

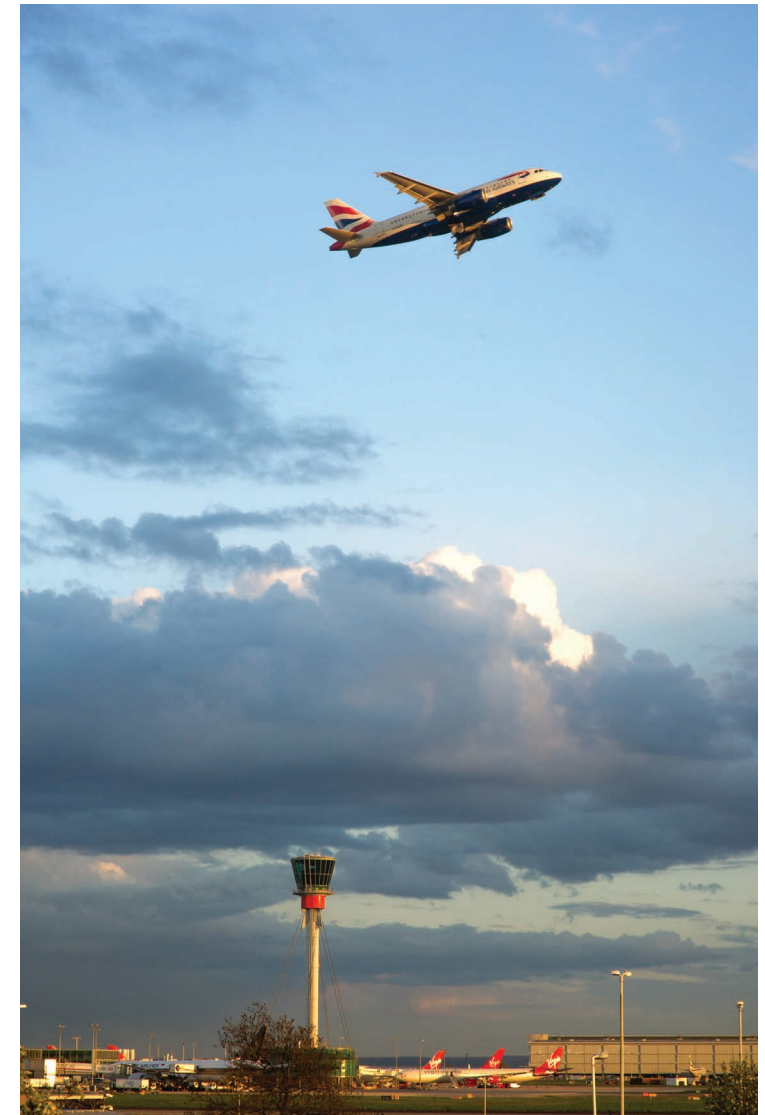
Airports Commission: Long-term hub capacity options

Heathrow Airport Limited response

17th July 2013

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This document is Heathrow's response to the Airports Commission's call for long-term hub capacity options. Our response follows a structure similar to the Commission's own paper.

