put forward by the applicant which are needed for operation and construction (and which may be over and above any which may form part of the development consent application) are acceptable.

5.180 The project should adhere to any national standards for sustainable drainage systems, which introduce a hierarchical approach to drainage design that promotes the most sustainable approach but recognises the feasibility and use of conventional drainage systems as part of a sustainable solution for any given site given its constraints.

5.181 The risk of impacts on the water environment can be reduced through careful design to adhere to good pollution practice.

Decision making

5.182 Activities that discharge to the water environment are subject to pollution control, and the considerations set out at paragraphs 4.53-4.59 above covering the interface between planning and environmental permitting therefore apply. These considerations will also apply in an analogous way to the abstraction licensing regime regulating activities that take water from the environment, and to the control regimes relating to works to, and structures in, on, or under, a controlled water.

5.183 The Secretary of State will generally need to give more weight to impacts on the water environment where a project would have adverse effects on the achievement of the environmental objectives established under the Water Framework Directive.

5.184 The Secretary of State will need to be satisfied that a proposal has had regard to the Thames river basin management plan and the Water Framework Directive and its daughter Directives on priority substances and groundwater. In terms of Water Framework Directive compliance, the overall aim of development should be to prevent deterioration in status of water bodies, to support the achievement of the objectives in the Thames river basin management plan and not to jeopardise the future achievement of good status for any affected water bodies. If the development is considered likely to cause deterioration of water body status or to prevent the achievement of good groundwater status or of good ecological status or potential, compliance with Article 4.7 of the Water Framework Directive must be demonstrated. Any use of Article 4.7 must be reported in the Thames river basin management plan.

5.185 The Secretary of State will need to consider the interactions of the preferred scheme with other plans, such as statutory water resources management plans.

5.186 The Secretary of State will need to consider proposals put forward by the applicant to mitigate adverse effects on the water environment, taking into account the likely impact of climate change on water availability, and whether appropriate requirements should be attached to any development consent and / or planning obligations. If the Environment Agency continues to have concerns, and objects to the grant of development consent on the grounds of impacts on water quality / resources, the Secretary of State can grant consent, but will need to be satisfied that all reasonable steps have been taken by the applicant and the Environment Agency to try to resolve the concerns.

Historic environment

Introduction

5.187 The construction and operation of airports and associated infrastructure has the potential to result in adverse impacts on the historic environment above and below ground. This could be as a result of the scale, form and function of the development, and the wider impacts it can create in terms of associated infrastructure to connect the airport to existing transport networks, changes in aircraft movement on the ground and in the surrounding airspace, additional noise and light levels, and the need for security and space to ensure the airport's operation.

5.188 The historic environment includes all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.

5.189 Those elements of the historic environment that hold value to this and future generations because of their historic, archaeological, architectural or artistic interest are called 'heritage assets'. Heritage assets may be buildings, monuments, sites, places, areas or landscapes, or any combination of these. The sum of the heritage interests that a heritage asset holds is referred to as its significance. Significance derives not only from a heritage asset's physical presence, but also from its setting.[210]

5.190 Some heritage assets have a level of significance that justifies official designation. Categories of designated heritage assets are:

- World Heritage Sites;
- Scheduled Monuments;
- Listed Buildings;
- Protected Wreck Sites;
- Protected Military Remains;
- Registered Parks and Gardens;
- Registered Battlefields; and
- Conservation Areas.[211]

5.191 Non-designated heritage assets of archaeological interest that are demonstrably equivalent to Scheduled Monuments should be considered subject to the policies for designated heritage assets.[212] The absence of designation for such heritage assets does not indicate lower significance.

5.192 The Secretary of State will also consider the impacts on other non-designated heritage assets on the basis of clear evidence that the assets have a significance that merits consideration in that decision, even though those assets are of lesser value than designated heritage assets. The non-designated heritage assets would be identified

[210] Setting of a heritage asset is the surroundings in which it is experienced. Its extent is not fixed, and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance, or may be neutral

[211] The issuing of licences to undertake works on protected wreck sites in English waters is the respons bility of the Secretary of State for Culture, Media and Sport and does not form part of development consent orders. The issuing of licences for protected military remains is the responsibility of the Secretary of State for Defence

[212] There will be archaeological interest in a heritage asset if it holds, or may potentially hold, evidence of past human activity worthy of expert investigation at some point. Heritage assets with archaeological interest are the primary source of evidence about the substance and evolution of places, and the people and cultures that made them

either through the development plan process by local authorities, including through 'local listing', or through the nationally significant infrastructure project examination and decision making process.

Applicant's assessment

5.193 As part of the environmental statement, the applicant should provide a description of the significance of the heritage assets affected by the proposed development, and the contribution of their setting to that significance. The level of detail should be proportionate to the asset's importance, and no more than is sufficient to understand the potential impact of the proposal on the significance of the asset. Consideration will also need to be given to the possible impacts, including cumulative, on the wider historic environment. At a minimum, the relevant Historic Environment Record[213] should be consulted and the heritage assets assessed using appropriate expertise. Where a site on which development is proposed includes or has the potential to include heritage assets with archaeological interest, the applicant should include an appropriate desk-based assessment and, where necessary, a field evaluation. The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage asset affected can be adequately understood from the application and supporting documents.

5.194 Detailed studies will be required on those heritage assets affected by noise, light and indirect impacts based on the guidance provided in *The Setting of Heritage Assets*[214] and the *Aviation Noise Metric*.[215] Where proposed development will affect the setting of a heritage asset, accurate representative visualisations may be necessary to assess the impact.

5.195 The applicant is encouraged, where opportunities exist, to prepare proposals which can make a positive contribution to the historic environment, and to consider how their scheme takes account of the significance of heritage assets affected. This can include, where possible:

- Enhancing, through a range of measures such as sensitive design, the significance of heritage assets or setting affected;
- Considering measures that address those heritage assets that are at risk, or which may become at risk, as a result of the scheme; and
- Considering how visual or noise impacts can affect heritage assets, and whether there may be opportunities to enhance access to or interpretation, understanding and appreciation of the heritage assets affected by the scheme.

Careful consideration in preparing the scheme will be required on whether the impacts on the historic environment will be direct or indirect, temporary or permanent.

Decision making

5.196 In determining applications, the Secretary of State will seek to identify and assess the particular significance of any heritage asset that may be affected by the proposed development (including by development affecting the setting of a heritage asset), taking account of the available evidence and any necessary expertise from:

[213] Historic Environment Records are information services maintained and updated by (or on behalf of) local authorities and National Park Authorities with a view to providing access to comprehensive and dynamic resources relating to the historic environment of an area for public benefit and use. Details of Historic Environment Records in England are available from the Heritage Gateway website. Historic England should also be consulted where relevant

[214] https://www.historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/

[215] https://www.historicengland.org.uk/images-books/publications/aviation-noise-metric/

- Relevant information provided with the application and, where applicable, relevant information submitted during examination of the application;
- Any designation records included on the National Heritage List for England;
- Historic landscape character records;
- The relevant Historic Environment Record(s) and similar sources of information;
- Representations made by interested parties during the examination; and
- Expert advice, where appropriate and when the need to understand the significance of the heritage asset demands it.

5.197 The Secretary of State must also comply with the regime relating to Listed Buildings, Conservation Areas and Scheduled Monuments set out in The Infrastructure Planning (Decisions) Regulations 2010.[216]

5.198 In considering the impact of a proposed development on any heritage assets, the Secretary of State will take into account the particular nature of the significance of the heritage asset and the value that they hold for this and future generations. This understanding should be used to avoid or minimise conflict between their conservation and any aspect of the proposal.

5.199 The Secretary of State will take into account: the desirability of sustaining and, where appropriate, enhancing the significance of heritage assets; the contribution of their settings; and the positive contribution their conservation can make to supporting sustainable communities – including to their quality of life, their economic vitality, and to the public's enjoyment of these assets. The Secretary of State will also take into account the desirability of new development making a positive contribution to the character and local distinctiveness of the historic environment. The consideration of design should include scale, height, massing, alignment, materials, use and landscaping (for example screen planting).

5.200 When considering the impact of a proposed development on the significance of a designated heritage asset, the Secretary of State will give great weight to the asset's conservation. The more important the asset, the greater the weight should be. The Secretary of State will take into account the desirability of sustaining and enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation, the positive contribution that conservation of heritage assets can make to sustainable communities including their economic vitality, and the desirability of new development making a positive contribution to local character and distinctiveness.

5.201 Once lost, heritage assets cannot be replaced, and their loss has a cultural, environmental, economic and social impact. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Given that heritage assets are irreplaceable, any harm or loss should require clear and convincing justification.

5.202 Substantial harm to or loss of a Grade II Listed Building or a Grade II Registered Park or Garden should be exceptional. Substantial harm to or loss of designated sites of the highest significance, including World Heritage Sites, Scheduled Monuments, Grade I and II* Listed Buildings, Protected Wreck Sites, Registered Battlefields, and Grade I and II* Registered Parks and Gardens should be wholly exceptional.

5.203 Any harmful impact on the significance of a designated heritage asset should be weighed against the public benefit of development, recognising that the greater the

[216] http://www.legislation.gov.uk/uksi/2010/305/regulation/3/made

harm to the significance of the heritage asset, the greater the justification that will be needed for any loss.

5.204 Where the proposed development will lead to substantial harm to or the total loss of significance of a designated heritage asset, the Secretary of State will refuse consent unless it can be demonstrated that the substantial harm or loss of significance is necessary in order to deliver substantial public benefits that outweigh that loss or harm, or alternatively that all of the following apply:

- The nature of the heritage asset prevents all reasonable uses of the site;
- No viable use of the heritage asset itself can be found in the medium term through appropriate marketing that will enable its conservation;
- Conservation by grant funding or some form of charitable or public ownership is demonstrably not possible; and
- The harm or loss is outweighed by the benefit of bringing the site back into use.

5.205 Where the proposed development will lead to less than substantial harm to the significance of a designated heritage asset, this harm should be weighed against the public benefits of the proposal, including securing its optimum viable use.

5.206 Not all elements of a World Heritage Site or conservation area will necessarily contribute to its significance. The Secretary of State will treat the loss of a building (or other element) that makes a positive contribution to the significance of a World Heritage Site or conservation area's significance either as substantial harm or less than substantial harm, as appropriate, taking into account the relative significance of the elements affected and their contribution to the significance of the World Heritage Site or conservation area as a whole.

5.207 Where the loss of significance of any heritage asset is justified on the merits of the new development, the Secretary of State will consider imposing a requirement on the consent, or require the applicant to enter into an obligation, that will prevent the loss occurring until it is reasonably certain that the relevant part of the development is to proceed.

5.208 The applicant should look for opportunities for new development within Conservation Areas and World Heritage Sites, and within the setting of heritage assets, to enhance and better reveal their significance. Proposals that preserve those elements of the setting that make a positive contribution to or better reveal the significance of the asset should be treated favourably.[217]

Recording

5.209 A documentary record of our past is not as valuable as retaining the heritage asset, and therefore the ability to record evidence of the asset should not be a factor in deciding whether consent should be given.

5.210 Where the loss of the whole or part of a heritage asset's significance is justified, the Secretary of State will require the applicant to record and advance understanding of the significance of the heritage asset before it is lost (wholly or in part). The extent of the requirement should be proportionate to the nature and level of the asset's significance. The applicant should be required to publish this evidence and to deposit copies of the reports with the relevant Historic Environmental Record. They should

[217] Further good practice advice on decision making in the historic environment can be found at: https://www.historicengland.org.uk/images-books/publications/gpa2-managing-significance-in-decision-taking/

also be required to deposit the archive generated in a local museum or other public repository willing to receive it.

5.211 Where appropriate, the Secretary of State will impose requirements to the development consent order to ensure that the work is undertaken in a timely manner, in accordance with a written scheme of investigation that complies with the policy in the Airports NPS and has been agreed in writing with the relevant local authority, and that the completion of the exercise is properly secured.

5.212 Where there is a high probability that a development site may include as yet undiscovered heritage assets with archaeological interest, the Secretary of State will consider requirements to ensure appropriate procedures are in place for the identification and treatment of such assets discovered during construction.

Landscape and visual impacts

Introduction

5.213 For airport development, landscape and visual effects also include tranquillity effects, which would affect people's enjoyment of the natural environment and recreational facilities. In this context, references to landscape should be taken as covering local landscape, waterscape and townscape character and quality, where appropriate.

Applicant's assessment

5.214 Where the development is subject to an Environmental Impact Assessment, the applicant should undertake an assessment of any likely significant landscape and visual impacts and describe them in the environmental statement. The landscape and visual assessment should reference any landscape character assessment and associated studies as a means of assessing landscape impacts relevant to the preferred scheme. In addition, the applicant's assessment should take account of any relevant policies based on these assessments in local development documents.

5.215 The applicant's assessment should include any significant effects during construction of the preferred scheme and / or the significant effects of the completed development and its operation on landscape components and landscape character, including historic characterisation. This should include assessment of any landscape and visual impacts as a result of the development, for example surface access proposals or aviation activity.

5.216 The assessment should include the visibility and conspicuousness of the preferred scheme during construction and the presence and operation of the preferred scheme and potential impacts on views and visual amenity. This should include any noise and light pollution effects, including on local amenity, tranquillity and nature conservation.

Mitigation

5.217 Adverse landscape and visual effects may be minimised through appropriate design (including choice of materials), and landscaping schemes. Materials and designs for the Heathrow Northwest Runway scheme should be given careful consideration.

Decision making

Landscape impact

5.218 Landscape effects depend on the nature of the existing landscape likely to be changed and nature of the effect likely to occur. Both these factors need to be considered in judging the impact of the preferred scheme on the landscape. The preferred scheme needs to be designed carefully, taking account of the potential impact on the landscape. Having regard to siting, operational and other relevant constraints, the development should aim to avoid or minimise harm to the landscape, providing reasonable mitigation where possible and appropriate.

Development proposed within nationally designated areas

5.219 Great weight should be given to conserving landscape and scenic beauty in nationally designated areas. National Parks, the Broads and Areas of Outstanding Natural Beauty have the highest status of protection in relation to landscape and scenic beauty. Each of these designated areas has specific statutory purposes which help ensure their continued protection and which the Secretary of State has a statutory duty to have regard to in decisions.

5.220 The Secretary of State should refuse development consent in these areas except in exceptional circumstances and where it can be demonstrated that it is in the public interest. Consideration of such applications should include an assessment of:

- The need for the development, including in terms of any national considerations, and the impact of consenting, or not consenting it, upon the local economy;
- The cost of, and scope for, developing elsewhere, outside the designated area, or meeting the need for it in some other way; and
- Any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.

5.221 Where consent is given in these areas, the Secretary of State should be satisfied that the applicant has ensured that the preferred scheme will be carried out to high environmental standards and, where possible, includes measures to enhance other aspects of the environment. Where necessary, the Secretary of State should consider the imposition of appropriate requirements to ensure these standards are delivered.

Developments outside nationally designated areas which might affect them

5.222 The duty to have regard to the purposes of nationally designated areas also applies when considering applications for projects outside the boundaries of these areas which may have impacts within them. The development should aim to avoid compromising the purposes of designation, and such projects should be designed sensitively given the various siting, operational, and other relevant constraints.

Developments in other areas

5.223 Outside nationally designated areas, there are local landscapes and townscapes that are highly valued locally and may be protected by local designation. Where a local development document in England has policies based on landscape character assessment, these should be given particular consideration. However, local landscape designations should not be used in themselves as reasons to refuse consent, as this may unduly restrict acceptable development.

5.224 In taking decisions, the Secretary of State will consider whether the preferred scheme has been designed carefully, taking account of environmental effects on the landscape and siting, operational and other relevant constraints, to avoid adverse effects on landscape or to minimise harm to the landscape, including by reasonable mitigation.

Visual impact

5.225 The Secretary of State will judge whether the visual effects on sensitive receptors, such as local residents, and other receptors, such as visitors to the local area, outweigh the benefits of the development.

Land instability

Introduction

5.226 The effects of land instability may result in landslides, subsidence or ground heave. Failing to deal with this issue could cause harm to human health, local property and associated infrastructure, and the wider environment. They occur in different circumstances for different reasons and vary in their predictability and in their effect on development.

Applicant's assessment

5.227 Where necessary, land stability should be considered in respect of new development, as set out in the National Planning Policy Framework and supporting planning guidance.[218] Specifically, proposals should be appropriate for the location, including preventing unacceptable risks from land instability. If land stability could be an issue, the applicant should seek appropriate technical and environmental expert advice to assess the likely consequences of proposed developments on sites where subsidence, landslides and ground compression is known or suspected. Applicants should liaise with the Coal Authority if necessary.

5.228 A preliminary assessment of ground instability should be carried out at the earliest possible stage before a detailed application for development consent is prepared. The applicant should ensure that any necessary investigations are undertaken to confirm that their sites are and will remain stable, or can be made so as part of the development. The site needs to be assessed in the context of surrounding areas where subsidence, landslides and land compression could threaten the development during its anticipated life or damage neighbouring land or property. This could be in the form of a land stability or slope stability risk assessment report.

Mitigation

5.229 The applicant has a range of mechanisms available to mitigate and minimise risks of land instability. These include:

- Establishing the principle and layout of new development, for example avoiding mine entries and other hazards;
- Ensuring proper design of structures to cope with any movement expected and other hazards such as mine and / or ground gases; or
- Requiring ground improvement techniques, usually involving the removal of poor material and its replacement with suitable inert and stable material. For development on land previously affected by mining activity, this may mean prior extraction of any remaining mineral resource.

Dust, odour, artificial light, smoke and steam

5.230 The construction and operation of airports infrastructure has the potential to create a range of emissions such as dust, odour, artificial light, smoke and steam. All have the potential to have a detrimental impact on amenity or cause a common law nuisance or statutory nuisance under Part III, Environmental Protection Act 1990.[219] These may also be covered by pollution control or other environmental consenting regimes.

[218] https://www.gov.uk/guidance/land-stability
[219] http://www.legislation.gov.uk/ukpga/1990/43/part/III

5.231 Because of the potential effects of these emissions and in view of the availability of the defence of statutory authority against nuisance claims described previously, it is important that the potential for these impacts is considered by the applicant in its application, by the Examining Authority in examining applications, and by the Secretary of State in taking decisions on development consent.

5.232 For nationally significant infrastructure projects of the type covered by the Airports NPS, some impact on amenity for local communities is likely to be unavoidable. Impacts should be kept to a minimum and should be at a level that is acceptable.

Applicant's assessment

5.233 Where the development is subject to an Environmental Impact Assessment, the applicant should assess any likely significant effects on amenity from emissions of dust, odour, artificial light, smoke and steam, and describe these in the environmental statement.

5.234 In particular, the assessment provided by the applicant should describe:

- The type and quantity of emissions;
- Aspects of the development which may give rise to emissions during construction, operation and decommissioning;
- Premises or locations that may be affected by the emissions;
- Effects of the emission on identified premises or locations; and
- Measures to be employed in preventing or mitigating the emissions.

5.235 The applicant is advised to consult the relevant local planning authority and, where appropriate, the Environment Agency, about the scope and methodology of the assessment.

Mitigation

5.236 The Secretary of State should ensure the applicant has provided sufficient information to show that any necessary mitigation will be put into place. In particular, the Secretary of State should consider whether to require the applicant to abide by a scheme of management and mitigation concerning emissions of dust, odour, artificial light, smoke and steam from the development to reduce any loss to amenity which might arise during the construction and operation of the development. A construction management plan may help clarify and secure mitigation.

Decision making

5.237 The Secretary of State should be satisfied that all reasonable steps have been taken, and will be taken, to minimise any detrimental impact on amenity from emissions of dust, odour, artificial light, smoke and steam. This includes the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

5.238 If development consent is granted for a project, the Secretary of State should consider whether there is a justification for all of the authorised project (including any associated development) being covered by a defence of statutory authority against nuisance claims. If the Secretary of State cannot conclude that this is justified, then the defence should be disapplied, in whole or in part, through a provision in the development consent order.

Community compensation

Introduction

5.239 The Secretary of State recognises that, in addition to providing economic growth and employment opportunities, airport expansion will also have negative impacts upon local communities. This will include impacts through land take requiring the compulsory acquisition of houses that fall within the new boundary of the airport, exposure to air quality impacts, and aircraft noise, that is both an annoyance and can have an adverse impact on health and cognitive development.

5.240 The Secretary of State expects the applicant to provide an appropriate community compensation package, relevant to planning. This will include financial compensation to residents who will see their homes compulsorily acquired, as well as ongoing financial compensation to the local community. In addition to controlling and reducing aircraft noise impacts, the applicant will be required to commit appropriate resources to mitigate the impacts of aircraft through noise insulation programmes for both private homes and public buildings such as schools.

5.241 A number of statutory protections are provided in these areas, and the applicant must fulfil its statutory duties in a timely and efficient manner.

5.242 Under planning law, residential and agricultural owners in the area within the red line on the map shown in Annex A will be able to make a claim for statutory blight upon the designation of the Airports NPS.

5.243 In addition, compensation can be sought in respect of loss of value of a property arising from the development during construction (under the Compulsory Purchase Act 1965)[220] and for loss of value arising from the operation of an expanded airport (under Part 1 of the Land Compensation Act 1973)[221] after one year of operation.

5.244 People are entitled to know what steps will be taken to help protect them against aircraft noise and, where appropriate, to help them to move house.

5.245 In addition to statutory requirements, Heathrow Airport has publicly committed to a community compensation package comprising a number of more generous offers:

- To pay 125% of market value, plus taxes and reasonable moving costs, for all owner occupied homes within the compulsory acquisition zone;[222]
- To pay 125% of market value, plus taxes and reasonable moving costs, for all owner occupied homes within an additional voluntary purchase / acquisition zone incorporating the area known as the Heathrow Villages;[223]
- Following a third party assessment, to provide full acoustic insulation for residential property within the full single mode easterly and westerly 60dB LAeq (16hr)[224] noise contour of an expanded airport;
- Following a third party assessment, to provide a contribution of up to £3,000 for acoustic insulation for residential properties within the full single mode easterly and

[220] http://www.legislation.gov.uk/ukpga/1965/56/contents
[221] http://www.legislation.gov.uk/ukpga/1973/26/contents
[222] http://your.heathrow.com/newpropertycompensation/
[223] http://your.heathrow.com/newpropertycompensation/
[224] Leq is the measure used to describe the average sound level experienced over a period of time (usually sixteen hours for day and eight hours for night) resulting in a single dec bel value. Leq is expressed as LAeq when it refers to the A-weighted scale

westerly 57dB LAeq (16hr) or the full 55dB Lden[225] noise contours of an expanded airport, whichever is the bigger; and

- To deliver a programme of noise insulation and ventilation for schools and community buildings within the 60dB LAeq (16hr) contour.[226]

5.246 In addition to the statutory requirements and the public commitments made by Heathrow Airport, the Government also supports the Airports Commission's recommendation for an additional component of ongoing community compensation proportionate to environmental impacts.

5.247 The Airports Commission suggested this should take the form of a national noise levy paid for by passengers. The Government does not consider a national levy appropriate, but supports the development of a community compensation fund at an expanded Heathrow Airport. The Government expects that the size of the community compensation fund will be proportionate to the environmental harm caused by expansion of the airport. The Government notes that, in its consideration of a noise levy, the Airports Commission considered that a sum of £50 million per annum could be an appropriate amount at an expanded Heathrow Airport, and that, over a 15 year period, a community compensation fund could therefore distribute £750 million to local communities.

5.248 Expansion at Heathrow Airport is likely to increase the amount of locally collected business rates in the area. The Government will consider how authorities can benefit from this through a business rate retention scheme and the opportunities for authorities to work together to share the benefits. Heathrow Airport is currently the highest single site business rates payer in the UK.[227]

Applicant's assessment

5.249 The Government expects to see arrangements being made for the community compensation schemes which Heathrow Airport has publicly stated would be provided, and for a community compensation fund.

5.250 The applicant should seek to minimise impacts on local people, to consult on the details of its works, and to put them in place quickly. The Government also looks to the applicant to consult on the detail of a community compensation fund.

Decision making

5.251 The Secretary of State will consider whether and to what extent the applicant has sought to minimise impacts on local people, has consulted on the details of its works, and has put mitigations in place, at least to the level committed to in Heathrow Airport's public commitments. This includes whether the applicant has set out appropriate eligibility criteria, how delivery will be ensured, and whether the applicant has made reasonable efforts to put the works in place quickly.

5.252 The Secretary of State will also consider whether the applicant has consulted on the details of a community compensation fund, including source of revenue, size and duration of fund, eligibility, and how delivery will be ensured.

5.253 The Secretary of State will expect the applicant to demonstrate how these provisions are secured, and how they will be operated. The applicant will also need to show how these measures will be administered to ensure that they are relevant to planning when in operation. The mechanisms for enforcing these provisions should also be

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[225] Lden is the 24 hour LAeq calculated for an annual period, but with a five decibel weighting for evening and a ten decibel weighting for night to reflect people's greater sensitivity to noise within these periods
[226] http://your.heathrow.com/newpropertycompensation/
[227] http://www.cvsuk.com/news-resources/news/draft-list-release

demonstrated, along with the appropriateness of any identified enforcing body, which may include the Secretary of State.

Community engagement

Introduction

5.254 The Government recognises that the planning, construction, and subsequent operation of a Northwest Runway will bring both significant impacts and opportunities to communities living around Heathrow Airport. Communities will wish to participate fully in the development and delivery of expansion, and the Government expects them to be able to do so.

5.255 There will be many opportunities for communities to engage as expansion is taken forward. The Government is required to consult on and publicise the Airports NPS, and the applicant is subject to pre-application consultation duties. Additional consultations on issues such as airspace change, overseen by the Civil Aviation Authority, will take place outside of the planning process. Ongoing engagement will also be required as the applicant takes forward its compensation package.

5.256 The Government wishes to maximise local stakeholder engagement with the expansion process, and it wishes to encourage any applicant and local stakeholders to strengthen the way in which the airport and local stakeholders work together to make engagement effective. Local stakeholders, including those representing communities around Heathrow Airport, have the experience and expertise to identify solutions tailored to their specific circumstances. A number of engagement forums already exist at Heathrow Airport. These have developed over time in response to emerging needs and are consistent with the Government's view that, in principle, it encourages collaborative local solutions.

5.257 A community engagement board will be developed at Heathrow Airport to help to ensure that local communities are able to contribute effectively to the delivery of expansion, including to consultations and evidence gathering during the planning process.

Applicant's assessment

5.258 The applicant must engage constructively with the community engagement board throughout the planning process, with its membership (including an independent chair), and with any programme(s) of work the community engagement board agrees to take forward.

Decision making

5.259 The Secretary of State will consider whether the applicant has engaged constructively with this community engagement board throughout the planning process.

Skills

Introduction

5.260 The Government is committed to helping people into jobs and improving the skills of the UK workforce, with a target of three million new apprenticeships being created in the current Parliament.[228] Continuing to create jobs and new training opportunities will

[228] https://www.gov.uk/government/news/government-kick-starts-plans-to-reach-3-million-apprenticeships

help to consolidate the national economic recovery, put the UK on the path to full employment and raise the nation's productivity. Apprenticeships have an essential role to play within this work, helping individuals to develop key skills which will benefit both them and employers.

5.261 To help deliver the Government's wider skills agenda, the Department for Transport published *Transport Skills Strategy: building sustainable skills* in January 2016, setting out its skills strategy for transport, including aviation, and an additional 30,000 apprenticeships by 2020 across the road and rail sectors.[229] The Strategic Transport Apprenticeship Taskforce has been created to deliver this work.[230]

5.262 The Government notes that Heathrow Airport already makes a significant contribution to local employment and already has a number of skills and employment initiatives designed to support the business needs of the airport. The Heathrow Academy, established in 2004, supports recruitment and retention of local residents across the retail, construction, aviation and logistics sectors, and includes apprenticeships as a part of the package.[231]

5.263 The Government notes that, with expansion, Heathrow Airport has publicly committed to ensuring 10,000 apprenticeships before 2030, thereby doubling the number currently available at the airport and in its supply chain and airport-related businesses.[232]

5.264 The Heathrow Northwest Runway scheme represents an opportunity to grow the number of jobs and apprenticeships supported by the applicant and its supply chain and airport-related businesses, particularly in neighbouring communities.

Applicant's assessment

5.265 Heathrow Airport should put in place arrangements for the delivery of the 5,000 new apprenticeships which it has publicly stated would be created. Heathrow Airport should set out the timetable for delivering the apprenticeships, provide information on the areas and skills to be covered by these apprenticeships, the breakdown between opportunities to be created within the core airport and those being offered by companies within its supply chain and other airport-related businesses, and the qualification level and standards which they will need to achieve. Heathrow Airport should also set out how it will publicly report progress against the target.

5.266 The Government expects the applicant to maximise the employment and skills opportunities for local residents, including apprenticeships.

5.267 Heathrow Airport will also need to show how these measures will be administered to ensure that they are relevant to planning when in operation. The mechanisms for enforcing these provisions should also be demonstrated, along with the appropriateness of any identified enforcing body, which may include the Secretary of State.

Decision making

5.268 The Secretary of State will consider whether Heathrow Airport has set out a credible plan to implement its commitment to deliver a total of 10,000 apprenticeships at an expanded airport.

[229] https://www.gov.uk/government/publications/transport-infrastructure-skills-strategy-building-sustainable-skills
[230] https://www.gov.uk/government/news/strategic-transport-apprenticeship-taskforce-to-boost-apprenticeships
[231] http://www.heathrow.com/company/heathrow-jobs/heathrow-academy
[232] https://www.heathrowexpansion.com/uk-growth-opportunities/job-opportunities/

5.269 The Secretary of State will consider how these provisions are secured, and how they will be operated.

Ruling out a fourth runway

Introduction

5.270 As part of its work, the Airports Commission considered the possibility that, in addition to the increased capacity provided by a Northwest Runway at Heathrow Airport, the airport might wish in the future to develop a fourth runway. The Airports Commission found no sound case for such a development.

5.271 First, the Airports Commission concluded that the airspace around the airport would be increasingly difficult to manage if a fourth runway was built. It noted that the airport could safely support 800,000 air transport movements per year at a four runway site, only 60,000 more than under the (three runway) Heathrow Northwest Runway scheme, but that the airspace impacts would lead to reduced numbers of air transport movements at the other airports in the London area.

5.272 Second, the Airports Commission concluded that it would be increasingly challenging to physically accommodate a fourth runway at the Heathrow Airport site. Taken together, these conclusions mean that building a fourth runway at Heathrow Airport would result in significant costs while providing less overall additional benefit.

5.273 Finally, the Airports Commission noted that there would be no guarantee that the potential demand for a further runway would be backed by a strong economic or environmental case. Any project to deliver a fourth runway at Heathrow Airport would be costly and extremely difficult to deliver given all of these considerations.

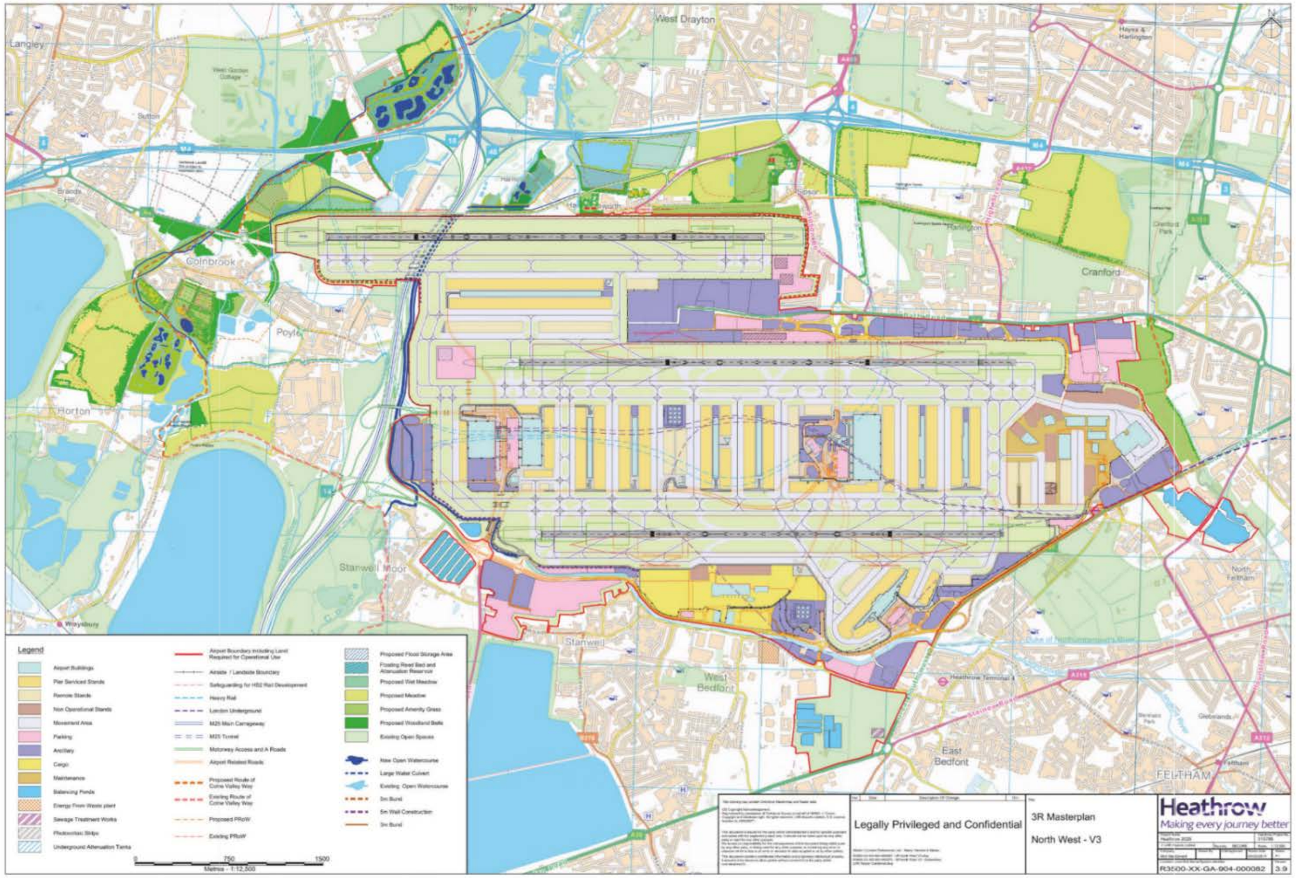
5.274 The Airports Commission also noted the importance of a clear signal from Government on limiting expansion to reassure local communities that Heathrow Airport will not expand any further.

Decision making

5.275 The Government agrees with the Airports Commission's recommendation and the analysis that underpins it, and therefore does not see a need for a fourth runway at Heathrow Airport. An application in the vicinity of Heathrow Airport for a fourth runway would not be supported in policy terms, and should be seen as being in conflict with the Airports NPS.

Annex A: Heathrow Northwest Runway scheme boundary map

Annex B: Illustrative Heathrow Northwest Runway scheme masterplan



NB: This map is for illustrative purposes and is a masterplan of the Heathrow Northwest Runway scheme as submitted by Heathrow Airport to the Airports Commission. It should not be considered as a detailed site plan; the full detail and design of the scheme will be considered as part of Heathrow Airport's development consent application.

Reduction in air cargo ATMs at Stansted

Background

As a result of the granting of Planning Permission following appeal, passenger throughput has risen to 43mppa and the maximum Cargo ATMs has fallen from 20,500 Cargo ATMs per year to 16,000.

1) Minimum reduction in Cargo ATMs

Assuming there is no significant growth in passenger ATMs to constrain Cargo ATMs:

20,500 to 16,000 = 22% reduction in Cargo ATMs

2) Midpoint reduction in Cargo ATMs

Assuming the Passenger ATMs rise to the level predicted by MAG of 253,000[1] and if MAG can reduce Other ATMs from 15,000 down to 10,000, with a limit of 274,000 total ATMs, that only leaves 11,000 Cargo ATMs:

20,500 to 11,000 = 46% reduction in Cargo ATMs

3) Maximum reduction in Cargo ATMs

Assuming the same as scenario 2 but Other ATMs remain at 15,000 then that only leaves 6,000 Cargo ATMs:

20,500 to 6,000 = 71% reduction in Cargo ATMs

[1] MAG Stansted Airport Planning Application – Planning Statement paragraph 2.80 on page 18

Table 15

Freight by Aircraft Configuration 2019 (a)
Comparison with Previous Year
Tonnes

	<---- Passenger Aircraft ---->			<---- Cargo Aircraft ---->			<---- Total ---->		
	2019	2018	Percentage Change	2019	2018	Percentage Change	2019	2018	Percentage Change
London Area Airports									
GATWICK	110 150	112 600	-2	208	-		110 358	112 600	-2
HEATHROW	1 503 730	1 606 432	-6	83 757	93 231	-10	1 587 486	1 699 663	-7
LONDON CITY	4	7	-43	-	-		4	7	-43
LUTON	353	253	40	35 408	25 940	36	35 761	26 193	37
STANSTED	6 874	-		217 265	226 128	-4	224 139	226 128	-1
Total London Area Airports	1 621 111	1 719 292	-6	336 637	345 300	-3	1 957 749	2 064 592	-5
Other UK Airports									
ABERDEEN	2 274	2 033	12	3 712	3 673	1	5 986	5 706	5
BARRA	12	13	-8	-	-		12	13	-8
BELFAST CITY (GEORGE BEST)	196	227	-14	-	-		196	227	-14
BELFAST INTERNATIONAL	17	21	-19	25 079	27 651	-9	25 095	27 672	-9
BENBECULA	36	24	50	2	-		38	24	58
BIRMINGHAM	15 764	18 313	-14	14 101	15 395	-8	29 866	33 709	-11
BRISTOL	11	7	57	-	-		11	7	57
CARDIFF WALES	1 795	1 446	24	9	13	-31	1 803	1 459	24
DONCASTER SHEFFIELD	8	75	-89	17 639	7 032	151	17 647	7 107	148
EAST MIDLANDS INTERNATIONAL	1	1		335 947	334 536		335 948	334 536	
EDINBURGH	34	171	-80	19 376	20 145	-4	19 410	20 316	-4
GLASGOW	11 960	14 526	-18	863	941	-8	12 822	15 466	-17
HUMBERSIDE	106	110	-4	10	11	-9	117	121	-3
ISLAY	313	283	11	-	-		313	283	11
ISLES OF SCILLY (ST.MARYS)	18	37	-51	50	37	35	68	74	-8
KIRKWALL	33	37	-11	-	-		33	38	-13
LANDS END (ST JUST)	39	40	-3	32	25	28	71	65	9
LEEDS BRADFORD	-	3		-	-		-	3	
LIVERPOOL (JOHN LENNON)	60	74	-19	724	85	752	784	159	393

Table 15

Freight by Aircraft Configuration 2019 (a)
Comparison with Previous Year
Tonnes

	Passenger Aircraft			Cargo Aircraft			Total		
	2019	2018	Percentage Change	2019	2018	Percentage Change	2019	2018	Percentage Change
LYDD	21	-		-	-		21	-	
MANCHESTER	104 635	110 412	-5	3 747	3 718	1	108 382	114 131	-5
NEWCASTLE	4 075	5 072	-20	670	452	48	4 745	5 524	-14
NEWQUAY	2	3	-33	-	-		2	3	-33
NORWICH	257	220	17	-	-		257	220	17
OXFORD (KIDLINGTON)	-	-		-	1		-	1	
PRESTWICK	7	14	-50	13 047	12 988		13 054	13 003	
SCATSTA	275	449	-39	-	-		275	449	-39
SOUTHAMPTON	203	231	-12	-	2		203	233	-13
STORNOWAY	179	217	-18	-	-		179	217	-18
SUMBURGH	321	333	-4	-	-		322	333	-3
TEESSIDE INTERNATIONAL AIRPORT	-	-		-	1		-	1	
TIREE	12	21	-43	-	-		12	21	-43
Total Other UK Airports	142 665	154 412	-8	435 009	426 705	2	577 673	581 118	-1
Total All Reporting UK Airports	1 763 776	1 873 704	-6	771 646	772 005		2 535 422	2 645 710	-4
Non UK Reporting Airports									
ALDERNEY	79	94	-16	1	2	-50	80	95	-16
GUERNSEY	221	241	-8	758	696	9	979	937	4
ISLE OF MAN	42	59	-29	78	92	-15	120	150	-20
JERSEY	162	186	-13	623	855	-27	785	1 041	-25
Total Non UK Reporting Airports	504	579	-13	1 461	1 644	-11	1 964	2 224	-12

(a) Domestic traffic is counted both at the airport of arrival and the airport of departure.
The total domestic plus international traffic is, therefore, only a measure of airport activity.

ARCADIS GUIDANCE TO THE CIVIL AVIATION AUTHORITY ON HEATHROW EXPANSION PROGRAMME

HEATHROW AIRPORT LIMITED MASTERPLAN REVIEW

STEP 0 REPORT - FINAL

OCTOBER 2019

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ARCADIS GUIDANCE TO THE CIVIL AVIATION AUTHORITY
STEP 0 REPORT

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Report No.	01

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CONTENTS

GLOSSARY

Abbreviation	Description
ADRM	Airport Development Reference Manual
ANPR	Automatic Number Plate Recognition
ANPS	Airports National Policy Statement
ATET	Around the End Taxiways
ATMs	Air Transport Movements
ASD	Airport Supporting Development (essential for safe and efficient operation of the airport)
ATP	Automated Ticket Presentation
BA	British Airways
BAA	British Airports Authority
CAA	Civil Aviation Authority
CAPEX	Capital Expenditure
CBS	Cost Breakdown Structure
CRA	Cost Risk Analysis
CDG	Paris Charles de Gaulle Airport
DCO	Development Consent Order
DDS	Design Day Schedules
DfT	Department for Transport (UK)
EASA	European Aviation Safety Agency
EEA	European Economic Area
EfW	Energy from Waste
GSE	Ground Service Equipment
HAL	Heathrow Airport Limited
HEP	Heathrow Expansion Programme
HSPG	Heathrow Strategic Planning Group
IATA ADRM 10	IATA Airport Development Reference Manual 10th Edition
ICAO	International Civil Aviation Organization
IDT	Integrated Design Team

Abbreviation	Description
IFS	Independent Fund Surveyor
JFK	John F. Kennedy International Airport
LoS	Level of Service
mppa	million passengers per annum
NA	Not Available
NATS	National Air Traffic Service
NWR	North West Runway (The 3rd runway as part of the Preferred Masterplan option)
OLS	Obstacle Limitation Surfaces
Oneworld	Refer Appendix B
OPEX	Operating Expenditure
PHP	Peak Hour Passengers
pph	Passengers per hour per lane
PT	Public Transport
RAG	Red; Amber; Green
RICS	Royal Institution of Chartered Surveyors
RWY	Runway
SkyTeam Alliance	Refer Appendix B
Star Alliance	Refer Appendix B
TAAM	Total Airspace and Airport Modeler
TfL	Transport for London
TN	Technical Note
Totex	Total Expenditure
Tph	Trains Per Hour
TWY	Taxiway
T5N	Terminal 5 North
UK	United Kingdom

LIST OF FIGURES AND TABLES

EXECUTIVE SUMMARY

Arcadis has undertaken a review to assess whether Heathrow Airport Limited (HAL) has put forward a Preferred Masterplan that is operable, deliverable, timely, reasonable and reliably costed and in the interest of consumers.