1. Introduction

- 1.1. Capacity is constrained at the UK's only global hub, Heathrow, which has been virtually full for a decade. Other international hub airports, such as Frankfurt, Paris and Amsterdam, have spare capacity and have been able to provide more services to an increasing range of growth markets. The UK therefore urgently needs additional capacity at its hub airport to compete.
- 1.2. The Government's vision is for Britain to win the global race for jobs and economic growth. To do so, we must be better connected to future growth markets – Asia, South America, North America – than our European competitors. Heathrow is one of the world's best connected hubs and is well placed to help Britain win the global race. Any alternative, including doing nothing or a split hub, will weaken Britain's competitiveness.
- 1.3. We have thought long and hard about the future of Heathrow. In recent months we have assessed many different options for new hub capacity, including those not based at Heathrow. In developing solutions for the future, we have listened, and we have learnt from the past. Today we are rejecting the previous proposal and we are putting forward new proposals which balance the need for growth with the impact on local communities. Some of our new options agree with the ideas of Tim Leunig, whose Policy Exchange report 'Bigger and Quieter' argued that moving Heathrow's runways to the west could reduce noise over London, since aircraft will be higher over any given place.
- 1.4. We are offering new thinking and new solutions:
 - that will connect the UK to the growth it needs more quickly than any other option
 - that can meet the UK's long-term needs, not just the short-term
 - that will continue to reduce the total number of people affected by noise from Heathrow
 - that deliver periods of respite from noise for every community under a flight path
 - that can be delivered within the UK's climate change and air pollution limits.
- 1.5. We are putting forward three options for adding runway capacity from the many we have assessed. These options are in the three geographical locations at Heathrow where a third runway is feasible: to the north, to the north-west, and to the south-west. We have not submitted an option to the south or east as the scale of impact on residential property in these areas would not be sustainable.
- 1.6. While we recognise that determining the right balance between the economic and environmental impacts of additional flights is ultimately a decision for Government, we believe the westerly options offer clear advantages. They result in fewer residential properties being demolished and, because these options are located further west than Heathrow's existing runways, aircraft would be higher over London, reducing the number of people exposed to aircraft noise.
- 1.7. We have investigated a range of other options which were not selected for inclusion in this document and would be happy to supply details of these at the Commission's request. There is much additional detailed analysis that supports the options we are submitting which, again, we will share with the Commission if requested to do so.
- 1.8. This document is intended to be read in the context of the following Heathrow publications:
 - One Hub or None
 - Best Placed for Britain
 - A Quieter Heathrow.It should also be considered in conjunction with our previous submissions to the Commission in response to its discussion documents.
- 1.9. We believe that a third runway delivers sufficient capacity to maintain the UK's global hub status for the foreseeable future, but we are also including proposals that demonstrate how every three-runway option could develop into four runways should it be required. We have the ability to add extra capacity as the need arises, which makes Heathrow a lower risk option than building a new four-runway hub from scratch based on uncertain future demand.
- 1.10. At this stage our proposals are in outline form only and further work would need to be undertaken, including with local authorities and the local community, to develop our plans if they are short-listed by the Commission.

2. The case for growth at Heathrow

As the UK's only hub airport, Heathrow offers the fastest, most cost-effective and most practical route for the UK to compete effectively in the global race to provide connections to emerging markets and to ensure its future prosperity.

- 2.1. Britain needs a world-class hub airport fit for the future: a national gateway to help our country compete and win in the global race for jobs and growth. UK businesses trade 20 times more with emerging markets that have daily flights than those with less frequent or no direct service. But Heathrow is slipping out of the 'Premier League' of Europe's international hub airports.¹ This is bad for Britain's future as a world economic power.
- 2.2. Heathrow is currently one of the few Premier League hubs in the world. It has the scale, the geographic location, the local market and the capability to be the winner in a tight race to be Europe's leading hub and support the UK's economic competitiveness.
- 2.3. Like much UK infrastructure, Heathrow historically suffered from out-dated facilities and decades of underinvestment. Since 2003, Heathrow has invested £11 billion in the airport – one of the UK's largest private sector investments. That money has allowed us to start completely rebuilding Heathrow, providing world-class passenger facilities such as Terminal 5 and the new Terminal 2, as well as providing new baggage systems and a more efficient airfield that reduces delays and emissions. The new layout is designed to be capable of expanding to accommodate future growth.
- 2.4. Operational performance has improved as a result and passengers say they notice the difference. The proportion of passengers rating their journey as 'very good' or 'excellent' has increased to 77% today from 48% in 2007. For two years running, passengers have rated Terminal 5 as the best airport terminal in the world and Heathrow was voted best large airport in Europe in 2013. Heathrow is already a gateway to the world of which the UK can be proud. But it is full.
- 2.5. In this document, we aim to set out a fresh and distinctive approach to adding capacity at Heathrow. We are offering a new approach to an old problem. We are making ten commitments that set out what Britain can expect from a third runway at Heathrow and which show the difference between our proposal today and those of the past.
- 2.6. Heathrow provides the effective, practical and deliverable route for expanding the UK's hub airport capacity. As such, we recognise the obligation on us to plan any expansion sensitively, to develop strategies to limit impacts and to put in place a comprehensive approach to mitigation.
- 2.7. Quieter planes, quieter operating procedures, noise mitigation, and operating restrictions will continue to reduce the impact of aircraft noise at Heathrow – even with a third runway. Two of our options site runways further to the west than previous proposals, which means aircraft will be flying higher over London. Even with a third runway, in 2030 there will be around 10-20% fewer people in total within