Our review has concluded that the Preferred Masterplan has been well developed and is technically compliant in meeting the requirements of the ANPS to deliver additional runway capacity at Heathrow by 2030.

At this moment in time, some detailed elements of the plan will not be fully developed but this is not unexpected for a scheme of this size or complexity. It is noted that HAL's approach has been diligent and they have engaged with stakeholders and consumers throughout the development process.

Arcadis' Key Findings

Operable:

- HAL has undertaken the appropriate level of detail to assure the proposed infrastructure will meet the operational demands placed on it at **Step 0**;
- The integration of the new infrastructure with the existing airport operation is feasible and is unlikely to conflict with current operations;
- HAL has demonstrated the increase in runway capacity will provide more operational flexibility and resilience; and
- HAL is yet to develop detailed Operational Readiness and Trials workstreams which will be key to ensuring a smooth transition without causing any operational issues.

Deliverable:

- HAL's delivery of the elements of the scheme are presented in a logical sequence;
- HAL has sought to deliver the most efficient sequencing with the aim of delivering the new runway by 2026 however this has created a programme that has little margin to allow for delays or risk;
- HAL's programme is not unfeasible however this is reliant on the programme timings set out in the plan to be delivered; and
- HAL will be reliant on other organisations to deliver some of the elements of the scheme which they do not control or can mitigate against. Delays could pose a risk to HAL's own delivery programme.

Timely:

- HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable;
- The current programme includes risk allowances for each component of the masterplan assessed on the basis of industry norms. There is no apparent programme-wide allowance for schedule risk; and
- With such a complex programme involving a significant range of interdependencies, many of which are out of the control of HAL, the objective to deliver an operational runway by 2026 carries a high level of risk.

Cost:

- HAL's Cost Estimate for **Step 0** is reasonably and reliably costed;
- HAL has developed a holistic baseline cost estimate and the approach to the structure and methodology of compiling the Cost Estimate reflects industry best practice; and
- The level of quantification and benchmarking has increased leading to an increased level of cost certainty.

Interest of Consumers:

- HAL continues to engage with consumers to capture insights as part of the masterplanning process to ensure that the interests of consumers are reflected in the Preferred Masterplan.

Arcadis has been appointed as a technical advisor to the Civil Aviation Authority (CAA) to undertake a review of Heathrow's Preferred Masterplan.

Arcadis has been asked to assess the Preferred Masterplan across different timeframes based upon the "Step" process utilised by Heathrow Airport Limited (HAL) throughout the masterplan development process.

These 'Steps' are in alignment to the "Phases" included in the single Preferred Masterplan released as part of the Airport Expansion Consultation on 18th June 2019.

Step 0 *is aligned to* ***Phase 1*** *that represents infrastructure required on the runway opening day, anticipated to be in 2026.*

Arcadis has not been asked to undertake an assessment that is aligned to ***Phase 2*** *for 2030 that is a specified year in the Aviation National Policy Statement (ANPS) for public transport mode share.*

Step 3 *is aligned to* ***Phase 2a*** *that represents the infrastructure requirement to meet 700,000 ATMs and 122.5mppa by the year 2033.*

Step 8 *is aligned to* ***Phase 4*** *where by 2050, the capacity at Heathrow is expected to be 142mppa.*

This **Step 0** report has assessed whether HAL's Preferred Masterplan and associated infrastructure required for the runway opening day in 2026 can deliver expansion in a manner that is operable, deliverable, timely, reasonably and reliably costed and is in the interest of consumers.

Two further reports will consider the delivery of expansion at **Step 3** and **Step 8** against the same objectives of this review.

Our assessment has been based on workshop and presentation sessions held between the CAA and HAL teams, and the review material provided by HAL. As part of the assessment process, Arcadis has raised queries with HAL based on these workshops, presentations and material. In addition, Arcadis has undertaken independent benchmarking assessments

It is worth noting that the meetings to date with HAL have been of a productive nature and the exchange of information and response to queries has in general been direct and forthcoming. Arcadis appreciates that some information that HAL has used to develop their Preferred Masterplan is commercially sensitive and access to this has been limited.

Report Themes

This report considers whether HAL's Preferred Masterplan proposal is:

- Operable;
- Deliverable;
- Timely;
- Reasonably and Reliably Costed; and
- In the Interest of Consumers.

All of the above themes are assessed in detail in separate chapters. The theme relating to 'In the Interest of Consumers' is assessed in all of the other themes and is concluded substantively in the last chapter of this report.

Operability

Heathrow is a live operational environment and the existing airport has to be able to function unhindered during the construction phases. To achieve this, airport operations must be maintained during the development of the proposed infrastructure and facilities. The development phases must also integrate into existing airport infrastructure.

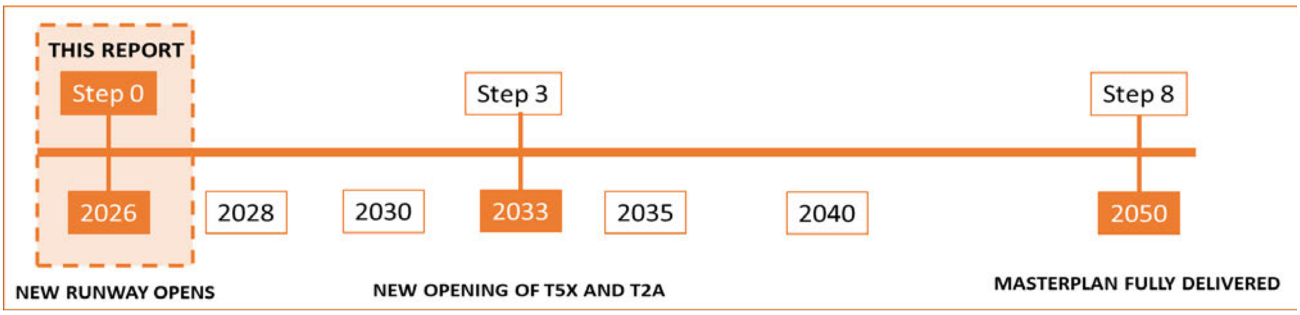
Arcadis has assessed both the design and the programme of the Preferred Masterplan to assess the operability of the airport from the existing situation to **Step 0** that takes the expansion up to the opening of the new 3rd runway.

Summary

Arcadis has undertaken its assessment using the information provided by HAL either directly or out in the public domain that takes the scheme to **Step 0**. The Preferred Masterplan sets out the infrastructure requirements up to **Step 0** using clearly developed capacity assessments of the airside, terminal and landside facilities.

Arcadis has analysed these assessments and is satisfied that HAL has undertaken the appropriate level of detail to assure the proposed infrastructure will meet the operational demands placed on it at this step of the development.

Arcadis has considered the level of flexibility and resilience that will be in place at **Step 0**. On the basis that the information provided by HAL has demonstrated the airport can adequately provide for the growth in passenger numbers and the increase



in runway capacity will provide more operational flexibility and resilience.

Arcadis acknowledges that HAL has used the masterplanning process to also look at today's operation and to take the opportunity to remove existing Airfield Hotspots. In addition, HAL is seeking to introduce taxiways around the end of runways (Around the End Taxiways (ATETs)) that will increase the flexibility of runway operations and be the first purpose built for this purpose incorporating international standards in a UK context.

Arcadis has identified potential challenges that may arise at **Step 0** in Landside areas if passenger mode choice is unchanged through some of the Surface Access Strategy work proposed by HAL.

If HAL cannot deliver the shift in mode share to public transport, there may be a greater demand on parking and forecourts than anticipated which could cause delays and congestion at the airport. However, at this stage in the masterplan process the level of detail required to assure the plan is not yet fully developed.

Arcadis is satisfied that the assimilation of the new infrastructure with the existing airport operation is feasible and is unlikely to conflict with current operations. HAL is yet to develop detailed Operational Readiness and Trials workstreams which will be key to ensuring a smooth transition without causing any operational issues.

Notwithstanding Arcadis' opinion that the Preferred Masterplan at **Step 0** will be operable, the challenges of deliverability, timeliness and cost still present the scheme with some challenges to open the new runway by 2026.

Delivery

The delivery of such a large and complex infrastructure project requires HAL to develop a delivery plan that is phased in a logical, feasible manner and has a robust programme for delivery taking into account the risks associated with it.

Arcadis has reviewed the Preferred Masterplan material to assess whether **Step 0** is deliverable and how new and impacted facilities will link with existing infrastructure and how HAL will maintain key assets during construction phases of delivery.

Summary

Arcadis has assessed the key elements required for the delivery of the new runway from the existing airport operation to 2026, **Step 0**.

It is clear from the significant amount of work that HAL has undertaken that the sequencing and multiple elements of the scheme are presented in a logical and well thought out sequence.

Arcadis has seen evidence that HAL has sought to deliver the most efficient sequencing to aim to deliver the new runway by 2026. This efficiency has however created a programme that has elements that HAL does not have direct control over that could create little margin for delays or risk.

HAL has undertaken a Quantitative Schedule Risk Analysis (QSRA) assessment of the proposed schedule, with respect to schedule integrity. This assessment resulted in a P value of [redacted], indicating a [redacted] likelihood of achieving the schedule. Arcadis recognises that this reflects a schedule that has been designed to deliver the new 3rd runway at the earliest possible opportunity. Arcadis has not reviewed the likelihood of any alternative runway opening dates as part of this review.

Although it is not unfeasible that this programme and sequencing for the delivery of the required infrastructure is achievable, this is reliant on the programme timings set out in the plan to be delivered on time.

Arcadis has identified a number of deliverability challenges that, although achievable to meet the ANPS target of 2030, could only be deliverable by 2026 if no significant delays take place in the programme.

The challenge presented by the development of a Preferred Masterplan is about creating the space and then using that space to deliver a new runway and the associated infrastructure. This involves a significant amount of clearance of existing assets as well as undertaking a very significant number of earthworks to enable construction to proceed.

Much of this work is outside of the airport's existing boundary and will be reliant on gaining the appropriate consents, acquiring land and working with other agencies or organisations. This could create a level of risk to the programme that HAL may not be able to mitigate.

It is clear from the evidence that HAL has undertaken a significant amount of planning in connection with logistics and the use of off-site hubs that are a mitigation to some of the delivery risks identified.

As well as off-site hubs, HAL has sought to develop its procurement strategy to ensure it has mitigated the supply chain risks associated with delivering such a complex programme.

Timing

The success of delivering expansion at Heathrow is predicated on the fact that the planned deliverables for each step can be provided in accordance with the specified duration in the programme and the dates and deadlines detailed.

Arcadis has assessed whether the Preferred Masterplan can be delivered in a timely manner. In doing so, consideration has been given to the risks to delivery and what the potential impact of failing to provide for the relevant deliverables does to the programme.

The review has considered the strategies HAL has developed to mitigate risks and any subsequent impacts from failure to deliver in a timely manner, with consideration for interdependencies

Summary

Arcadis considers that the overall Preferred Masterplan programme schedule is at the level of detail required for a programme of this scale at this stage of the development process.

HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable.

The assessment by Arcadis highlights that whilst the activities controlled by HAL can probably be delivered within the timescales indicated in the masterplan programme, the overall sequence necessary to deliver an operational runway by 2026 are dependent on the timely completion of activities that are outside of the control of HAL. For example, the masterplan assumes that the DCO will be resolved within statutory timescales.

Furthermore, whilst individual elements of the masterplan include risk allowances based on benchmarks, there is little programme-wide contingency. With such a complex programme involving many critical interdependencies, the objective to deliver an operational runway by 2026 is associated with a high level of risk.

Arcadis can see from the evidence that HAL has undertaken the appropriate level of work in developing its plans and is confident that the approach used would allow HAL to achieve the ANPS target for increased runway capacity by 2030.

Although HAL has indicated that they could mitigate some of the potential delays through re-phasing and moving around work elements within the programme, the key consequence of delays to the delivery of the runway or re-scheduling of works is likely to be an increase in costs and a risk of not achieving the 2026 date.

In the report we highlight four areas where we believe that HAL is particularly reliant on positive programme outcomes to deliver the 2026 operational date:

- Dependency on the timing of the DCO;
- Delivery of enabling infrastructure (e.g. A4 relocation);
- Earthworks schedule; and
- Operational readiness.

Cost Estimate

A high-level summary of the Cost Estimate is detailed in the Table 1. A breakdown of the Task Orders contained in the **Step 0** report are detailed in Section 5. All costs within HAL's Cost Estimates are based on Q3 2014 prices.

The Risk Reserve detailed in Table 1 is HAL's assessment of programme level risk. Risk allocation related to the Task Orders is contained as contingency and is included in the Direct and Indirect Costs in Table 1.

[redacted]

Arcadis has assessed whether the capital expenditure of the Preferred Masterplan phase for **Step 0** has been reasonably and reliably costed in relation to its design and programme.

Arcadis has reviewed HAL's approach to the Cost Estimate and process for development and has assessed the certainty and reliability of the Cost Estimate, including quantification, pricing and confidence in costs, the application of on-costs and HAL's approach to risk.

The review has observed that the level of maturity within the Cost Estimate, including the robustness of the evidence provided by HAL, in relation to its Preferred Masterplan and associated cost is appropriate for the current stage of the programme.

Arcadis has not reviewed property valuations as part of this review, and due to the confidential nature of the property cost estimate a breakdown of these costs is not available as part of this report.

Summary

It is Arcadis' opinion that on balance, HAL's Cost Estimate for **Step 0** is reasonably and reliably costed.

HAL has taken on board Arcadis's comments from previous reports regarding the structure of the Cost Estimate and produced a comprehensive document capturing all the relevant Cost Estimate data in one singular, well integrated, document.

The structure of the Cost Estimate reflects industry best practice standards and forms a good baseline on which to move forward. This can now form the basis on which to monitor and implement a change control process.

The structure of the Cost Estimates for each Task Order (TO) provides a standard platform for approaching the estimate and reflects best practice with how HAL has approached the quantification and pricing of direct and indirect costs

The level of quantification within the detailed estimates reflects the level of detail provided by HAL. The extent of quantification has increased since the Purple Book and the reliance on allowances reduced which leads to an increased level of certainty.

Whilst HAL has reflected schedule risks in their risk models Arcadis is of the opinion that due to the ambitious and optimistic programme, as discussed in Sections 3 and 4 of this report, there remains further risk on the programme which could have an inherent risk on the Cost Estimate and the associated risks realised. The Cost Estimate is currently based on a risk percentage, the level of which has been reviewed against the Quantitative Cost Analysis.

Interest of Consumers

For the purpose of this report 'consumers' are defined as both passengers and users of the cargo users at the airport.

To review HAL's Preferred Masterplan with regards to the interest of consumers Arcadis has considered how HAL has acquired consumer insight and how well HAL has incorporated consumer insight into their masterplan development process.

This review will be building upon a previous Arcadis report submitted in December 2018, '*An initial review of consumer interests in the development of the HAL Masterplan*'.

Summary

Although not explicitly considered as part of this report, Arcadis has continued to see examples where the interests of consumers are being tested through the development of the Preferred Masterplan.

In considering elements that are valued by consumers, the development of the infrastructure seeks to ensure that the existing airport operation can function whilst this phase of construction is taking place.

In addition, some of the work seen by Arcadis is seeking to increase the flexibility of the airport and ensure there is sufficient resilience available to cope with operational challenges.

HAL is seeking to minimise disruption for both consumers and the local community. HAL has spent a significant amount of effort to develop its delivery programme in a logical sequence to reduce the impact the works will have on both these groups.

In **Step 0**, there are no direct infrastructure improvements being proposed to support cargo users. However, there is evidence that HAL is actively engaging with the cargo community to develop improvements that will be delivered in future steps of the masterplan.

The majority of infrastructure improvements will benefit the consumers at Heathrow. The increase in runway capacity and on-going capacity improvements should contribute to delivering a scheme that is in the interest of consumers.

1 INTRODUCTION

Arcadis has undertaken a review of the Heathrow Airport Expansion Programme (HEP). This section sets out the objectives and approach to the key areas of focus Arcadis has adopted in compiling the report.

The steps taken by Arcadis to gather the relevant supporting information from HAL and other stakeholders have been identified and outlined in this section.

1.1 Background

Arcadis has been appointed by the Civil Aviation Authority (CAA) to provide technical advice in support of their work on capacity expansion at Heathrow Airport.

As part of this process Arcadis is undertaking a review of the Heathrow Airport expansion plans as detailed in their Preferred Masterplan published in June 2019. The Preferred Masterplan will act as part of Heathrow Airport Limited's (HAL) application for a Development Consent Order (DCO). HAL's application for a DCO is anticipated to be submitted in 2020. The DCO, if granted, will contain the relevant permissions for building and operating an expanded Heathrow.

The Preferred Masterplan comprises of four phases. Each phase indicates the predicted annual passenger throughput, air traffic movements (ATMs) and the infrastructure enhancements required to accommodate this growth.

The phases represented in HAL's Preferred Masterplan are split into sub-phases. Previously the phases and sub-phases were identified as 'Steps'.

Preferred Masterplan Phases					
Phase	**Step**	**Year**	**Passengers (mppa)**	**ATMs (000s)**	**Infrastructure**
1	**0**	**2026**	[redacted]	[redacted]	[redacted]
1a	1	2028	[redacted]	[redacted]	[redacted]
2	2	2030	[redacted]	[redacted]	[redacted]
2a	**3**	**2033**	[redacted]	[redacted]	
3	4	2035	[redacted]	[redacted]	[redacted]
3a	5	2040	[redacted]	[redacted]	[redacted]
3b	6	2040+	[redacted]	[redacted]	-
3c	7	2040+	[redacted]	[redacted]	-
4	**8**	**2050**	[redacted]	[redacted]	[redacted]

Table 2 Preferred Masterplan Phases
Source: (01 Masterplan Briefing - HAL May 2019), (04 Forecasting and Capacity - HAL 2019)

Arcadis has been tasked with reviewing three key steps throughout the entire process: **Step 0, Step 3** and **Step 8**.

Arcadis' review of HAL's Preferred Masterplan will take the form of three reports. This approach has been approved by the CAA.

Step 0 Report (this report): Reviews the Preferred Masterplan with a focus on the requirements to open the 3rd runway in 2026 providing a capacity of 95mppa.

Step 3 Report: Reviews the requirements to achieve a capacity expansion of 122mppa using 2033 as the indicative point that this number of passengers will be processed.

Step 8 Report: Reviews the requirements up to the planned completion of the expansion programme with a date point of 2050, achieving a capacity of 142mppa.

1.2 Objectives

Our review of HAL's Preferred Masterplan considers whether the proposal is:

- Operable;
- Deliverable;
- Timely;
- Reasonably and Reliably Costed; and
- In the Interest of Consumers.

All of these themes are assessed in detail through the reports in separate chapters. The theme relating to 'In the Interest of Consumers' is featured in all of the chapters and is concluded substantively in the last chapter of the **Step 0** report.

This report focuses on analysing the themes as part of the **Step 0** proposals linked to the opening of the 3rd Runway. Steps 3 and Step 8 will be addressed in future reports.

When conducting our review, we have focussed on the following key technical areas, including elements of capex:

- Airfield;
- Terminals and Satellites;
- Landside;
- Surface Access; and
- Other key components including enabling works.

All the above key technical areas have been reviewed from the perspective of the themes identified. The scope of our review with regards to each theme is described in the following sections.

1.2.1 Operability

The airport will remain open during the construction phases. To achieve this, airport operations must be maintained during the development of the proposed infrastructure and facilities. The development phases must also integrate into existing airport infrastructure.

Arcadis has assessed both the design and the programme of the Preferred Masterplan to assess the operability of the airport from the existing situation to **Step 0** that takes the expansion up to the opening of the 3rd runway.

Arcadis's assessment includes analysis on the following:

- The impact the Preferred Masterplan has on existing and future airport operations, including: Airfield, Terminals, Landside & Surface Access;
- Analysis of the operability of the plan with regards to complex issues including configuration, flexibility and resilience;
- Testing the reliability of forecasts and evaluating assumptions made by HAL;
- Reviewing the detail and calculations behind capacity assessments produced by HAL;
- The anticipated impact on existing consumers and operating airlines; and
- Observed level of maturity with regards to airport operations in the future.

1.2.2 Delivery

Arcadis has reviewed the Preferred Masterplan material to assess whether **Step 0** is deliverable. Our review has considered the following:

- The scope, design and programme;
- Feasibility of construction and ongoing airport operation during construction;
- Scope gap in deliverables, including the robustness of the programme for delivery and any risks associated with it;
- How new and impacted facilities will link with existing infrastructure and how HAL will maintain key assets during construction phases of delivery;
- The appropriateness of the detail provided in Project Management Plans and Programmes;
- The observed level of maturity with regards to deliverability; and
- Evidence that the single Preferred Masterplan and future development of the masterplan to DCO submission are adequately considered and appropriate for DCO award.

Some of these issues will be discussed in more detail in further reports as their impact on the deliverability of the scheme in **Step 0** is minimal.

1.2.3 Timing

This report assesses whether the single Preferred Masterplan at **Step 0** can be delivered to the anticipated timelines. Our analysis considers the following:

- Evidence that the single Preferred Masterplan and planned deliverables for each step can be provided in accordance with the specified duration in the programme and the dates and deadlines detailed;
- The risks to providing the relevant deliverables in accordance with the current specified duration in the programme and/or on the dates and deadlines detailed;
- The potential effect on overall programme durations of requirements that are not directly controlled by HAL, including the DCO and consent for the Energy from Waste (EfW) Plant.
- The impact of failing to provide for the relevant deliverables in accordance with the current specified duration in the programme;
- What strategies have been developed to mitigate risks and any subsequent impacts from failure to delivery in a timely manner, with consideration for interdependencies; and
- Evidence that the single Preferred Masterplan and future development of the masterplan to DCO submission are adequately considered and appropriate for DCO award.

1.2.4 Cost Estimate

Arcadis has assessed whether the capital expenditure of the Preferred Masterplan phase for **Step 0** has been reasonably and reliably costed in relation to the design and programme provided in the single Preferred Masterplan.

Arcadis' study has reviewed HAL's approach to create and develop the Cost Estimate of their masterplan, including:

- Review of approach to Cost Estimate and process for development and future development, amendments to Cost Estimate based on progress, assessment of progress and amendments to date;
- Scope gap review;
- Accounting for inflation; and
- Any corresponding impact with Opex and/or Totex.

Arcadis has assessed the certainty and reliability of the Cost Estimate, including:

- Quantification of costs (assessing the amount measured, the basis of the measurements and the extent of the work where quantification has not yet been undertaken);
- Pricing and confidence in costs (total, measured, assessed, benchmarks);
- Application of on-costs; and
- Approach to risk.

In addition, Arcadis has observed the level of maturity within the Cost Estimate. This includes:

- The robustness of evidence provided by HAL in relation to its single Preferred Masterplan and associated cost; and
- The integration of Cost Estimate with other elements of the single Preferred Masterplan such as; design, procurement, programme, logistics, external and mitigating factors, project specifics.

1.2.5 Interest of Consumers

For the purpose of this report 'consumers' are defined as both passengers and cargo operators of the airport.

To review HAL's Masterplan with regards to the interest of consumers Arcadis has considered the following:

- HAL's process for acquiring consumer insight
- The relevance of the information and the utilisation of customer insight;
- How well HAL has incorporated consumer insight into their masterplan development process;
- How well HAL's Masterplan reflects the stated and expected interests of existing and future consumers; and
- How well the future development of the masterplan reflects the interests of consumers.

This review will be building upon a previous Arcadis report submitted in December 2018, '*An initial review of consumer interests in the development of the HAL Masterplan*'.

1.3 Review Approach and Key Steps

Arcadis has proposed an approach to this masterplan review to meet the objectives identified above. The approach is aligned with CAA's expectations as agreed in a memo titled *HAL Masterplan Review* submitted by Arcadis to the CAA in July 2019.

The approach, and key steps taken are set out below:

- Arcadis has collected data and assessed all the information provided to it by HAL and has also used its own information and data for benchmarking and industry standards;
- Data and information have been analysed to understand the basis or source of the data. In addition, an assessment of the assumptions and parameters have been checked to ensure any proposed outcomes are aligned with these;
- The proposed technical solutions in the Preferred Masterplan have been reviewed and validated to ensure they meet the required criteria and objectives set;

- The impact of the proposed masterplan on various stakeholders has been considered;
- The delivery sequence and timing of the proposed masterplan has been reviewed;
- A study of the existing infrastructure has been undertaken to understand its link to the proposed facilities;
- The future demand and capacity needs of the expanded airport have been analysed and validated;
- An identification of any gaps in the robustness of the proposed masterplan, and an assessment of confidence in its delivery, have been undertaken;
- An interrogation of capacity assessments/ calculations has been made and these have been validated to ensure their alignment to expectations; and
- A review of the direct costs, indirect costs and programme specific costs in the Cost Estimate has been made to determine the appropriateness of quantities, rates, percentage additions and allowances.

In the Interest of Consumers

Although this theme does not have a dedicated chapter as part of this **Step 0** report, Arcadis has considered the consequential impact that the themes will have on consumers and has made the relevant commentary within the theme chapters.

Arcadis has considered:

- To what extent HAL has gathered and utilised consumer insights to develop the masterplan;
- How well HAL has incorporated the interests of consumers into its masterplan development process; and
- Whether the masterplan reasonably reflects the stated and expected interests of existing and future consumers.

This element primarily builds upon the recent Arcadis Report '*An initial review of consumer interests in the development of the HAL Masterplan*' (dated December 2018).

2 OPERABILITY

Arcadis has assessed the **Step 0** proposals from an operational perspective. The impact on airport operations, configuration, flexibility and resilience has been assessed. This includes analysis of airside, terminal and landside infrastructure.

Arcadis has considered the simulation studies, assessed the reliability of forecasts and evaluated assumptions used in determining HAL's models. **Step 0** has also been assessed against industry planning and compliance standards.

Arcadis's key findings are:

- HAL has undertaken the appropriate level of detail to assure the proposed infrastructure will meet the operational demands placed on it at **Step 0**;
- HAL has demonstrated the increase in runway capacity will provide more operational flexibility and resilience;
- The integration of the new infrastructure with the existing airport operation is feasible and is unlikely to conflict with current operations; and
- HAL is yet to develop detailed Operational Readiness and Trials workstreams which will be key to ensuring a smooth transition without causing any operational issues.

2.1 Definition of Theme

This section of the report reviews the operability of **Step 0** and included an overview of the existing airport infrastructure and an analysis of the future infrastructure required to achieve the objectives of the HAL's Preferred Masterplan.

Step 0 corresponds to Phase 1 of the Preferred Masterplan. This step/phase is when the new third runway becomes operational. This is currently anticipated to be 2026. This phase also includes some enhancements to existing facilities to meet the terminal and apron capacity demand.

This section of the report also assessed the assumptions contained within the Preferred Masterplan, considered the compatibility of the proposals with the existing layout of Heathrow Airport and reviewed the adherence to statutory requirements and known constraints.

In this high-level assessment of operability, we have considered the following elements of the Preferred Masterplan:

- Airfield, including the 3rd Runway;
- Terminals;
- Landside; and
- Wider surface access considerations.

As part of the masterplan HAL has completed forecasting and demand analysis. The Arcadis analysis has considered the appropriate metrics, including passenger numbers and aircraft movements, in the review.

2.2 Assessment

2.2.1 Methodology

Our review consists of a high-level assessment of publicly available information and documentation provided to us by HAL at the time of writing this report. This documentation (listed in Table 3) includes a number of reports, presentations as well as a number of reference drawings.

Report Title	Report Source
Heathrow Strategic Brief	HAL – Public Documents
Preferred-Masterplan - June 2019	HAL – Public Documents
Updated-Scheme-Development-Report-Document-1-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-2-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-3-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-4-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-5-of-5	HAL – Public Documents
[redacted]	HAL – Airline Sharepoint
	HAL - Presentations
	HAL - Presentations
	HAL - Presentations
	HAL - Presentations
	HAL
	HAL
	HAL
	HAL – Airline Sharepoint
	HAL – Airline Sharepoint
Cargo Transformation Board pack	CAA

Table 3 Operability Documents Reviewed
Source: (CAA 2019), (HAL 2019)

2.2.2 Overview of Existing Infrastructure

The airport currently operates with a two-runway configuration. The runways are parallel and spaced far enough apart to enable independent parallel approaches. The dimensions of the runways are as follows:

- Northern Runway (09L/27R) – 3,902m x 50m; and
- Southern Runway (09R/27L) – 3,660m x 50m.

The declared capacity of the existing airfield is 88 movements per hour. The airport is currently limited to a total of 480,000 ATMs per year due to a planning condition associated with the construction of Terminal 5.

In the period 1st April 2018 to 31st March 2019, the airport handled 467,000 ATMs which is 98% of the capacity limit and equates to approximately 650 arrivals and 650 departures per day.

The terminal infrastructure at Heathrow consists of four terminals. Terminals 2, 3 and 5 are situated between the runways and Terminal 4 is located to the South of the Southern Runway.

In 2018 the airport handled approximately 80 million passengers per annum (mppa). The following data has been provided by HAL for each Terminal:

- Terminal 2 – [redacted] mppa;
- Terminal 3 – [redacted] mppa;
- Terminal 4 – [redacted] mppa; and
- Terminal 5 – [redacted] mppa.

The terminal facilities have surface access links for both private vehicles and public transport. The surface access infrastructure consists of adjacent vehicle forecourts, short stay car parks, road links to the motorway network and public transport interchanges for coaches, local buses, London Underground, and taxis.

2.2.3 Background of Current Operations

2.2.3.1 Airfield

Runways

The existing two runways at Heathrow are 3,902m x 50m and 3,660m x 50m. The runways are separated by 1,425m between centrelines. This allows for independent parallel approach. The runways are designed to operate the largest commercial aircraft, categorised as Code F by European Aviation Safety Agency (EASA) standards, which have a wingspan of up to 80m wide.

The runways are generally operated in segregated mode – landing aircraft are allocated to one runway and departing aircraft to the other. At specific times of the day when there is a build-up of airborne holding for arriving aircraft, tactical measures such as using both runways for landings can be applied to minimise delays.

Despite the fact the minimum runways separation requirements as per EASA CS-ADR-DSN issue 4 and ICAO Aerodrome Design Manual (Doc 9157) Part 1 Runways are met, there is still a dependency between where air traffic control can position the arrival of an aircraft approaching one runway and an arrival on the other runway. The reasons behind this constraint are related to thresholds, approach categories, approach slopes, CTR Obstacles and abatement procedures. Separation between aircraft needs to be increased which reduces the landing rate on the runways and therefore the overall capacity. Solving the capacity constraint in this respect may impose the upgrade of the approach instruments / equipment and procedures and more advanced radar monitoring techniques.

Heathrow currently utilises its runways in an alternating operation, where they are switched for departing and arriving aircraft. This is done primarily to offer respite to local communities living under the flight paths from noise and overflying of aircraft. During westerly operations, the runways are alternated at 3pm each day. During easterly operations, the legacy of the now rescinded Cranford Agreement which prevented departures over Cranford from the northern runway, prevents runway alternation.

2.2.3.2 Terminals and Satellites

Heathrow has four operational terminals – T2, T3, T4 and T5. Terminal 1 is closed but houses the baggage handling system for T2. Terminal 1 is scheduled for demolition to enable future expansion of T2.

Terminal 2

- T2 opened in 2014;
- The main T2 terminal building is supported by a satellite – T2B;
- T2 is used by Star Alliance members and also by other non-affiliated airlines e.g. Aer Lingus;
- Handled [redacted] million passengers in 2018; and
- Current T2 area – 297,900m^2.

Terminal 3

- T3 is the oldest operational terminal at Heathrow today and opened in 1961;
- T3 is used by Oneworld members, Virgin Delta and SkyTeam;
- Handled [redacted] million passengers in 2018; and
- Current T3 area – 225,780m^2.

Terminal 4

- T4 is the only terminal located outside of the central core of the airport, being situated to the south of the southern runway;
- T4 opened in 1986;

- T4 is used by SkyTeam Alliance members and other non-aligned airlines;
- T4 handled [redacted] million passengers in 2018; and
- Current T4 area – 132,400m^2.

Terminal 5

- T5 opened in 2008;
- T5 is used exclusively by British Airways and Iberia;
- T5 handled [redacted] million passengers in 2018; and
- Current T5 area – 526,000m^2.

2.2.3.3 Landside

Car Parking

HAL has stated that the current car parking facilities for both airport workers and passengers total 67,050 spaces around the airport. This is made up of:

- 42,000, HAL controlled spaces;
- 9,500 off-site (Purple Parking in Southall, Bath Road and other)*;
- 9,300 onsite tenanted spaces;
- 3,100 off-site tenanted spaces;
- 2,700 car hire; and
- 450 taxi feeder park.

The airport has an existing cap of 42,000 spaces as part of the planning consent obtained for Terminal 5.

Of the total 67,050 car park spaces available the following spaces reserved for passengers and staff are:

- 33,000 passenger spaces across short stay, multi-storey and surface car parks including offsite locations;
- 24,800 staff spaces; and
- The remaining spaces are onsite tenanted spaces.

*It should be noted that the 9,500 off-site spaces declared by HAL has significantly decreased since the site being used by Purple Parking has now been redeveloped for housing.

2.2.2.4 Surface Access

Heathrow's baseline 2017 Public Transport mode share is circa. 40%. The mix of Public Transport services at the airport consist of:

- Heathrow Express – 4 trains per hour (tph);
- Piccadilly line – 12tph;
- TfL Rail Service – 2tph; and
- Various bus and coach services from CTA, T5 and T4.

This Public Transport infrastructure is currently not operating at full capacity which gives the airport scope to increase the use of public transport with this existing infrastructure as well as introducing new services such as the recently launched *Guildford Railair* coach as indicated in its plans.

2.2.4 **Review of Preferred Masterplan**

2.2.4.1 General Overview

The previous sections provided an overview of the infrastructure and operations of the current airport. This provides context for the review of the Preferred Masterplan proposals.

This section follows the overview by providing analysis on the operability of the masterplan proposals. It follows a logical sequence starting with the work HAL has undertaken on traffic forecasting and the design day schedule. This forms the basis of the capacity and design of the masterplan proposals.

The review then focuses on the individual aspects of the **Step 0** proposals, namely airfield, terminal and landside developments.

2.2.4.2 Traffic Forecasting

A fundamental aspect of airport masterplanning is the development of traffic forecasts. This provides the basic assumptions required to plan for the future growth of the airport.

HAL has developed Design Day Schedules (DDS) as part of this process. The DDS is typically used as the basis of designing the future size and capacity of an airport.

From our engagement with HAL, Arcadis has seen examples of the DDS and summaries of the methodology process behind their development. We note references to the [redacted] and [redacted] that documents the schedule generation methodology. Arcadis has not been provided with this documentation.

The DDS examples and extracts that were presented to Arcadis, included the following information:

- Flight and passenger information;
- Load factors;
- Annual passengers;
- Transfer rates; and
- Allocated stands.

The DDS has been used to derive passenger flows, transfer volumes and number of aircraft on the ground. The DDS information has been used for a range of workstreams in the masterplan process. The DDS has been used to inform the following sections of the masterplan:

- Masterplan design;

- Airfield;
- Terminal, satellites, aprons;
- Connectivity (bags and passengers);
- Surface Access;
- Environmental; and
- Utilities.

For example, the data from the DDS has been used in conjunction with the input assumptions for terminal and airside capacity modelling. The DDS suite serves as a single source so that all HAL workstreams use the same data for consistency.

Arcadis has seen evidence that a comprehensive suite of DDS has been developed by HAL. These were initially formulated back in 2015 and have been updated over subsequent years as the masterplan process has progressed.

The initial DDS were developed to match the Airports Commission and were provided for key years (2030 and 2040) with different scenarios, including carbon capped, carbon traded and baseline. These have been updated to account for future traffic, new layouts and phasing years. As a result, the DDS suite has expanded to encompass schedules for additional phasing years and different traffic scenarios such as high and base case.

Table 4 shows that HAL has developed DDS for a number of scenarios including a base and high case up to the opening of the new runway, and a base case and three variations of a high case in the year the third runway becomes operational. It should be noted that HAL has also developed DDS for two runway operations with increased traffic scenarios in the years prior to the opening of the third runway.

Year	Runways	Annual Movements			
		Scenario 1	*Scenario 2*	*Scenario 3*	*Scenario 4*
2018	2	[redacted]			
2022	2				
2023	2				
2024	2				
2025	2				
2026	2				
2027	3				
2030	3				
2035	3				
2040	3				
2045	3				
2050	3				

Table 4 Suite of DDS Currently Available for Use
Source: ([redacted])

Based on this information, Arcadis is satisfied that the DDS suite appears comprehensive, providing parameters and assumptions that should aid various disciplines under the masterplan process, such as the terminal and airfield capacity studies.

The provision of schedules for a range of years in the masterplan period, as well as different traffic levels (high and base) indicates that HAL are testing different operating and growth scenarios for the development of the airfield.

The DDS for a two-runway scenario between 2018 to 2026 demonstrates that HAL has considered the operation of the airfield during the development works prior to the opening of the third runway (**Step 0**).

The DDS work appears to be detailed and is an ongoing process as per the Preferred Masterplan and phasing, as well as any layout changes. Arcadis notes that the DDS suite encompasses important years in the masterplan period and a variety of air traffic growth scenarios. To ensure confidence in the validity of the DDS data as an input to the different masterplan interfaces, we recommend that ongoing monitoring of the process is maintained by HAL in order to mitigate any potential risk.

2.2.4.3 Airside

3rd Runway Location

The requirement of the Airports National Policy Statement (ANPS) is that the runway must be at least 3,500m in length and enable an additional 260,000 ATMs per year. The position of the new runway must enable independent runway operations.

The position of the new runway has been through an extensive evaluation process and has been sited in accordance with the ANPS. This review does not revisit the previous study, but HAL has detailed the process in *Document 2* of their *Updated Scheme Development Report*.

The new runway will be separated by 1,035m from the existing Northern Runway, from centreline to centreline. This will enable independent runway operations. HAL has previously stated that further benefits would be realised by separating the runways further apart than 1,035m. However, they have decided against this as greater separation would require further loss of property in Harmondsworth and 1,035m runway separation would be more efficient for ground operations. As a comparison, the centreline separation between the existing Northern and Southern Runways is 1,425m.

Arcadis agree with HAL's assessment with regards to the separation of the new 3rd runway from the existing Northern Runway and believe that a separation of 1,035m (as per the ICAO & EASA requirements) creates the conditions for operations density increase by introducing the independent parallel approaches and departures strategy, leading therefore toward absolute higher probabilities to meet the objectives in the ANSP. However, the delivery of the extra 260,000 ATMs is still subject to modelling which is currently an ongoing process.

3rd Runway Length

Analysis into the appropriate length of the runway was completed during the Airports Commission process. HAL provide a summary of the approach taken to the determine the length of the runway in *Document 2* of their *Updated Scheme Development Report*.

The length of the proposed runway is 3,500m. It will be 60m in width, comprising 45m of runway and 7.5m wide shoulders on either side. This enables Code F operations.

The design of the runway also includes provision of displaced thresholds at both ends. These would be 550m (subject to final NATS/HAL safety case) at each runway end and this is designed to reduce noise impacts from aircraft on surrounding communities.

Runway Infrastructure and System

With the provision of the 3rd Runway, adjustments have been proposed for the two existing runways that will enable independent alternation of flightpaths across the three runways. These adjustments are designed to reduce the impact of aircraft noise on the surrounding community, enable efficient use of taxiways around the end of runways (Around the End Taxiways (ATETs)) and increase the flexibility of runway operations.

ATETs are a type of taxiway with the same characteristics as existing taxiways across the airfield. The only difference is that they are positioned at the end of runways to enable aircraft to taxi from one side of a runway to the other without having to cross an active runway. They are designed to be operated independently of runways and the ATET and the runway can be used simultaneously. Arcadis believes that this will contribute to the more effective operation of the airport and is configured for minimum land take.

On the existing southern runway, a 550m displaced threshold will be introduced. The centre runway (existing northern runway) will have 1,101m displaced thresholds introduced at both ends. Aircraft on approach will be at a higher altitude as they overfly local communities with the aim of reducing noise impact. At the east end of the centre runway, a new 211m starter extension strip will be provided to maintain a 3,500m take off run available as a result of the ATETs located at the western end.

The introduction of the 3rd runway requires changes to the modes of operation. One runway will be dedicated to landing aircraft, one to departures and the other used for landing and departing aircraft in a mixed mode operation. The different modes of operation will be circulated around the three runways to provide periods of respite from aircraft noise for local communities.

Airfield Modelling

Airfield modelling and simulation work has been undertaken for the future runway operations by HAL. This has been undertaken in conjunction with NATS. The modelling software used by HAL is Total Airspace and Airport Modeler (TAAM). TAAM is an industry recognised tool for airfield modelling and it is understood that this has been used for a number of years by HAL. Arcadis is satisfied that this is an appropriate tool to conduct airfield modelling.

HAL has confirmed that the modelling process has included engagement with airlines on a bi-lateral and multi-lateral basis. It is understood that these discussions are confidential but Arcadis is satisfied that the airlines have been involved to provide a further level of verification, debate and analysis to the modelling process.

We have seen evidence that the simulation work has taken into account the daytime mode changes – alternating each runway between landing, departure and mixed mode. Furthermore, simulation has been undertaken for both easterly and westerly runway operations.

From our review of supporting documentation relating to the airfield design provided by HAL, a comprehensive list of modelling assumptions demonstrates that development work and analysis has been undertaken behind the future runway operations and airfield assessments for the masterplan development. The list of modelling assumptions encompasses both airspace and airfield characteristics which relate to aircraft separation, arrival and departure routings, taxiway flows, stand plans, ground movement speeds and the planned runway threshold displacements.

From these modelling assumptions, Arcadis believes that HAL has conducted airfield modelling that accurately replicates the future layout and assumed operation that this might entail. Arcadis has seen select outputs of the airfield modelling work that has been undertaken by HAL which were presented in workshop sessions. The outputs that have been made available indicate airborne delay, arrival taxi time and departure taxi time for different configurations of the runway operating modes.

HAL has not completed modelling for low visibility procedures at this stage but has started initial consideration for understanding the impact on the most complicated areas of the airfield. Arcadis is satisfied that the modelling is sufficiently advanced at this stage and would not expect this level of detail for a masterplan.

Overall, Arcadis is satisfied that HAL has conducted modelling that accurately tests their assumptions and proposed airfield infrastructure. It has been indicated by HAL that airfield modelling is ongoing to further develop the airfield design and test the proposed infrastructure against other scenarios such as low visibility operations and runway outages.

Taxiway System

The taxiway system is thoroughly described in the *Updated Scheme Development Report* produced by HAL in *Chapter 2*, *Document 2*.

The general layout of the current taxiway system consists of dual parallel taxiways assigned to each runway in part connected with nine cross-field taxiways linking north and south areas. Located to the south side of the Southern Runway (09R/27L) are Terminal 4 and the cargo area which are also linked with the whole airport taxiway system.

The new runway will require a taxiway system that connects with the new aprons and terminal as well as with the existing taxiway system. The taxiway system will have to comply with many requirements to avoid any single points of failure, predictable and reliable respite from noise and compliance to EASA requirements for airfield geometry. In order to meet the above criteria, HAL decided to adopt a detailed scheme development process of optimisation regarding options development and selection.

The current layout of the airfield does not include any taxiways that go around the ends of the runways. All aircraft currently accessing T4 and the cargo area must cross the Southern Runway. The new sections of the airfield are designed to eliminate similar scenarios. Aircraft using the new 3rd Runway will not be required to cross the central runway to reach the rest of the airfield. It is preferable that, following the requirements for taxi time reduction, aircraft using T4 and the cargo area to be assigned the use of the future Centre and South Runways. Longer term, aircraft using T5N will use the new 3rd Runway and the existing Northern Runway.

The Total Airspace and Airport Modeller (TAAM) and Air Traffic Control (ATC) simulator modelling employed by HAL indicates that if aircraft were required to cross the central runway then it would not be possible to deliver the additional 260,000 ATMs as detailed in the NSP.

HAL propose dual Around the End Taxiways (ATETs) on the central runway to prevent aircraft having to cross active runways. These will be located at the west side of the airfield where the majority of the apron capacity is located. Situating the ATETs on this side reduces the overall land take required. This will also provide environmental and operational benefits as it minimises taxi times for aircraft accessing the new runway.

The ATETs will be Code F compliant and therefore compatible with all aircraft sizes using the airport. This provides maximum operational benefits and, as they are dual taxiways, will enable one taxiway to be used for departures and the other for arrivals.

On a localised section of the ATETs, the vertical stabiliser of Code F and some larger Code E (Boeing 7474-8i) aircraft will infringe the take-off climb surface of the obstacle limitation surfaces (OLS) associated with the central runway, as indicated in Figure 1. This will have an impact upon airfield operations whilst Code F aircraft are taxiing in this area. The impact of this could be either airfield operations related restrictions or amendments to aircraft performance (through updates to Type A charts) depending on detailed solutions to be agreed upon with the airlines at the detailed design stage.

However, considering the small proportion of Code F aircraft movements Arcadis does not believe this should have a detrimental impact on safety or capacity. Movement of Code F aircraft in this area will be managed operationally by ATC to comply with airfield operations requirements and maintain the safe movement of aircraft, expected by routeing Code F aircraft on the outer of the two taxiways.

The alternative would be to redesign the airfield with wider spacing between the runway and taxiways. Arcadis believes that this would be excessive and is satisfied that the design proposed is sufficient with regards to safety and operational risks and that HAL has provided a pragmatic solution.

[redacted]

[redacted]

Overall, Arcadis agrees with the location and the design of the ATETs from an operational and airfield safety perspective.

Aprons and Stands

During **Step 0** there is no significant terminal expansion proposed with additional capacity being accommodated within the existing infrastructure. As a result, the apron infrastructure will remain similar to the existing layout. However, additional aircraft stands will be provided on existing airside areas.

Currently, Taxiway Kilo is under construction. The taxiway is located between the now closed Terminal 1 and Terminal 2B, as can be seen from Figure 2. Its completion will provide a new link between the two existing runways. The completion of the taxiway will also allow for additional aircraft parking space (Kilo box stands) either side of the taxiway. Some of these are already operational whilst others are under construction.

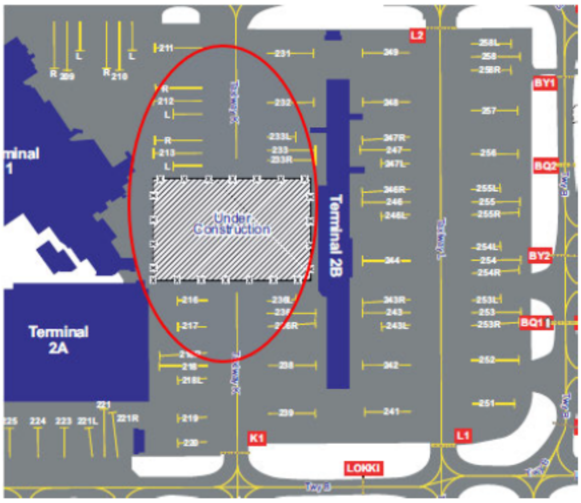


Figure 2 Taxiway Kilo and Asocciated Stands
Source: (NATS - AIS 2019)

As part of the 'T5 Plus' scheme, five non-contact stands located at the northern and southern ends of the T5B and T5C satellites will be converted to contact stands. It is expected that the required conversion works would render these stands temporarily unavailable and that during this period, alternative stands should be provided to accommodate any associated shortfall in capacity that may arise on the T5 apron. If the stands are currently used for towing, when aircraft are on the ground for prolonged periods between flights, then we believe that this would not be an issue as these can be accommodated elsewhere, for example in the Eastern Maintenance Base or on the 580s/590 stands.

It is proposed in HAL's *Stand Throughput* report that some or all of stand numbers 580s and 590s, currently located in the middle of the airfield between Terminal 5C and Terminal 3, could be reallocated from T3 to T5.

Arcadis are satisfied that these additions can be provided in an operable manner. The new stands will be accommodated within the existing airside infrastructure.

The *Stand Throughput* document outlines the mppa/stand ratio for the actual and declared capacity in 2018, on a per terminal and total stand basis. For both actual and declared capacity, the mppa/stand ratio is just below 0.5mppa.

At **Step 0**, the proposed additions and re-allocation of stand infrastructure, along with the envisioned capacity, the mppa/stand ratio for the overall airfield is 0.51 mppa. We have undertaken a high-level benchmark of airports which are either operating with three runways or have proposed development of a third runway with passenger throughput similar to the rate that is expected in **Step 0** (see Table 5 below).

For clarity, HAL provide two scenarios (A & B) in the *Stand Throughput* document. The difference between the two scenarios is the allocation of remote stands between terminals and consequently how this corresponds to the mppa/stand figures. However, in each scenario the total number of stands, the overall airport capacity and the overall mppa/stand throughput is constant. Therefore, the analysis in Table 5 accounts for both scenarios.

Our high-level benchmark analysis indicates that the annual passenger to stand ratio in **Step 0** is aligned with similar sized airports operating with or proposing a third parallel runway. It is Arcadis' opinion that the annual passenger to stand ratio is in the upper range. However, based on comparison with similar sized airports, Arcadis is comfortable with the stand throughput proposed by HAL.

Airfield Hotspots

The existing layout has four airfield hotspots as indicated below:

- **HS1 (Links 23, 22 and 21)** – Pilots must maintain a good lookout and are responsible for wing tip clearance;
- **HS2 (SATUN)** – Pilots must maintain a good lookout and are responsible for wing tip clearance;
- **HS3 (Link 28)** – Code F movements must take care. Link 28 East of Taxiway Alpha is not Code F compliant; and
- **HS4 (TWY Y)** – Pilots are to ensure they have clearance to enter the runway before crossing the holding point.

The masterplan process is removing these hotspots by design over a period of time. Arcadis believes using the masterplan process to eliminate the hotspots is a sensible approach to enhancing the safety of the airfield. Arcadis' analysis of the airfield layout does not indicate that any new hotspots will be created.

Cargo Facilities

In 2018, approximately 1/3 of the UK's long-haul export goods moved through Heathrow airport and the airport is the UK's biggest port by value. The main cargo facilities are located to the south of the airport. This infrastructure handles a significant amount of cargo which equates to c. 1.7 million tonnes per annum. This is supported by the large amount of freight and logistics businesses located

Airport	Total No. of Terminals	Annual Pax - based on 3 parallel runways (MPPA)	Total No. of Stands	Annual Pax per Stand (MPPA)	Comments
Heathrow*	4	95.0	186	0.51	
Hong Kong*	3	97.0	160	0.61	Based on three runway system with 3rd runway passenger building (Masterplan 2030)
Singapore Changi*	4	82.0	159	0.52	
Kuala Lumpur	2	70.0	162	0.43	
Munich*	2	61.0	156	0.39	Third runway plans submitted but not pursued during the current Bavaria Coalition Government legislative period (2018 – 2023).
Beijing Capital	3	95.5	171	0.56	

*Third runway proposed or in development

Table 5 Comparison of Heathrow Step 0 Scenario mppa per Stand Ratio
Source: (Arcadis Internal Library 2019)

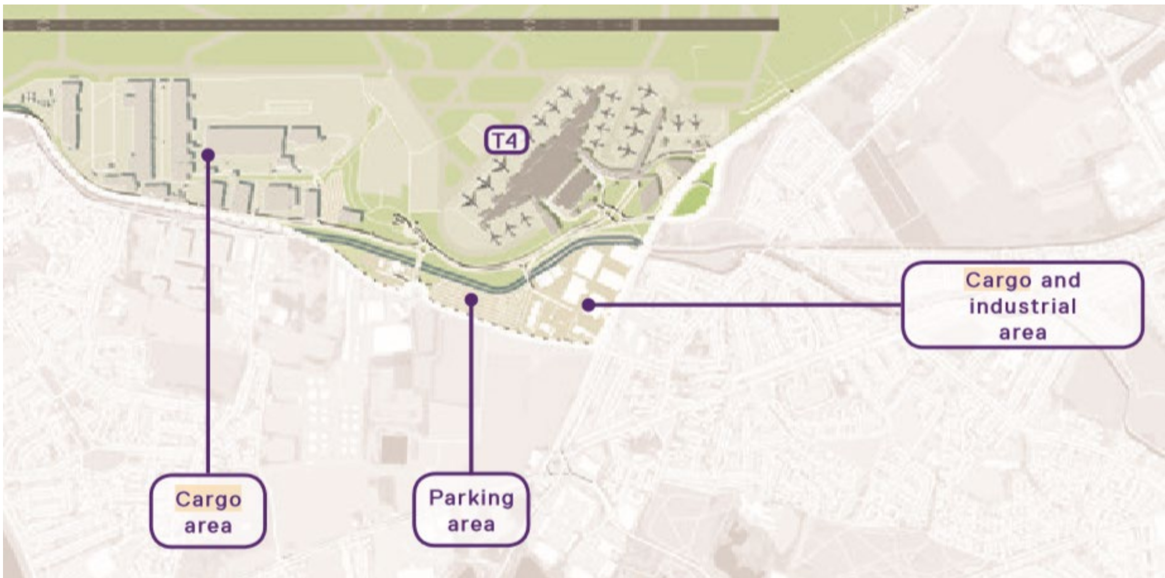


Figure 3 Location of Cargo Terminal and Cargo Related Businesses in the Surrounding Area
Source: (Preferred Masterplan - HAL 2019)

in the surrounding areas of this airport (refer to Figure 3 above).

Arcadis understands that new third runway would permit the growth of cargo volumes to the forecasted demand which is anticipated to reach 3 million tonnes per annum by the year 2040.

The Preferred Masterplan proposes up to 206,000m^2 of additional cargo facilities to support the forecasted demand. The development strategy followed to meet the projected demand comprises of four key criteria:

- Increasing capacity to facilitate the throughput of 3M tonnes per annum;
- Improving performance and efficiency;
- Reducing freight vehicle traffic; and
- Minimising risk of delivery vehicles.

HAL has proposed improvement measures support each of the development strategies. The improvement measures are explained concisely in Table 6.

These infrastructure developments are not proposed to be delivered before 2026 so are not covered in the **Step 0** report. Arcadis aims to undertake a full analysis of the proposed cargo infrastructure in the Step 3 and Step 8 reports.

Air Traffic Control Tower

A second ATC tower is proposed in the masterplan (refer Figure 4). This is positioned adjacent to the hard stands array facing T5XN in the west side.

HAL anticipates that technology may negate the need for a second tower. Therefore, the position of the tower is for safeguarding purposes only should it be required in future.

Arcadis has no information about the height, line of sight or any other parameter in relation to its construction.

From aeronautical point of view the location of the tower must be checked against the height limitations imposed by the Obstacle Limitation

Development Strategy	Improvement Measures
Increasing Capacity To facilitate cargo throughput of 3M Tonnes P.A	• Facilitating growth and intensification of land use on site • Provision of additional capacity thorough development of new cargo terminals / transhipment facilities
Improve performance and efficiency	• Minimising Minimum Connection Times (MCTs) for transiting freight through • Addressing traffic issues at Control Posts • Addressing access issues with Dnata City • Reducing number of touch-points
Reducing Freight Vehicle Traffic	• Consolidation of freight forwarder facilities • Providing excellent airside road links from new apron areas to the cargo areas • Provision of cargo staging areas close to aprons • Provision of transhipment areas
Minimising risk of delivery vehicles using residential roads by	• Developing a truck park with appropriate call forward facilities • Investigate the possibility of an Intermodal / Rail hub for cargo

Table 6 HAL Development Strategy for Cargo
Source: (Cargo Transformation Board pack 2019)

Surfaces provisions – *EASA CS ADR DSN – Chapter H*.

Rescue and Fire Fighting Services

ICAO Document 9137 – Airport Services Manual Part 1 details the regulations and requirements for the fire protection level based upon the air traffic movements at airports. Heathrow Airport is able to provide Rescue and Fire-Fighting Services category A 10 level.

Within the Preferred Masterplan document HAL is declaring a Satellite Fire Station in relation to the 3rd Runway operation positioned in proximity of new THR 27R, east of TXN satellite. The requirement is that the fire service must be able to response to emergencies and reach the runway thresholds within three minutes of a call.

It is noted that the position of the facility may require 90 degree turns when accessing taxiways. ICAO recommends that 90-degree turns should be avoided. However, Arcadis accepts that the level of detail in the masterplan may not show all of the airside roads. We would expect that the design will allow provision for local airside roads to prevent this scenario.

A more centrally located position to the runway would provide a faster response time to the west side of the new 3rd Runway, however, with the competing demands of other airfield infrastructure Arcadis believes the proposed location can provide a compliant solution.

Therefore, Arcadis is satisfied that the location of the fire station can be made compliant regarding emergency response times.

As the masterplan develops the final design of the facility will be determined. This will include items such as the vehicle fleet allocation and the extinguishing agents. Following this, the Emergency Plan will detail the response plan for emergencies and the specific detail regarding equipment and personnel.

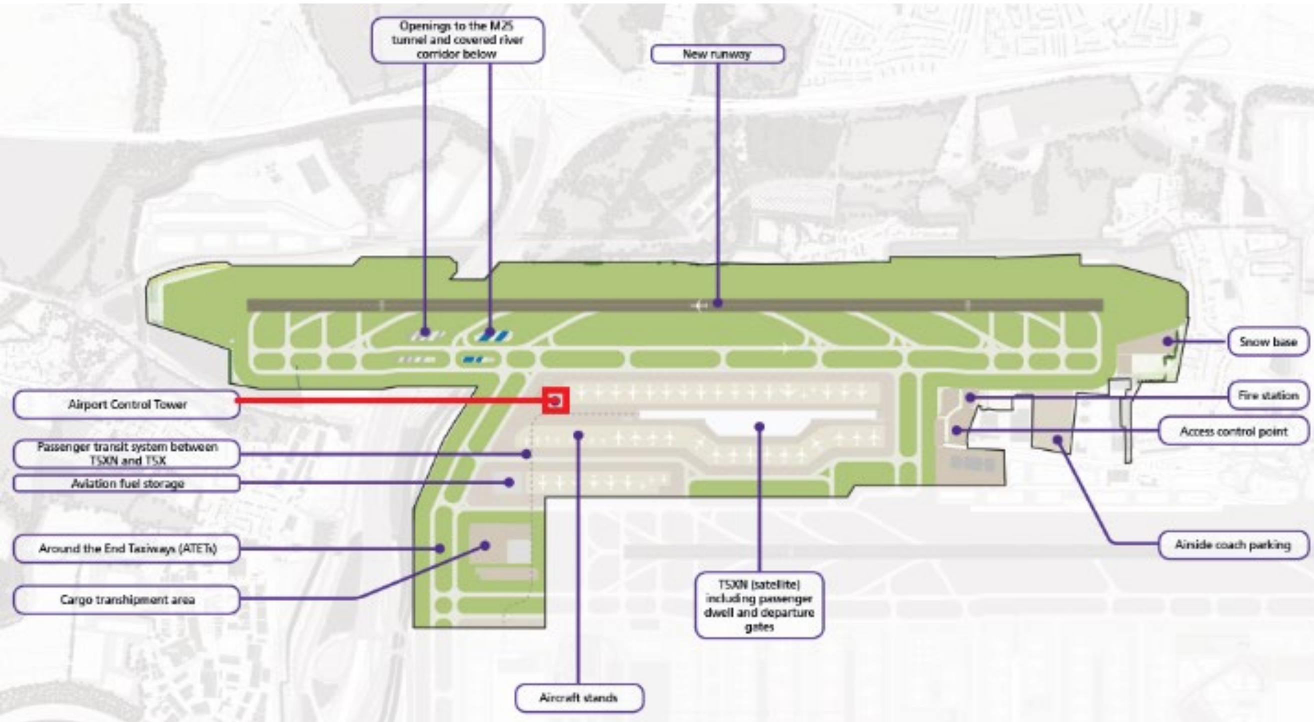


Figure 4 ATC Second Tower Location – 3rd Runway
Source: (Preferred Masterplan - HAL 2019)

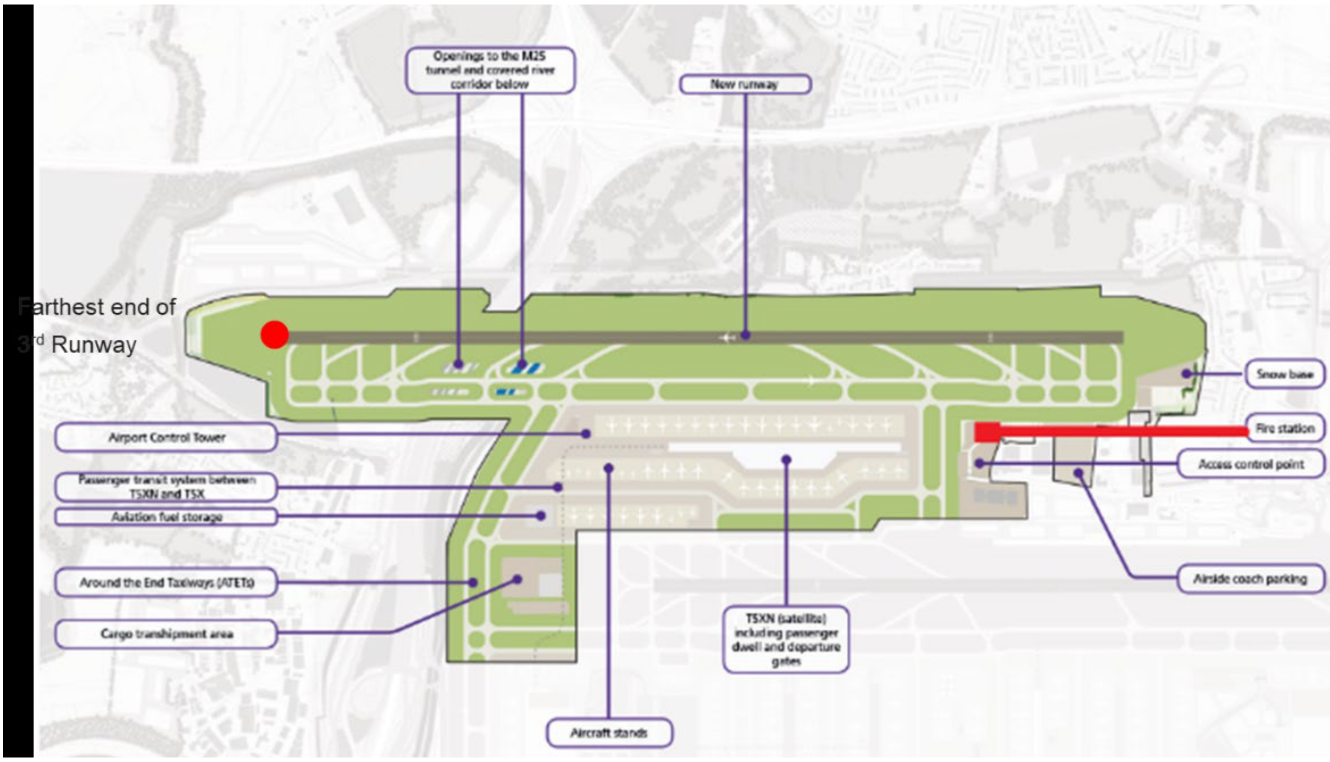


Figure 5 Satellite Fire Station Location
Source: (Preferred Masterplan - HAL 2019)

Fuel Farm

The aviation fuel demand at Heathrow today is [redacted] million litres per day. This is delivered primarily through an extensive pipeline system including the use of rail transport.

Before being pumped through the hydrant systems, the aviation fuel needs a buffer (ground level tanks) in order to ensure a settling period for quality aircraft delivery purposes and in a certain adequate volume aiming to continue to feed the airport in case of supply disruption.

There are two fuel farms at Heathrow today:

- Northern (Perry Oaks) Fuel Farm; and
- Southern (Cargo Zone) Fuel Farm.

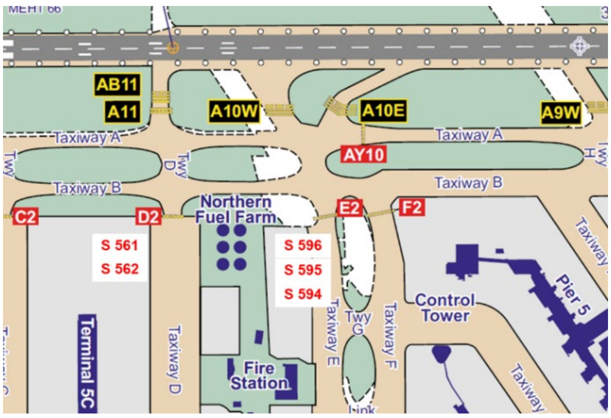


Figure 6 Existing Fuel Farm – Perry Oaks Depot
Source: (NATS - AIS 2019)

The Northern Fuel Farm is located west of Pier 5 Terminal 3, South form TWY B, neighbouring Stands 596, 595,594. (Figure 6).

The Cargo Zone Fuel Farm is located South from TWY S, across Cargo Apron Z (Figure 7).

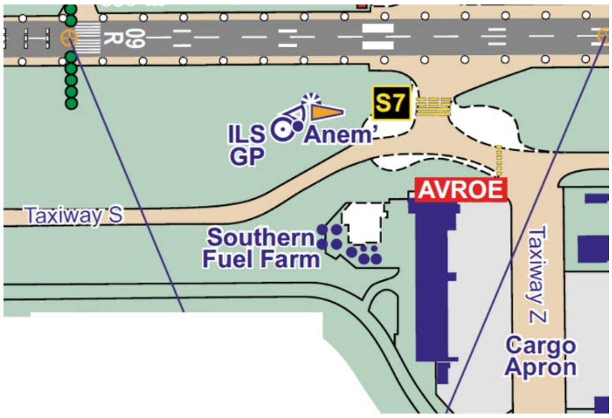


Figure 7 Cargo Apron Fuel Farm
Source: (NATS - AIS 2019)

HAL has evaluated several options for fuel storage facilities development in order to cope with the forecasted 740k ATMs average peak demand schedule and [redacted] million litres per day required by the expanded airport. Some supply disruptions were considered - ranging from 2 to 14 days with severity of fuel loss of supply from 25% to 40%.

The most fuel resilient option identified as optimum was the construction of four supplementary tanks next to Perry Oaks Depot, on parking stand 596 and six more tanks on the Southern Apron. Thus, this option would be able to withstand a prolonged 35% supply disruption and up to five days at 40%.

Together with the above planned extension there are also reconfiguration of the supply network as pipelines and Railhead.

The development of the fuel farms and space reconfiguration must also take into account the safe distances in relation to the existing structures and operating aircrafts. Information received from HAL indicates that the safety clearances for the fuel tanks are compliant with the Control of Major Accidents Hazards (COMAH) regulations.

Arcadis believes that HAL has undertaken a comprehensive analysis of the fuel demand. The proposed expansion of the existing facilities planned to meet this demand, whilst providing the necessary capacity for disruption.

Ground Support Equipment (GSE)

HAL has presented a high-level view within the Preferred Masterplan document setting out the positioning of the Maintenance Base for Ground Support Equipment (GSE) repairment and parking within Area A, 3rd Runway related.

While the location of the GSE Maintenance (and other similar facilities) is dictated by the aerodrome performance and standard operating practices, the GSE inventory and capability is important for the entire airport operations.

This defines the services assumed by HAL and technical capabilities of other airport users such as Handling Companies.

Currently, Arcadis has not analysed any GSE fleet inventory, capacity estimation or planning in relation to the new 3rd Runway operations. There is a risk that GSE may need to take up stand space that could cause operational inefficiencies.

Snow Base

The Preferred Masterplan has the location of the Snow Base at the east end of new runway 09L/27R in the proximity of the GSE Repairment facility.

The location of the Snow Base as indicated in Figure 8 below is dictated by the local standard operating procedures of the aerodrome.

Arcadis believes that the snow base is located in a suitable position on the airfield to respond to operational needs in periods of adverse weather.

2.2.4.4 Terminal and Satellites

As **Step 0** does not include expansion to existing terminals or the construction of new terminals, Arcadis has focused on the external airport infrastructure and the construction of the runway. However, as part of the existing 'On-Airport' portfolio of capital projects, HAL currently has plans to increase the capacity of T5 and potentially T3 in advance of the new terminal facilities being developed and to maximise the opportunity of a potential uplift in ATMs following the DCO approval. These projects are referred to as the 'Plus' projects.

Additional demand in this period is anticipated by HAL to be absorbed by the existing terminal facilities. There will be additional capacity measures implemented but these will be through alterations to the existing infrastructure and measures including technological enhancements to processing facilities.

Arcadis is satisfied with the approach taken by HAL. Namely, that **Step 0** concentrates on external infrastructure and airfield infrastructure. Arcadis after a high-level assessment based on the thumb

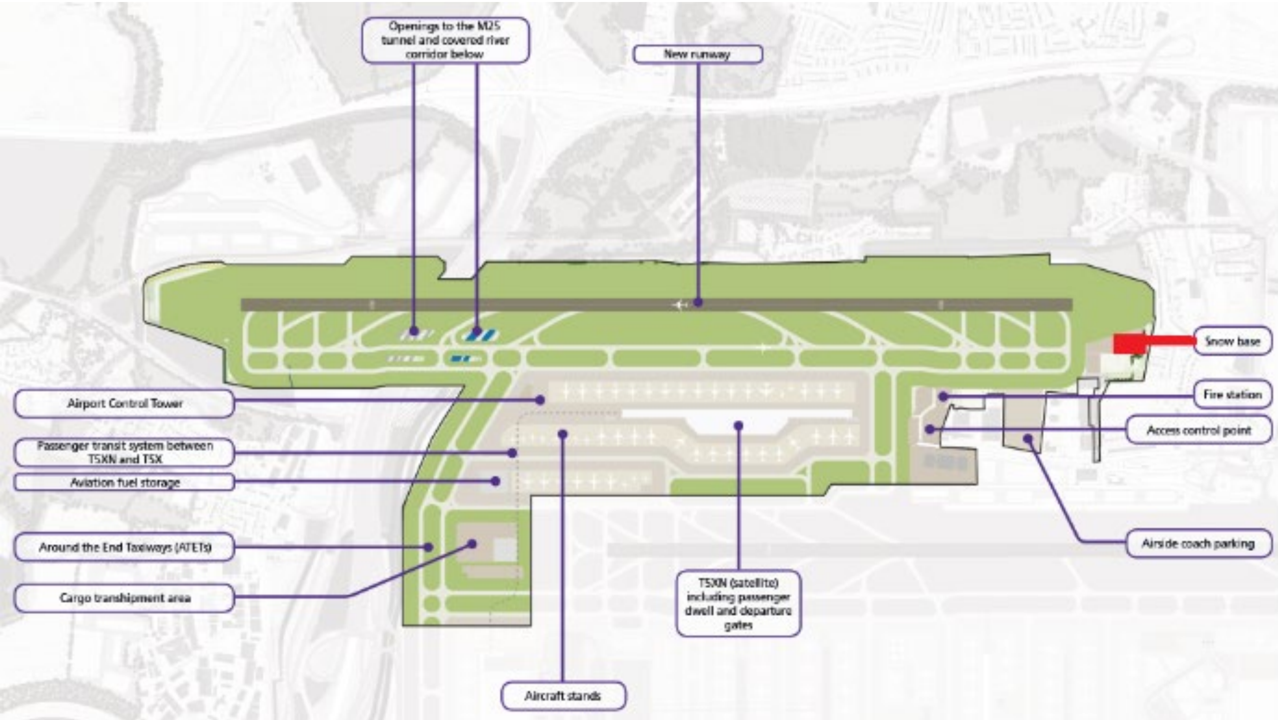


Figure 8 Snow Base Location Zone A
Source: (Preferred Masterplan - HAL 2019)

rules and benchmarks due to limited access to information is satisfied that the terminal facilities can cater for the passenger demand in the Step 0 phase.

2.2.4.5 Landside

Forecourts

HAL is proposing to provide ‘Kiss and Fly’ facilities within the new parkways. Arcadis has measured the total airport wide kerbside that amounts to circa 32m per mppa. Arcadis has not been provided with any figures for the equivalent Kerb length HAL’s new scheme will provide. It is not possible to make any meaningful analysis on whether this will be operable to a reasonable level of service. Arcadis considers that if HAL significantly reduces capacity from today’s available kerb capacity, the drop off services may become have operational challenges

Taxi and Private Hire Vehicles

Arcadis has considered the effect that the proposed Heathrow Access Charge may have on Black Taxi and Private Hire Vehicle (PHV) fares and availability. The Heathrow Access Charge is a strategy to be implemented, originally as a pollution charge and then moving on to an access charge in 2026, this fare will be enforced for both private vehicles and taxis, with staff, freight and busses/coaches being exempt. If the access charge is applied upon every entry rather than on a daily basis, passengers will have to pay more to use these services.

Some passengers are unable to use public transport due to their location (when the public transport network is not operational -such as very early mornings) or due to a physical disability (that reduces access to public transport). Those passengers are likely to be adversely impacted financially by HAL’s access scheme

In addition, this may lead to a reduction in the number of taxis and PHVs available at the airport, which would create longer queues at the Taxi ranks and for passengers seeking to use PHVs.

Bus and Coach

HAL has stated that they will expand the Central Bus Station and landside terminal zones to account for their improved bus and coach network. Arcadis has not been provided information by HAL of any plans to expand the bus and coach facilities at T4 and T5, with the proposed increased bus and coach services.

Arcadis considers that there is a risk that without an increase in available facilities, the airport will be unable to manage this increase in demand which will cause operability problems and cause delays to both passengers and staff using these services.

Car Parking

The current number of passenger parking spaces both short and long stay is 33,000, this includes both HAL controlled spaces and offsite Purple Parking. This sets a ratio of 435 parking spaces per mppa.

Whilst HAL do not have a target for **Step 0**, the current proposals for the number of HAL controlled parking spaces for passengers is 38,600 for 2030 with this number increasing in line with expansion through to **Step 8** (2050). This level of parking sets a ratio of between 330 and 335 parking spaces per mppa.

Arcadis notes that HAL has included 9,500 off-site parking spaces currently outside of their control in their baseline numbers. This has created a surplus of parking in their current levels compared to the proposed expansion plans as the latter only includes HAL controlled spaces.

As HAL is unable to rely on the additional provision of external parking for passengers, Arcadis have analysed the HAL provided numbers in terms of operability despite this discrepancy in methodology.

This reduction is reliant upon a significant level of change in how passengers choose to travel to and from the airport over the next ten years where the airport has little control. HAL has set out its Surface Access Strategy which includes high level information on incentives that aim to offer a Public Transport alternative for passengers travelling to and from the airport.

However, aside from the introduction of the Heathrow Access Charge, it is not apparent within the documentation how HAL will achieve this reduction in demand if passengers choose to continue to access the airport by private car and wish to park.

The risk associated with the reduction in parking space ratios is that HAL will have to manage the demand.

Staff Travel

The baseline of staff parking numbers for 2013 originally recorded has been flagged as anomalous by HAL, and as such are mediating between the significantly higher 2009 and 2017 values for their baseline. This does not affect their ability to operate the airport post 2026 but will significantly affect their ability to meet the 2030 and 2040 ANPS targets.

A modal shift to public transport will reduce car parking spaces for staff allowing spaces to be used for passengers. Car parks are to be consolidated into fewer sites that are clustered together into groups with good access to road networks. HAL has anticipated an increase of 2,150 car parking space provision in 2026.

The allocation of staff car parking is within HAL’s control and the opportunity to achieve their proposed reduction is possible. This is however dependant on alternative options being available for staff to be able to get to and from work. Arcadis notes that without other options being available, there is a risk that the ability of the airport to bring in this change is limited and their ability to deliver the parking capacity for use by passengers at **Step 0** is reduced. This again may create the knock-on operability issues highlighted above in both the car parks and forecourts.

Freight

The opening of the 3rd Runway will see an increase in ATMs and will result in an increase in the availability of air freight capacity at the airport. This will mainly be in the availability of more 'belly hold' capacity rather than through a significant growth in dedicated air cargo flights.

Although HAL has set out a plan to increase the use of virtual consolidation of freight, the evidence or impact of this is yet to be demonstrated. Arcadis believes that the increase in air freight capacity at Heathrow is likely to lead to a greater volume of road-based freight traffic accessing the airport campus to feed this demand.

This increase in air freight activity will impact on the operability of the airport as the resulting increase in road-based freight is likely to increase queuing at control posts and delays on the airport and wider road networks.

HAL has not set out detailed information on the level of freight activity linked to the opening of the 3rd Runway in 2026. Arcadis is therefore unable to fully review the operability implication the growth of air freight will have in Step 0 at this stage.

2.2.4.6 Surface Access Strategy

The ANPS detailed a number of requirements for surface access as follows:

- Increase the proportion of passengers accessing the airport by public transport, cycling and walking to at least 50% by 2030 and at least 55% by 2040;
- Reduce staff car journeys by 25% by 2030 and by 50% by 2040 from a 2013 baseline level;
- Strive to meet the HAL public pledge to keep landside related traffic no greater than 2019 levels;
- Set out the mitigation measures that it considers are required to minimise and mitigate the effect of expansion on existing surface access arrangements; and
- Keep CO^2 emissions within UK climate change targets.

This section analyses the assessment for Step 0 up until the anticipated runway opening in 2026. It should be noted that there are no specific ANPS targets set for this period. However, the existing Surface Access Strategy mode share targets seek to maintain a public transport mode share above 40% with a goal of 45% by 2024.

Most of the targets set out as part of the ANPS for an expanded airport are measures that are required beyond the Step 0 date. Arcadis recommends that the work to achieve these targets should begin in the early phases. The masterplan does not include the anticipated metrics for achieving these targets by 2026. However, it does include the progress expected to be made by HAL by 2027.

HAL has stated that 'good progress' is expected to be made on the mode share and staff travel targets. HAL also state that compliance with UK Air Quality limits is expected to be achieved by 2027. HAL is confident that the pledge to keep landside traffic levels no greater than 2019 levels is expected to be achieved.

HAL's pledge of generating no more airport related traffic greater than 2019 levels is in the process of being monitored by HAL for the purpose of setting a baseline. HAL are utilising an Automatic Number Plate Recognition (ANPR) systems in a tight corridor around the airport. To date, HAL has not provided information on how their consolidation areas for retail and construction traffic will be taken into account for this purpose.

As the current proposed monitoring cordon does not include airport specific facilities such as the proposed Consolidation Centre the quantity of traffic not using 'airport roads' but still Heathrow related traffic will not be captured as part of this calculation.

In order to achieve this a range of infrastructure measures have been proposed for the period up to 2027. The relevant tangible measures proposed to achieve these targets include:

- Expanded coach facilities at Central Bus Station and Landside Terminal Zones;
- Cycle lanes and bus priority on A3044;
- Cycle lanes and bus priority on A4;
- Piccadilly Line enhancements (by TfL);
- New Multi-storey long stay car park at T4 (on site of existing surface level parking); and
- Staff parking reduced from approximately 25,000 spaces to approximately 19,000.

The following operational improvements are proposed:

- New taxi backfilling model;
- Vehicle access charge;
- Elizabeth Line operational;
- New Heathrow Travel Account for staff; and
- New coach services.

The above measures will contribute to the achievement of increasing the use of Public Transport and sustainable modes of travel and that these infrastructure and operational models will help meet the surface access targets. However, the targets for **Step 0** are not clearly defined and these are only specified for later phases.

The provision of this information for **Step 0** would assist Arcadis in determining the potential impact that these could have on the operability of the Landside areas of the airport in 2026.

2.2.5 **Review of ANPS and Regulatory Compliance**

This section of the report reviews **Step 0** against the main principles of the ANPS. The main points for **Step 0** relate to the airport design specifications and the surface access considerations.

2.2.5.1 Airport Design

The Preferred Masterplan has adopted the airport planning principles including those provided by:

- International Civil Aviation Organization (ICAO);
- European Aviation Safety Agency (EASA) Certification Specifications and Guidance Material for Aerodromes Design (CS-ADR-DSN);
- UK Department for Transport (DfT); and
- Civil Aviation Authority (CAA).

Arcadis agrees that the Preferred Masterplan provides the minimum required runway length and meets the requirements set out in ANPS regarding the 3rd Runway.

The working assumption is that the new 3rd Runway will be operational by 2026. In order to achieve this a significant amount of non-airport infrastructure works will be required to accommodate the new runway including river diversions, moving the M25 motorway, building other local roads etc. This is in addition to the works necessary to integrate the new runway and associated infrastructure including taxiways, service roads and utilities.

Analysis of how this will be achieved is detailed in the Delivery section of this report however from an operational perspective there are a range of issues to consider. The analysis in this section focuses on the on airport operational aspects once the infrastructure has been completed.

Step 0 assumes that when the runway opens the maximum capacity of the airport will be 95mppa (Updated Scheme Development Report 2 of 5) split between terminals as per the *Masterplan Proposal Study* and [redacted]

However, **Step 0** does not propose any significant changes to the existing terminal facilities. Additional demand is anticipated to be catered for by enhancing existing facilities which are part of the existing 'On-Airport' portfolio of capital projects and are referred to as the *Plus* projects. This includes increasing T5 capacity to 40mppa through the T5 plus programme comprising of works including the extension of T5B and C by converting remote stands to contact stands.

A layout of the airport at **Step 0** is located in Appendix A. This image is sourced from *HAL's Preferred Masterplan* dated June 2019.

2.3 Capacity Review

2.3.1 **Airside**

Arcadis is aware that prior to **Step 0** HAL is seeking to raise the capacity through the removal of the ATM cap through the DCO process. The removal of the cap will enable an additional 25,000 ATMs per annum on the two existing runways.

HAL states that this growth can be achieved mainly with airspace and operational changes along with minor infrastructure changes. For this reason, this has not been considered as a separate phase of the masterplan.

HAL states that the capacity of the three-runway system will achieve a minimum rate of 129 movements per hour. This is broken down per runway as follows:

- 48 movement per hour on the mixed mode runway (arrivals and departures);
- 39 arrivals per hour on the arrivals runway; and
- 42 departures per hour on the departures runway.

This capacity that this achieves will enable HAL to deliver its stated aim of achieving 756,000 ATMs, supporting 142mppa including an 8% resilience allowance.

Arcadis is satisfied with the fact that HAL has considered consumer interest as a key consideration in the evaluation of masterplan assembly options and also during the development of the Preferred Masterplan. However, we still foresee possibility of passenger dissatisfaction due to increased taxi time from the new 3rd Runway.

The forecasted proportion of narrow-body aircraft to the total traffic at Heathrow is more than 62% while for wide-body aircrafts is around 38% in the year 2022 and 2023. Arcadis foresees a scope for up gauging the fleet mix. This might result in substantial reductions in infrastructure requirements. Due to insufficient data, we are unable to analyse the rationale used behind keeping the percentage of NB aircrafts as high as 62%. However, to support our observation we have prepared a benchmark study in comparison with the Paris Charles de Gaulle Airport which is Europe's second-busiest airport after London Heathrow airport. This analysis can be found in Table 7.

Airport	LHR		CDG
Year	2022	2023	2018*
Annual ATM's (000s)	[redacted]		481
Annual Pax (MPPA)			72.22
% of NB Daily Pax ATM's			48%
% of WB Daily Pax ATM's			52%
Total	100%	100%	100%

**2018 data is used for comparison due to unavailability of future fleet mix*

Table 7 Comparison of Aircraft Fleet Mix with Arcadis Benchmarked Data
Source: (Arcadis Internal Library 2019)

Arcadis believes that there will be potential to increase the proportion of wide-bodied aircraft once the NWR is operational. Prior to this, Arcadis believes that the proportion of narrow-body to wide-body aircraft is unlikely to change due to the existing capacity constraints and business models.

However, after assessing all the available documents and information provided by HAL, Arcadis is satisfied that HAL has undertaken the necessary detailed work in the development of **Step 0** proposal.