Figure 1: If government supports a third runway at Heathrow, we will:

Our commitments	Our approach
Connect Britain to economic growth	by enabling airlines to add new flights to fast-growing markets
Connect UK nations and regions to global markets	by working with airlines and government to deliver better air and rail links between UK regions and Heathrow
Protect 114,000 existing local jobs and create tens of thousands of new jobs nationwide	by developing our local employment, apprenticeships and skills programmes and supporting a supply chain throughout the UK
Build more quickly and at lower cost to taxpayers than building a new airport	by building on the strength the UK already has at Heathrow
Reduce aircraft noise	by encouraging the world's quietest aircraft to use Heathrow and routing aircraft higher over London so that fewer people are affected by noise than today
Lessen noise impacts for people under flight-paths	by delivering periods of noise respite with no aircraft overhead and providing noise insulation for people in high-noise areas
Treat those most affected by a third runway fairly	by ensuring compensation greater than market value is offered to anyone whose home needs to be purchased
Keep CO₂ emissions within UK climate change targets and play our part in meeting local air quality limits	by incentivising cleaner aircraft, supporting global carbon trading and increasing public transport use
Increase the proportion of passengers using public transport to access Heathrow to more than 50%	by supporting new rail, bus and coach schemes to improve public transport to Heathrow
Reduce delays and disruption	by further improving Heathrow's resilience to severe weather and unforeseen events

¹ See analysis included in Heathrow's submission to the Airports Commission on Airport Operational Models

Heathrow's noise footprint than today. Improving on the previous proposal for a third runway, all of our options will use runway alternation in order to provide periods of respite from noise with no aircraft overhead. We believe residents should receive free insulation in high noise areas or where there is a significant increase in noise, and that there should be support for residents in the highest noise areas to move house should they wish.

- 2.8. A third runway at Heathrow is consistent with meeting the UK's legally binding climate change targets. New aircraft and engine technology, operational efficiencies and sustainable biofuels will allow the UK to more than double air traffic by 2050 without increasing emissions. We can add capacity at Heathrow without exceeding air pollution limits. Cleaner vehicles, an increased proportion of passengers travelling by public transport and new aircraft technology will mean that levels of nitrogen dioxide would be within EU limits. Concentrations of fine particles are already within EU limits.
- 2.9. We will ensure that compensation greater than market value is offered to anyone whose home needs to be purchased. If Government policy supports a third runway, then a property market support bond scheme will also be put in place to guarantee the value of property until a new runway is constructed and address property blight resulting from exposure to new aircraft noise. We will also develop new noise mitigation schemes if a third runway is supported by Government. We will be proactively engaging with local communities on our proposals.
- 2.10. Passengers will benefit from a third runway by having a greater choice of destinations, airlines, flights from UK regions, onward transport and lower fares than at a new hub airport. Our route modelling suggests that the extra take-off and landing slots delivered by a third runway would provide 40 new long-haul destinations by 2030, providing Heathrow with 130 total long-haul destinations. Relieving the capacity constraint will also have the benefit of reducing the upwards pressure on airfares that increasing levels of un-served demand apply at Heathrow. Two smaller, 'Second Division' London hubs on the other hand would inevitably result in fewer directly accessible long-haul destinations, a less attractive choice of long-haul flight timings, less competition and higher average long-haul ticket prices.
- 2.11. By the time a third runway opens, public transport infrastructure including Crossrail, the Piccadilly Line upgrade, Western Rail Access, High Speed 2 and Southern Rail Access could link Heathrow to the whole of the UK and allow more passengers to access Heathrow on public transport than ever before. 15 million more passengers could use public transport to access Heathrow by 2030. This would increase Heathrow's public transport mode share from 40% to more than 50%, even with more passengers, thereby allowing us to be able to deliver more flights without increasing the traffic on the road due to the airport.
- 2.12. A third runway at Heathrow can deliver greater economic benefits to the UK than any other currently proposed transport infrastructure project. It will create jobs, facilitate trade, boost spending in the wider economy and improve public finances. We estimate that benefits of £100 billion present value (PV) would accrue to the UK from expanding Heathrow, the majority of which will be for the wider economy.