Apron Facility Review

This section reviews the proposals for the planning and design of the apron and stand facilities. It also reviews the methods used for stand planning.

The [redacted] document details the current assumptions being used by HAL to generate apron frontage and stand planning. HAL has used the ICAO wingspan standards for Code C, E and F aircraft.

The proposed clearances being used by HAL are a 7m inter-stand clearway plus 1m clearance either side. The ICAO publication, *Document 9157 Aerodrome Design Manual,* states a minimum of 7.5m clearance for Code E and F aircraft and 4.5m for Code C.

HAL is using an approximate stand depth of 92m. The justification for this depth is that there is sufficient space for an 82m length aircraft with clearance all around. HAL has indicated that Heathrow is not considered by the airlines as being a critical airport for fuselage length. These are also dimensions that HAL has previously used for apron and stand facilities.

HAL is also applying a [redacted] buffer to the calculated stand frontage to provide resilience for events such as:

- Arrivals / departures off slot;
- Stand outages;
- Clearing time between aircraft departing or arriving; and
- Layout inefficiencies.

This [redacted] buffer is based on historic planning figures validated by HAL data from 2009 and 2016. Although Arcadis does not see this approach as being unreasonable, no rationale has been provided as to why the resilience buffer is a percentage of stand frontage and if alternatives have been considered. For example, additional stands for resilience are based on a percentage of provided stands rather than frontage.

However, Arcadis is satisfied that the HAL parameters comply to relevant industry standards and in some cases exceed the standards for apron and stand design.

With regards to stand planning, HAL has used stand planning models to determine how effectively flights can be allocated to the defined stand layouts within the masterplan. This includes validating the stand frontage. The relevant stand planning assumptions include:

- Linking flights i.e. the turnarounds based on the design day schedules;
- Time between flights on stands (buffer) to build in resilience – [redacted] minutes;
- Towing of aircraft that are on the ground for a prolonged period of time between flights – HAL has used a time of more than [redacted] hours and a minimum of [redacted] minutes on stand for arrivals and departures if an aircraft is towed as per the HAL operational stand planning;
- No allocation preferences other than the over-arching terminal occupancy – airlines are assigned any stand within the allocated terminal / apron;
- Resilience of one remote Code E contingency stand on each apron which aligns with HAL operational stand planning; and
- Target pier service level of 95% as per the current regulated service level.

This is a typical approach used in airport planning and Arcadis agrees with the principles being used to develop the input assumptions used for stand planning. The majority of the assumptions are aligned with HAL's operational stand planning practices and reflects the current operation and is assumed by HAL as being low risk.

It should be noted that although the stand planning model has been developed on the assumption that airlines can be assigned to any stand within their allocated terminal or apron, airlines currently have preferences for stands. HAL supports the principle that airlines can be assigned to any stand, as detailed in [redacted]

Arcadis notes that HAL's plans appear to be working on the assumption that this current airline behaviour will need to change. There is no supporting evidence that the airlines are willing to adopt to this new way of working.

Arcadis notes that there may be a risk that if the airlines do not change their current behaviours, the consequences may lead to the introduction of stand inefficiencies and may therefore impact on the operation.

Notwithstanding this, Arcadis is satisfied that the approach being used by HAL for stand planning is appropriate and provides enough flexibility for operational purposes.

2.3.2 Terminals and Satellites

Arcadis has reviewed a document produced by HAL titled [redacted] in order to assess the requirements for terminal and apron facilities.

This document sets out the parameters and assumptions used by HAL in determining the initial view of terminal and apron facility requirements for each of the masterplans used for the M3 Gateway evaluation.

M3 is a milestone used to confirm the shortlisted masterplan options to be taken forward in the detailed masterplan evaluation.

The assumptions are based on information that is related to industry recommendations, operational assumptions and standards previously used by HAL:

- Assumptions that other airports / airlines have already achieved;
- IATA ADRM;
- Previous HAL standards;
- HAL standards relating to operations and passenger service levels;
- Service offering that is currently being worked towards at Heathrow; and
- Observations of passenger processor / transaction times and data.

[redacted] includes recommendations for sensitivity testing focussing in particular on assumptions that affect space take. The [redacted] document categorises the tabled parameters and assumptions under the following themes:

- Stand planning;
- Passenger waiting times;
- Passenger processing;
- Baggage Reclaim; and
- Transfers.

The parameters and assumptions are used within HAL's models to derive the facility requirements in each masterplan for:

- Stands;
- Check-in processing facilities;
- Ticket presentation ATP / desks;
- Security lanes;
- Lounge population;
- Immigration processing facilities;
- Baggage reclaim belts;
- Queue lengths to inform queueing space; and
- Transfers.

The *IATA Airport Development Reference Manual (ADRM)* – 9th and 10th editions – has also been considered by HAL. Arcadis is aware that the 11th edition of ADRM has been published and is the latest version.

Arcadis acknowledges that much of the masterplanning work undertaken by HAL was developed prior to the March 2019 publication of the 11th edition of the ADRM. HAL is aware of the latest edition of ADRM and will be undertaking a comparison with earlier editions to ensure that the input assumptions are aligned with the latest industry recommendations.

Terminal Assumptions

This section reviews the proposals for the planning and design of the terminal facilities.

A comparison of some of the relevant parameters relating to passenger processor waiting times in [redacted] with ADRM 10 are presented in Table 8. Arcadis is satisfied that the passenger processor waiting time assumptions in [redacted] appear to be within the range of IATA ADRM LoS C / Optimum.

Arcadis notes that for some processors, HAL has utilised a mid-range value such as for standard bag drop. However, for other processors, such as standard check-in or security lanes, a lower or upper range value has been applied.

Arcadis has observed that for some processors, [redacted] refers to a transaction. An example of this is for self-service kiosks and premium (business and first class) check-in counters. The transaction is a metric that accounts for varying processing times aligning with IATA ADRM. Arcadis assumes that these transaction times relate to the processor transaction assumptions stated in [redacted] Clarification has been sought from HAL on this point.

Our analysis has identified that the immigration waiting time assumptions in [redacted] are noticeably different from the IATA ADRM recommendations (see Table 8).

Passenger Waiting Times (minutes)				
Processor	**Passenger Type**	**IATA ADRM LoS**	**ADRM LoS Assumption**	[redacted]
Kiosks	All Passengers		1 - 2	
Bag Drop	Standard		1 - 5	
	Premium		1 - 3	
Check-In Full Service	Standard		10-20	
	Business		3-5	
	First		3-5	
Ticket Presentation	All Passengers		ADRM 10 does not consider automated ticket inspection gates	
Security	Standard		5-10	
	Premium	**LoS C / Optimum**	1 - 3	
	Transfer		5-10	
Immigration*	Non-EEA		5 - 10	
	EEA			
	eGates		ADRM 10 does not consider eGate processors	
	Premium		1 - 5	
	Transfer		5	
Baggage Reclaim	All terminals except northern apron		ADRM considers waiting times based on narrowbody / widebody aircraft	
	Northern apron			

Table 8 Comparison between ADRM LoS and [redacted] Passenger Processor Waiting Time Assumptions
Source: [redacted] Modelling Assumptions 2018) & (IATA ADRM Edition 10 2014)

Although IATA ADRM does not distinguish the different types of immigration lanes (in the case of Heathrow, EEA and non-EEA immigration facilities), the parameters used by HAL does account for these different immigration lanes as well as standards that reflect the airport's operation i.e. previous BAA (HAL) standards. Arcadis believes that this is a sensible approach to immigration facilities reflecting the actual operations of the airport.

HAL has set out a comprehensive list of parameters and assumptions that relate to processor transaction times and modal splits for different check-in types (desks, kiosks, bag drop) or immigration routes (EEA/non-EEA or eGate).

Arcadis has reviewed these assumptions and compared with its own benchmarked data for New York – JFK and Paris – CDG airports. We consider that JFK and CDG are reasonable comparisons for terminal parameters and assumptions due to the mixture of traffic and the passenger profile. The figures in Table 9 provide a comparison of processing times.

The figures provided by HAL for [redacted] indicate that check-in processing times are broadly in line with JFK and CDG. The exception is with bag-drop where JFK and CDG are achieving lower processing times. However, Arcadis is comfortable that [redacted] per transaction represents a reasonable assumption as HAL is in the process of testing the impacts of shorter and longer transaction times.

HAL currently process [redacted] passengers per hour in security, which is lower than both JFK and CDG. The proposal in [redacted] is for [redacted] passengers per hour. Arcadis is comfortable that this is a reasonable assumption, considering that HAL aims to introduce high automation in its operating system.

However, Arcadis considers that significant improvements in the system and operational processes would be required to achieve reliable throughput above [redacted] passengers per hour.

Arcadis understands that this is a sensitivity test and is attempted to make significant improvements in the process. However, Arcadis is unable to assess the impacts and benefits of such an aspirational number due to unavailability of further information as to how the expectations would be fulfilled.

		JFK (T5)	Paris CDG
Airport-wide Pax 2018 (MPPA)	[redacted]	62	72.
Processor	[redacted]	cessor Transaction Times (seconds)	
Self-Service Kiosk	[redacted]	125	90
Bag Drop	[redacted]	30	50
Assisted Check-In Desks	[redacted]	140	130
Security Lane	[redacted]	~180 pax per hour	~150 pax per hour
Immigration	[redacted]	Not useful for comparison as based on US CBP requirements.	Not available for comparison
	[redacted]	vision (%)	
Departure Lounge	[redacted]	50%	70%
	[redacted]		

Table 9 Comparison of [redacted] Assumptions of Processor Transaction Times and Arcadis Benchmarked Data
Source: ([redacted] Modelling Assumptions 2018) & (Arcadis Internal Library 2019)

Arcadis is satisfied that HAL's capacity modelling inputs are reasonable for the studies it has undertaken as part of its masterplanning process. The parameters / assumptions for the processor transaction times, modal splits for check-in methods and immigration channels (EEA or non-EEA) and baggage reclaim operation and capacity have been developed from a range of information sources including:

- British Airways data;
- Data from current terminal operations;
- Previous BAA (HAL) planning assumptions;
- HAL surveys;
- Passenger analysis;
- T5 modelling assumptions; and
- UK Border Force – source of assumptions relating to immigration.

Although these information sources are referenced in [redacted] they have not been made available to Arcadis by HAL.

Arcadis has been able to determine from our engagement with HAL and the available information in [redacted] that the planning parameters and assumptions have been developed from and align to industry recognised standards, such as *IATA ADRM Version 10* and a broad range of data related to Heathrow's operation.

Arcadis is satisfied that these assumptions in [redacted] are reasonable inputs for the capacity analysis workstreams in the masterplan process. Arcadis has validated its assessment with analysis of industry guidelines such as IATA and our own benchmarked data.

Terminal Sizing

The terminal buildings are not being expanded during **Step 0**. HAL has studied the maximum potential capacity of the terminal facilities, particularly for T5 as provided in the presentation 04 Forecasting and Capacity. This has resulted in the assumption that the maximum capacity can be increased. For example, T5's capacity could be increased from the current [redacted] to [redacted]

According to HAL, this increased capacity could be achieved by implementing terminal operating process improvements, including stand and other facility upgrades. HAL's studies have resulted in the updated capacities for all terminals:

[redacted]

This generates an overall capacity of 95mppa. No specific details of the internal terminal operating process improvements have been provided by HAL. Additional stands and stand upgrades are being provided on the T2 (with 4 new Code F stands) and T5 aprons.

The lack of information for the current and proposed passenger processor facilities within the terminals means that Arcadis is unable to assess and review in detail whether the capacity increases proposed by HAL can be achieved.

However, from a high-level perspective, Arcadis has analysed the terminal capacity in terms of required area and mppa. Based on the passenger throughput in 2018 and the terminal area, the overall m² per mppa ratio for all terminals is [redacted]

This is substantially above the [redacted] per mppa ratio targeted by HAL in Evaluation 2 of the masterplan process. As indicated in Table 10, all terminals are currently achieving a m² per mppa greater than [redacted]

Arcadis has used the [redacted] per mppa ratio and the terminal areas to estimate the maximum highest potential capacity at high level in terms of mppa, the results of which are summarised in Table 12. When compared with the proposed capacity increases by HAL, it can be seen that by using HAL's own benchmark, there is excess capacity at a declared 95mppa throughput.

These high-level outputs cannot be used to arrive at a definitive conclusion. This would need to be verified by the capacity modelling undertaken by HAL which assesses the terminal facility and passenger processor requirements. From the available information provided by HAL, Arcadis understands that the terminal design will move to a 'bottom up' analysis, based on the DDS and input assumptions as stated in technical note [redacted] HAL has stated that this will be completed at the end of August 2019.

Table 10 below presents the square metre per mppa currently achieved in all terminals. The square metre area per mppa ratio is used to validate the amount of space achieved per million passengers annually. This analysis clearly helps to establish that the area per mppa in T2, T4 and T5 is well above the targeted high-level metric of 12,500m²/mppa which was established during Evaluation 2. Whilst, in T3 the area per mppa falls just below the targeted value.

Subsequently, in Table 11 we have derived the terminal area requirements from the php numbers based on the regulations provided in the *IATA ADRM 10*. It is noted that the areas of T2 and T5 are substantially above the mandatory IATA space definition criteria. T3 just falls above the expected range, whilst T4 is experiencing a minor shortfall to align with the expected IATA requirements. However, we are comfortable that the Terminal areas are within the acceptable range of IATA recommendations.

Terminal Current	Terminal Area (sqm)	MPPA (2018)	Achieved Space (sqm/MPPA)
	Source: HAL	*Source: www.heathrow.com*	
T2	[redacted]	18.5	[redacted]
T3		19.5	
T4		9.4	
T5		32.8	
Total		80.2	

Table 10 Existing Square Metre per mppa Achieved
Source: (Arcadis 2019)

Terminal	T2		T3		T4		T5		T5X	
[redacted]										
Area/PHP by IATA (sqm)	30	30	30	30	30	30	30	30	30	30
Required Area (sqm) per IATA	[redacted]									
Total Required Terminal Area (sqm) per IATA										
Existing Terminal Areas (sqm) from HAL									Not available	
Difference (sqm)	63,900		5,280		-2,600		205,000		-	

Table 11 Terminal Area Requirement Based on IATA ADRM 10
Source: (IATA ADRM Edition 10 2014), (HAL 2019), [redacted] *- HAL 2019), (Arcadis 2019)*

Terminal Current	Terminal Area (sqm)	Space target (sqm/MPPA)	[redacted]	MPPA (2018)	Capacity Gap (MPPA)
Source	*From HAL*	[redacted]		*www.heathrow.com*	
T2	[redacted]				13
T3					4
T4					4
T5					22
Total					43

Table 12 Terminal Capacity Gap
Source: (www.heathrow.com 2018), ([redacted] Modelling Assumptions 2018), (HAL 2019)

Arcadis is satisfied that HAL is undertaking the necessary detailed work in the development of planning parameters and assumptions for the purpose of determining the facility requirements for the terminals and aprons.

2.4 Summary

Arcadis has assessed all the available information and data shared during the **Step 0** to consider whether the Preferred Masterplan will be Operable.

The approach taken by Arcadis has been analyse the capacity assessments made by HAL of the airside, terminals and landside facilities and consider whether these are appropriate.

In addition, Arcadis has also assessed the simulation studies, forecasts, assumptions and parameters used in developing the HAL Preferred Masterplan to determine whether these use industry and compliant standards.

Arcadis is satisfied that HAL's capacity assessments are based on sound data and are fit for purpose. In addition, the forecasts, models and standards used to develop the Preferred Masterplan are also compliant with industry best practice and there are no departures from standards in the information used by HAL.

Arcadis observes that based on the capacity requirements set out by HAL, their Preferred Masterplan does provide a scheme that can assimilate with the existing airport operation and the current configuration in **Step 0**.

Arcadis has considered the level of flexibility and resilience that will be in place at **Step 0**. On the basis that the information provided by HAL has demonstrated the airport can adequately provide for the growth in passenger numbers and the increase in runway capacity will provide more operational flexibility and resilience.

Arcadis has identified potential challenges that may arise at **Step 0** in Landside areas if passenger mode choice is unchanged through some of the Surface Access Strategy work proposed by HAL. However, at this stage in the masterplan process the level of detail required to assure the plan is not yet fully developed.

Although there may be some challenges that may arise, at this point in the masterplan process Arcadis is satisfied that on balance the proposals are operable and can be integrated into existing airport infrastructure.

HAL is yet to develop detailed Operational Readiness and Trials (ORAT) workstreams which will be key to ensuring a smooth transition without causing any operational issues.

Notwithstanding Arcadis' opinion that the Preferred Masterplan at **Step 0** will be operable, the challenges of deliverability, timeliness and cost still present the scheme with some challenges to open the new runway by 2026.

3 DELIVERY

Arcadis has assessed whether the masterplan and plans for **Step 0** are deliverable. As part of this review, consideration has been given to the scope and design provided for and when this is scheduled to be delivered according to HAL's current programme.

The review has assessed the feasibility of constructability (including logistics) and ongoing delivery during "construction" phases of the programme from today's existing operations to **Step 0**.

Arcadis has analysed any scope gap in deliverables, the robustness of the programme for delivery, the internal and external risks to delivery, and the confidence in HAL's ability to deliver the infrastructure required for **Step 0**.

Arcadis's key findings are:

- HAL's delivery of the elements of the scheme are presented in a logical sequence;
- HAL has sought to deliver the most efficient sequencing with the aim of delivering the new runway by 2026 however this has created a programme that has little margin to allow for delays or risk;
- HAL's programme is not unfeasible for the delivery of the required infrastructure however this is reliant on the programme timings set out in the plan to be delivered; and
- HAL will be reliant on other organisations to deliver some of the elements of the scheme which they do not control or can mitigate against. Delays could pose a risk to HAL's own delivery programme.

3.1 Definition of Theme

This section of the report reviews the deliverability of **Step 0** to understand if the required changes can be achieved in practice and can integrate with the existing airport infrastructure.

Arcadis has reviewed the proposals to ensure that they follow a logical delivery sequence. The scale and complexity of the proposed expansion of Heathrow requires a significant volume of work outside of the existing airport perimeter including earthworks, roads, rail, rivers and utilities before airport related infrastructure can be built.

The critical path to constructing the runway relies on these works being completed in a logical sequence. This review analyses the logical sequence of events to ensure that overall layout at the end of **Step 0** can be achieved.

Arcadis has reviewed the Preferred Masterplan material to assess whether **Step 0** is deliverable. Our review has considered the following:

- The scope, design and programme;
- Feasibility of construction and ongoing airport operation during construction;
- Scope gap in deliverables, including the robustness of the programme for delivery and any risks associated with it;
- How new and impacted facilities will link with existing infrastructure and how HAL will maintain key assets during construction phases of delivery;
- The appropriateness of the detail provided in Project Management Plans and Programmes;
- The observed level of maturity with regards to deliverability; and
- Evidence that the single Preferred Masterplan and future development of the masterplan to DCO submission are adequately considered and appropriate for DCO award.

Some of these issues will be discussed in more detail in further reports as their impact on the deliverability of the scheme in **Step 0** is minimal.

The review includes the following stages of the scheme delivery:

- Proposed Construction Phasing;
- Procurement;
- Pre-Construction;
- Early Works;
- Creating the Space;
- Earthworks; and
- Main Works.

Arcadis has identified potential risks to delivering the infrastructure needed to achieve Step 0. These are important to identify and mitigate against due to the volume of external infrastructure works required to achieve the Step 0 airport works.

3.2 Assessment

3.2.1 Methodology

This review is based upon discussions with HAL and a review of documentation released by HAL (listed in Table 13 below). This documentation includes a number of reports, presentations as well as a number of reference drawings.

Report Title	Report Source
HEP Procurement Strategy Review	Arcadis
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	Gardiner & Theobald LLP
[redacted]	Gardiner & Theobald LLP
[redacted]	Gardiner & Theobald LLP
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
DfT Heathrow Expansion Programme Assurance Review of Heathrow Airport Limited's Delivery Schedule	Costain

Table 13 Delivery and Timing documents reviewed
Source: (CAA 2019), (HAL 2019), (Arcadis Internal Library 2019), (IFS 2019)

In addition to this documentation Arcadis has had various workshops and briefing meetings with HAL where there was the opportunity to discuss with HAL the detail behind the information presented.

It is apparent that a significant amount of work has been undertaken by HAL on the likely sequence, impacts and durations of the overall Preferred Masterplan schedule. This would be in keeping with a Nationally Significant Infrastructure Project seeking approval via the Development Consent Order (DCO) process.

The need to assess the impacts of construction on all the receptors around Heathrow required a detailed review of the methodologies and timings being proposed for the development.

The following sections review the deliverability of the proposed development at Heathrow. They will review the sequence of the works as a whole and in detail for key elements of the development.

3.2.2 Proposed Construction Phasing

Step 0 requires an expansion of the airport boundary to accommodate the new runway and airfield infrastructure. Prior to this, the main works required are outside of the existing boundary.

The challenge presented by the development of a preferred Masterplan is about creating the space and then using that space to deliver a new runway and the associated infrastructure. This involves a significant amount of clearance of existing assets as well as undertaking a very significant number of earthworks to enable construction to proceed.

HAL has created a time slice walk through (images in Appendix A) of the likely construction process that will be undertaken to allow for a runway to open in the 4th quarter of 2026, **Step 0**.

These time slices are in 6-month windows and help to explain the thinking and challenges associated with the development. It is apparent from a detailed assessment of the points in time that the challenge to the development timescale is the creation of the space, the requirement for HAL to clear the construction zone of existing occupiers and incumbents prior to undertaking the construction process.

Any relocation, from rivers and roads to people, businesses and ecology, must be considered within the timescale and context of availability and vacant possession. The proposed relocations may be a significant and very real constraint and may be perceived as potentially negative.

Arcadis understands that it is difficult to capture the real impacts of these process on people, flora, fauna, infrastructure and the environment however, it is apparent that much thought has gone into how the construction process can be incorporated into this live environment.

The development requires the removal or relocation of some key utilities to the west of the existing boundary. These are indicated as early works and will pave the way for the construction of the new M25 route. the indicated sequence of works shows these works being undertaken prior to gaining approval for the overall development via the DCO process.

HAL will also require early engagement with the utility companies and will therefore incur costs before the approval for the scheme has been achieved.

The sequencing proposed by HAL will also require front end design and procurement for key replacement facilities that are required to be vacated to deliver the proposed earthworks strategy. These include the following:

- Energy from Waste facility;
- Harmondsworth Primary School; and
- Colnbrook Immigration Centre facility.

Arcadis understands that the Energy from Waste facility move will be subject to a separate Town and Country Planning Application. Arcadis has not seen any evidence that HAL has considered the risk to the delivery programme or any mitigation if this application is refused or challenged.

The proposed construction phasing indicates when the location of these facilities will be developed, and the detailed programme gives an indication for when the replacement facility will be constructed and made operational

The outer boundary indicated on Figure 9 is the extent of the construction works for **Step 0**. This is the work envelope for all works associated with the HAL Masterplan and includes areas outside of the current and future airport boundary.

Arcadis understands that prior to DCO approval HAL has identified a number of enabling works that they could start which are restricted to utilities and linked to environmental issues. HAL has proposed the phasing for these early works begins in the first half of 2020 with the relocation of utilities in the path of the realigned M25. This is followed by ecological works in the first half of 2021.

HAL has indicated that, upon DCO approval the following works will begin in early 2022:

- Utilities diversions;
- River diversions;
- Local road diversions;
- M25 diversion;
- Earthworks; and
- Establishment of the Construction Consolidation Site.

These elements of work are critical features of **Step 0** and require to be progressed in advance of the airfield works. The schedule issued to Arcadis for review indicated timescales for these activities, some of which occur prior to DCO approval. However, the sequence and timings are built around the needs of vacant possession of key areas to facilitate construction activities associated with the new runway development.

Arcadis considers that this approach to deliverability developed by HAL is sequenced logically. The programme set out by HAL indicates that the utility works will begin shortly after DCO approval, followed thereafter by the other infrastructure listed above. This culminates in construction of the airfield infrastructure starting in mid-2023.

3.2.3 Procurement

HAL has created a delivery procurement strategy that has been reviewed by the airline community. The high-level mission statement seeks to "Create a Heathrow Expansion Procurement Strategy that motivates productivity, drives value for money to create a new UK benchmark for the way infrastructure is sustainably procured that delivers the programme."

This has then been further clarified by HAL who list 5 statements on how this will be achieved. These

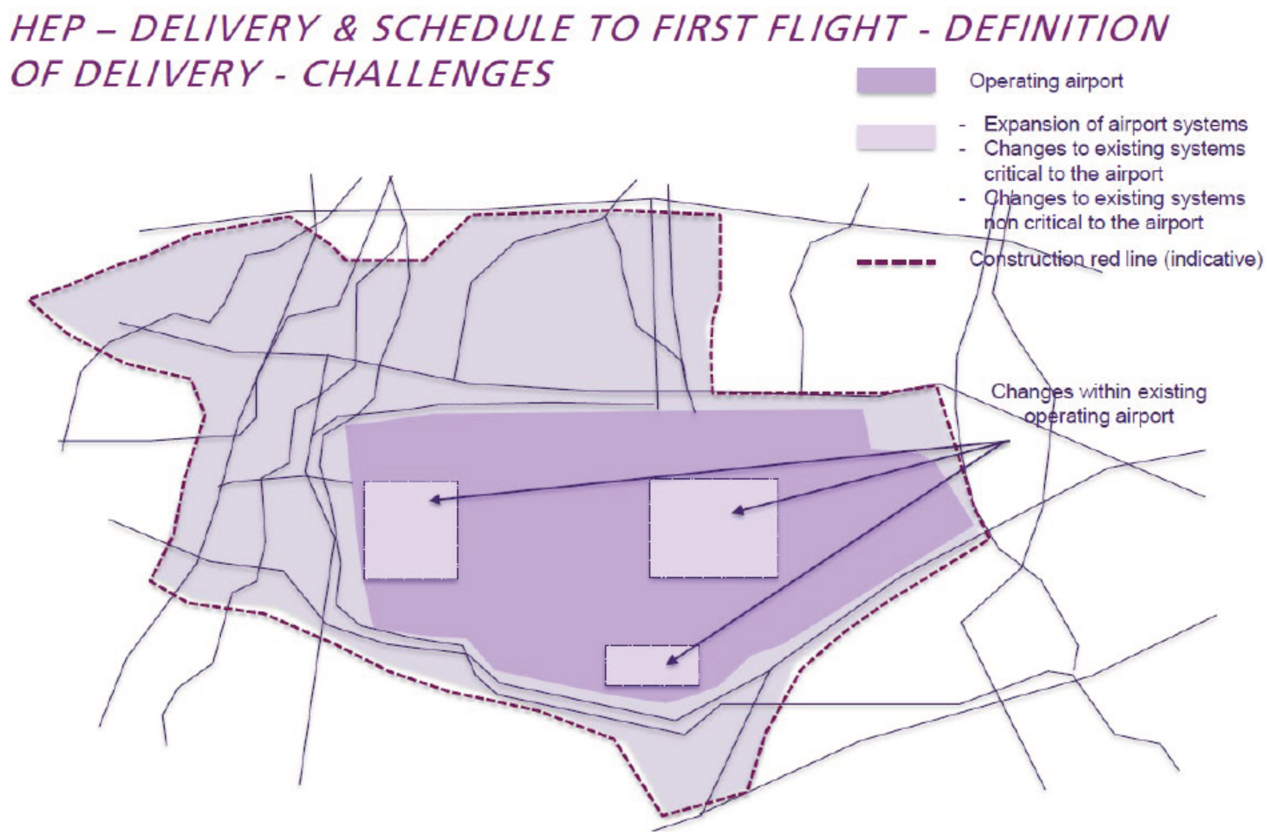


Figure 9 Extent of Expansion Works
Source: ([redacted] - HAL 2019)

are extracts form a report created by HAL and offered as part of the review process.

1. Establishing HAL as a UK Client of Choice

There is a strong pipeline of infrastructure work in the UK over the next 10+ years. Heathrow's total spend accounts for 4%, with the remainder lying largely with the government. To attract the supplier market, it is critical that HAL positions itself as a client of choice. HAL will be placed front and centre in the programme as the owner and will define long-term value.

2. Mobilising the UK supply chain for successful delivery of an expanded Heathrow

Delivering a programme that will enable an aircraft to take off from the new northern runway will be an enormous construction delivery challenge. It is vital that HAL sets the supply chain up for success and utilises different procurement engagement models to harness the value created in the supply chain by being a capable owner that will build relationships.

3. Creating the right environment that motivates the supply chain to be successful to deliver the programme

Once the supply chain is mobilised onto the programme, it is essential that commercial and contracting environment motivates productivity and value for money. Heathrow will form long-term enterprises through the creation of an inclusive ecosystem (supply chain) environment that stimulates value creation and focuses on outcomes. Additionally, HAL will need to create the environment that helps people and the supply chain fulfil their potential and work together to deliver with energy and pride.

4. Supporting the operation, the passenger and the local community

Construction will be delivered against the backdrop of a live airport environment, busy road network and bustling local communities. It is of paramount importance that any potential impacts by construction activities are managed and mitigated and communicated with the operation and airlines. Heathrow will optimise the use of off-site hubs to increase productivity and predictability, improve quality, health and safety thereby significantly reducing the number of workers on site.

5. An alert and agile Procurement Strategy that is aware of market dynamics and forces

The programme will be spanning numerous years. During this time, Britain with be exiting the European Union and numerous market movements and changes will take place. Therefore, the procurement strategy needs to be agile to manage challenges and optimise opportunities.

Arcadis understands that HAL has undertaken a deep review of the procurement process that they wish to use to engage with the required supply chain. HAL has set out to engage the whole of the UK into the development giving opportunities to other parts of the UK and not just the South East construction market.

This strategy seems to be targeted to spread the manufacturing process across a large an area as possible. The manifestation of this strategy will most likely be a benefit during the latter stages of the development when the development moves to a more terminal and passenger process facilities delivery. During the early stages the works are mainly around works in the ground and demolition and clearance of existing space.

The approach for expansion demonstrates HAL has learnt lessons from their previous experience of T5 and T2A developments. This learning has been brought into the strategy procurement plan.

In discussions with HAL during this review process the key themes that are to be targeted involve identification of the interface between work packages. Examples were discussed around how the key earthworks packages should be phased to minimise the risk of disruptions and delays across the geography of Heathrow. This proactive approach should provide dividends when applied to key packages, however there are multiple interfaces across the planned works, and this will require a significant input from HAL.

As part of the document review, it should be noted that there was no detailed procurement timeline, or a detailed design development programme available however, this would not be unusual for a development at this stage.

Success in the next stages will require careful and detailed design development and procurement to ensure works are brought at the appropriate time and with the right level of commercial tension built into the process.

Some of the key early works packages may require to be procured under the OJEU guidance process. This adds time to the overall period due to the rules governing notification and assessment of a large pool of potential contractors. HAL are seeking clarification of the need to follow OJEU processes. At the point of review this had not been clarified.

The early utilities reconfiguration (SSE power lines) require the works to be procured via the utility companies own contractual arrangement prior to the DCO approval. HAL will need to work closely with the existing supply chain to achieve the goal of clearing the existing pylons and substations by the required date to facilitate the M25 works. Also, within these early works will the need to instigate the replacement of the Lakeside Energy from Waste (EfW) facility. The procurement of this facility will be undertaken by a third party on behalf of HAL. This will add risk into the programme that HAL can only attempt to influence but not control.

HAL has also identified other key assets that will require separate procurement strategies. These include the replacement Colnbrook Immigration Centre facility and Harmondsworth Primary School. HAL identified these as likely to be design and build contracts with a modulization delivery strategy.

These projects may undergo a re-evaluation as HAL works through the detailed design development programme.

In line with statement 2 listed above, HAL is cognisant that the magnitude of HEP will require a wide range of suppliers and contractors to deliver the programme successfully. In particular, it is key that HAL engage early with the supply chain to allow potential suppliers to understand the pipeline of opportunities associated with HEP.

This will be a key factor in ensuring that the supply chain have the capacity to respond to the aggregate demand of HEP. From our interactions with HAL, it is clear that they have initiated engagement with the supply chain in specific areas, such as earthworks contractors where capacity may be a particular concern. HAL also plan to undertake market-wide supplier engagement, commencing with the "Heathrow Expansion Supplier Event" in September 2019.

The key to any procurement strategy is to choose the most appropriate to the needs of the projects, no one solution fits all situations. The strategy of supply chain engagement and a non-confrontational strategy will require detailed assessment over the next few months to establish the requirements.

3.2.4 Pre-Construction

The key to any development is to gain the required statutory approvals for the scheme. With the development at Heathrow this will primarily be gained by using the systems designed for Nationally Significant Infrastructure Projects (NSIP) also known as the Development Consent Order (DCO) process. This process was created by the Planning Act of 2008.

As part of the process defined by the Act, there are various defined processes that must be achieved within prescribed timescales. To fulfil all the requirements of the process the developer (in this case HAL) must create a design the sets out and defines the extent of the proposed development. HAL has created a series of drawings and plans the defines the 3R Masterplan which establishes the extent of the proposed works. These plans have been used as the basis of the assessments as required by the DCO process.

Whilst Arcadis has not undertaken a detailed assessment of the quality of the design outputs HAL has created, it should be assumed they will be fit for purpose. HAL has set a target to achieve the required public and specialist consultations by the end of 2019 to enable the completion of the pre-submission process in early 2020. The target submission date for the DCO documentation is [redacted] 2020.

The Planning Act of 2008 set out a prescribed process that will be followed submission. These includes set timescales for each section of the process. Therefore, the period from submission to expected delivery of the approval by the Secretary of State for transport is set at between [redacted] to [redacted] months. HAL has allowed a period of [redacted] months within their proposed programme. Which translates into an average of 520 calendar days.

The HAL programme for the development process gives a clear indication of the timelines for pre-submission and post submission as set out by HAL. It also shows some of the early works required to be processed while the DCO process is being undertaken, to maintain the programme. These activities are to be progressed at risk and are required to underwrite the 2026 runway opening date, **Step 0**.

Arcadis has compared HAL's timescales compared with other development that have used the DCO process and there are examples where the timings to achieve consent have been extended.

The HAL programme is dependent upon having an undisputed submission that will pass through the pre-examination and examination process without dispute. To underwrite this aspiration the original documentation will have to achieve total and full compliance with the DCO requirements.

Whilst there is little doubt that HAL is planning to achieve a 100% compliant submission there are always external influencers that could cause the planned timescale to be extended beyond the planned 17-month period.

Although none of these examples are a direct comparator to Heathrow Expansion, as can be seen from the graph in Figure 10 the process does not always follow the prescribed timescales. One third of all the applications that have been through this process having exceeded the number of days HAL are planning that their application will take, with two going to Judicial Review.

The impacts of any delay will have a significant influence on the overall development at Heathrow. The current plan is to follow the achievement of the DCO approval in November 2021 with the start of earthworks in the spring of 2022.

The approval will also grant approvals for various key activities such as ecology mitigation works in the winter of 2021 and spring 2022, The approval also triggers the following key activities:

- River diversions;
- Demolition of properties;
- Establishment of construction consolidation sites;
- Utility diversion; and
- Construction of the trunk roads diversions.

The period between delivery of the DCO approval and the start of the key earthworks is only four months which also includes the Christmas period. HAL has indicated that they are confident that they will be able to set up the team to deliver this.

This period would have to include for the finalisation of the contract conditions and the mobilisation of key staff and equipment for an activity that is key to the success of the opening of the new runway in 2026.

Any prolongation of the strict timescales will have a detrimental impact on the early works of the development.

HAL will also have to consider any constraints placed upon the development by the planning process. Whilst detailed consultation with the public, local authorities and the key consent granting bodies will help to clarify and draw out any imposed constraints; until the planning process has completed its full course these will not be fully known, and the impacts assessed. Which may impose restrictions on the planned early works.

A key part of the development phasing proposed by HAL will be to gain access to key areas to deliver the programme. HAL has identified key Vacant Possession (VP) dates, which have been derived from a detailed phasing strategy. To manage the impacts of and plan to minimise the influence of the key VP dates HAL has undertaken extensive negotiations with the relevant owners and interested parties.

While these are commercial agreements which have not been open to review, the principle is to negotiate key VP dates and not rely on legislation that would be granted as part of the DCO process. The normal convention would be to seek Compulsory Purchase Orders (CPO) powers over all the required land identified in the Preferred Masterplan. However, this process can take up to 9 months to deliver the required access, which would have a detrimental impact on the planned timescales.

No information was offered as to the likely success of this strategy and it remains a key constraint on the development. In discussions with HAL, the current strategy is underwritten by the main earthworks being sequenced to commence in an area not requiring VP of property and in an area already agreed with the landowners. However, some of the early works associated with ecology and river diversions require access to significant parcels of land around the western side of Heathrow.

The current plan as declared by HAL will be to obtain key VP of land as soon as the DCO has been declared. There are at least [redacted] VP's required to be obtained by mid November 2021. These relate to setting up of the construction logistics and the early earthworks. HAL assume that these will be obtained, and the work commenced as envisaged. The impact of no availability of the vacant possession dates will require assessment if the dates slip. The worst-case scenario would be to delay the development; however, it may only involve a re-sequence of the works until the possession dates are achieved.

A development of such a size as the expansion at Heathrow requires a significant amount of design input to feed into the procurement process. The schedule issued to Arcadis to review did not contain a detailed design programme.

When questioned, HAL indicated that the design programme would be developed during the next stages of the programme. This would be in keeping with a development at this stage in the process. There will therefore be a need by HAL to work up the design to a suitable stage to allow for a meaningful procurement process.

This will be a balance between the commercial decision to commit funds to designing a development that has not gained planning approval. However, the expansion at Heathrow has been

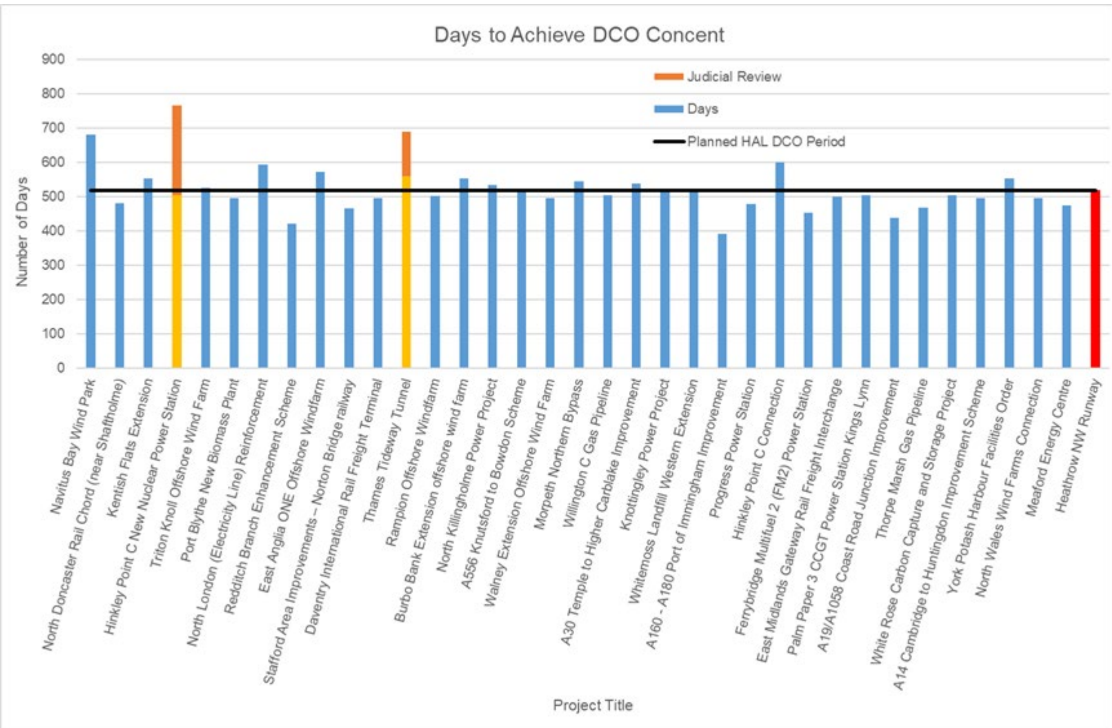


Figure 10 Graph Presenting the Days to Achieve DCO Consent
Source: (Bircham Dyson Bell-DCO Applications 2014)

sanctioned by the government and parliament so it is more a question of undertaking the design at the most appropriate stage in the development balanced against incurring costs in advance of official approval.

However the front end of this development is aggressive in its need to commence works four months after formal approval and the design will need to be progressed over the next few months to ensure the procurement process can be developed to ensure the works packages are set up to deliver the works when required.

The key to delivering **Step 0** by 2026 requires the full DCO process to have been completed by the 4th quarter 2021. Thus, allowing HAL to mobilise the required early works contractors. Whilst HAL has planned the DCO timescale around the "normal" allocation of time, it does not allow for any contingencies in the timings. The Heathrow scheme has attracted a lot of public scrutiny over the years and there would be no reason to suggest that it will not be subject to intense scrutiny during the Development Consent Order process.

The proposed development programme requires that the earthworks proceed in the spring of 2022, and therefore any delays in the approval process will have a detrimental impact on the proposed start of works.

3.2.5 Land and Property Acquisition

Prior to the DCO application, HAL will need to have identified the extent of land and building acquisitions that will be necessary for expansion. It is understood that these acquisitions will be through a combination of agreed purchases followed by compulsory purchases.

The main period for this stage will be from [redacted] 2019 to [redacted] 2022 including the periods for acquisition by mutual agreement followed by compulsorily powers coming into effect. HAL has identified the stages as follows:

Timescale	Agreement
[redacted]	Create Bond subject to board approval
	Agree relocation and options agreement
	Bonds redeemed subject to board approval
	Businesses start to relocate
	Acquire homes
	Compulsory Acquisition Powers

Table 14 Acquisition Timescales
Source: [redacted];HAL 2019)

HAL has provided the total number of bonds and agreements required for residential and commercial properties prior to the DCO submission. This is broken down into the completion requirements per month and day.

Arcadis has not seen any assessments from HAL regarding the level and complexity of these acquisitions so cannot determine whether HAL's timescales or their ability to process the volumes of transactions set out below is feasible. It is however important to note that where HAL cannot secure acquisitions through agreement, the use of compulsory purchase powers may throw up additional complications that may impact on delivery.