- 2.13. A third runway at Heathrow is the fastest, most cost effective and most practical route to meeting the UK's international connectivity needs. A third runway can be delivered at less cost to the taxpayer than building a new hub airport. The options that we are putting forward could be delivered from 5 ½ - 10 years after receipt of planning permission and for £14-18 billion. This compares favourably with a new Thames Estuary airport which we do not believe could be operational before 2034 and which its promoters admit could cost £70-80 billion, of which at least £25 billion would need to be funded by the taxpayer. Adding capacity at Heathrow avoids the transition costs and risk of moving to a new airport.
- 2.14. A third runway is not just a short-term fix - all of the options we are putting forward for three runways have been designed so that they are capable of evolving to four runways if ever required to do so. We believe that a third runway provides sufficient capacity until at least 2040 and that demand beyond this point is very difficult to predict now. One of the advantages of the Heathrow option is that additional capacity could be added gradually as demand requires, whereas a new hub airport would require most investment upfront based on uncertain future demand.
- 2.15. We believe there is a compelling case for growth at Heathrow. Britain faces a choice. We have one of the world's most successful hub airports in Heathrow. We can decide to build on this strength. Or we can start again from scratch. Building from our existing strength can connect the UK to growth more quickly and at lower cost. Starting again from scratch will cost the taxpayer more, take longer and will not deliver an airport that's in the right location to help the UK win the global race. Growth won't wait. With every passing year, Britain is cutting itself off from trade and jobs. It's time for a third runway at Heathrow.

3. Three runways are enough to maintain the UK's global hub status for the foreseeable future

By 2030, Heathrow could be operating to 40 more long-haul destinations, directly connecting the UK to more of the world's fastest growing markets.

- 3.1. There are only six hub airports worldwide that have regular, direct connections to more than 50 long-haul destinations. No country has more than one major long-haul hub. In Heathrow, London has one of these Premier League intercontinental hubs. All four of Heathrow's competitor European hub airports - Paris, Frankfurt, Madrid and Amsterdam - either already have or are committed to developing plans for enough runway capacity to serve an average of around 700,000 flights per year each, nearly 50% more than the presently constrained Heathrow. A third runway at Heathrow would provide sufficient capacity for the foreseeable future, for the reasons explained below.
- 3.2. First, Heathrow forecasts constrained traffic growth of ~0.5-1% p.a. at the UK's hub, through until 2025, with growth slowing as the hub capacity constraint tightens between now and then. This low level of growth reflects the reality that Heathrow is already operating at over 98% of its 480,000 Air Transport Movements (ATM) cap.

The growth is driven by incremental increases in the average aircraft size operating at Heathrow. Any more intensive use of two runways at Heathrow should only be considered as part of a transitional plan towards a third runway. Any transitional plan should recognise the importance of respite to local residents.