Acquisition	Type	Requirement
Bonds	CPZ Residential Properties	[redacted]per month
Bonds	Wider Property Offer Zone (WPOZ)	TBC
Commercial Agreement	Business relocation	[redacted]greements per week

Table 15 Acquisition Requirements
Source: [redacted];HAL 2019)

3.2.6 Early Works

HAL has identified works that are required to commence prior to receiving full approval of the development via the DCO process. These are in addition to the main works design and procurement process that would naturally occur during the DCO timescale, in support of an earliest start on site of the main body of works.

The works revolve around the clearance of existing infrastructure that due to restrictive timescale are required to commence early to facilitate the relocation of the main M25 road re-alignment works. See the extract below from a presentation created by HAL to indicate these early works.

The image below shows the extent of these works to clear the area for the M25 reconfiguration. From the programme information and phasing slides produced by HAL it is apparent that these works are required to commence in early 2020. The assumption being that the utility company responsible for the assets will undertake these works under a local Town and Country Planning Application (TCPA). The risk to the programme would be that if this strategy is brought into question then the overall development would be significantly compromised.

As part of an overall Heathrow development HAL will be undertaking expansion works within the western campus. These works will be improvements to T5A and expansion of T5B and T5C. These works are listed as Business As Usual (BAU) investments and will contribute to the baseline growth at Heathrow. However, these will also support the additional passenger processing requirement to be in place when the new runway capacity is delivered.

The key to the expansion of Heathrow will be to remove the constraints in the way of the new airfield development. The M25 is a significant impediment to the expansion. Therefore, HAL propose to move it further west and build over the existing alignment. However, to undertake these works the proposal will require designing to the relevant standards imposed by Highways England. Currently HAL propose to

[redacted]

[redacted]

design and procure these works on behalf of Highways England and manage the delivery to achieve a transfer of the motorway across to the new alignment by [redacted] 2025. This will require the design to be progressed sufficiently to allow for procurement of the main packages of motorway works to commence from the [redacted] of 2022. There will be a significant amount of design, approvals and procurement required over the next 2 years to ensure this target is achieved.

The risk to the HAL development timelines will be that some of these activities within this timescale are not under the direct control of HAL and are therefore susceptible to other organisation's timescales. The procurement process associated with the M25 possibly required to follow the OJEU process which could add time and complications to the process. The HAL procurement department are actively investigating this risk. Until this has been clarified it remains a procurement timescale risk.

Other areas that are required to be replicated or replaced include the key Energy from Waste (EfW) facility as managed by Grundon. There is also a primary school to be replaced and a key immigration facility. HAL has worked hard to minimise the need to replace existing facilities, and when investigated as part of the Arcadis study, the response has been to consolidate functions within the impacted organisations existing facility or to agree a commercial agreement. This has helped to minimise the quantum of works that require re-provision and replacements. Of those identified to be replaced HAL have a clear strategy to create replacement facilities. However, these replacement projects may require separate (TCPA) applications due to the need to gain vacant possession early in the overall programme.

Existing Facility	Vacant Possession Date	Programme Indicating Replacement
SSE Power Lines Relocated	[redacted]	
Energy from Waste Facility		
Immigration Centre		
Harmondsworth Primary School		
Heathrow Primary School		
Heathrow Special Needs Farm		

Table 16 Key Facilities that Need to be Replaced
Source: ([redacted])

There will be a residual risk to the development timelines if these projects cannot gain the required planning approval by the required date.

It should be noted that there does not appear to be a timeline for replacement of the Heathrow Primary school or the Heathrow Special Needs Farm.

There is a significant amount of key activities that are positioned as early works within the proposed development timelines. While this is not unsurprising within the context of the volume of works required to be completed within a tight target to achieve a new runway by 2026. Some of the identified works will require separate approval routes to the main DCO, they will also require commitment to placement of contracts to deliver replacement assets before the main works are let.

There is also a need to review the planned dates for some of the replacement assets as the school replacement projects are not harmonised with the school academic year.

3.2.7 **Creating the Space**

3.2.7.1 Rivers

Water courses are a significant constraint to the development at Heathrow. Not only for flood risk mitigation but also because of their wider influence on the surrounding environment. It will be of interest to the Environmental Agency as to how HAL deals with the migration from the existing systems to the new. The following slide extracted for the HAL presentation gives an indication of the challenge.

Part of the early works will be to divert the existing rivers, creating new fluvial paths and infill existing ponds. The impact of these environmentally sensitive systems will require very careful management and will be seasonally influenced.

The proposed phasing and schedule identify the time periods for these works. There is a significant risk to the front end of the programme associated with these works, due to the potential restrictions imposed by the consent granting body.

Prior to any earthworks to the west and north of the existing campus the river diversions are key to the release of the space. Due to the nature of river flows the system of temporary or permanent diversion are subject to key invert levels. HAL has created a strategy where these factors are considered.

The phasing diagrams provide evidence that HAL is working closely with the various bodies top provide a system that will maintain the river flows necessary to support aquatic life above and below the development zone.

Further work will be required to fully understand the risks associated with the fluvial flows around Heathrow. With reference to the protection measures to be put in place to protect these vulnerable environments. This will be particularly key during the earth work seasons where the potential to cause pollution damage to watercourses is at the highest.

The agreed code of construction practice would be the document that sets the criteria for working in and around any water courses at Heathrow. Although Arcadis has not been provided with specific monitoring or enforcement criteria that would be used to ensure compliance, the high-profile nature

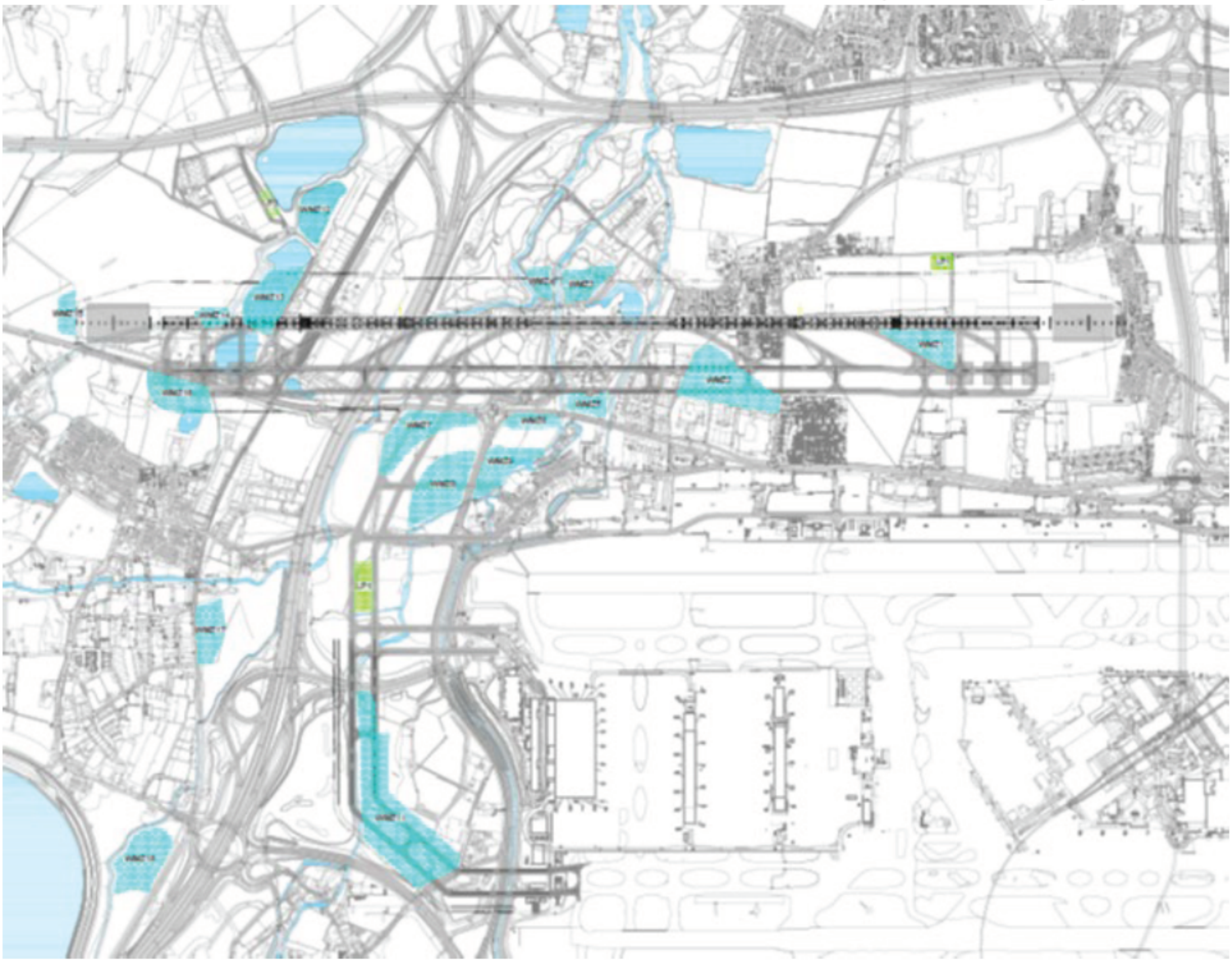


Figure 12 Waterways Impacted by Expansion Plans
Source ([redacted])

of the development should ensure the works are kept under scrutiny and any pollution or risk of pollution of water course will reflect badly on HAL and could cause a delay to the progression of the works.

The river diversions as required by the development place these environmentally sensitive areas in conflict with the timings and demands of the construction process. The consent granting body associated with these water courses has significant interest and powers over the scheme, which could lead to tensions in the approval process. Careful management of the changes to the water courses will be the route through these challenges. HAL will need to be aware of the seasonal nature of some of these works and draw up a plan accordingly. The existing rivers and water courses and the new routes play a significant role in the ecology and environment of the areas around Heathrow and are very susceptible to damage caused by the construction process.

3.2.7.2 Roads

Heathrow is surrounded by an extensive road system. Ranging from nationally significant roads system (M25) to major trunk roads and minor local roads. The planned development impacts this road system from the south of the airport around the western side and too the northern zone. Part of the early works will be to reconfigure these roads to create the space to deliver the Heathrow expansion as set out in the Preferred Masterplan.

To facilitate the expansion at Heathrow, major changes to the surrounding road network are required. This includes realignment of the M25 and A4. The schematic of the existing road network is shown in Figure 13 and the new road network is shown in Figure 14.

The A4 will be realigned and reconfigured to the north of the NWR. HAL has currently produced a number of alternative alignments due to the complexity of this work. The proposals will however enable offline construction prior to connecting to the existing road network. It is proposed that the A4 diversion works begin in [redacted] 2022 and conclude in [redacted] 2024.

HAL has built an extensive road development sequence that respects the need to maintain access for all around the airport as well as maintaining routes for staff and passengers into the airport. The road system are the main arteries for all the functions at the airport, and ensure it continues to function.

While much has been made of the relocation of the M25 to free up the runway development the re-provision of the existing A4 provides a much more challenging route and resolution and will directly influence the earthworks to the north of the existing runway.

The sequence published by HAL indicates the significant level of thinking that has gone into the works and indicates that the road design has also been adjusted to provide the maximum space for the earthworks.

The impact of the works sequence associated with the relocation of the M25 is a significant strand through the main works programme. The re-provision of the HV infrastructure is planned to commence before the DCO approval has been achieved.

Once approval is given the space can be cleared for the new M25 route. This can be constructed “off-line” to minimise disruption. Once completed, the existing M25 can be transferred to the new route. The existing M25 can then be cleared and the area prepared for the earthworks and runway infrastructure construction.

This string of activities is key to the creation of the new runway and requires the early works to commence before the main approval of the Preferred Masterplan. This indicates the significant nature the road system will play in the development of the Heathrow scheme. Arcadis notes that the delivery of the road elements is crucial to the timeline risk associated with works commencing before the DCO process has delivered the required development approval.

The current scheme indicates that the relocation of the M25 infrastructure will be constructed adjacent to the existing route. This would be the preferred solution to creating the space required to deliver the runway. It also creates the opportunity to construct most of the new motorway “off-line” with minimal disruption to the existing traffic flows.

There are significant challenges associated with the motorway junctions as these will be re-modelled to provide access to the new road layout. These will be the areas of concern during the development because of the risk that these will be the cause of major disruption and delays to the free flow of traffic into the Heathrow campus.

There will be an area of the M25 / A4 development that will require careful co-ordination. This will be the construction of the new M25 route around the existing A4 overbridge. This bridge cannot be demolished and cleared until the alternative A4 route has facilitated the closure of the existing road.

This will place areas of the A4 road development as constraints on the creation of the alternative M25 route. This will require careful management and close co-ordination between two key packages of works. The phasing plans as presented by HAL indicates that the new A4 route will be opened in early 2024. With a target to complete the M25 works 1 year later.

In addition to the M25 realignment, the existing single J14 on the M25 will be removed and replaced with two junctions. Again, Arcadis understands that this will be constructed offline and then connected once complete.

Arcadis understands that the diversion of the A3044 is included within the local roads programme however the delivery programme does not state if the realignment will be constructed offline. It is proposed that the construction of the A3044 diversion begins in [redacted] 2022 and concludes in [redacted] 2024.

Arcadis agrees with the principle that constructing the roads offline is the right approach as it should simplify and speed up the construction process, whilst minimising impact on the existing road network or airport operation.

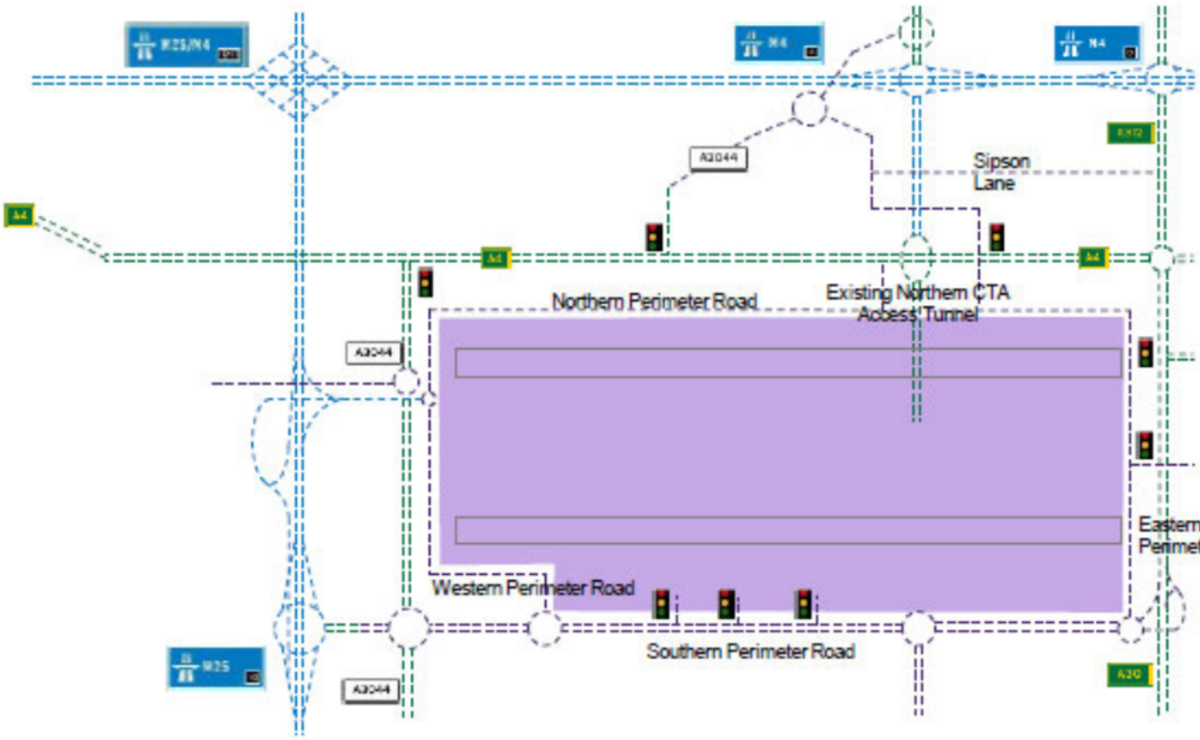


Figure 13 Existing Roads Layout
Source: ([redacted])

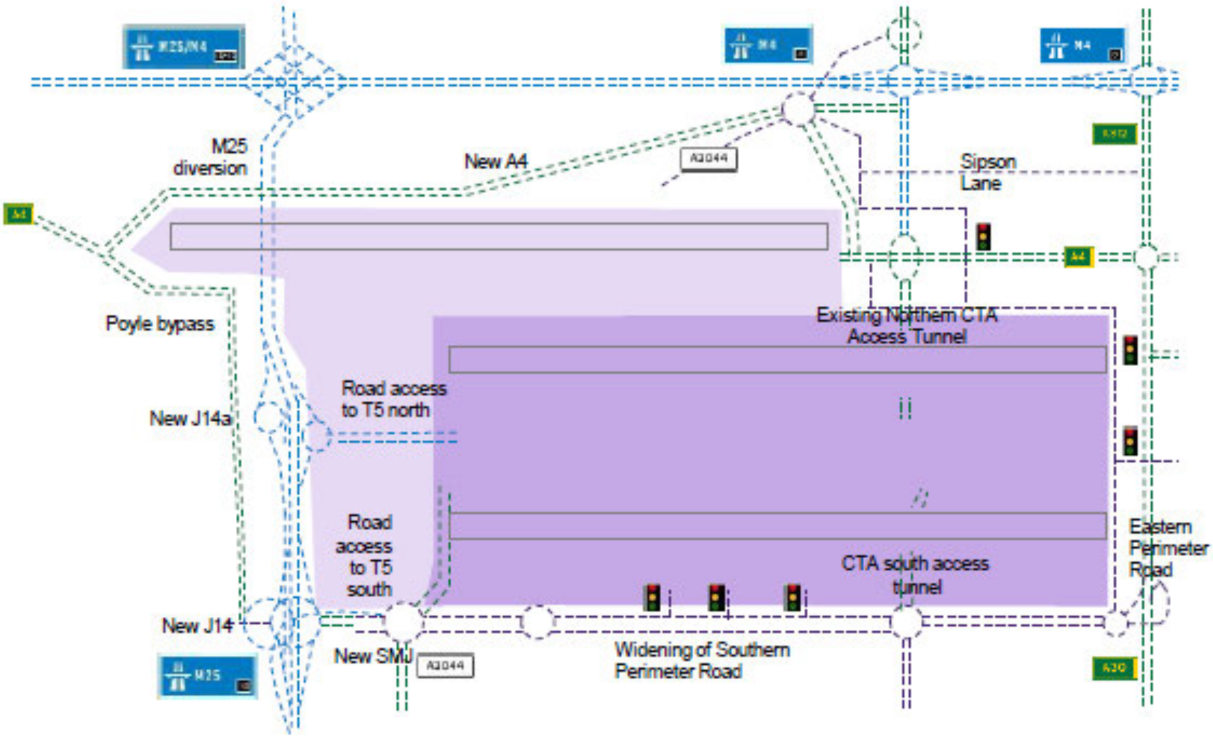


Figure 14 New Roads Layout
Source: ([redacted])

3.2.7.3 Rail for Construction

The non-passenger rail system will be enhanced with new freight, fuel and sidings facilities to the north-west of the new 3rd runway.

For operational purposes the primary use of the rail facilities is to provide and maintain the fuel supply

to the airport. However, HAL has indicated that the rail facilities are also planned to be used to transport construction materials to and from the site.

The railhead is scheduled to be completed in [redacted] 2023 – and so will not be available for the first year of construction which includes the construction of the A4, A3044 and M25, initial earthworks, river diversions, property demolition and utility diversions.

3.2.7.4 Utilities

The first major utility works is currently planned by HAL to commence prior to DCO approval. The works to the M25 are dependent on relocating the existing above ground electricity pylons. These are currently situated in the path of the realigned M25. The works to relocate these are scheduled for [redacted] 2020.

All utility works are scheduled for completion in [redacted] 2024.

3.2.7.5 Properties

HAL has indicated that demolition of properties will commence in [redacted] 2022 with the last demolition scheduled to be completed [redacted] 2024. This is consistent with the assumption that the acquisition process will have concluded by [redacted] 2022.

However, as indicated in the risk section below, there is a risk that the acquisition process takes longer than anticipated which may then impact upon the overall delivery timescales.

The acquisition of properties is controversial with any development. Arcadis has not seen any provision in the delivery timetable to take into account potential action by protestors that may slow down or hinder the delivery of this phase of the process.

3.2.8 **Earthworks**

HAL has placed a significant amount of work to resolve the earthworks strategy and when questioned provided a credible sequence of works.

The following extracts from a HAL presentation captures the strategic view of the early earthworks around the area of Harmondsworth, Sipson and Longford villages.

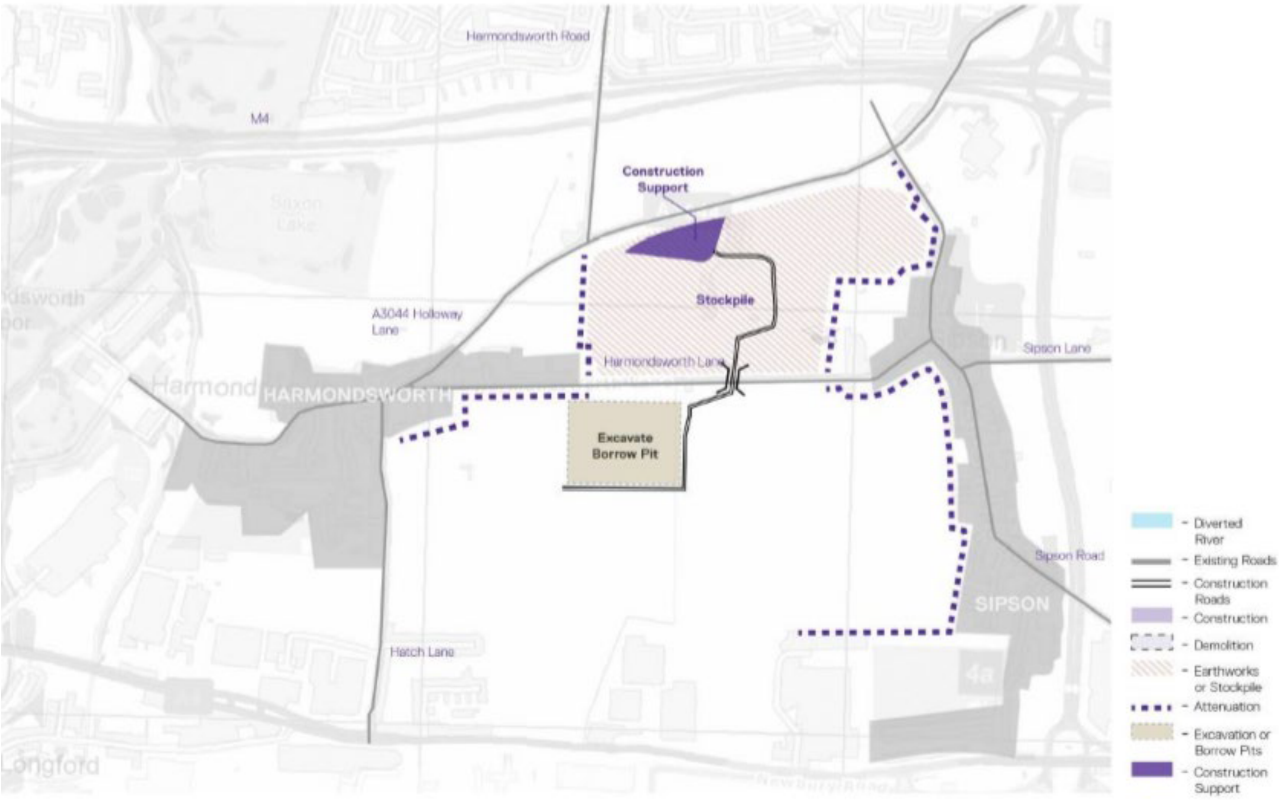


Figure 15 Earthwork Phasing – Stage 1
Source: ([redacted])

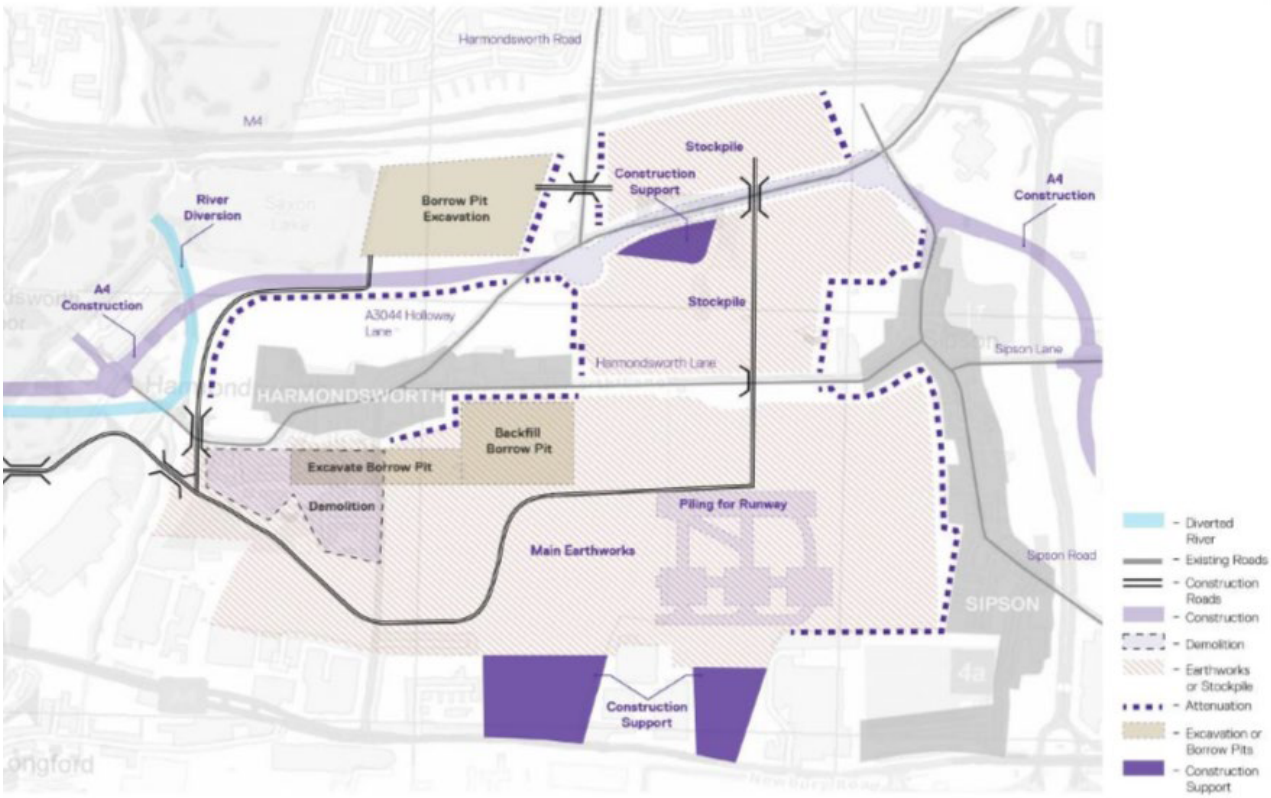


Figure 16 Earthwork Phasing – Stage 2
Source: ([redacted])

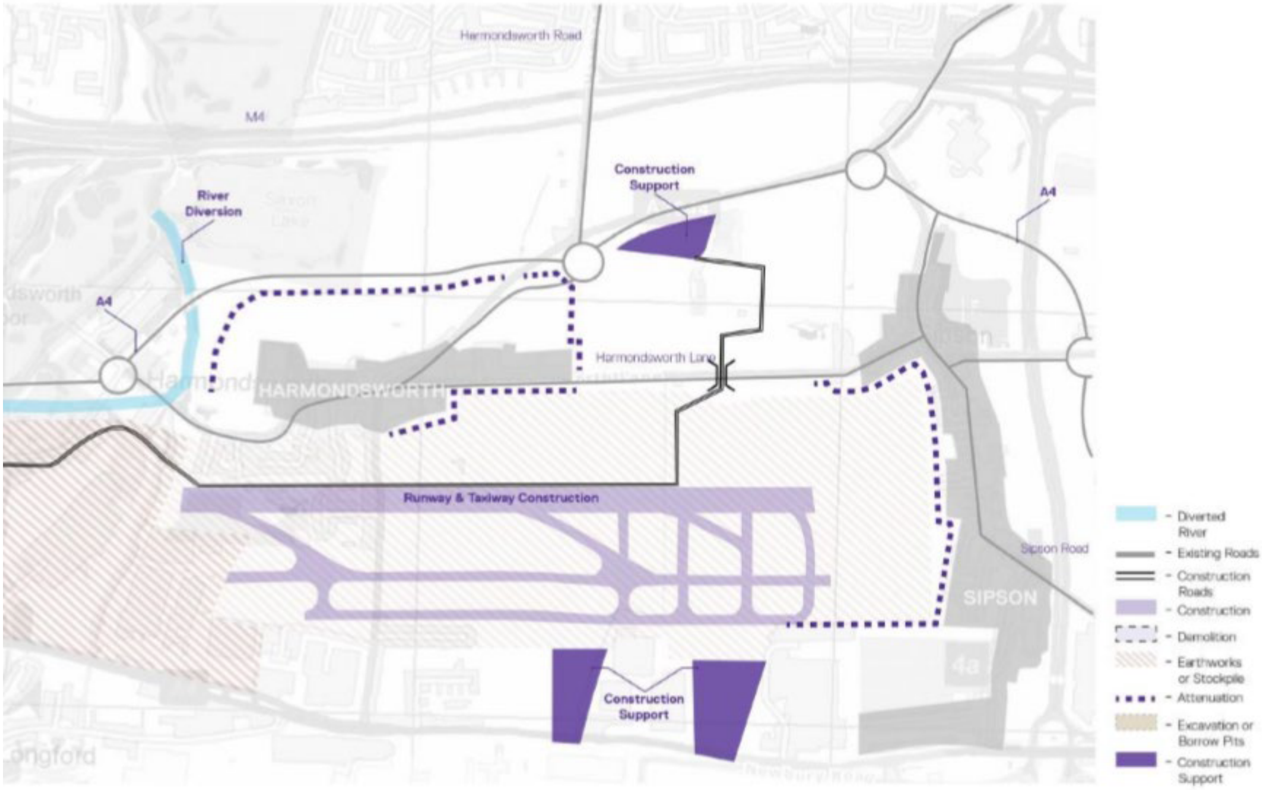


Figure 17 Earthworks Phasing – Stage 3
Source: ([redacted])

As can be seen from the high level slides the earthworks and reconfiguration of the road system are linked and create a delivery sequence.

The challenge to the earthworks will be the need to create borrow pits that provide clean fill and transfer any contaminated arisings into the borrow pits to mitigate any migration of spoil off site. This sequence is critical to the success of the earthworks strategy and relies heavily on integration between differing suppliers and the works commencing at the earliest opportunity in [redacted] 2022.

When asked for clarification HAL confirmed that they will require long working windows and multiple shifts during the first year to achieve the target of moving [redacted] material during the first year and approximately [redacted] the following year. This presents a very challenging target to be achieved by the supply chain and will require detailed engagement with existing contractors. When challenged HAL responded that they have had extensive dialogue with the supply chain and validated the targets against industry norms. However, it is a challenging target and could be easily de-railed by exceptionally inclement weather or curtailed by intervention by the local authorities if the impacts of the works become intolerable.

The success of the earthworks programme will rely heavily on a positive engagement with the specialist supply chain, as well as the contractors having access to the right equipment in enough volume to achieve the goals set. Procurement of the supply chain will have to have progressed to the point of placement of the contracts due to the limited mobilisation period after approval has been granted. There are significant risks within the earthworks works packages due to the interfaces between each area. HAL is aware of this risk and intend to engage with the supply chain on a more collective responsibility contract.

With a limited earthwork season (spring to autumn) these targets are ambitious and will require multiple shifts per day and 6 days a week working. Which may cause conflicts with the local authorities due to detrimental impacts. Arcadis understands that HAL is working through these challenges to create a stable working regime that will help to achieve these goals.

3.2.9 Main Works

Once the space has been cleared by the early works and the reconfiguration of the road systems, the remain space will be developed to create the new runway. There are multiple areas of development that will be progressed upon completion of the DCO process. The constraints at the beginning are around the environmental mitigation measures that will be required to be instigated as soon as the DCO approval has been granted. The early stages are governed by the need to set up the construction support areas and logistic strategy.

Very quickly the whole area will be impacted by the development. With the earthworks dominating the northern sector. The early years are dominated by the need to relocate and remove the existing occupiers of the areas under development. These include commercial properties, residential properties and a few key utility relocations. This is shown as taking 2022 and 2023 in the phasing plans. While the areas are being cleared of existing functions and facilities the existing airfield will be adapted to allow for connections into the new areas.

HAL has undertaken a detailed assessment of the main body of works to understand the required sequence, constraints and influencers on the works. They have created a high-level programme with the appropriate time periods to undertake the identified scope in the required sequence. It is the appropriate level of planning with the information available at this early stage in the development. Further work will be required to determine the next level down in detail to enable a guidance programme can be created to inform the procurement process. The programme has a series of key milestones that help to identify the targets to be achieved it also identifies the multiple level of projects that are to be delivered.

The development at Heathrow is complex in that it requires a significant number of projects to clear space and then change the function of that space. Which in a normal development would provide a clear and concise path through the development to enable the easy identification of the key or critical projects. The reconfiguration of Heathrow to facilitate additional airline capacity requires the redevelopment of entire sections of the surrounding areas. The consequence will be that any of these projects and sub-projects could have a detrimental impact on the overall development. It will be up to HAL to instigate a robust management and control plan to ensure close monitoring of all projects with the portfolio of development at Heathrow.

HAL has published a works delivery sequence in the form of time slices slides (Appendix A). These provide a pictorial representation of the main works over a period of 2020 to runway opening in 2026. It is clear to see from these slides that the area around Heathrow will be significantly impacted by construction activities. There will be concerns that the extra traffic needed to feed the construction sites will cause disruption to the normal operations at Heathrow. HAL is fully aware of this risk and in discussion have referenced the work done to identify remote parking, and remote manufacturing centres to move as much of the construction process away from the Heathrow site. There is bound to be a detrimental impact of the works on the day to day operations, with particular concern around the changes to the roads systems. Further work will be required to fully understand these risks and impacts.

3.2.10 Risks

HAL has identified the top 15 Expansion Risks for the **Step 0**, as indicated in Figure 18. A number of these directly relate to Deliverability.

HAL has identified that the pre-DCO enabling works can begin prior to the main external works. The schedule indicates that this will include ecology related works beginning [redacted] in 2022. This will be ongoing whilst the DCO application is under consideration and awaiting a final decision. We do not consider this a risk to the delivery programme.

Arcadis considers the earliest risk to the delivery of **Step 0** comes from the DCO process, property acquisition and business relocation. These must be completed prior to the main **Step 0** construction programme.

The risks have been identified by HAL and mitigation measures are in place. The relevant Risk ID and Risk Titles are detailed in the HAL document, Risk Management – M4 and the summary of these risks are indicated below.

Arcadis has seen evidence that HAL has been working through the risks identified in this early phase of the process and is seeking to develop appropriate mitigation measures to minimise the impact of any risks.

HAL has undertaken a Quantitative Schedule Risk Analysis (QSRA) assessment of the proposed schedule, with respect to schedule integrity. This assessment resulted in a P value of [redacted], indicating a [redacted] likelihood of achieving the schedule. Arcadis recognises that this reflects a schedule that has been designed to deliver the new 3rd runway at the earliest possible opportunity. Arcadis has not reviewed the likelihood of any alternative runway opening dates as part of this review.

It should be acknowledged that such a major programme will have risks that HAL can mitigate as these are directly under HAL's control. However, there will be a number of risks that HAL does not have direct control over which could lead to delays in the programme that will impact on HAL's ability to deliver the timetable for **Step 0**.

[redacted]

[redacted]

3.3 Summary

Arcadis has assessed the key elements required for the delivery of the new runway from the existing airport operation to 2026, **Step 0.**

It is clear from the significant amount of work that HAL has undertaken that the sequencing and multiple elements of the scheme are presented in a logical and well thought our sequence.

Arcadis has seen evidence that HAL have sought to deliver the most efficient sequencing to aim to deliver the new runway by 2026. This efficiency has however created a programme that is both ambitious and optimistic with little margin for delays or risk.

Although it is not unfeasible that this programme and sequencing for the delivery of the required infrastructure could be achievable, this is reliant on the programme timings set out in the plan to be delivered.

Arcadis has identified a number of deliverability challenges that, although may be achievable to meet the ANPS target of 2030, could only be deliverable by 2026 if no significant delays take place in the programme.

The first challenge to delivering the new third runway by 2026 requires the full DCO process to have been completed by [redacted] 2021.

Whilst HAL has planned the DCO timescale around the “normal” allocation of time, it does not allow for any contingencies in the timings. The Heathrow scheme has attracted a lot of public scrutiny over the years and there would be no reason to suggest that it will not be subject to intense scrutiny during the DCO process.

The proposed development programme requires that the earthworks to proceed in [redacted]f 2022, and therefore any delays in the approval process will have a detrimental impact on the proposed start of works.

There is a significant amount of key activities that are positioned as early works within the proposed development timelines. While this is not unsurprising within the context of the volume of works required to be completed within a tight target to achieve a new runway by 2026, some of the identified works will require separate approval routes to the main DCO, they will also require commitment to placement of contracts to deliver replacement assets before the main works are let. There is also a need to review the planned dates for some of the replacement assets such as the school replacement projects that are not harmonised with the school academic year.

The river diversions are environmentally sensitive areas in conflict with the timings and demands of the construction process. The consent granting body associated with these water courses has significant interest and powers over the scheme, which could lead to tensions in the approval process.

Careful management of the changes to the water courses will be the route through these challenges. HAL will need to be aware of the seasonal nature of some of these works and draw up a plan accordingly.

The existing rivers and water courses and the new routes play a significant role in the ecology and environment of the areas around Heathrow and are very susceptible to damage caused by the construction process.

The road system amendments proposed by the scheme are a significant risk to the development due to the complex sequence of works required. There are many risks associated with the re-configuration of the road systems and as such the construction activities will present many challenges

The success of the earthworks programme will rely heavily on a positive engagement with the specialist supply chain, as well as the contractors having access to the right equipment in enough volume to achieve the goals set.

Procurement of the supply chain will have to have progressed to the point of placement of the contracts due to the limited mobilisation period after approval has been granted. There are significant risks within the earthworks works packages due to the interfaces between each area.

The volume of earthwork required to be achieved in the first two years is significant. A limited earthwork season (spring to autumn) means these targets are ambitious and will require multiple shifts per day and 6 days a week working. Which may cause conflicts with the local authorities due to detrimental impacts.

HAL has published a works delivery sequence covering the main works over a period of 2020 to runway opening in 2026. It is clear to see that the area around Heathrow will be significantly impacted by construction activities. There will be concerns that the extra traffic needed to feed the construction sites will cause disruption to the normal operations at Heathrow.

HAL is fully aware of this risk and in discussion have referenced the work done to identify remote parking, and remote manufacturing centres to move as much of the construction process away from the Heathrow site.

There is likely to be a detrimental impact of the works on the day to day operations, with particular concern around the changes to the roads systems. Further work will be required to fully understand these risks and impacts.

4 TIMING

Arcadis has assessed whether the masterplan and plans for the **Step 0** period is timely. The review has considered whether the Preferred Masterplan and planned deliverables for **Step 0** can be provided in accordance with the specified duration in the programme and the dates and deadlines detailed.

Arcadis has considered the risks to providing the relevant deliverables in accordance with the current specified duration in the programme and on the dates and deadlines detailed in HAL's plans.

The review has analysed the impact of failing to provide for the relevant deliverables in accordance with the current specified duration in the programme and what strategies have been developed to mitigate risks and any subsequent impacts from failure to delivery in a timely manner, with consideration for interdependencies.

Arcadis's key findings are:

- HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable;
- The current programme includes risk allowances for each component of the masterplan assessed on the basis of industry norms. There is no apparent programme-wide allowance for schedule risk; and
- With such a complex programme involving a significant range of interdependencies, many of which are out of the control of HAL, the objective to deliver an operational runway by 2026 carries a high level of risk.

4.1 Definition of Theme

This section of the report reviews whether the Preferred Masterplan can be delivered in a timely manner from the existing airport infrastructure to **Step 0.**

Arcadis has already reviewed the proposals to ensure that they follow a logical delivery sequence. This purpose of this section of the report is to assess the programme Work Breakdown Structure (WBS) and overall schedule resilience.

The WBS has been presented to Arcadis in a form of a detailed Gantt chart developed in recognised programme management software using benchmarked and as build data sources to develop the schedule. Table 17 sets out the key dates that are contained within the programme that HAL is seeking to achieve to be able to deliver the new runway by 2026, **Step 0**.

[redacted]

Table 17 List of Milestones
Source: (Arcadis 2019)

4.2 Assessment

In order to undertake this review Arcadis has engaged with HAL attending presentations with HAL then providing the presentation slide decks.

In addition, Arcadis has undertaken sessions with the relevant Subject Matter Experts at HAL who have developed the programme schedule and have answered detailed questions regarding the information presented to Arcadis.

Arcadis has been provided with access to a detailed assessment of the schedule structure that was undertaken by Costain on behalf of the Department for Transport in June 2019. The report investigated the Work Breakdown Structure (WBS) and overall schedule resilience

The results of those investigations is published in a report *DfT Heathrow Expansion Programme, Assurance Review of Heathrow Airport Limited Delivery Schedule* dated 14th June 2019.

Arcadis' review has fundamentally considered the same information and approach that has already been assessed by Costain but for the purpose of this report has only considered the programme up to **Step 0**.

4.2.1 Pre-Construction

Development Consent Order

The expansion at Heathrow requires the developer to seek a DCO and there are clear steps that the developer will need to follow to comply with the process.

Arcadis has examined HAL's programme and the timings are dependent upon HAL having an unopposed submission that will pass through the pre-examination and examination process without dispute. The proposed DCO timescale does not allow for any deferral of the final approval date of the submission. To underwrite this aspiration the original documentation will have to achieve total and full compliance with the DCO requirements.

HAL is fully aware that there is opposition to their scheme and there have been legal challenges and attempts to seek multiple judicial reviews over time to seek to slow down or stop expansion at Heathrow. HAL has experience of working through complex planning submissions and are aware of the level of engagement required to gain approval.

As part of the DCO process, there is a requirement to create a body of information and evidence prior to formal submission. HAL has undertaken multiple formal consultations as well as many informal consultations. This has enabled them to capture a significant amount of responses and points of issue.