- 3.3. Second, by the time a third runway is operational in 2025 (which is already the quickest route to meeting UK's international connectivity needs), a significant proportion of unconstrained hub demand, that develops over the intervening period, may well have been lost – either for good, or for the long term. Overseas governments, airlines, and hub airports such as Dubai and Istanbul, are already making major investments that exploit the UK's hub capacity constraint.
- 3.4. Third, we have assumed as our central case a growth in passenger numbers of 5% p.a., from 2025 to 2030, once a third runway becomes operational in 2025. Thereafter we assume a central case 2.4% p.a. growth in passengers. The five year period of 5% p.a. growth is based on Heathrow's research of other previously constrained international airports. This shows a growth rate of 2.5% above the underlying market level for the first five years, following the introduction of additional capacity, returning to market level thereafter. This higher initial growth rate, followed by a return to the underlying growth rate, is consistent with a phased approach to introducing additional capacity at Heathrow e.g. phased development of terminal infrastructure. It is also consistent with delivering more flights over time with less noise. The period of 5% growth p.a. represents some initial recapture of demand that Heathrow has lost over the period when it has been capacity constrained. The 2.4% underlying growth rate is based on Heathrow's unconstrained econometric long-term forecast and is broadly consistent with the long term unconstrained growth rate forecast by DfT. Heathrow regards any longer term forecasts to 2050 to be too uncertain to be a reliable planning tool at this stage. The uncertainty over long run demand makes adding a third runway at Heathrow an attractive option, as a fourth runway could be added in the longer term if it was ever required.
- 3.5. Fourth, we estimate that in 2030 a three-runway Heathrow will be handling approximately 570,000 ATMs and 100 million passengers. This level of operation leaves plenty of spare runway capacity, providing additional resilience for the operation on the 10-15 'red days' per year when adverse conditions can lead to significant operational disruption e.g. as a result of severe weather. During the 2030s and beyond, we envisage that ATMs and passenger numbers would continue to grow towards full capacity. High levels of resilience would be sustained by improvements in operating capability and technology, developed over the intervening 20 to 30 years. Several important improvements to Heathrow's operating capability are already in plan (see Heathrow's response to the Airports Commission's discussion paper on short and medium term measures). Sustained high levels of resilience in this latter period may also be supported by greater operational freedoms on the 10-15 'red days' of the year. These freedoms would enable the airport community to use the runways more flexibly in order to deal with these adverse conditions. The freedoms would not apply on the 350 other days of the year of more normal operations.
- 3.6. Fifth, the [benefits/capacity/capability] offered by a third runway will be substantial. By 2030, there is expected to be significant growth in the number of long-haul destinations served by the world's top international airports. A third runway at Heathrow will increase the range of direct and frequent long-haul destinations available to passengers. Capacity can be delivered more quickly at Heathrow than by building a new hub airport and existing network strengths mean new routes are more likely to be delivered at Heathrow than at other airports.
- 3.7. We estimate that a third runway would enable Heathrow to regularly serve 130 long-haul destinations - 40 more than today - including Manila, Kathmandu, Kochi, Jakarta, Bogota, Harare, Santiago, Lima, Mombasa, Osaka, Thiruvananthapuram (India), Ho Chi Minh City, Peshawar, Fukuoka, Penang, Chengdu, Fuzhou, Astana, Hanoi, Caracas and Porto Alegre. This level of global connectivity would sustain the UK's global hub status.
- 3.8. Heathrow would also have the capacity to connect to a number of routes within the British Isles currently served by competing hub airports in Europe, for example: Guernsey, Jersey, Inverness, Isle of Man and Humberside. Connecting ten UK regional airports with an average of three services each per day, and connecting 40 more long-haul destinations with a daily service requires 50k ATMs (Air Transport Movements) p.a. This represents about 20% of the full potential additional ATMs of a third runway. The remaining 80% of additional capacity would be used over time to improve connectivity via increased frequencies on existing long-haul routes and across the short-haul network.
- 3.9. Sixth, for planning purposes we consider 740,000 Air Traffic Movements (ATMs) p.a. a reasonable estimate of the capacity of a three-runway Heathrow over the longer term. With the realisation of the currently envisaged improvements in procedures and technology over the longer run, a three-runway Heathrow operating at this level would be more resilient than today.
- 3.10. Although the assumed future peak runway rates are lower than today (see Section 10.10), we also anticipate that the following factors will add additional resilience as they become available:
 - with three runways in operation, one of the runways will need to handle both arriving and departing aircraft while the other two would be dedicated, one handling arrivals and one handling departures. This combination enables more efficient use of the runways than today's two-runway operation where one runway is dedicated to arrivals and the other to departures. The innate efficiency of one of the three runways always being operated in alternating arrivals and departures mode delivers a peak of 48 movements per hour versus 38 or 42 movements on the segregated runways. This method of operation is always required on one of the runways to balance the number of departures and arrivals in a three-runway airport. It should be noted that it will not have the detrimental effect on respite that would be associated with operating in mixed mode in a two-runway airport, because of the ability to continuously rotate which runway is being used

- the virtue of having two arrivals streams means that, as a broad operating principle, aircraft of a similar size can generally be directed to land on the same runway, thereby reducing wake vortex effects and the average spacing between planes
- the airspace change required to enable hub expansion could enhance departure routing efficiency by enabling earlier divergence of planes departing on the same Standard Instrument Departure (SID) and hence reduced departures separations
- such initiatives as the Single European Sky ATM Research programme (SESAR) are due to deliver technological benefits in both the airborne and ground control environments including:
 - better flow management through integration of automated arrival, surface movement and departure management (so called Arrivals/Surface/Departures Management integration)
 - more consistent separations between aircraft using Time Based Spacing
 - better flow rates (particularly during low visibility conditions) using both Performance Based Navigation and Closely Spaced Parallel Approaches
 - over the longer term Light Detection and Ranging (LIDAR) based wake vortex detection
- the capacity benefits delivered by some of the above initiatives will be somewhat offset by the increase in average size of the aircraft in the fleet operating at Heathrow e.g. more A380 aircraft. These larger aircraft types require wider separations.