These consumer insights have been fed back into the design development process. This should give HAL the opportunity to balance their emerging design and associated mitigation with the needs of the scheme objectors.

Arcadis has not undertaken a comparison between the 3,000 responses received in the spring 2018 consultations and the emerging design agreed at the M4 gateway. HAL has confirmed that it has taken into account, and sought to address, the concerns raised during the public consultations.

Having also engaged with the relevant consent granting bodies, HAL has a clear understanding of the concerns and areas of objections likely to come from these sources.

In addition, HAL has also taken extra measures to ensure that they gain acceptance from a wider audience with the introduction of an inclusive procurement strategy and a draft construction management plan. The dedicated expansion website pages have extensive information and are designed to help engagement of all relevant parties.

Whilst there is little doubt that HAL is planning to achieve a 100% compliant submission there are always external influencers that could cause the planned timescale to be extended beyond the planned [redacted] month period. As can be seen from the graph (refer to Figure 10) the process does not always follow the prescribed timescales.

The period allowed by HAL from submission to approval of approximately [redacted] days. Arcadis has compared these timescales against other submissions and although some simpler developments are shorter, 1/3 of schemes that have gone through the DCO process have taken longer.

Arcadis considers that a vigorously pursued Judicial Review could cause enough delay to the approval process to cause the planned spring earthwork window being lost, delayed or compromised.

Arcadis considers the time allowance between DCO approval and start of works in [redacted] 2022 is ambitious with little or no contingency. It will rely on a period of effective and swift discharging of the planning conditions imposed on HAL after the DCO date.

It is likely that HAL will be aware of the planning conditions at the point of the Planning Inspectors recommendation to the Secretary of State. However, there will be a risk that more will be imposed during the final stages of the process.

Consent Deliverables.

Arcadis is aware HAL understands its requirement to map the environmental impacts of the planned works in detail. HAL has indicated an understanding of the seasonal variations for each species expected to be discovered within the development zone.

As part of its assessment Arcadis discussed with HAL how they would deal with contingencies if species were discovered in key earthwork zones. One example includes Badger Setts within the area of the early earthwork areas. There are known Badger Setts on the edge of some of the early earthwork zones. These will be of interest to the Environmental Agency and the means by which HAL will protect existing species.

As part of the Preliminary Environmental Impact Report (PEIR) a full field and desktop study of all the areas impacted by the scheme will need to be undertaken by HAL. Arcadis understands the scope of this study has been agreed with the relevant authorities. This will form the basis of all studies and environmental mitigation measures undertaken between pre-submission and the completion of all works.

HAL has indicated that they have created all documentation as required by the Development Consent Order (DCO) process as well as enquires by the relevant authorities. The published schedule indicates the time allowed for these studies. HAL is aware of the need to create the full information pack in support of the DCO submission prior to the review by PINS (Planning Inspectorate) as any failure to provide the full information will risk the rejection of the submission at the first hurdle.

4.2.2 Design

The Preferred Masterplan schedule supplied by HAL has indicated a period for design development. HAL has indicated that there are several key design Consultants engaged to deliver the necessary detail, from concept guardians through to engineering specialists.

The design programme as indicated on the Preferred Masterplan schedule indicates the required time frame for the design and is at a level that would be in keeping with a pre-submission scheme. However, Arcadis considers that the complexity and potential impacts of the works would requires a clearer statement of the design development process.

Arcadis has not been able to analyse the fully detailed design programme but HAL has indicated that this has been set up to feed into the procurement timescale. Arcadis considers that with a scheme of this complexity there will be a need to progress the design on many fronts to ensure visibility of the interfaces between works packages and systems to ensure compliance. HAL is aware of this constraint and are pursuing this strategy through the procurement process.

HAL is currently working through the design development to achieve the Preferred Masterplan milestone of M5. This is intended to pull in all the comments and issues raised during the consultation process to provide an updated design that will form the basis of the DCO submission in [redacted] 2020.

This should also provide the basis upon which the early works packages will be progressed into the procurement process. There are indications of the need to progress key areas of design early to feed the requirements of the early works and procurement of the large infrastructure works.

Arcadis were unable to review in detail the plan for elements such as the SSE high voltage works, the M25 infrastructure, the replacement of the Immigration Centre and Harmondsworth School facilities. These will require detailed work over the next period to ensure full compliance prior to the works commencing on site.

Arcadis is aware that one of the key constraints to the development of the new runway construction will be the Energy from Waste facility. HAL are working with the owner of this asset to undertake a separate planning application to relocate this facility. There is a significant risk that by removing this facility from the DCO process that the Local Authority Planning Application could reject or defer this application and causing this project, and the DCO, to be delayed.

It is Arcadis' view that this could have a detrimental impact on the planned construction sequence and timings of the main runway works. Although HAL is aware of this risk, by transferring this to a separate developer they have diminished their close control of this risk and any opportunity to mitigate this.

4.2.3 Procurement

HAL has created a delivery procurement strategy that has been reviewed by the airline community. The high-level mission statement to "Create a Heathrow Expansion Procurement Strategy that motivates productivity, drives value for money to create a new UK benchmark for the way infrastructure is sustainably procured that delivers the programme."

Arcadis has not been provided a detailed procurement plan built into the information supplied by HAL. Discussions with HAL indicates that it has been undertaking a review of the works packaging strategy and procurement methodology to ensure their stated aims (as listed above) will be achieved.

The focus to date has been to create the design and delivery strategy as required to meet the requirements of the DCO process. Whilst HAL has engaged the services of a professional construction adviser who has advised them on construction methodology, sequence, and timings, there is a lack of detail to the next level on procurement.

Arcadis has raised queries in discussion with HAL on the likelihood of the need to build the OJEU process into the time allowance for works, especially those relating to works outside of the airport boundary.

HAL has not yet clearly identified which packages of works may require OJEU. This may be a function of the unknown status of the UK post 31st October 2019 however any requirement to undertake OJEU procurement could extend the programme and therefore delay the implementation of works.

4.2.4 Pre-DCO Works

Arcadis understands that, to achieve the required clearance of the development space there are certain projects that need to be undertaken prior to the full DCO approval has been achieved.

These are required to clear key areas to facilitate the works and are time critical. This is because of the long string of works that follow these key early works or the need to remove the constraint on the development early.

These projects include the relocation of a high voltage cables and associated substations, which are required to cleared out of the way to make room for the construction of the new M25 alignment. This works sequence influences the requirement to demolish the existing M25 road to allow for construction of the new runway. Whilst it is not a constraint on the commencement of the runway works it is an influence on the middle section of the runway development.

Other projects are pre DCO due to the need to re-provide the facilities to enable occupancy by the construction contractors to clear the areas and commence the earthwork as soon as possible. These projects include for the re-provision of the Harmondsworth Primary School, Immigration Centre, and Energy from Waste facility.

4.2.5 Roads

The reconfiguration of the M25 and A4 are key to the release of a significant area of the development site, to the north and west of the existing Heathrow campus.

The M25 road amendment is constrained by two primary strings. The first will be the design and procurement processes that are required to deliver a Highways England compliant scheme. the second will be the need to clear high voltage surface cables from the development zone.

This sequence is shown below.

1. Re-provide HV Infrastructure
2. Clear the space
3. Create the Alternative M25 Route
4. Re-Locate M25
5. Clear the existing M25
6. Complete the Earthworks and Runway

Source [redacted])

Due to the timing of the works the HV infrastructure works will occur prior to the scheme DCO approval. These works will have a significant influence on the overall development timescale and any delays in this work stream will impact in HAL's ability to deliver the runway for 2026.

The current sequence and timings assume that all the works will commence at the earliest opportunity and the design and procurement and works to the SSE HV network will commence pre DCO approval. Arcadis understands that there are few opportunities to mitigate delays in this sequence, however it will not completely stop the commencement of the runway build but significantly influence the completion of the middle section.

The other key road system will be the relocation of the A4 trunk road. This again will influence the earthworks and development to the north west of the current campus. It is vital that traffic is routed away from the main earthworks zones and an alternative route around the western perimeter is created, before the existing road system is shut down.

The significance of the A4 will also play into the relocation of the M25, as there is currently a significant bridge that takes the A4 over the M25. The impact of this can be seen by the following works sequence. Deliver the alternative A4 Route including a temporary bridge over the 'live' M25 and an enabling A4 bridge over the M25 diversion.

1. **Deliver the alternative A4 Route**
2. **Transfer Traffic onto the new A4**
3. Demolish Existing A4/M25 overbridge
4. Complete Alternative M25 Route
5. Relocate M25
6. Clear the existing M25
7. Complete the Earthworks and Runway

Source [redacted])

The creation of the new A4 route will involve a significant bridge structure over the live M25 to allow traffic to pass from the west of Heathrow to the north.

These two areas will need to be worked up in detail with the supply chain to de-risk these very difficult scope of works. Whilst a period for these works has been allowed within the Preferred Masterplan programme schedule, Arcadis understands that it will be difficult for HAL to assess the certainty of the proposed timescale until further design work has been undertaken.

Although the existing construction delivery consultant will have undertaken a review of the sequence and timings to give a professional opinion on the likelihood of achieving the required dates, there is a risk that any delay to the A4 is again likely to impact on HAL being able to achieve the runway opening of 2026.

4.2.6 Earthworks

HAL has developed a strategy around the DCO consent being delivered in [redacted] 2021, and the main earthwork commencing in [redacted] 2022.

The requirement is therefore for HAL to mobilise, set up the required logistics centres, clear any DCO conditions, achieve vacant possessions, and undertake environmental mitigation measures in order to achieve a meaningful start of the earthworks in [redacted] 2022.

The stated goal of the first year of earthworks is to move approximately [redacted] of material. To achieve this goal HAL is planning to work extended days and weeks during this first season. Whilst much thought and investigation of the possible methodologies has been undertaken, HAL cannot finalise the actual methodology until the DCO process has delivered any imposed constraints.

Due to the tight timescales allowed in the programme, between the DCO approval and the start of works, any delays in the DCO approval process will have a direct impact on the ability of HAL to achieve the planned start of the works in the [redacted] 2022. The target of the [redacted] of material to be moved would then be compromised.

The HAL strategy requires large areas of land and existing facilities to be available under Vacant Possession at the beginning of the works. To achieve this, HAL has indicated that they will be negotiating agreements with the various landowners and vested interests prior to the DCO. These agreements are planned to come into force at the point of DCO approval with dates indicated within the programme for some of the key land acquisitions to become operational [redacted] after the issue of the DCO.

Arcadis is not able to accurately forecast whether the required parcels of land will be available on the required date, with the risk that the process may take longer than planned. This will also put pressure on the earthworks sequence and methodology leading to potential delays in the release of areas to following activities.

The earthwork periods are constrained by weather impacts, with the expectation that the majority of the work will be carried out from spring to autumn in 2022 and 2023. Seasonal variance and inclement weather could have a significant impact on the ability of HAL to deliver the required production targets.

Arcadis considers that with a limited earthwork season (spring to autumn) the programme targets are challenging and will require multiple shifts per day and 6 days a week working. Arcadis understands that HAL is working through these challenges to create a stable working regime that will seek to achieve these goals.

4.2.7 Runway Opening

The runway delivery sequence as defined by HAL in the time slice presentation (images in Appendix A), seems to be in keeping with the known constraints around the campus at Heathrow.

Arcadis has seen a sequence that shows a clear strategy to deliver the works as and when required. It highlights the works necessary to be cleared in advance of the main runway delivery. It also shows the constrained method of delivery for the main runway works. The Preferred Masterplan programme schedule supplied by HAL indicates the proposed time periods for the works.

Arcadis has discussed the development of the programme with HAL. Arcadis notes that no separate allowance has been made for programme-wide schedule risk. HAL has clarified that programme allowances for individual work-packages are based on industry benchmarks for completed work and accordingly include allowances for programme delay.

However, in our experience, a prudently designed masterplan schedule will include some allowance for programme risk, dealing for example with the interdependency of work items on the schedule.

Arcadis has analysed the document "[redacted]t" that was published on [redacted] 2019. HAL's report sets out information on the benchmark data used and the source of that data. Although this helps to validate the time periods allowed within the programme, it does not eliminate any schedule risk and only clarifies the periods used.

4.2.8 Schedule Risk

Arcadis notes that, throughout the schedule and delivery sequence published, HAL has taken an optimistic approach to the interdependency of key components of the Masterplan. Whilst this outcome may indeed be delivered, it would be a prudent step by HAL to take greater account of a number of highly significant sequencing risks that we set out below:

Dependency on the Timing of the DCO.

HAL has been optimistic in achieving the key dates as set out above. HAL's Preferred Masterplan programme schedule assumes the ability to complete the DCO process within the proposed 17-month timescale.

Delivery of Enabling Infrastructure

The timescales to relocate the SSE High Voltage infrastructure, the M25 Motorway and the A4 Trunk road is again reliant on a smooth programme without delays or disruption. The A4 relocation must be completed for the site for runway construction to be made fully available.

Earthworks Schedule

Even once the site is available, the need to achieve [redacted] of earthworks in the first year, to the start of works within [redacted] of receiving the DCO is again ambitious, relying on additional consents to allow for extended working days.

Operational Readiness

HAL has not yet shared their plan for "day one operations". Arcadis has analysed the programme and has identified a period allowed for operational readiness. This period is indicated on the programme as 5 1/2 months, from [redacted] 2026 to [redacted] 2026.

Arcadis' assessment, based on other operational readiness activities that Arcadis has been involved with (including T5 and T2 at Heathrow) is that this duration is optimistic, as the new runway will require extensive integration into the existing Heathrow operations.

Arcadis understands that the new infrastructure will also require integration into a revised airspace plan.

Prior to this testing and proving period, there will be a need to update the airfield licence and operating procedures to accommodate changes to airspace.

These tasks are not highlighted on the master schedule received by Arcadis. The assumption being that these tasks will be undertaken in parallel with the construction delivery team and be ready and agreed prior to the operational testing period.

The date is driven by completion of the runway construction, which is shown as [redacted]. There is little or no contingency built into the start of this operational readiness period which we considered to be an optimistic position.

No information was provided on the detailed programme as to how the new runway capacity will be integrated into the existing Heathrow operations. Further work will be required to clarify all the conditions necessary to achieve a successful integration of the new assets.

Given the high reputational risk associated with handover and operational readiness, we expect that HAL would take a more conservative approach to their planning of handover timescales.

4.3 Summary

Arcadis considers that the overall Preferred Masterplan programme schedule is at the level of detail required for a programme of this scale at this stage of the development process.

HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable.

HAL are aware of these risks. Figure 18 for example sets out HAL's assessment of the top 15 expansion risks, which include for example, the extension of the DCO period.

The programme has been developed from a sequence of discrete activities that each include their own allowances for schedule risk based on industry norms. There is no apparent programme-wide allowance for schedule risk and, based on our understanding of the methodology adopted by HAL, no additional risk allowance for the particular challenges associated with the delivery of the works sequence in a constrained location.

The risks and the work HAL has undertaken to consider these to the delivery and therefore the timing is set out in 3.2.10 above. Arcadis has seen evidence that HAL is continually developing and refining its risk assessment to the programme.

Arcadis has no doubt that HAL has spent a significant amount of resource developing its plans and is confident that this approach would allow HAL to achieve the ANPS target for increased runway capacity by 2030.

However, there are a number of elements within the programme that HAL will not have full control over and therefore cannot fully mitigate the risks associated with these tasks being delivered. The lack of control on specific elements such as the DCO process, SSE HV works, the Waste to Energy facility and M25 works could lead to timings and key milestones not being achieved that will have a knock-on to the rest of the programme.

Although HAL has indicated that they could mitigate some of the potential delays through re-phasing and moving around work elements within the programme, the key consequence of delays to the delivery of the runway or re-scheduling of works is likely to be an increase in costs and potential failure to achieve the 2026 date.

The ***Heathrow Expansion Programme, Assurance Review of Heathrow Airport Limited Delivery Schedule*** report prepared for the DfT by Costain has also highlighted a similar set of risks associated with meeting the 2026 timescale but again agrees with Arcadis' view that the ANPS target of 2030 can be achieved.

5 COST ESTIMATE

Arcadis has assessed whether the Preferred Masterplan Capital Expenditure (CAPEX) for the **Step 0** period is reasonably and reliably costed. The review has considered the approach HAL has taken to build, further develop and update their cost estimate in accordance with the Preferred Masterplan.

Arcadis has examined HAL's approach to developing the cost estimate any 'Scope Gap' and the certainty of the cost estimate based on the quantification of costs, pricing and confidence in costs, application of on-costs and HAL's approach to risk and maturity.

Arcadis's key findings are:

- HAL's Cost Estimate for **Step 0** is reasonably and reliably costed;
- Arcadis's comments from previous reports to the CAA have been taken on board by HAL and an all-encompassing baseline cost estimate has been produced by HAL;
- HAL's approach to the structure and methodology of compiling the Cost Estimate reflects industry best practice;
- The level of quantification and benchmarking has increased since previous iterations of the Cost Estimate with analysis of benchmarks from other sectors incorporated leading to an increased level of cost certainty; and
- [redacted]

5.1 Definition of Theme

This section of the report reviews the Cost Estimate for **Step 0.** HAL's Cost Estimate has already been reviewed and assured by the Independent Fund Surveyor (IFS). To understand the IFS's approach Arcadis met with the IFS in May 2019. Arcadis consider that the IFS has undertaken a thorough and detailed review of the Cost Estimate and have therefore looked to build on and further the work already done by the IFS rather than duplicate.

Arcadis has assessed whether the Preferred Masterplan Capital Expenditure (CAPEX) is reasonably and reliably costed. Arcadis has based their assessment on industry practice and Royal Institution of Chartered Surveyors (RICS) New Rules of Measurement (NRM).

An industry recognised approach to cost estimating is detailed below in Figure 19.

After compiling the Base Costs of the Cost Estimate Indirect costs are taken into consideration, these are detailed in Figure 20.

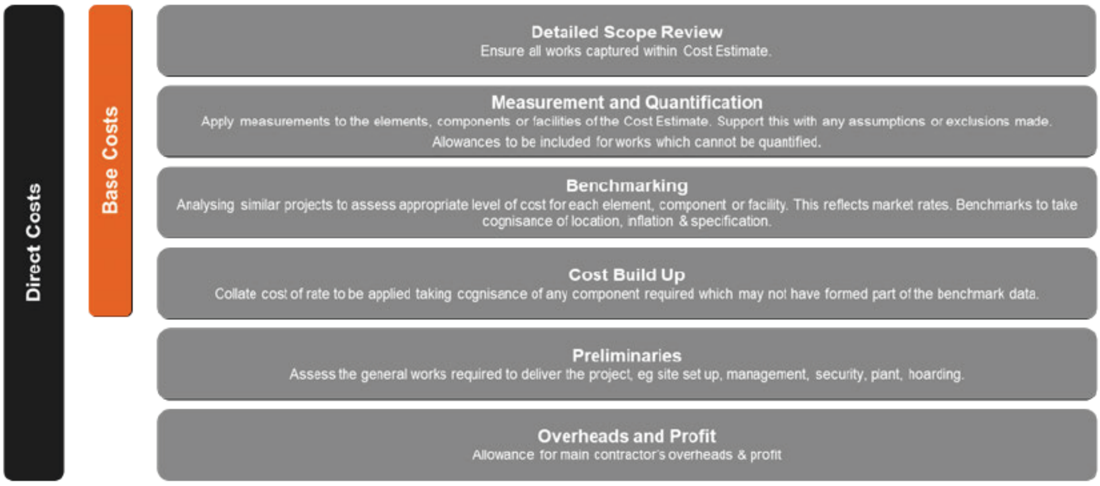


Figure 19 Approach to Cost Estimating, Direct Costs

Figure 20 Approach to Cost Estimating, Indirect Costs

Arcadis has considered the approach HAL has taken to build, further develop and update their Cost Estimate in accordance with the Preferred Masterplan. This consideration includes:

- HAL's approach to developing the Cost Estimate, process for development and future development, amendments to the Cost Estimate based on progress, assessment of progress and amendments to date; and
- Scope Gap review (Cost Estimate to design and delivery of Preferred Masterplan).

Arcadis has reviewed the certainty of the Cost Estimate that HAL has produced for the Preferred Masterplan This review includes:

- Quantification of costs: Assessing the amount measured, the basis of the measurements and the extent of work where quantification has not yet been undertaken;
- Pricing and confidence in costs (total, measured, assessed, benchmarks);
- Application of on-costs; and
- Approach to risk.

Arcadis has assessed the observed level of maturity within the Cost Estimate. This has included assessing:

- The robustness of evidence provided by HAL in relation to its Preferred Masterplan and associated cost; and
- The integration of Cost Estimate with other elements of the Preferred Masterplan such as; design, procurement, programme, logistics, external and mitigating factors, project specifics.

5.2 Assessment

5.2.1 Information Reviewed

In order to undertake this review Arcadis has engaged with HAL attending presentations with HAL for each Task Order. These Task Orders reflect the packages of work that the Cost Estimate is broken down into and is likely to be reflective of the structure of the packages to be procured. Following the presentations HAL provided the slide decks. These presentations were:

Report Title	Report Source
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL

Table 18 Presentations and Documentation Provided by HAL

Following these presentations, HAL provided their Cost Estimate; dated [redacted], which forms the main document for review under this section of this report. This document contains sections on scope, cost, schedule, risk & inflation. It has appendices containing:

[redacted]

This document collates all the elements of the Cost Estimate and as such addresses one of the concerns Arcadis previously noted in earlier reports to the CAA.

Task Order	Direct (£m)	Indirect (£m)	Sub-Total (£m)
Enabling works	[redacted]	[redacted]	[redacted]
Earthworks	[redacted]	[redacted]	[redacted]
Utilities	[redacted]	[redacted]	[redacted]
Rivers	[redacted]	[redacted]	[redacted]
Roads	[redacted]	[redacted]	[redacted]
Runways & Taxiways	[redacted]	[redacted]	[redacted]
Landscape	[redacted]	[redacted]	[redacted]
Programme Specifics	[redacted]	[redacted]	[redacted]
		Total:	[redacted]

Table 19: Direct and Indirect breakdown of Cost Estimates
Source: ([redacted])

The largest section of the document is Appendix C: Cost Estimate. This contains cost reports at Task Order level, that reflect the different type of works being delivered as part of the programme.

Each Task Order outlines the scope, quantification, pricing, direct costs, indirect costs, assumptions & exclusions and benchmarking. In addition to the main document, Excel files were provided for the Cost Estimate element.

The Task Orders in the Cost Estimate cover all the works necessary for the Preferred Masterplan to be delivered. Arcadis has considered the following for review in **Step 0**:

- Earthworks;
- Utilities;
- Enabling Works;
- Rivers, Roads; and
- Runways & Taxiways and Landscaping.

In addition to the documents compiled by HAL Arcadis has also referred to the Independent Fund Surveyor's (IFS) report dated March 2019.

5.2.2 **HAL Approach to Cost Estimate**

HAL has set out their approach to the Cost Estimate in the following presentations and documents:

- [redacted]
- [redacted]
- [redacted]

The Cost Estimate is based on the M4 Preferred Masterplan and is further derived from the steps of the Illustrative Masterplan, the 'Kit of Parts', which was developed by the IDT and describes the key elements of scope, and other design & scoping information.

The Cost Estimate is broken down at Task Order level into direct costs and indirect costs.

HAL's structure and approach is set out as follows:

Direct Costs

- Receive design documents, drawings, scope/specifications, assumptions;
- Quantify, measure, enumerate, understand assumptions, raise queries, prepare Cost Estimate. Quantities are based on data provided or confirmed by the HAL's Integrated Design Team (IDT) which have been spot checked by HAL;
- Assumptions & exclusions made at Task Order level;
- Price using either top down benchmarks, bottom up pricing, reach back to business, speak to supply chain. Rates based on facilities benchmarked or elemental/bottom up rates; and
- Finalise Direct Costs within Cost Estimate.

Indirect Costs (added to direct costs)

- Project Specifics – assess costs specific to location/operation of construction;
- Preliminaries – Percentage added to allow for cost of site establishment, contractor management and consumables during construction;
- Overheads & Profit – Percentage added to allow for margin made by Main Contractor;
- Design – Percentage added to allow for Architectural, Structural, Civil, M&E etc. fees;
- Leadership & Logistics – Percentage added to allow for Heathrow Management, Client PM/CM, Programme Logistics;
- Risk/Contingency – Percentage added to the base costs, project specifics, preliminaries, OH&P, L&L and design of each Task Order to allow for project and programme risks, supported by a cost risk analysis with derived probability confidence level; and
- Risk Reserve – Enhanced risk percentage added at Programme level.

Following the production of the Cost Estimate, HAL has then put in place the following assurance measures:

- Level 1 Assurance is defined as carried out by peers. The assurance is specific to the Task Order but includes the activities identified in the

HAL assurance check list this includes computation checks which Arcadis, in their previous reports, stated that HAL needed to address;

- Level 2 Assurance is a review undertaken by a Senior separate individual;
- Level 3 Assurance is Cost, Time and Scope review undertaken by the Development Director, supported by the Head of PMO and Head of Estimating and presented by the Task Order PM's (with Estimator and scheduling support);
- Each estimate is signed separately against the headings of prepared by, assured by, approved by and endorsed by. These signatories are the Estimator, Lead Estimator, Head of Estimating and HAL Project Manager respectively;
- External Review is undertaken by the IFS and a report has been provided – recommendations from the report are being worked through from HAL and the IFS to inform future estimates; and
- HAL held a series of engagement sessions with the IFS presenting the schedule and Cost Estimates.

This level of assurance should eliminate arithmetical errors, this was previously addressed and recommended by Arcadis when undertaking the review of the Purple Book which was HAL's previous iteration of the Cost Estimate.

Arcadis considers the structure, approach and assurance to be reasonable for the stage of the project.

Inflation

All costs within HAL's Cost Estimates are based on Q3 2014 prices, which aligns to the reviews undertaken by the Airports Commission.

In the period between 2014 and the time of this review, there has been a net positive inflation rate for both construction and general price levels in the UK and in London. Therefore, when HAL adjust the estimate to take account of this inflation, the total of HAL's Cost Estimate will increase.

HAL's approach has been to track the costs of a number of indexes against RPI, shown in Figure 21, including:

- Indices produced by the Office for National Statistics:
  - Construction Output Price Index (COPI); and
  - Infrastructure Output Price Index (IOPI) Enabling works.
- The Building Cost Information Service's (BCIS) Tender Price Index (TPI); and
- Indices produced specifically for HAL:
  - Heathrow Price Index (HPI); and
  - Heathrow Cost Index (HCI).

Indices are produced by Professional Consultants from the construction market. Due to the diverse nature of the scope of the Heathrow Expansion Programme, HAL is currently undertaking a review of the scope to identify the most appropriate indices to apply to specific areas of scope. For example, it may be appropriate to apply Building Cost Indices to some aspects of scope and Infrastructure Indices to others.

[redacted]

[redacted]

Arcadis consider this a reasonable approach to analysing and applying inflation, however, would expect HAL to have provided their Cost Estimates in real terms at this stage, making clear their assumptions on the appropriate indices for use by scope area. Furthermore, HAL should consider the impact of inflation on prices throughout the duration of the programme.

5.2.3 Step 0 Review

The overall Cost Estimate and its component parts are approximately made up of:

- Direct costs: [redacted]
- Indirect costs: [redacted]
  - Project specifics;
  - Preliminaries;
  - Overheads & profit;
  - Design;
  - Leadership & logistics; and
  - Risk.
- Other costs: [redacted]
  - Programme specific costs; and
  - Management risk reserve.

Each of these component parts have been reviewed through this report. A detailed review of the individual Task Orders is contained within Appendix C of this report.

The direct costs and indirect costs are attributed to Task Orders in the Cost Estimate. The Task Orders are not fully contained in any of the Steps of the Preferred Masterplan.

However, for the purposes on the **Step 0** review, Arcadis has selected the Task Orders where most of the cost falls within the timescale of **Step 0**. The Programme Specific costs also mainly fall within **Step 0**, so they are also considered in this report.

HAL has reached the total of [redacted] for **Step 0** by time-slicing the costs, based on assets that are in operation to deliver an operational runway. The sum of the sections for review will not directly equal the total for **Step 0**. Arcadis has considered as part of this review whether the costs are reasonable and reliable.

Any Cost Estimate can only be based on the scope, design, programme and data that is available at the point in time that the estimate is carried out and any assumptions and exclusions that are made.

The Cost Estimate is integrated with the other elements of the masterplan.

Arcadis has assessed the approach to the Cost Estimate and the inputs and outputs used to develop the estimate and consider these to be reasonable and reliable. However, the outcome is still subject to multiple influences, some of which are highlighted in the Deliverability & Timing sections of this report.

The planned construction methodology and sequencing have been incorporated into the Cost Estimate. If the plan changes or there are any issues with activities that have interdependencies with others there will be an impact on the Cost Estimate.

The provision for risk in the estimate is designed to build in cost for uncertainties and takes a benchmarked and probabilistic modelled approach to cover risk events. It covers most likely eventualities rather than all eventualities.

5.3 Direct Costs

5.3.1 Introduction

Direct costs are the labour, material, sub-contractor, plant and equipment costs that can be directly attributed to creating an asset. They are typically activities that are quantified and priced for which allowances can be made that are directly related to the project scope.

Within HAL's Cost Estimate the direct works Task Orders considered in the **Step 0** report are:

- Earthworks;
- Utilities;
- Enabling works;
- Rivers;
- Roads;
- Runways & taxiways; and
- Landscaping.

Whilst reviewing the direct costs Arcadis has looked at each Task Order individually and address the items listed in the table below.

Area Assessed	Assessment Undertaken
Scope vs priced activities	Relative to design & Cost Estimate maturity
Key quantities analysis	IDT vs HAL quants check
Key rates analysis	View on rates; benchmarks
Key quantities sensitivity	What could change; impact
Key rates sensitivity	What could change; impact

Table 20 Arcadis' Assessments Undertaken

The review of the individual Task Orders is contained in Appendix C of this report.

5.3.2 **Direct Costs Step 0 Overview**

Scope vs Priced Activities

In general, Arcadis considers the priced activities are a reasonable reflection of the scope outlined.

The level of detail varies across each of the Task Orders which is reflective of the level of design development and maturity. The level of maturity for individual Task Orders is aligned with DCO and programme requirements.

Earthworks, roads and runways & taxiways have a high level of quantification and benchmarking whereas for utilities and landscaping is considerably lower.

Key Quantification Analysis

Across the Task Orders considered in this report, the overall level of quantified activities, by value of the direct costs, is [redacted]

The highest level is [redacted] for earthworks and the lowest level is [redacted] for utilities, which is reflective of the maturity of design. The levels of quantification are shown in the graph below.

[redacted]

[redacted] [redacted]

[redacted]

The quantities used in the Task Order Cost Estimates come from several sources:

- Provided by the IDT;
- On screen quantification;
- Drawings;
- Design guidelines; and
- Google Earth.

The earthwork volumes have also been modelled by a leading earthworks contractor. This was stated by HAL at a presentation/review meeting on 6th June and adds to the level of assurance.

The level and methods of quantification are reasonable at this stage, however, could be improved significantly for utilities as the project develops. It would be better to have a higher level of quantification now, but it is not untypical for the level to be low at this stage as utilities are an 'open and see' item.

The reliability is good given that the quantities provided by the IDT have also been spot checked by HAL, Arcadis has not seen evidence of this but HAL has stated in meetings with Arcadis that spot checks have been carried out and the IFS report also states that HAL informed them the quantities have been spot checked. HAL's Level 1 Assurance requirements also includes major quantities checks for accuracy.

Pricing and Key Rates

The Cost Estimate has been priced using a combination of benchmarking, market testing, bottom up elemental estimating, calculated rates, historic rates including Purple Book 0.63, previous Heathrow projects, other UK projects, estimators experience and allowances.

In our earlier reports Arcadis commented on the source of HAL's benchmarking where HAL had only analysed previous Heathrow projects. HAL has now addressed this and incorporated benchmark data from other sources, namely:

- Environment Agency;
- Highways England;
- London Underground;
- Rail sector;
- Water sector;
- Utilities;
- International airports;
- Consultant databases; and
- Heathrow, T5 and T2A.

Arcadis considers that this approach is reflective of industry best practice.

Across the Task Orders considered the overall level of benchmarked, market tested or calculated activities by value of the direct costs is [redacted] The highest level is [redacted] for earthworks and runways & taxiways whilst the lowest level is [redacted] for enabling works.

Arcadis considers the level is too low for enabling and HAL needs to benchmark, or market test these work activities to increase cost certainty. Currently there is a risk regarding the cost assurance of this Task Order.

The levels of pricing are shown in Figure 23.

[redacted]

Arcadis considers that the extent and coverage of the pricing and benchmarking is generally reasonable at this stage, however It could be improved for enabling works, landscaping, utilities and rivers as more detail becomes available as the design develops.

Cost Significant Items

Across the Task Orders considered, 85% of the cost is in 23% of the items.

The level of quantification for Step 0 increases to 75%, compared to 72% of all the cost.

The largest contributors to the cost significant items are

- Earthworks ([redacted]
- Roads ([redacted]
- Utilities ([redacted] and
- Runways & taxiways ([redacted]

Earthworks, roads and runways & taxiways all have a high level of quantification and benchmarking so the cost significant items can be considered reasonably and reliably quantified and priced. Utilities is the least developed in both quantification and benchmarking and Arcadis considers that this would benefit the most from an increased level of detail to price against. Arcadis has not had the benefit a presentation/review meeting on Utilities so the level of information available is not fully known.

5.4 Indirect Costs

5.4.1 Project Specifics

Project Specifics are extensions of direct costs that are specific to a location or operation of construction. As a result, they are generally priced on an individual Task Order basis.

HAL set out in their Assessment of Cost Estimate Adjustments that at M4 estimate stage masterplan relevant project specifics will be individually assessed and priced and this is demonstrated in each of the Task Order Cost Estimates.

Project Specific allocations have been added as a percentage at line item level in the Cost Estimates to allow for costs that have not been included in the direct costs i.e. not covered in the benchmark cost, market cost or allowance. Where they have been added it is generally in groupings of line items within each Task Order.

The allocations may include allowances for airside working, site specific complexities, temporary works, phasing or night-time working assumptions. These are reflective of the programme and HAL's proposed methods for delivering the works.

The percentages applied appear higher than the overall percentage of direct costs for each Task Order as they are only applied to selected direct cost items.

Table 21 details the percentage for Project Specifics applied to each Task Order, column A. However, for some of the Task Orders this percentage has not been applied to all of the line items forming the base construction cost, therefore column B shows the total value of project specifics included expressed as a percentage of the total base cost.

This table highlights that the project specifics for Task Orders such as Utilities and Rivers may be low.

Task Order	Project Specifics % applied (Col A)	Project Specifics expressed as a % of base cost (Col B)	Description
Earthworks	[redacted]	[redacted]	Night-time working
Utilities	[redacted]	[redacted]	Airside working
Enabling Works	[redacted]	[redacted]	Asbestos removal
Rivers	[redacted]	[redacted]	River diversions
Roads	[redacted]	[redacted]	Complexity, interfaces, modifications, temporary works
Runways/ Taxiways	[redacted]	[redacted]	Night working, phased working, disrupted shifts
Landscaping	[redacted]	[redacted]	Interfaces

Table 21 Summary of Project Specifics included in HAL Cost Estimate
Source: ([redacted])

Task Orders

Earthworks – Project specifics have been applied to line items in the Cost Estimate where HAL's programme shows night-time working is required. These are generally cut & fill activities where it has been assumed that [redacted] of work will be done at night.

Utilities – Allowance applied to activities that are within the current airport boundary. Most of the utilities work is outside the current boundary and as such project specific items are not applicable.

Enabling – Allowance applied to items relating to building and properties demolition for asbestos removal which is the only area applicable to project specifics.

Rivers – Allowance applied to river diversions. This includes the requirement for temporary culverts under the A4, the requirement for temporary bridges at J14 & A4 and EA attendance during construction.

Roads – Multiple allowances have been applied at different locations to take account of airside working, traffic management, temporary works during construction and the complexity of works due to interfaces and modifications to existing road. The percentages that have been applied against line items in the Cost Estimate include:

- M25 alignment [redacted]
- Junction 14, [redacted]
- J14A [redacted]
- J14 Running Lanes [redacted]
- A4 Western [redacted]
- Emirates Junction [redacted]
- Western Perimeter Road [redacted]
- Northern Perimeter Road [redacted]
- Beacon Road Roundabout [redacted]
- Southern Access Tunnel [redacted] and
- Eastchurch Road & Southern Road [redacted]

Runways & Taxiways – Several separate allowances have been applied to active runway and taxiway safety zones. These include labour premiums for night working, allowances for phasing to align with runway alterations & operational restrictions and disrupted shifts. Percentages that have been applied include:

- Existing runway [redacted]
- Decommissioning [redacted]
- Taxiways 23.6% to [redacted]
- Relocation [redacted] and
- De-icing pads [redacted]

Landscaping – The airside working allowance is applied to cover possible interface of works required for the NE noise mitigation bund with other works.

5.4.2 Preliminaries

Preliminaries are added to the individual Task Order's direct costs and project specific costs to cover the cost required to deliver the works but not included in the rates, such as:

- Contractor's Project Management and Engineering team;
- Site accommodation;
- Scaffolding;
- Hoarding;
- Temporary services;
- Temporary works;
- Office equipment;
- Safety & security & environmental protection;
- Bonds, guarantees, warranties & insurances;
- Plant & equipment; and
- Maintenance of site records, completion and post-completion requirements.

Within HAL's Cost Estimate preliminaries have been applied at [redacted] for civils works and [redacted] for building works. Previously in the Purple Book HAL had applied a wider range of percentages with the majority of the works having between [redacted] applied to the equivalent **Step 0** Task Orders.

HAL's assessment of Cost Estimate adjustment states that at M4 stage there will be a review of preliminaries at an asset by asset level informed by clarity of project specifics. This is not how HAL has applied preliminaries within the Cost Estimate. Arcadis considers that this needs to be developed to assure the costs. This will be affected by the procurement strategy and how the works packages are structured. Arcadis consider that a bottom up estimate of the preliminaries needs to be undertaken for the next iteration of the Cost Estimate.

HAL has undertaken benchmark studies to review the percentages applied. They have reviewed 50 projects at Heathrow from the Q5 and Q6 programmes. The Q5 works at Heathrow were large scale projects with similar types of facilities to the Heathrow Expansion Programme. HAL has also reviewed 16 projects from rail, utilities, property sectors and other aviation projects.

The percentages applied in the M4 estimate are consistent with these benchmarks.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] preliminaries applied to all Cost Estimate line items, in line with the [redacted] provision for civils works.

Enabling Works has [redacted] preliminaries applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include preliminaries, so no further provision has been added. The overall percentage for preliminaries for Enabling Works is therefore expressed as [redacted]

Roads has [redacted] preliminaries applied to all items except for the commuted sum relating to Highways England works where the preliminaries are deemed to be already included. The overall percentage for Roads is therefore expressed as [redacted]

Arcadis considers the current percentage allowances to be reasonable.

5.4.3 Overheads & Profit

Overheads & Profit are added to the direct costs, project specific costs and preliminaries. Overheads & Profit reflect the operating expenses (or head office administrative costs) of running the main contractor companies that will implement the projects and the profit margin to be made by the main contractors after accounting for all costs and expenses.

Overheads & profit have been applied [redacted] in the HAL Cost Estimate.

HAL has undertaken benchmark studies to review the percentage applied. HAL has reviewed at least 49 projects at Heathrow from Q5 and Q6. HAL has also reviewed 37 projects from other sectors. The projects from rail, commercial, infrastructure, schools, facilities management & retail sectors. Whilst Arcadis has seen the results of this review we have not interrogated these results.

The percentage applied in the Cost Estimate falls is in line with the average of all the benchmarks.

The benchmark for the Q5 works and the other sectors exceed the average. As the Q5 works is comparable with the Heathrow Expansion Programme it could be considered appropriate to apply a higher percentage for overheads & profit i.e. [redacted] However, the Q6 works are more recent and are lower than the average, which could be indicative of the Heathrow market trend.

Arcadis considers that as Overheads & Profit are at company level rather than site level it would be more pragmatic to use a blend of the Q5 and Q6 data.

Previously HAL had generally applied a percentage of [redacted] however they did apply [redacted] to demolitions and earthworks.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] overheads & profit applied to all Cost Estimate line items.

Enabling Works [redacted] overheads & profit applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include overheads & profit, so no further provision has been added. The overall percentage for overheads & profit for Enabling Works is therefore expressed as [redacted]

Roads has [redacted] overheads & profit applied to all items except for the commuted sum relating to Highways England works where the overheads & profit is deemed to be already included. The overall percentage for Roads is therefore expressed as 7.2%.

5.4.4 Leadership & Logistics

Leadership and Logistics costs cover HAL's programme/project delivery management and programme wide logistics and overhead requirements.

HAL's definition of Leadership costs include:

- Central charges for accommodation;
- Utilities;
- Control posts;
- Staff costs for development;
- IT;
- Central resource;
- Insurance charges; and
- Commercial & control consultancy – including project management, cost management, project controls & risk management; delivery integration services – integration services including early construction/build advice & scheduling; programme design integration services – coordinating integrated schedule across the programme and commercial audit – across the programme.

Logistics costs include:

- Site security;
- Site accommodation for operatives;
- Waste management;
- Car parking and bussing;
- Catering; and
- Delivery strategy & escorting and traffic management.

HAL provides these services to contractors instead of the contractors providing them, with the costs coming through the preliminaries. This gives HAL the opportunity to benefit from economies of scale as well as guaranteeing consistency and compliance with security requirements.

Leadership & Logistics costs are added to the direct costs, project specific, preliminaries and overheads & profit at [redacted] HAL has based this percentage on the Q6 model which was derived from Q5. The approximate split in the Q6 model is [redacted] leadership and [redacted] logistics.

The Assessment of Cost Estimate Adjustments states that at M4 stage there will be a review of Leadership & Logistics and improved understanding of Preliminaries to ensure no overlap in costs.

Arcadis has not seen any evidence that this has been undertaken and would expect to see this when bottom estimates for preliminaries and Leadership and Logistics are undertaken. We would expect to see this at M5.

A review of the Leaderships & Logistics costs has not been incorporated into the M4 estimate but HAL plan to carry out a review and test the model for the M5 estimate. It would be ideal for a review to be incorporated in the current Cost Estimate, but it is still a reasonable allowance and it should not adversely affect the outcome.

The IFS conducted a benchmarking study for Leadership & Logistics in Q6 and found it to be comparable with other programmes.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] leadership & logistics applied to all Cost Estimate line items.

Enabling Works has [redacted] leadership & logistics applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include leadership & logistics, so no further provision has been added. The overall percentage for leadership & logistics for Enabling Works is therefore expressed as [redacted]

5.4.5 **Design**

Design costs have been accounted for within the estimate and include for architectural, structural, civil engineering, mechanical & electrical design and any other specialist design and consultancy fees required to deliver the HEP programme.

Design costs have been applied [redacted] in the Cost Estimate, this percentage has been applied to the direct costs, project specific costs, preliminaries and overheads & profit. The application of this percentage is consistent with industry standard best practice as recommended in the NRM2 which sets out guidelines for production of estimates.

HAL's Assessment of Cost Estimate Adjustments states that at M4 stage the design costs will be based on benchmarked percentages in accordance with the complexity of the works for all assets.

HAL has undertaken benchmark studies to review the percentage applied. HAL has reviewed 36 projects at Heathrow from Q5 and Q6 programmes. They have also reviewed 503 projects from other sectors.

The Q5 works at Heathrow is considered comparable with the HEP as it consisted of large high value and high-profile buildings such as T2A. The Q6 works were smaller scale projects, split between new build and refurbishment works. The projects from other sectors include water, rail, middle eastern airports, laboratory building and office building. The other sectors may not be directly applicable, but they provide a useful sample for reference.

The percentage applied in the M4 estimate falls in between the Q5 benchmark and other sectors/Q6 benchmarks. This is representative of the location and type of works being carried out and takes account of all the benchmarks.

Arcadis consider that this might be slightly low as there will be other consultancy services associated with the DCO process and land acquisition which would probably not have been required in the Q5 or Q6 programmes.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] design applied to all Cost Estimate line items.

Enabling Works has [redacted] design applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include design, so no further provision has been added. The overall percentage for design for Enabling Works is therefore expressed [redacted]

Roads has [redacted] design applied to all items except for the commuted sum relating to Highways England works where the design is deemed to be already included. The overall percentage for Roads is therefore expressed as [redacted] Within this Task Order these are an allowance so Arcadis are unable to verify this.

5.4.6 **Risk**

Risk is added to the direct costs, project specific costs, prelims, overheads & profit, design and leadership & logistics to cover the cost of unforeseen circumstances or uncertainties in the project. It covers the cost of events that might happen but are not certain to happen.

Risk contingency has been applied at [redacted] to all Cost Estimate line items which is the same as the M3c estimate. This includes [redacted] for costs, uplifted by [redacted] for scheduling/finance.

Overall the M4 Cost Estimate includes [redacted] risk, as a risk reserve has been added. Between M3c and M4 significant scope re-assessment took place reducing the programmatic flexibility in execution, so further risk contingency was required which has been defined as Risk Reserve.

Risk Reserve has been added at a programme level and is therefore not directly seen in the Task Orders within the Cost Estimate. It is calculated by replacing the [redacted] provision at line item level with [redacted] for off airport infrastructure, [redacted] for on airport infrastructure and [redacted] for property.

The IFS M3c report quotes that the risk range applicable to this stage would be [redacted]. As the risk is now [redacted] this meets the IFS recommendation and is in line with industry benchmarks.

The Assessment of Cost Estimate Adjustments states that at M4 stage there will be a programme specific Quantitative Schedule Risk Analysis (QSRA) / Quantitative Cost Risk Analysis (QCRA).

HAL undertook a Cost Risk Analysis (CRA) to provide a bottom up view of whether the applied contingencies percentages were appropriate for this stage. This did not directly inform the contingencies applied in the estimate, but it does provide a countermeasure.

CRA Basis

The risk was modelled against the 142mppa scheme to Step 8 (inclusive of Step 0 and Step 3).

The risks were evaluated collaboratively by risk managers, project managers and commercial managers.

There were [redacted] risks and opportunities considered. Of these [redacted] risks & [redacted] opportunities were modelled discretely in the cost risk model. The risks and opportunities included in the CRA were derived from the programme level risk register, red risks from the task orders and risks and opportunities identified during interviews with the task order project managers and costs estimators i.e. programme wide employer risk and categories of risk by contract/area.

Some example risk drivers, applicable to Step 0 include:

- Property market forces;
- Southern Road tunnel construction;
- Impacts on airfield operations;
- Insufficient time given for businesses to relocate could result in extinguishment;
- Acceleration of compulsory property purchases;
- Increased Wider Property Offer Zone scope;
- 3rd party service diversions for utilities works;
- Ground slab required for M25 tunnel; and
- Reuse topsoil/aggregates on site.

Uncertainty ranges were derived from benchmarks or programme experts and used on direct costs at Cost Breakdown Structure (CBS) level 2 (approximately [redacted] items) for rates, quantities and design maturity. Going forward, design maturity will not be used when scheme progresses to M5 as the scheme will be more developed.

The risk contingency and risk reserve included in the M4 estimate were replaced by quantified uncertainties, risks and opportunities and a risk analysis was carried out using Monte Carlo analysis in MS Excel using @Risk to model the risks.

The CRA shows that [redacted] level of confidence aligns with the [redacted] risk provision in the M4 estimate. This means a [redacted] probability of completing the programme within the total Cost Estimate.

Historically, typical or standard probabilities used in programmes and projects are P50 and P80. [redacted] is a reasonable mid-point of these probabilities. If a higher level of confidence is required, the risk contingency in the Cost Estimate would need to be increased.

At the M5 stage HAL is looking to increase the probability rating through improved development and knowledge of design, scope, quantities and/or rates without reducing the risk and contingency allowances.

Optimism Bias has not been included in the Cost Risk Analysis. If it had been the risk provision and overall Cost Estimate would increase, so the additional assurance it would give would come at a premium.

Stage Observations

The risk analysis was carried out for the whole programme and is not split between stages.

However, it can be derived from the M4 P50 contribution to total cost above base cost that the top 3 category contributors are Terminals, Piers & Satellites (Step 3), Property (Step 0) and Baggage (Step 8).

It is also possible to derive that just under half of the cost by category can be attributed to Step 0 and that there is a high number of low to medium cost categories in Step 0.

From the P90 percentage risk by CBS scope it can be derived that categories in Step 0 are typically lower than the overall average.

This could be in part due to the design for Step 0 categories being more developed than the later stages and more cost being in the base cost.

5.5 Programme Specific Costs

Introduction

Programme specifics capture the programme level costs that facilitate the delivery of the Heathrow Expansion Programme that can't be directly attributed to the Task Orders.

The scope for programme specifics includes property acquisition, noise insulation, development consent order (DCO) CAT B costs, T5+, T1 baggage prolongation and other operational and community spends.

HAL has engaged with specialist property consultants and HAL finance department to inform their preparation of the Cost Estimate.

Scope vs Priced Activities

The priced activities align with the scope summarised above and detailed in the Cost Estimate.

The Cost Estimate contains lump sums that are either calculated separately elsewhere or are allowances retained from Purple Book 0.63. Items calculated separately include the property cost forecasted and items within the Management Business Plan 2019.

Within the Programme Specific Costs HAL have included a section for Community mitigation scope which includes Section 106 payments and noise mitigation. Allowance for Community Infrastructure Levy (CIL) is also included. An assumption has been made that any additional community requirements will be funded from CIL and Section 106 payments. HAL have not made any specific inclusion or reference to an annual Communities Compensation Fund which was referenced as part of the National Policy Statement.

Key Quantities

There are no quantities provided in the Cost Estimate to review.

However, HAL states that there is quantification in the Management Business Plan (MBP)19 provided by HAL and the property costs provided by the specialist property consultants.

[redacted]

It should be noted that HAL has engaged specialist professional property consultants to develop this element of the cost plan. Due to the sensitivity of this data Arcadis has not had sight of the build up to this element of the cost plan and are therefore unable to comment and conclude on HAL's approach to quantification of this element. However, the fact that specialist consultants have been engaged infers that HAL's approach is reasonable as these consultants should have access to reliable sources of data.

Key Rates

There are no rates provided in the Cost Estimate to review due to the sensitivity of the data.

However, HAL states that [redacted] of the Cost Estimate has been market tested. This is mainly associated with property costs, noise insulation and DCO costs.

The remaining [redacted] of the Cost Estimate is based on allowances associated with T5+, T1 baggage prolongation and allowances retained from Purple Book 0.63.

[redacted] market testing would lead to good reliability in the Cost Estimate. Property costs are entirely dependent on the market so we can verify that the approach is reliable but can't verify the detail as we don't have the rates to review.

Indirect Costs

Indirect costs have been considered on a line by line basis and applied where applicable, which is reasonable for this level of Cost Estimate.

Project specific costs have not been applied to any of the line items.

Preliminaries, OH&P, Design have only been applied to building works.

Leadership & Logistics have been applied to buildings, resource efficiency and airfield vehicles.

Risk has been applied to all items except noise insulation, T5+ and T1 baggage prolongation.

Quantity/Rate Sensitivity

It is not possible to comment on individual quantities and rates as the detail is not included in the Cost Estimate.

The fact that cost forecasted data from specialist property consultants and HAL has been utilised by HAL increases confidence and should reduce sensitivity. Clearly any change in extent of provision or changes in market rates will impact the overall cost.

Items relating to programme specifics are included in the Cost Risk Analysis and risk allowance has been included in the indirect costs. There is not a direct correlation between the two but there is provision.

5.6 Summary

It is Arcadis' opinion that on balance, HAL's Cost Estimate for **Step 0** is reasonably and reliably costed.

HAL has taken on board Arcadis's comments, from earlier reports to the CAA reviewing the Purple Book, regarding the structure of the Cost Estimate and produced a comprehensive document capturing all the relevant Cost Estimate data in one singular document.

[redacted]

The above document also includes the detailed estimates for each individual Task Order. The build up to the estimate for each Task Order takes cognisance of the data provided by the IDT, HAL's programme and HAL's proposed methods of execution.

The structure of the Cost Estimate reflects industry best practice standards and forms a good baseline on which to move forward. This can now form the basis on which to monitor and implement a change control process.

The structure of the Cost Estimates for each Task Order provides a standard platform for approaching the estimate and reflects best practice with how HAL has approached the quantification and pricing of direct and indirect costs.

The level of quantification within the detailed estimates reflects the level of detail provided by the IDT. The extent of quantification has increased since the Purple Book and the reliance on allowances reduced which leads to an increased level of certainty.

However, there are some Task Orders where the level of quantification is lower than we would expect at this stage. The most significant one being the utilities. This is partly reflective of the nature of the works and the reluctance for utility companies to engage on developments at such an early stage of the programme.

Arcadis considers that this could be progressed further and that this currently poses a risk to the Cost Estimate. There is also potential for this to impact the programme which would put further pressure on the Cost Estimate.

The level of benchmarked rates for **Step 0** accounts for an average of [redacted] which is a significant increase from Arcadis' review of the Purple Book, albeit that one would expect to see a higher level of benchmarking for **Step 0** as these works are the initial works in the programme and the design is more progressed for these Task Orders.

When analysing the Purple Book, the resultant [redacted] is the benchmarked percentage for the HEP as a whole. As previously recommended by Arcadis HAL has drawn on benchmark data from other large programmes of work in other sectors and brought this into their analysis with their own internal data.

Arcadis considers the [redacted] to be a reasonable percentage for the current stage however there are two Task Orders, in particular where we would have expected the benchmarking to be further progressed, namely utilities and for enabling works, in particular the demolitions, hence these add a level of uncertainty to the Cost Estimate. These two elements account for [redacted] of the Step 0 total.

With regards to HAL's approach to indirect costs, this appears reasonable, however we would expect to see the assessments for preliminaries and project specifics moving away from benchmarked percentages and towards bottom up estimates. HAL has started to address this within the Project Specifics by reflecting specific items identified within the delivery reports.

HAL has applied a percentage for risk at Task Order level and at management reserve level, they have also undertaken a QCRA to verify this. Whilst this a reasonable iterative approach Arcadis would expect to see risk applied at TO level based on a fully managed risk structure with a further risk reserve being held at management level reflecting the outputs of a fully managed risk approach.

Whilst HAL has reflected schedule risks in their risk models Arcadis believes that due to the level of control HAL has on some of these elements, as discussed in Sections 3 and 4 of this report, there remains further risk on programme which will have an inherent risk on the Cost Estimate.

6 INTEREST OF CONSUMERS

Although not explicitly considered as part of the Step 0 report, Arcadis has continued to see examples where the interests of consumers are being tested through the development of the Preferred Masterplan.

This view has mainly been formed through and building upon a previous Arcadis report submitted in December 2018, *'An initial review of consumer interests in the development of the HAL Masterplan'*.

Arcadis's key findings are:

- HAL is seeking to ensure that the existing airport operation can function whilst this phase of construction is taking place;
- HAL is seeking to increase the flexibility of the airport and ensure there is sufficient resilience available to cope with operational challenges;
- HAL is seeking to minimise disruption for both consumers and the local community; and
- HAL has spent a significant amount of effort to develop its delivery programme in a logical sequence to reduce the impact the works will have on both these groups.

'Consumers' are defined as both passengers and cargo operators of the airport for the purpose of this report.

To review HAL's Preferred Masterplan with regards to the interest of consumers Arcadis has considered how HAL has acquired consumer insight and how well HAL has incorporated consumer insight into their masterplan development process.

Step 0 does not necessarily deliver infrastructure that consumers will directly identify with as assets as much of the work is enabling and 'making the space' for the construction of the 3rd Runway.

In Step 0, there are no direct infrastructure improvements being proposed to support cargo operations. However, there is evidence that HAL is actively engaging with the cargo community to develop improvements that will be delivered in future steps of the masterplan.

The majority of infrastructure improvements will benefit the passenger consumers at Heathrow. The increase in runway capacity and on-going capacity improvements should contribute to delivering a scheme that is in the interest of consumers.

Our discussions with HAL have indicated that the interest of consumers is now embedded into their masterplanning thought processes and HAL can point to examples where the interests of consumers has informed the evaluation process and option appraisal choices for a number of different components of the Scheme.

APPENDIX A Layouts

The Airport layouts images below set out the main infrastructure changes that will be in place through the three Steps that Arcadis has been asked to review the Preferred Masterplan. The HEP construction phasing images set out the time slices in 6 monthly increments from DCO through to 2026.

AIRPORT LAYOUT AT STEP 0

AIRPORT LAYOUT AT STEP 3

AIRPORT LAYOUT AT STEP 8

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

APPENDIX B Alliances

Oneworld

Oneworld is an airline alliance. The objective of this alliance is to be the passengers first choice for the world's frequent travellers. This company is based in New York and comprises of the following member airlines:

Figure 24 Oneworld Alliance Member
Source: (Oneworld 2019)

SkyTeam Alliance

Amsterdam headquartered SkyTeam is formed of 19 member alliances. This group targets to make the global travel seamless and provides access to 1,150 destinations worldwide.

Figure 25 Airline Members of SkyTeam Alliance
Source: (SkyTeam Alliance 2019)

Star Alliance

Star Alliance currently comprises of 28 member airlines, each with a unique culture and style. The Alliance members offer smooth connections across the global air network. It is coordinated by a German based project company. All the members of this group are presented below in Figure 26.

Figure 26 Members of Star Alliance
Source: (Star Alliance 2019)

APPENDIX D Document Register

The **Step 0** review undertaken by Arcadis for all the themes is based upon discussions with HAL, publicly available documents and the documentation shared by HAL (listed in Table 32 below). This documentation includes a number of reports, presentations as well as a number of reference drawings.

Report Title	Report Source
Operability	
Heathrow Strategic Brief	HAL – Public Documents
Preferred-Masterplan - June 2019	HAL – Public Documents
Updated-Scheme-Development-Report-Document-1-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-2-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-3-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-4-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-5-of-5	HAL – Public Documents
[redacted]	HAL – Airline Sharepoint
[redacted]	HAL - Presentations
[redacted]	HAL - Presentations
[redacted]	HAL - Presentations
[redacted]	HAL - Presentations
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL
[redacted]	HAL – Airline Sharepoint
[redacted]	HAL – Airline Sharepoint
Cargo Transformation Board pack	CAA

Report Title	Report Source
Delivery and Timing	
[redacted]	

Report Title	Report Source
Interest of Consumers	
[redacted]	

*Table 32 List of Documents Referred During **Step 0** Review*
Source: (Arcadis 2019)

APPENDIX E References

Arcadis has used a number of reference source documents as part of this Step 0 review. A number of these documents have been supplied by HAL and others are benchmarking or technical documents used by Arcadis in assessing the Preferred Masterplan.

Document/ Author Name	Source/ Author/ Website	Year
[redacted]		
Arcadis	-	[redacted]
Arcadis Internal Library	Arcadis	2019
Bircham Dyson Bell-DCO Applications, Overall days from application to decision	Arcadis	2019
CAA	-	2019
Capital Cost Estimate – Arcadis Review.	Arcadis	17th May 2019
Cargo Transformation Board Pack	CAA	2019
HAL	-	2019
[redacted]		
HEP Assurance Review of HAL Delivery Schedule	DfT	2019
[redacted]		
IATA ADRM 10th Edition	Arcadis Internal Library	2014
IFS	-	2019
[redacted]		
NATS – AIS	http://www.nats-uk.ead-it.com	2019
[redacted]		
Heathrow Website	http://www.heathrow.com	2018
Oneworld Alliance	https://www.oneworld.com/members	2019
SkyTeam Alliance	https://www.skyteam.com/en/about/	2019
Star Alliance	https://www.staralliance.com/en/member-airline-details	2019

Table 33 List of References
Source: (Arcadis 2019)

APPENDIX F Technical Glossary

Technical Terms	Page Number (First Use)	Description
CTR Obstacles	11	Area around the control tower with a radius of 25 miles, where the significant obstacles for the local air traffic are plotted on the charts published in AIP
Code F Aircraft	11	Code F aircraft is categorised by a wingspan of 65m but < 80m. Common example is Airbus A380 “Superjumbo”
TfL Rail Service	12	Refers to the stopping service that runs from Paddington along a similar line to the Heathrow Express. This will be replaced by the Elizabeth Line once it comes into full operation but until then the service is referred to as TfL Rail
DDS	12	For the purpose of forecasting, it is necessary to develop detailed flight schedules for a design day or busy day and are also referred as Design Day Flight Schedules (DDS)
NATS	14	It is the main air navigation service provider in the UK.
Code E Aircraft	15	Code E aircraft is categorised by a wingspan of 52m but < 65m. Common examples are B777 Series / B787 Series / A330 Family
OLS Surfaces	15	Combination of multicomplex angled surfaces around airports defining the airspace maintained free of any obstacles posing threat to air navigation and operations
NB aircraft	23	Aircraft with single-aisle arrangement
WB aircraft	23	Aircraft with twin-aisle arrangement
Code C Aircraft	24	Code C aircraft is categorised by a wingspan of 24m but < 36m. Common examples are Boeing 737/ Airbus A320 Family
LoS	25	Accounts for demand, processing rates and service quality considerations while defining the quality of service provided at an airport. it is measured by IATA on three levels such as overdesign, optimum and suboptimum

Table 34: Technical Glossary
Source: (Arcadis 2019)

ARCADIS Design & Consultancy for natural and built assets

Arcadis is the leading global Design & Consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 28,000 people active in over 70 countries that generate more than €3 billion in revenues.

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Freight by Aircraft Configuration 2019 (a)
Comparison with Previous Year
Tonnes

Table 15

	<---- Passenger Aircraft ---->			<---- Cargo Aircraft ---->			<---- Total ---->		
	2019	2018	Percentage Change	2019	2018	Percentage Change	2019	2018	Percentage Change
London Area Airports									
GATWICK	110 150	112 600	-2	208	-		110 358	112 600	-2
HEATHROW	1 503 730	1 606 432	-6	83 757	93 231	-10	1 587 486	1 699 663	-7
LONDON CITY	4	7	-43	-	-		4	7	-43
LUTON	353	253	40	35 408	25 940	36	35 761	26 193	37
STANSTED	6 874	-		217 265	226 128	-4	224 139	226 128	-1
Total London Area Airports	1 621 111	1 719 292	-6	336 637	345 300	-3	1 957 749	2 064 592	-5
Other UK Airports									
ABERDEEN	2 274	2 033	12	3 712	3 673	1	5 986	5 706	5
BARRA	12	13	-8	-	-		12	13	-8
BELFAST CITY (GEORGE BEST)	196	227	-14	-	-		196	227	-14
BELFAST INTERNATIONAL	17	21	-19	25 079	27 651	-9	25 095	27 672	-9
BENBECULA	36	24	50	2	-		38	24	58
BIRMINGHAM	15 764	18 313	-14	14 101	15 395	-8	29 866	33 709	-11
BRISTOL	11	7	57	-	-		11	7	57
CARDIFF WALES	1 795	1 446	24	9	13	-31	1 803	1 459	24
DONCASTER SHEFFIELD	8	75	-89	17 639	7 032	151	17 647	7 107	148
EAST MIDLANDS INTERNATIONAL	1	1		335 947	334 536		335 948	334 536	
EDINBURGH	34	171	-80	19 376	20 145	-4	19 410	20 316	-4
GLASGOW	11 960	14 526	-18	863	941	-8	12 822	15 466	-17
HUMBERSIDE	106	110	-4	10	11	-9	117	121	-3
ISLAY	313	283	11	-	-		313	283	11
ISLES OF SCILLY (ST.MARYS)	18	37	-51	50	37	35	68	74	-8
KIRKWALL	33	37	-11	-	-		33	38	-13
LANDS END (ST JUST)	39	40	-3	32	25	28	71	65	9
LEEDS BRADFORD	-	3		-	-		-	3	
LIVERPOOL (JOHN LENNON)	60	74	-19	724	85	752	784	159	393

Freight by Aircraft Configuration 2019 (a)
Comparison with Previous Year
Tonnes

Table 15

	Passenger Aircraft			Cargo Aircraft			Total		
	2019	2018	Percentage Change	2019	2018	Percentage Change	2019	2018	Percentage Change
LYDD	21	-		-	-		21	-	
MANCHESTER	104 635	110 412	-5	3 747	3 718	1	108 382	114 131	-5
NEWCASTLE	4 075	5 072	-20	670	452	48	4 745	5 524	-14
NEWQUAY	2	3	-33	-	-		2	3	-33
NORWICH	257	220	17	-	-		257	220	17
OXFORD (KIDLINGTON)	-	-		-	1		-	1	
PRESTWICK	7	14	-50	13 047	12 988		13 054	13 003	
SCATSTA	275	449	-39	-	-		275	449	-39
SOUTHAMPTON	203	231	-12	-	2		203	233	-13
STORNOWAY	179	217	-18	-	-		179	217	-18
SUMBURGH	321	333	-4	-	-		322	333	-3
TEESSIDE INTERNATIONAL AIRPORT	-	-		-	1		-	1	
TIREE	12	21	-43	-	-		12	21	-43
Total Other UK Airports	142 665	154 412	-8	435 009	426 705	2	577 673	581 118	-1
Total All Reporting UK Airports	1 763 776	1 873 704	-6	771 646	772 005		2 535 422	2 645 710	-4
Non UK Reporting Airports									
ALDERNEY	79	94	-16	1	2	-50	80	95	-16
GUERNSEY	221	241	-8	758	696	9	979	937	4
ISLE OF MAN	42	59	-29	78	92	-15	120	150	-20
JERSEY	162	186	-13	623	855	-27	785	1 041	-25
Total Non UK Reporting Airports	504	579	-13	1 461	1 644	-11	1 964	2 224	-12

(a) Domestic traffic is counted both at the airport of arrival and the airport of departure.
The total domestic plus international traffic is, therefore, only a measure of airport activity.

More Airlines Are Stuffing Cargo Into Passenger Seats To Counter Coronavirus Slump

Box Office: 'F9' Tops $400M Global With $70M US Debut

Press Release No 9

Date 2 March 2021

January Air Cargo Demand Recovers to pre-COVID Levels

Translations

国际航协：1月份航空货运需求恢复到危机前水平 (pdf)
Demanda de Carga Aérea Regresa a Niveles Pre-COV D en Enero (pdf)
Demanda por carga aérea se recupera em janeiro e atinge n veis pré-COVID (pdf)
Le trafic de fret aérien revient au niveau d'avant la COVID (pdf)

The International Air Transport Association (IATA) released January 2021 data for global air cargo markets showing that air cargo demand returned to pre-COVID leve s (January 2019) for the first time since the onset of the crisis January demand also showed strong month-to-month growth over December 2020 levels

Because comparisons between 2021 and 2020 monthly resu ts are distorted by the extraordinary impact of COVID-19, unless otherwise noted a l comparisons to follow are to January 2019 which followed a normal demand pattern.

- Global demand, measured in cargo tonne-kilometers (CTKs*), was up 1 1 % compared to January 2019 and 3% compared to December 2020 All regions saw month-on-month improvement in air cargo demand, and North America and Afr ca were the strongest performers
- The recovery in global capacity, measured in available cargo tonne-kilometers (ACTKs), was reversed owing to new capac ty cuts on the passenger s de Capacity shrank 19 5% compared to January 2019 and fell 5% compared to December 2020, the first monthly decline since April 2020
- The operating backdrop remains supportive for air cargo volumes
  - Conditions in the manufacturing sector remain robust despite new COVID-19 outbreaks that dragged down passenger demand The global manufacturing Purchasing Managers' Index PMI) was at 53 5 in January Results above 50 indicate manufacturing growth versus the prior month
  - The new export orders component of the manufacturing PMI – a leading ind cator of air cargo demand– continued to point to further CTK improvement However, the performance of the metr c was less robust compared with Q 2020 as COVID-19 resurgence negatively impacted export business in emerging markets Should this continue or expand to other markers, it could we gh on future air cargo growth
  - The level of inventories remains relatively low compared to sales volumes Historically, th s has meant that businesses had to quickly refill their stocks, for wh ch they a so used air cargo services

Air cargo traffic is back to pre-crisis levels and that is some much-needed good news for the global economy But while there s a strong demand to ship goods, our ab lity is capped by the shortage of belly capacity normally provided by passenger aircraft That should be a sign to governments that they need to share their plans for restart so that the industry has clar ty in terms of how soon more capacity can be brought online In normal times, a third of world trade by value moves by air Th s h gh value commerce is vital to helping restore COVID damaged economies —not to mention the critical role air cargo s p aying in distributing lifesaving vaccines that must continue for the foreseeable future," said Alexandre de Juniac, IATA's Director General and CEO

JANUARY 2021 (%CHG. VS 2019)	WORLDSHARE1	CTK	ACTK	CLF(%-PT)[2]	CLF(LEVEL)[3]
Total Market	**100.0%**	**1.1%**	**-19.5%**	**12.0%**	**56.9%**
Africa	2 1%	21 1%	-10 9%	12 7%	8 0%
Asia Pacific	32 8%	-6 8%	-29 %	16 1%	66 5%
Europe	22 2%	-0 %	-19 9%	12 2	62 7%
Latin Amer ca	2 %	-1 2%	-30 7%	7 5%	39 0%
Middle East	13 1%	6 0%	-17 3%	12 5%	56 9%
North America	27 %	11 7%	-6 8%	8 8%	53 2%

1) % of industry RPKs in 2020 2) Change in load factor vs the same month in 2019 3) Load Factor Level

January Regional Performance

Asia-Pacific airlines saw demand for international air cargo fall 3 2% in January 2021 compared to the same month in 2019 This was an improvement from the 0% fall in December 2020 International capacity remained constrained in the region, down 27 0% versus January 2019, which was a deterioration compared to the 26 2% year-over-year decline recorded in December The region's airlines reported the h ghest international load factor at 7 0%

North American carriers posted an 8 5% increase in international demand in January compared to January 2019, far surpassing the % gain in December 2020 compared to December 2019 Economic activity in the US continues to recover and its January manufacturing PM s reached a record-high, pointing to a supportive business environment for air cargo International capacity fell by 8 5% compared to January 2019 In December 2020, capacity was down 12 8% versus the same month in 2019

European carriers' international cargo demand slipped 0 6% in January compared to same month in 2019 Th s was an improvement from the 5 6% fall in December 2020 over the year-ago period International capacity decreased 19 5%, a deterioration from the 18 % year-to-year decline recorded for December

M ddle Eastern carriers posted a 6 0% rise in international cargo volumes in January versus January 2019, which was an acceleration over the 2 % year over year gain recorded in December compared to December 2019 Of the region's key international routes, Middle East-As a and M ddle East-North Amer ca have provided the most significant support January capacity was down 17 3% compared to the same month in 2019 Th s was a s ight reduction compared to the18 2% decline recorded in December 2020 compared to the year-ago period

Latin American carriers reported a decline of 16 1% in international cargo volumes in January compared to the 2019 period, wh ch was an improvement from the 19 0% fall in December 2020 versus a year ago Drivers of air cargo demand in Latin America remain relatively less supportive than in the other regions International capac ty decreased 37 0% compared January 2019, largely unchanged from the 36 7% year-over- year dec ine recorded in December 2020

Afr can a rlines' cargo demand soared 22 % compared to the same month in 2019, ec ipsing the 6 3% year-over-year increase for December 2020 Robust expansion on the Asia-Africa trade anes contributed to the strong growth January international capac ty decreased by 9 1% compared to January 2019, reduced compared to the 17 8% capacity decline recorded in December 2020 versus December 2019

- Download complete Air Cargo Market Analysis for January 202
- Read remarks of Alexandre de Juniac, Director General & CEO, IATA
- Access COVID-19 Passenger business setback in January, though cargo positive (pdf) presentation from Brian Pearce, Chief Economist, IATA
- Access Critical Criteria for Health Apps (pdf) presentation from Nick Careen, Senior Vice Pres dent Airport, Passenger, Cargo & Security, IATA
- L sten to the teleconference (mp)

For more nformation, please contact

Corporate Communications
Tel 1 22 770 2967
Email corpcomms@iata org

Notes for Editors

- Please note that as of January 2020 onwards, we have clarified the terminology of the Industry and Regional series from Fre ght' to Cargo', the corresponding metrics being FTK (changed to CTK'), AFTK (changed to ACTK'), and FLF (changed to CLF'), in order to reflect that the series have been consisting of Cargo (Freight plus Mail) rather than Freight only The data series themselves have not been changed
- IATA (International Air Transport Assoc ation) represents some 290 airlines compr sing 82% of global air traffic
- You can follow us at twitter com/iata for announcements, po icy positions, and other useful industry information
- Explanation of measurement terms
- CTK cargo tonne-kilometers measures actual cargo traffic
- ACTK avai able cargo tonne-kilometers measures available total cargo capacity
- CLF cargo load factor is % of ACTKs used
- IATA statistics cover international and domestic scheduled air cargo for IATA member and non-member airlines
- Total cargo traffic market share by region of carriers in terms of CTK is Asia-Pacific 32 8%, Europe 22 2%, North America 27 %, M ddle East 13 1%, Latin America 2 %, and Afr ca 2 1%

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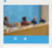
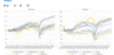
World Trade Organization

World trade primed for strong but uneven recovery after COVID-19 pandemic shock





Qatar Airways "hungry" for more freighters

23 / 06 / 2021

By Damian Brett

Qatar Airways is "hungry for more freighters" as it considers its options for future orders of all-cargo aircraft.

Speaking at the Qatar Economic Forum hosted by Bloomberg, Qatar Airways chief executive Akbar Al Baker said that for the last two years, excluding FedEx and UPS, the airline had been the largest freight carrier in the world and growth had accelerated during the pandemic.

Al Baker said the carrier would like to order more freighters but there is a wait for slots at Boeing. He said that the airline would also like to be the launch customer for either the proposed B777X freighter or the A350 freighter.

"We are really hungry for more freighters," Al Baker said. "Unfortunately David [David Calhoun, president and chief executive of The Boeing Company] cannot produce for us more B777F, the earliest he can give me is in 2023."

He added: "We are very keen to be a launch customer, be it for the A350F or the B777X freighters. At Qatar Airways, we will concentrate on airfreight as an important part of our total strategy, of course, but first we are an airline to carry passengers."

According Qatar Airways website, all 26 of the B777 freighters it has ordered from Boeing have now been delivered – the first of which arrived in 2010. It also operates two B747-8Fs.

Al Bakar's desire to order cargo aircraft and potentially be a launch customer for a new freighter model shouldn't come as too much of a surprise.

In a June interview with Reuters,Qatar Airways chief executive Akbar Al Baker said that the company was considering an order for 30 or more freighters from Airbus or Boeing as part of a fleet renewal programme.

One of the aircraft under discussion was a B777X Freighter, he said. The fleet replacement programme would take place over several years, he explained.

He also discussed the possibility of being the launch customer for the B777X at the 2019 Paris Airshow.

While Boeing has yet to confirm plans for a B777X freighter, it has discussed the possibility in the past.

"A freighter version is being considered using the -8X airframe and may be available 18-24 months after the -8X enters service," it said in a 2015 company presentation.

Boeing is developing two passenger versions of its 777X – the 777-8 and 777-9. The 777X has new GE Aviation GE9X engines and new wings made of carbonfibre, making it lighter and therefore delivering 10% lower fuel use and emissions and 10% lower operating costs "than the competition".

It was initially hoped that the first deliveries of the B777X-9 would have taken place by now, but are now expected in 2023.

Meanwhile, Airbus is also considering a new production freighter model. Reports suggest that the airframer has been canvassing airline opinion on the potential for a widebody freighter version of the aircraft, which would be a little longer than the A350-900.

Airbus will need commitments from around 50 airlines before it can launch a programme, Reuters said.

In 2007, *Air Cargo News* sister title *FlightGlobal* reported that Airbus was considering a A350-900F, which would have a similar payload and volume to the 90 tonne MD-11F and a range of 9,250km (5,000nm).

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Assessment of the value of air freight services to the UK economy

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Background

This study has been produced by Steer for Airlines UK with support from Heathrow Airport Limited, Manchester Airports Group and the Freight Transport Association. It has been undertaken in the context of the UK Government developing its Aviation Strategy, due for publication in Summer 2019, with a Green Paper expected in December 2018. As part of this process, the Government is consulting stakeholders to identify barriers to growth and how to reduce them. While many high value-added industries make significant use of air freight, there remains limited understanding of the role of air freight within the UK economy. The purpose of this study is to assess and quantify the value of the air freight industry to the UK economy, and in particular, its importance to UK regions, international trade and industrial sectors.

Key figures

- Air freight services contribute £7.2 billion to the UK economy and support 151,000 jobs.
- Across all sectors of the economy, £87.3 billion of UK gross value added (GVA) is currently dependent on air freight exports, including a very significant proportion of the GVA of some key industries and their supply chains:
  - Pharmaceuticals - £13.9 billion
  - Computer, electronic & optical - £8.3 billion
  - Creative arts & entertainment - £5.3 billion.
- In 2017 air freight represented 49% of the UK's non-EU exports by value (£91.5 billion) and 35% of non-EU imports (£89.9 billion) - over 40% of total trade by value but under 1% by volume of goods shipped.
- Germany ships just 25% of its non-EU export value by air, and most other major EU economies ship between 20% and 40%. Only Ireland ships a greater share of its non-EU exports by air than the UK.
- 9% of GVA in the North West (worth 14.9bn) is currently dependent on air freight services, compared to less than 2% of London's output. Figures are 8.6% in Wales, 7.6% in the East Midlands and 6.8% in the South West.

Industry structure

The air freight industry is complex and highly fragmented. The four major sub-markets within air freight are General cargo, Express, Specialist and niche products and Mail. Although the industry is complex and business models overlap, two principal business models serve all four markets; the forwarder model and the integrator model.

These business models dominate the UK's major air freight airports: Heathrow, East Midlands, Stansted and Manchester. Heathrow is by far the largest general air freight market using the forwarder business model and the overwhelming majority of cargo is transported in the bellyhold of passenger aircraft, mostly on long-haul routes. East Midlands, by contrast, is dominated by express freight using the integrator business model, with freight carried in freighter aircraft, often overnight on routes to mainland Europe, but also on intercontinental routes. Stansted has a combination of integrators and other freighters, while Manchester is largely bellyhold, although on a much smaller scale than Heathrow.

One notable feature of the UK air freight market is the huge importance of Heathrow and its surrounding freight facilities, with most forwarders having major consolidation centres in the vicinity of the airport. Very significant volumes of air freight are trucked to such facilities near Heathrow, processed and then trucked to another airport, either in the UK or in continental Europe, without ever flying in or out of Heathrow itself.

Night operating restrictions, based on movement limit and noise quota systems, are currently in place at Heathrow, Gatwick and Stansted, while other airports have to produce noise action plans which may set out operating limits for the night period. There is also an additional noise quota limit incentivising the user of quieter aircraft.

The quality of the UK's air freight infrastructure is a major issue, with freight facilities at UK airports often being decades old and having suffered from continued under-investment. While other airports are not as slot congested as Heathrow, they now cater to significantly more widebody freight capacity than the facilities were originally designed for.

Although the terms of the UK's exit from the EU are still being negotiated, withdrawal from the EU has the potential to affect the UK freight industry through changes to customs arrangements and changes to air services agreements (ASAs).

This analysis of the structure of the air freight industry raises a number of issues relevant to the formulation of national aviation policy. These include:

- the positive and negative aspects of the concentration of the air freight industry at and around Heathrow;
- the quality of infrastructure supporting air freight services;
- the balance of the impacts of night and noise restrictions on local residents and air freight services;
- the potential for growth of air freight services at airports outside the South East of England; and
- the management of the potential impacts of Brexit.

Market Analysis

Bellyhold cargo at Heathrow accounted for over 60% of total UK air freight volume in 2017, with forwarders and shippers utilising its extensive intercontinental passenger network. Over 30% of total air freight was shipped on US routes and most of the remainder on Asian routes. Freighter and integrator cargo is concentrated at East Midlands and Stansted, which, in 2017, together accounted for over 20% of all UK freight and the majority of freighter (60%) and integrator (79%) activity. Integrators accounted for over 90% of freight at East Midlands. At Stansted, integrators FedEx and UPS were the largest cargo airlines, although intercontinental freighters such as Qatar Airways, Cargolux and China Southern also accounted for a large share of volume.

In the last 15 years, aside from the decline in 2009 due to the fallout from the financial crisis, total volumes have remained relatively flat, growing with a compound average growth rate (CAGR) of +1.2% over the 15-year period with volumes only surpassing the pre-crisis peak in 2016.

North America was the largest destination market (accounting for 32% of volume), followed by Europe (25%, 18% of which was to the EU) and, South and East Asia (19%). Heathrow, and to a lesser extent Gatwick, handled predominately North American and Asian freight, benefitting from extensive passenger networks. The large European share of volume at East Midlands reflects the airport's role within its integrators' networks. Similarly, at Stansted, much of the freight volume is on European and North American routes.

A relatively large share of many regional airports' volume (including Manchester, Birmingham, Glasgow and Newcastle) is accounted for by Middle Eastern routes, reflecting the importance of the Gulf carriers' networks to these airports' freight operations. Airports in Scotland and Northern Ireland, such as Aberdeen, Belfast and Edinburgh, have a relatively large share of domestic volumes, which is likely to be because trucking to other parts of the UK from these locations is less time-effective.

Although Heathrow is one the largest airports in the EU in terms of freight volumes, due to its slot and operating constraints described above, it has a significantly lower amount of freighter activity compared to other major European hub airports.

As air freight has started to grow again after several years of stagnation, the increasing volumes and longhaul connections at major airports outside the South East of England as well as the prospect of the third runway bringing additional capacity at Heathrow, give rise to a number of policy issues for consideration, including:

- how to make best use of existing infrastructure and unlock more capacity through investment in air freight facilities at UK airports;
- how to manage the air freight implications of the third runway at Heathrow; and
- how to support the air freight sector to grow sustainably.

International Trade

In 2017, non-EU trade classified as being transported by air accounted for over 40% in terms of value but under 1% of total trade in volume terms (with sea accounting for over 98%). Air freight represented 49% by value of non-EU exports (£91.5 billion) and 35% by value of non-EU imports (£89.9 billion).

Many of the products with a high share of UK trade value transported by air, such as aircraft engine parts and power generating machinery, have a high share of both import and export value, likely reflecting the global nature of these industries' supply chains and manufacturing processes. One exception is pharmaceuticals, which account for a significant proportion of export (but not import) value.

It is also interesting to compare the UK's use of air freight for its exports and imports against other European countries. Although Germany is by far the largest EU exporter to non-EU countries, only 25% of its goods by value are transported by air, whereas the UK, which has the second largest total export market, ships a far higher proportion (49% by value) by air. Most of the other major EU economies ship between 20% and 40% of the value of their non-EU exports by air; only Ireland (64%) ships a greater share of its non-EU exports by air than the UK.

On the import side, the UK is the second largest market in the EU and has the highest share of imports transported by air, which makes its imports by air (£90 billion) the most valuable in the EU. Like the UK, most other major European economies ship lower proportion of their non-EU imports (compared to exports) by air, with most importing 10% to 30% by air in value terms.

The importance of air freight to UK international trade, and in particular the UK's higher dependence on air freight than most other countries raises issues for consideration in the development of the UK Government's Aviation Strategy on the appropriate level of Government support for the air freight sector and how its importance should be reflected as part of the strategy for the aviation sector as a whole.

Economic analysis

We have used two different, complementary, approaches to assessing the economic value of air freight:

- the traditional measure of economic impacts on employment, income and GVA of the air freight industry and associated services, generally known as "direct", "indirect" and "induced" impacts (based on the activity in the sector itself and on upstream monetary flows between the air freight industry and other sectors in the economy); and
- the wider economic impacts of air freight, sometimes referred to as "catalytic impacts", which consider how air freight facilitates economic activity in other sectors (based, in this case, on estimating what proportion of GVA in those sectors is currently reliant on air freight services).

Using the traditional approach, we have estimated the "direct", "indirect" and "induced" impacts using a recognised methodology based on the use of Input-Output tables (I-O tables), produced by the Office for National Statistics (ONS). Direct impacts relate to the employment, income and GVA generated by the sector itself, indirect impacts take account of the knock-on effects in the sector's supply chain, while induced impacts also include the impacts of employees' spending in the economy. These can be calculated from the I-O table, by inspection for direct impacts and via standard techniques for the indirect and induced impacts.

Including all of these impacts, we estimate that air freight services support GVA of **£7.2 billion**, **151,000** jobs and associated income of **£4.1 billion** (2014 data and prices).

Note that this result only relates to activities and expenditure either within the air freight and supporting industries, its supply chain and spending by its workforce. It does not include "downstream" effects, i.e. the effect on the industries purchasing air freight services, or the wider, catalytic, impacts on the whole economy. To estimate these, we have used an approach based on the fact that supplying air freight services does not fully represent either the value of what is being flown, or the value of timely delivery. In terms of the value of what is flown, air freight imports and exports, between them, were worth £181 billion (2017 values and prices) , or close to 25 times more than the economic added value (GVA) calculated using the direct, indirect and induced methodology described above.

Each sector of the economy produces outputs for which customers are willing to pay, with primary and secondary sectors producing physical products such as food, machine parts, cars and so on. For these sectors of the economy, their outputs equate to particular commodities so that, for example, farms produce agricultural products while automotive plants produce cars and trucks. Hence, there is a correspondence between each industry and its outputs. By using this correspondence (together with information on exports by air from HMRC, and in comparison with output from ONS), we can establish, for each industry producing physical outputs, what proportion of those outputs is represented by exports transported using air freight services.

It is reasonable to make the assumption that all output contributes equally to the GVA generated by an industry. We have also made the assumption that the proportion of an industry's GVA supported by air freight services is equal to the proportion of its outputs which are exported by air. The final step in this analysis is to recognise that, if a portion of an industry's GVA is dependent on air freight services, then the suppliers who provide inputs to that industry are also dependent on the air freight services.

Using this approach, we have estimated the level of GVA currently dependent on air freight across the economy. Across all sectors of the economy, **£87.3 billion of GVA is currently dependent on air freight exports**. This represents **5% of the total GVA measure of national output** (£1,747 billion in 2016).

While the level of GVA currently dependent on air freight might potentially be reduced through the use of alternative modes of transport, the fact that such alternatives are generally poor substitutes for air freight, which is both much faster and much more expensive than surface freight, indicates that the level of GVA dependent on air freight is likely to remain significant. This indicates that air freight is a very important service supporting a significant fraction of national economic activity.

The analysis of the level of industries' and their supply chains' added value (GVA) which is currently dependent on air freight, enables us to estimate the regional importance of air freight services, by considering the regional distribution of output for each industry.

This analysis demonstrates the importance of the air freight industry in the North West, where £14.9 billion of GVA is currently dependent on air freight, representing 9.0% of the whole economy of the region. Similarly, air freight supports very significant proportions of economic activity in many regions, including 8.6% in Wales, 7.6% in the East Midlands, 6.8% in the South West, 6.0% in the West Midlands and 5.9% in Northern Ireland. The contrast between the very important role of Heathrow in providing air freight services, compared with the high dependence of regions away from the South East economies on air freight, is stark.

Considering both the industry structure and this economic analysis raises particular issues relevant to the formulation of national aviation policy as the UK Government develops an aviation strategy towards 2050:

- how to protect and develop the significant share of the UK economy currently dependent on air freight services; and
- how to support UK regions and nations whose economies are heavily dependent on air freight services, particularly where local airports do not currently benefit from strong air freight services.

1 Introduction

Background

1.1 This study has been produced by Steer for Airlines UK with support from Heathrow Airport Limited, Manchester Airports Group and the Freight Transport Association. It has been undertaken in the context of the UK Government developing its Aviation Strategy, due for publication in Summer 2019, with a Green Paper expected in December 2018. As part of this process, the Government is consulting stakeholders to identify barriers to growth and how to reduce them. While many high value-added industries make significant use of air freight, there remains limited understanding of the role of air freight within the UK economy. The purpose of this study is to assess and quantify the value of the air freight industry to the UK economy, and in particular, its importance to UK regions, international trade and industrial sectors.

Our Approach

1.2 To undertake this assessment, we have undertaken a review of the available literature, with data and information gathered from the following sources:

- The Civil Aviation Authority (CAA);
- The Department for Transport (DfT);
- Her Majesty's Revenue and Customs (HMRC);
- The Office of National Statistics (ONS);
- Eurostat;
- The Official Airline Guide (OAG);
- The United Nations Statistic Division (UNSD); and
- Individual airport traffic statistical releases.

1.3 In addition, we have held interviews and received data from industry stakeholders, including:

- Passenger airlines (UK and foreign);
- Integrators;
- Cargo airlines;
- Airport operators;
- Freight industry trade bodies; and
- UK-based companies using air freight.

This Report

1.4 The remainder of this report is structured as follows:

- Chapter 2 gives an overview of the air freight industry in relation to markets, business models and constraints;
- Chapter 3 describes the UK freight industry in relation to freight volumes;
- Chapter 4 describes air freight's role in international trade; and
- Chapter 5 provides a quantification of the economic contribution of air freight.

1.5 Illustrative case studies have also been provided in the text.

2 Industry structure

2.1 In this chapter we provide an overview of the major sub-markets within air freight, the primary business models serving them and the interaction between industry actors. The end of the chapter also provides a description of the current constraints within the UK market, based on information and views provided by stakeholders.

Overview

2.2 The air freight industry is complex and – at some levels – highly fragmented. The organisation which operates the aircraft is often not the same organisation with which the shipper has made a contract – airlines rarely interact directly with the ultimate customer (the shipper). The four major sub-markets within air freight that we have identified are:

- General cargo;
- Express;
- Specialist and niche products; and
- Mail.

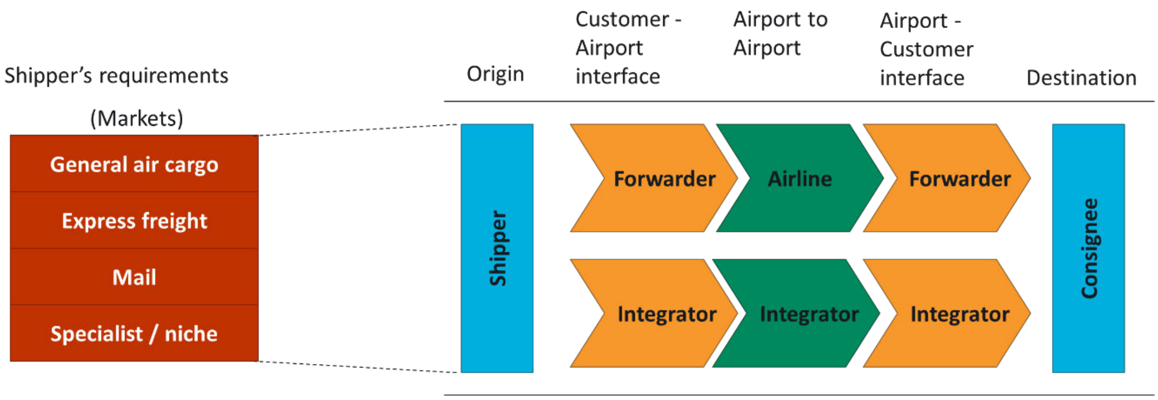
2.3 The products offered within each sub-market are generally driven by customer requirements, which may include (but are not limited to): cost, speed, predictability, storage requirements and shipping regulations.

2.4 Although the industry is complex and business models overlap, two principal business models serve all four markets; the forwarder model and the integrator model. Over the last thirty years, these two types of service providers have significantly increased their product range, coverage and scale of operation, to the point where they now serve almost every market.

2.5 Integrators traditionally offered a worldwide courier product for documents and parcels, but now offer a range of products and geographies which compete at some level with every logistics provider in the supply chain. The forwarders, partly in response and partly in search of higher yields, have expanded their product range to include greater international coverage, door to door products and other logistic services.

2.6 The interaction between the four sub-markets and these two business models is illustrated in Figure 2.1 below.

Figure 2.1: Typical end to end journey: interaction between markets and business models



2.7 In the remainder of this chapter we provide, in turn, a more detailed description of the air freight sub-markets and business models.

Air freight markets

General air cargo

2.8 General air cargo forms the majority of air freight being shipped to and from the UK and is shipped predominately using passenger bellyhold capacity. General cargo is the standard core product offered by most freight-carrying airlines and therefore consists of a broad range of goods. The main carriers of general cargo in the UK are therefore IAG Cargo (British Airways and IAG group airlines), Virgin Atlantic and a number of foreign (predominately American and Asian) passenger airlines flying on long-haul routes, split approximately 40:60 in terms of volumes flown.

2.9 End-customer relationships are generally owned by freight forwarders, who act as intermediaries between shippers and airlines. Freight forwarders will often maintain relationships, possibly on a tendered basis, with a range of shippers, many of whom will have a requirement to send large volumes of freight on a regular basis.

Express freight

2.10 Although air freight is, by its nature, time-critical, express freight services are used when particularly rapid delivery is required and are generally sold on the premise of a guaranteed delivery slot. As well as a guaranteed delivery time, customers are also often able to track a shipment's progress, enabling them to have up-to-date information on geographical position, estimated time of delivery, details of any delays and revised delivery times.

2.11 The international express market is dominated by the four main integrators (DHL, FedEx, TNT (now a subsidiary FedEx)) and UPS), who carry freight on a mixture of their own aircraft and purchased bellyhold capacity. Integrators use their own aircraft within Europe and on high-volume long-haul routes, and purchase bellyhold capacity on lower volume long-haul routes where they do not operate their own aircraft.

2.12 Although business-to-business (B2B) activity still accounts for much of express freight volumes (for example on just in time supply chains), the growth of E-Commerce has increased the demand for business-to-consumer (B2C) services. This has, to some extent, changed the dynamic of express air freight services as a growing share of express demand is now driven by consumer expectation of fast delivery.

Specialist and niche cargo

2.13 In addition to speed, some cargo shipments have requirements that cannot be met by general air cargo due to specific storage, security or regulatory requirements. Some of this cargo, such as perishable foodstuffs or pharmaceuticals, can be shipped as bellyhold freight but will usually require specialist containers and packaging. In some cases, it may also require specially trained staff or additional paperwork.

2.14 Other types of specialist cargo, such as dangerous goods, are not permitted to be carried on passenger aircraft and are therefore transported on dedicated freighters operated either by freight airlines or integrators. In some cases, shippers' requirements will not be met by either bellyhold or dedicated freighter capacity; in such cases, aircraft will need to be specifically chartered to transport goods. Examples of such goods include outsize shipments, goods destined for remote destinations or goods with particular handling requirements – such as live animals.

Mail

2.15 UK air freight capacity is used for mail by the Royal Mail domestically for its faster delivery options and for most of its international deliveries. Nearly all domestic mail is carried by chartered freighters, whereas European and Intercontinental mail is largely carried in the bellyhold of scheduled passenger flights.

2.16 A small number of freight only airlines operate in the UK in support of the major integrators and the Royal Mail; these operators generally supply both aircraft and crew and effectively lease capacity to the integrators and Royal Mail. In 2017, West Atlantic and Titan Airways accounted for over 90% of the domestic mail carried by air in terms of weight.

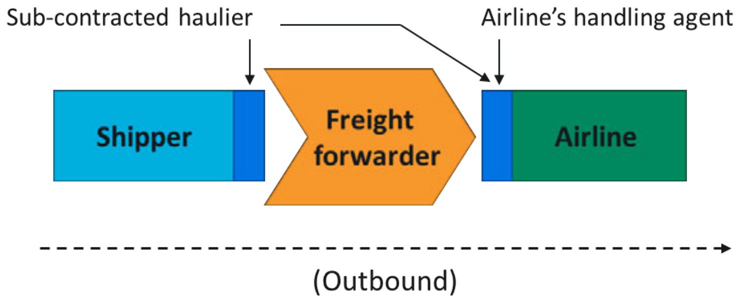
Air freight business models

Forwarder model

2.17 In the forwarder model intermediaries (forwarders) provide the link between those with a requirement for air freight (shippers) and those with the means to provide capacity (airlines), by consolidating consignments from a number of shippers and purchasing capacity from freighter or passenger airlines. This means airlines have little contact with shippers. Many forwarders will ship any type of cargo, but the majority of consignments are general air cargo.

2.18 The forwarder model is illustrated in Figure 2.2. After collecting from the shipper (by subcontracted haulier), the forwarder will often consolidate freight at a regional centre before moving consignments in volume to its warehouses close to an airport, where freight is further consolidated before being sent (by subcontracted haulier) to the airport. At the airport, consignments may be handed directly to the airline, or – more typically – to the airline's appointed handling agent.

Figure 2.2: Typical end to end journey: Freight forwarder



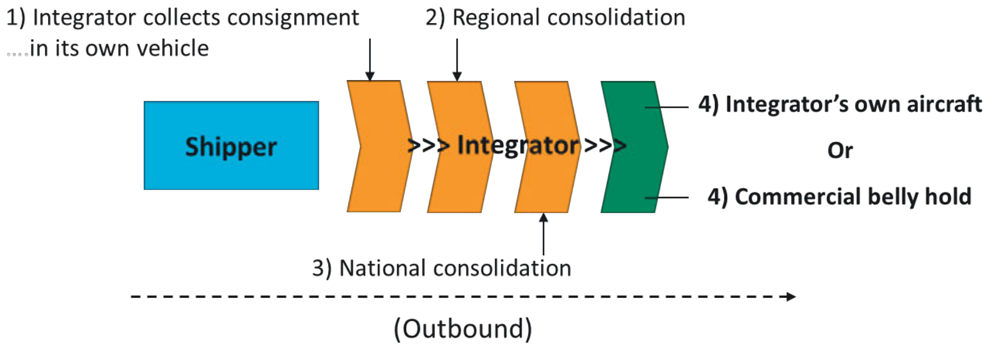
2.19 Freight forwarder activity in the UK is concentrated around Heathrow – Heathrow airport Limited (HAL) stated that approximately 450 freight forwarders are located within five miles of the airport. The concentration of forwarder activity around Heathrow also means that cargo leaving from other UK airports (both around London and further afield) is often consolidated around Heathrow before being trucked to the relevant airport, in some cases not actually being flown to or from Heathrow Airport at all.

Integrator model

2.20 In contrast to the forwarder-airline model, the integrator model has sought to offer customers a logistics solution which combines an extensive surface transport collection and delivery network with an in-house fleet of aircraft, thereby offering an "integrated" product, generally controlling the entire logistics chain from pick up to delivery. While the majority of cargo is express-like products, integrators carry all forms of cargo. On short-haul routes, this is predominately with their own aircraft, while on long-haul routes this is often on purchased bellyhold capacity (with the integrator effectively acting as a forwarder in the latter case).

2.21 A depiction of the integrator model is shown in Figure 2.3. The integrator will collect the goods and deliver them to the final destination, providing all the links in the transport chain, controlling the choice of mode (where appropriate) and offering a comprehensive information flow along with the physical transport of the goods. This is usually using their own road transport, handling, transit warehousing facilities and (for short haul) aircraft.

Figure 2.3: Typical end to end journey: Integrator forwarder



2.22 Integrator air freight activity in the UK is dominated by DHL, FedEx, TNT and UPS concentrated at East Midlands (c.50%) and Stansted (c.25%). Only a small number of dedicated cargo freighter flights operate at Heathrow.

Other models

2.23 Although the forwarder and integrator models are the two principal models handling the majority of UK air freight, several other smaller models exist, including:

- Courier and express services, which use either integrators' services or their own small chartered freighters for especially time-sensitive products such as automotive parts or newspapers.
- Specialist operators, which meet shippers' specific storage or temperature requirements en-route to the airport, in storage before shipping and on board the aircraft for goods such as pharmaceuticals or fresh salmon. Goods may be shipped on specialist freighters or in specialist containers as bellyhold cargo if specified requirements can be met.
- Air cargo brokers, who do not provide vehicles or warehouse space, but who work with freight forwarders, shippers, logistics providers, governments, and relief organisations to offer chartered freighter aircraft on a onetime or long-term basis.
- Mail, which is flown domestically on tendered dedicated freighters and internationally using tendered UK and foreign airline bellyhold capacity.

Trucked freight

2.24 Alongside the business models described above, a significant amount of air freight is transported in customs-bonded trucks between the UK and continental Europe and is classified as air freight with an assigned flight number. Freight is often flown to continental Europe, particularly from Asia, as there is often more available air freight capacity than to UK airports, partly due to lack of available slots for freighter aircraft at Heathrow. The freight is trucked as bonded freight to avoid having to undergo local customs procedures so that importers only need to deal with the UK customs authorities rather than investing in systems to deal with multiple customs authorities. This represents an inefficiency from the perspective of the UK economy as whole. See also the Case Study on consumer electronics imports at the end of this chapter.

2.25 In contrast to goods from Asia, Heathrow stated that goods destined for North America are also often trucked to the UK, in particular Heathrow, from continental Europe in order to take advantage of cheaper rates from the UK on North American routes. As Heathrow is the primary European hub for North American passenger connections, there is a significant level of bellyhold capacity available, which means air freight rates are cheaper compared to other European airports.

Structural constraints

Air freight business models at UK airports

2.26 The business models described above dominate the UK's major air freight airports: Heathrow, East Midlands, Stansted and Manchester (see Figure 3.1 below). Heathrow is by far the largest general air freight market using the forwarder business model and the overwhelming majority of cargo is transported in the bellyhold of passenger aircraft, mostly on long-haul routes. East Midlands, by contrast, is dominated by express freight using the integrator business model, with freight carried in freighter aircraft, often overnight on routes to mainland Europe, but also on intercontinental routes. Stansted has a combination of integrators and other freighters, while Manchester is largely bellyhold, although on a much smaller scale than Heathrow.

2.27 One notable feature of the UK air freight market is the huge importance of Heathrow and its surrounding freight facilities, with most forwarders having major consolidation centres in the vicinity of the airport, as noted in paragraph 2.19 above. Very significant volumes of air freight are trucked to such facilities near Heathrow, processed and then trucked to another airport, either in the UK or in continental Europe, without ever flying in or out of Heathrow itself.

2.28 Another common model is freight arriving from long haul origins (such as China or the US) flown into Heathrow and then being trucked to other airports (e.g. East Midlands) to be flown to continental airports overnight, leading to a symbiotic relationship between the different airports.

2.29 Both of these models mean that the resilience of the road network to and from airports is an important factor in reliability of service. To a large extent, they reflect the constraints on the UK air freight industry, discussed further below.

Operating restrictions

2.30 Night operating restrictions, based on movement limit and noise quota systems, are currently in place at Heathrow, Gatwick and Stansted. The current restrictions to October 2022, are summarised for current and future seasons in Table 2.1. The restrictions apply from 11:30pm to 6am, with less stringent restrictions also applying between 11pm and 11:30 pm, and between 6am and 7am.

Table 2.1: UK airport night-time operating restrictions

Airport	Seasonal Movement Limit	
	Winter (2018/19 –2021/22)	Summer (2019-2022)
Heathrow	2,550	3,250
Gatwick	3,250	11,200
Stansted	5,600	8,100

Source: DfT

2.31 There is also an additional noise quota limit incentivising the user of quieter aircraft.

2.32 Apart from the restrictions at these three London airports, other airports have to produce noise action plans which may set out operating limits for the night period.

2.33 Integrator stakeholders consulted as part of this study stated that the way in which these operating restrictions are applied impacts their ability to operate effectively, as the express business model (described above) is dependent on being able to ship goods during the night to enable maximum productivity for customers who rely on shipments being picked up close to the end of the working day and delivered as early as possible the next.

Capacity

2.34 Several stakeholders have noted that capacity constraints are a significant hinderance to the operation of UK air freight – one stated that it has caused volume growth to fall behind other European countries and another stated it is one of the main reasons why so much freight is flown to mainland Europe and trucked to the UK – in turn causing more road and port congestion.

2.35 While many of the UK's airports are not currently particularly congested, the concentration of air freight activity at Heathrow, which is severely slot constrained and which operates at 98% capacity, means that the congestion there has a disproportionate impact on UK air freight. Slot constraints at Heathrow mean that no additional freighter operations are possible, while the larger passenger aircraft such as the A380 actually have lower freight capacity than the aircraft they are replacing, particularly 747s.

2.36 Historically, much of the UK air freight activity is concentrated around Heathrow due to its significantly more extensive intercontinental passenger network compared to those of other UK airports. Although this remains the case, new intercontinental passenger connections at regional UK airports have increased possibilities for transporting long-haul freight as bellyhold cargo. As discussed in Chapter 3, some other major UK airports have increased their bellyhold volumes significantly with new connections to Asia – one stakeholder noted that Emirates is the "best in class" at utilising regional capacity.

Infrastructure

2.37 Several stakeholders commented that the quality of the UK's air freight infrastructure is a major issue, with freight facilities at UK airports often being decades old and having suffered from continued under-investment. While other airports are not as slot congested as Heathrow, they now cater to significantly more widebody freight capacity than the facilities were originally designed for.

2.38 At Heathrow, the infrastructure has led to severe levels of road congestion, with trucks often queueing for hours at the Cargo Horseshoe (Heathrow's main freight facility), with some operators investing in off-site facilities to mitigate these problems[1]. However, restrictions imposed by the Border Force currently prevents any new such remote-site facilities being developed.

2.39 The Heathrow Cargo Working Group has proposed measures to mitigate these problems, including more flexibility in allowing multiple consignments in bonded truck movements around the airport vicinity.

[1] In particular, some operators have remote "Internal Temporary Storage Facility" (ITSF-R) with customs bond facilities.

Potential Brexit impacts

2.40 Although the terms of the UK's exit from the EU are still being negotiated, withdrawal from the EU has the potential to affect the UK freight industry through changes to customs arrangements and changes to air services agreements (ASAs). The purpose of this section is not to speculate on the likely outcome of the negotiations but to describe the impact of any possible changes to current arrangements.

Customs checks

2.41 Under current arrangements, goods traded between the UK and other EU countries are not required to undergo customs checks at ports or airports. However, depending on the terms of the UK's withdrawal agreement, this may cease to be the case. This would mean, firstly, freight traveling by air between the UK and other EU countries may be required to undergo customs checks at airports and, secondly, that freight being trucked in free circulation between the UK and continental Europe may be required to undergo customs checks at ports.

2.42 As has been discussed, much of freight being trucked between the UK and continental Europe travels in customs-bonded trucks and freight traveling on these trucks should not be required to undergo additional customs checks at ports should these be imposed. However, it is likely that trucks carrying bonded freight may still be affected by customs checks at ports, if they were introduced, as additional checks of other trucks are likely to cause delays at ports.

Air service agreements

2.43 The UK is currently part of European Common Aviation Area (ECAA), which includes all EU member states and a number of other European countries. The ECAA entitles an airline with an operating licence from any ECAA country to operate flights anywhere within the ECAA. For example, a UK airline can currently operate a domestic flight in Germany or an international flight between Ireland and France.

2.44 The EU also has a number of bilateral agreements negotiated on behalf of its members with non-ECAA countries, the most important being the 'open skies' agreement with the USA. These agreements are often more liberal for freight services compared to passenger services; the EU-US deal grants 7th freedom rights for cargo services compared to 5th freedom rights for passenger services. 7th freedom rights allow airlines to fly between two foreign countries (for example, a UK airline flying between the USA and Canada), whereas 5th freedom rights only allow airlines to fly between two foreign countries if the journey ends or begins in the airline's own country (for example, a UK airline flying between the UK and Mexico via the USA).

2.45 Leaving the ECAA without an agreement in place would mean UK airlines would no longer have the right to fly to and from EU Member States under existing arrangements, or to fly to third countries, such as the US, under the terms of the EU's open skies agreements. This means the UK would be required to fall back on bilateral agreements with both third countries (such as the USA) and ECAA members.

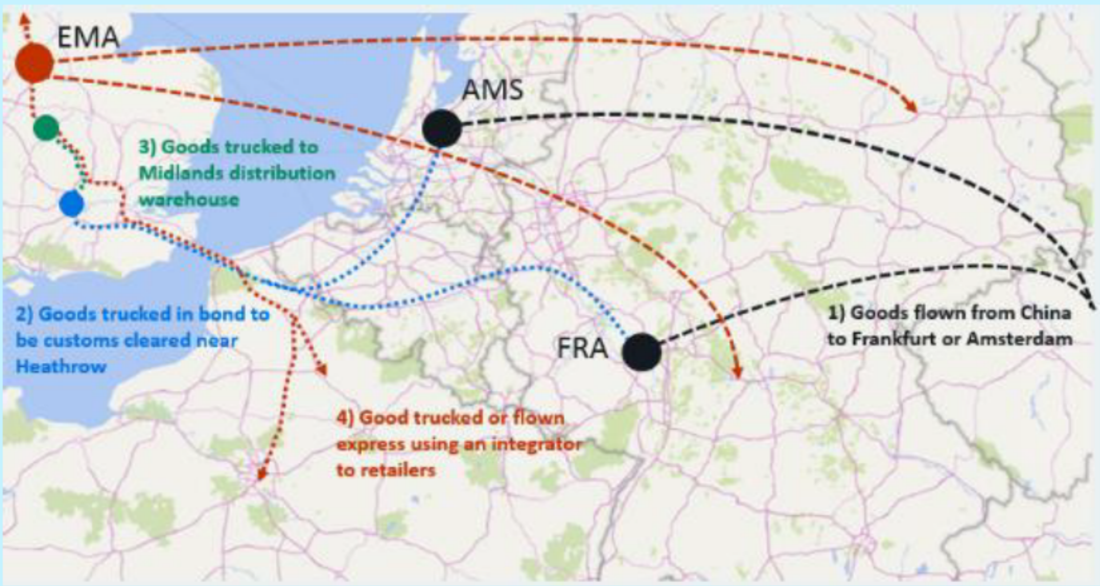
2.46 Many bilateral agreements are more restrictive than the ECAA and, for example, the EU-US open skies agreement. This may lead to more restrictions on how freight is flown between different countries, leading to slower transit times and/or higher costs, unless similarly liberal agreements can be negotiated by the UK with the EU and with other key countries such as the US.

Case Study – Consumer electronics imports

In 2017, the UK imported £10.6 billion's worth of consumer electronics accessories, equivalent to just under 90,000 tonnes of goods. These imports, which are comprised of items such as iPhone cables, car hand-free kits and other similar accessories, are imported primarily from China and other East Asian countries. In 2017, 64% of the total import value was transported by air.

A consumer electronics importer consulted as part of this study, which imports its goods from 20 different locations in China, stated that it imports approximately two thirds of its goods (in value terms) by air, with the remaining third transported by sea. More bulky goods, such as laptop bags and wireless routers tend to be transported by sea, with smaller, lighter items, such as cables, transported by air. Although using air freight is approximately four times more expensive then transporting goods by sea, air freight is often more cost effective as goods can be transported much faster.

Typical journey for imported consumer electronics goods



Since 2008, large retailers selling consumer electronics have been ordering smaller quantities of goods more frequently, which means suppliers need to be able to respond to orders more quickly. As a consequence, volumes shipped by sea have fallen in recent years as, from China to its main distribution warehouse in the Midlands, goods typically take one week by air compared to five to six weeks by sea. This also means warehouse usage has been halved through better management of inventory.

However, despite the need to import goods by air, the importer stated that it only flies around 20% of its total imports directly to the UK, with the remaining 80% being flown to mainland Europe (usually to Frankfurt or Amsterdam) and trucked in bond to the UK via a ferry or the Channel Tunnel. Imports are usually customs cleared at facilities near Heathrow, before being trucked to its Midlands distribution centre.

The importer stated the reason such a high proportion of its goods are flown to the UK via Europe, is because the UK's air freight capacity is not sufficient to service the required import volumes. Goods are trucked as bonded freight to avoid having to undergo Dutch or German customs procedures, as the importer incurs fewer administration costs as it is only required to deal with UK customs.

The importer stated that, as most of its imports are flown in freighter aircraft, one of the reasons why it often cannot fly its goods into the UK, is because not enough UK airlines operate these types of aircraft. Many airlines that in the past operated long-haul freighter services, for example IAG Cargo at Stansted, no longer do; therefore, there are fewer long-haul freighter options available. However, the main problem the importer cited with UK air freight capacity was the quality of the infrastructure.

The importer stated that it avoids using UK airports because they are too congested and therefore not efficient; air freight infrastructure has not been upgraded in line with increased traffic, which causes delays that can be avoided at continental European airports. The importer stated that there should be better utilisation of regional airport capacity at, for example, Manchester, which was cited as a relatively good operation with not enough freight capacity.

Policy considerations

2.48 The analysis in this chapter raises a number of issues relevant to the formulation of national aviation policy. These include:

- the positive and negative aspects of the concentration of the air freight industry at and around Heathrow;
- the quality of infrastructure supporting air freight services;
- the balance of the impacts of night and noise restrictions on local residents and air freight services;
- the potential for growth of air freight services at airports outside the South East of England; and
- the management of the potential impacts of Brexit.

3 Market Analysis

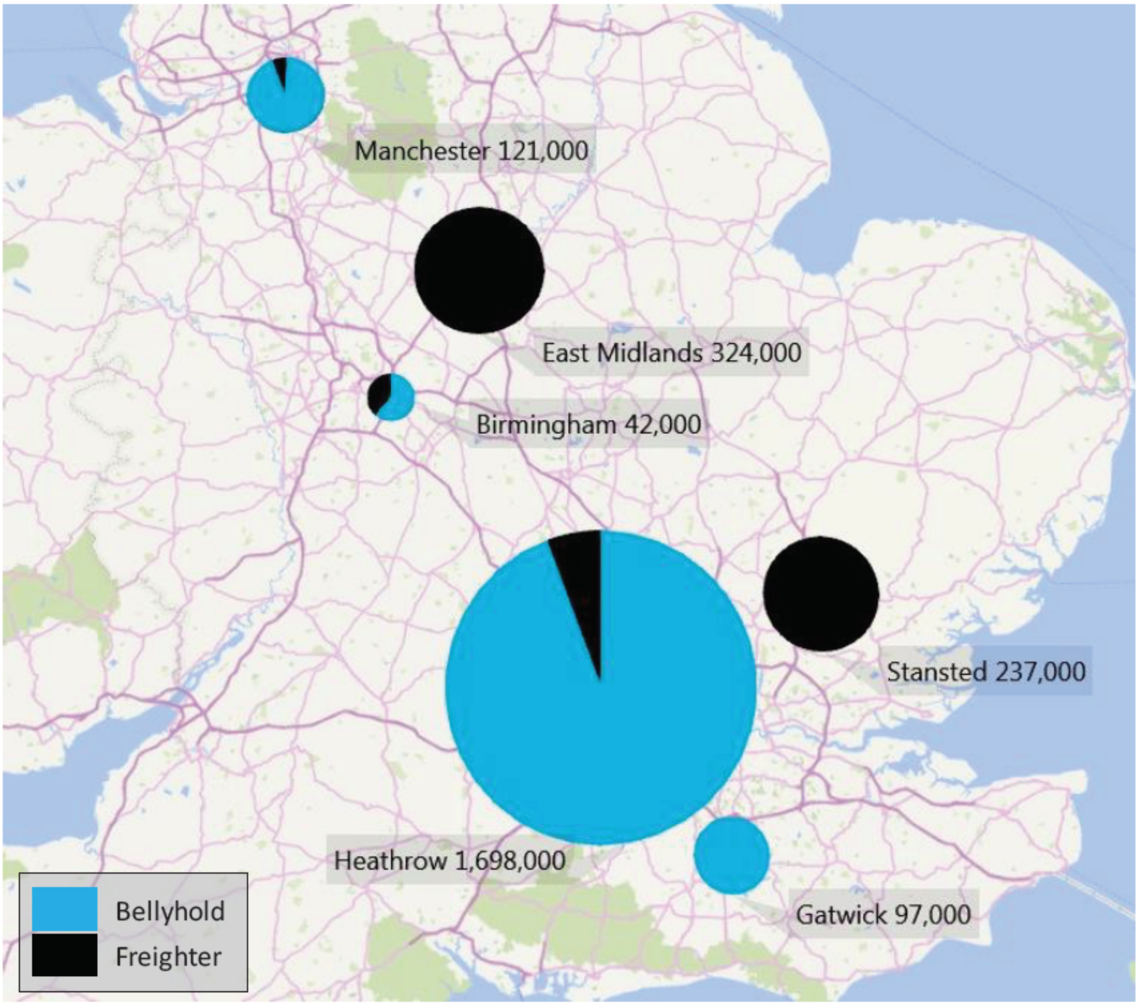
3.1 This chapter describes UK air freight volumes flown from key airports as well as recent growth trends, freight destinations, freight activity at other major UK airports and international comparisons. The analysis of UK freight volumes is based on data provided by the CAA and international comparisons based on Eurostat data.

Overview of air freight volumes

Key airports

3.2 Figure 3.1 shows the volume (tonnage) and type of freight handled at the six largest UK freight airports – the remaining airports not shown each represent less than 1% of the market in terms of volume.

Figure 3.1: Freight volumes at six largest UK airports, tonnes (2017)



Source: CAA

3.3 Bellyhold cargo at Heathrow accounted for over 60% of total UK air freight volume in 2017, with forwarders and shippers utilising its extensive intercontinental passenger network. Over 30% of total air freight was shipped on US routes and most of the remainder on Asian routes. The number of freighters at Heathrow are flown by a mixture of cargo-only airlines and passenger airliners with some freighter aircraft.

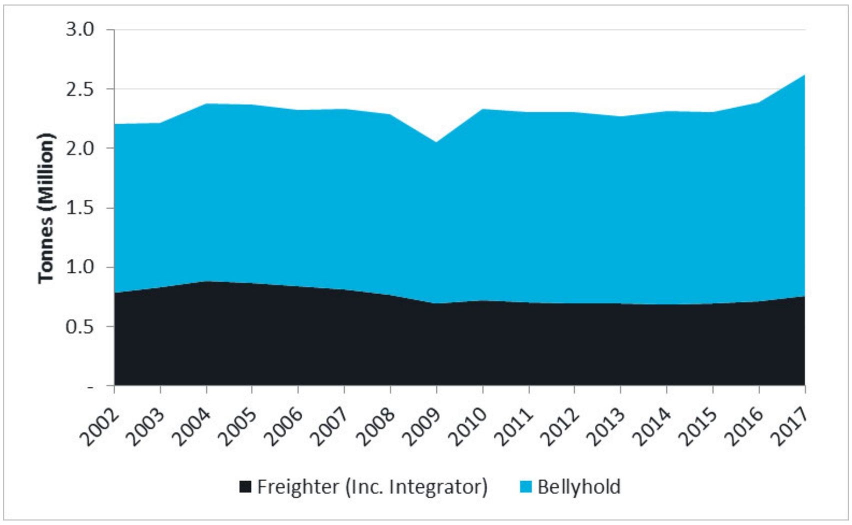
3.4 Freighter and integrator cargo is concentrated at East Midlands and Stansted, which, in 2017, together accounted for over 20% of all UK freight and the majority of freighter (60%) and integrator (79%) activity. Integrators accounted for over 90% of freight at East Midlands, with much of freight being shipped to Europe, particularly Germany, where DHL and UPS both have major hubs, as well as on intercontinental routes. At Stansted, integrators FedEx and UPS were the largest airlines, although intercontinental freighters such as Qatar Airways, Cargolux and China Southern also accounted for a large share of volume.

3.5 Almost all freight at Gatwick and Manchester was carried as bellyhold cargo in 2017, predominately to the UAE and the USA. Although both airports had relatively large freighter operations prior to the financial crisis, these operations have ceased completely at Gatwick and almost completely ceased at Manchester. Prior to 2016, freight handled at Birmingham was almost all bellyhold, and although most of Birmingham's freight volume was carried as bellyhold cargo to Asia in 2017, about a third of its volume was freighter and integrator cargo.

Volume growth

3.6 Figure 3.2 shows the development of total UK freight volumes in the last 15 years. Aside from the decline in 2009 due to the fallout from the financial crisis, total volumes have remained relatively flat, growing with a compound average growth rate (CAGR) of +1.2% over the 15-year period with volumes only surpassing the pre-crisis peak in 2016.

Figure 3.2: UK freight volumes, Million Tonnes (2002-2017)



Source: CAA

3.7 The relatively modest CAGR of +1.2% for total volumes is due to a combination of growing bellyhold volumes, which over the 15-year period grew with a CAGR of +1.8%, and stagnating freighter volumes, which declined with a CAGR of -0.2%.

3.8 The share of total volumes carried by freighter aircraft has fallen from over 35% in 2002 to under 30% in 2017 and has fallen away significantly at some airports. The market for dedicated freighter services has struggled globally since the financial crisis due to falling sea-freight rates and the continued rise of air passenger demand (and associated bellyhold capacity), which have driven down freighter yields. Although some UK airports have retained important integrator, and to lesser extent, freight operations, freighter activity has remained relatively flat in recent years and is currently lower than pre-crisis levels.

3.9 Although bellyhold cargo volumes have grown more strongly and are now above pre-crisis levels, their growth has been somewhat inhibited by capacity constraints at Heathrow and limited intercontinental networks at many other UK airports. However, combined bellyhold and freighter volumes grew by 10% in 2017, which suggests the slow growth of the previous few years may have ended.

3.10 The +1.2% CAGR for total UK volumes to some extent masks the mixed performance of different UK airports. Heathrow, East Midlands and Stansted have grown relatively steadily over the last few years, whereas smaller airports have seen more significant increases or decreases in volumes (discussed further later in this chapter). The net result has been a consolidation of freight operations at the largest airports. Between 2002 and 2017, Heathrow's share of total volumes increased from 56% to 65%, while the combined share of East Midlands, Stansted and Manchester increased from 23% to 26%.

Destinations

3.11 Figure 3.3 shows the origin/destination of freight handled at UK airports in 2017[2]. Across all airports, North America was the largest market (accounting for 32% of volume), followed by Europe (25%, 18% of which was to the EU) and, South and East Asia (19%). Heathrow, and to a lesser extent Gatwick, handled predominately North American and Asian freight, benefitting from extensive passenger networks.

3.12 The large European share of volume at East Midlands reflects the airport's role within its integrators' networks, as DHL and UPS have major hubs in Leipzig and Cologne respectively. Similarly, at Stansted, much of the freight volume is on European and North American routes – FedEx has a major hub in Memphis and Stansted is used by FedEx and other

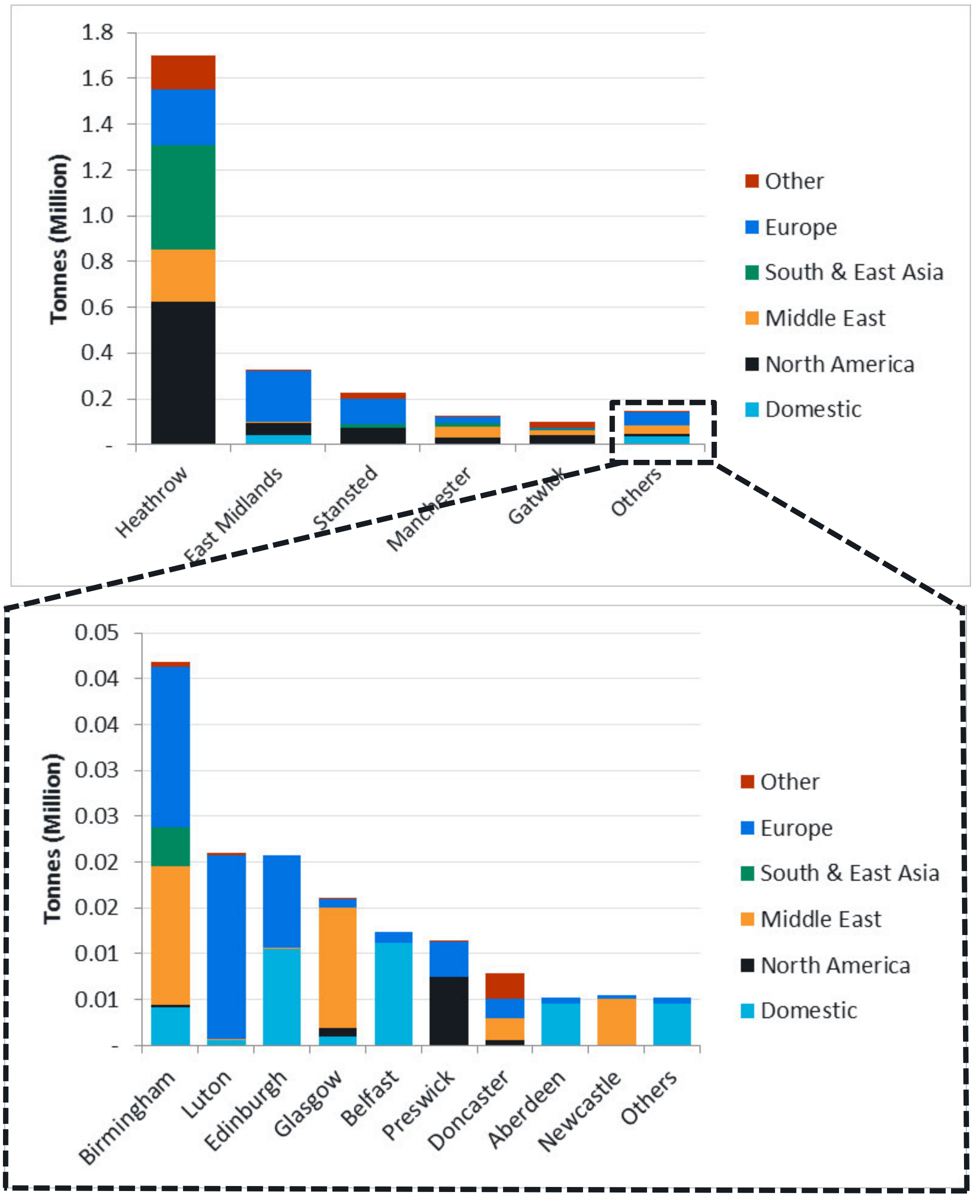
[2] Note that this is based on the origin/destination of the flight to/from the UK, which is not necessarily the same as the true origin or final destination of the cargo itself.

operators for distribution throughout Europe.

3.13 A relatively large share of many regional airports' (including Manchester, Birmingham, Glasgow and Newcastle) volume is accounted for by Middle Eastern routes, reflecting the importance of the Gulf carriers' networks to these airports' freight operations. As commented above, stakeholders noted Emirates is one of the best airlines at utilising regional airport capacity.

3.14 Airports in Scotland and Northern Ireland, such as Aberdeen, Belfast and Edinburgh, have a relatively large share of domestic volumes, which is likely to be because trucking to other parts of the UK from these locations is less time-effective.

Figure 3.3: Destination[3] of UK freight volumes, Million Tonnes (2017)



Source: CAA

[3] The "destination" as defined in CAA data is the destination of the flight departing the UK (or origin of arriving flight). It is not necessarily the final destination (true origin) of the freight consignments themselves, as they may be transhipped onto subsequent flights to onward destinations.