- 3.11. NATS have endorsed these planning assumptions as a reasonable basis for our analysis of the infrastructure requirements and impact assessments of a three-runway airport.
- 3.12. This assessment of the ultimate capacity of three runways in the long term and the passenger/ATM growth that is likely to arise and which could be physically accommodated in the shorter term, have formed the basis for the impact modelling we have undertaken. We have produced two data points:
- 2030 with 570,000 ATMs carrying 100 million passengers p.a. (mppa)
 - 2040 with 740,000 ATMs carrying 130 million passengers p.a.
- 3.13. These figures are broadly in line with the Department for Transport's own unconstrained forecast numbers for growth at Heathrow of 109mppa in 2030 and 135mppa in 2040. We have assessed the environmental impacts of a three-runway airport operating at full capacity in 2040. Based on the continued development and deployment of new technology, we calculate that the reductions in the number of people affected by noise in 2030 can be maintained to 2040, and that with on-going reductions in emissions from other local sources, air quality limits will not be compromised.
- 3.14. In order to assess what infrastructure will be required to handle this growing number of flights and passengers at Heathrow, a set of flight schedules have been developed. We have used the estimated passenger throughput numbers to develop a representative set of 'busy day' schedules. This is principally done using an econometric model to forecast long-term passenger demand by region based on future changes in income (GDP and consumer expenditure) and changes in

fares (driven by oil price, taxes, charges and efficiency gains). We have applied market growth rates from the econometric model to the 2011 passenger numbers to produce a 2030 flight level passenger forecast (consistent with constrained and unconstrained periods of growth laid out above). Aircraft type changes are then applied on the basis of fleet plans supplied by carriers or known aircraft orders. Flight level passenger forecasts are calculated by applying 95th percentile load factors on hourly, market and arrival/departure basis. Our schedules assume a continuation of Heathrow's long run transfer traffic levels at an average of 35% across the airport.

- 3.15. In conclusion, we believe that a third runway delivers sufficient capacity to maintain the UK's global hub status for the foreseeable future, but we are also including proposals that demonstrate how every three-runway option could develop into four runways should it be required. We have the ability to add extra capacity as the need arises, which makes Heathrow a lower risk option than building a new four-runway hub from scratch based on uncertain future demand.

4. The economic benefits of a third runway

The additional hub capacity from a third runway at Heathrow is estimated to deliver benefits of £100bn present value (PV), the majority of which accrues to the wider UK economy, through improved connectivity and tens of thousands of additional jobs.

- 4.1. A third runway at Heathrow would deliver greater economic benefits to the UK than any other option for new runway capacity. It will create jobs, facilitate trade, boost spending in the wider economy and improve public finances. We estimate that benefits of £100 billion PV would accrue to the UK from expanding Heathrow.
- 4.2. By delivering a third runway at Heathrow the current trade and investment advantages which the UK enjoys, and London's status as a world city, will be preserved and enhanced. The value to the UK of a third runway is driven by stimulating international trade, foreign direct investment and the local economy. Additional value is created by passengers taking extra and more direct journeys. Supply chains and the UK Government also benefit from extra revenues. Additional hub capacity can be delivered by 2025, well ahead of any other proposal, delivering much greater, earlier benefit to the UK.
- 4.3. Heathrow is the best location for the UK's hub. The current centre of UK economic gravity is to the west of London where highly productive clusters in industries like IT and pharmaceuticals have grown around Heathrow over the last 50 years. 202 of the UK's top 300 company HQs are within a 25-mile radius of Heathrow. Foreign owners of firms with HQs in the Thames Valley also employ up to 75,000 workers elsewhere in the UK.² All of this can only be enhanced by additional capacity and connectivity at Heathrow.
- 4.4. Expanding Heathrow would not only protect the existing 114,000 local jobs that depend on the airport but also create 70,000 to 150,000 new local jobs. By contrast, closing or downsizing Heathrow would result in the biggest mass redundancy in British history.

² See Best Placed for Britain, 2013

- 4.5. The additional hub capacity will stimulate significant direct, indirect and induced contributions to the UK economy. Overall the benefit is estimated to be in the range of £50-156 billion present value (PV), with a central estimate of over £100 billion PV. Most of these benefits are reliant upon the improved intercontinental connectivity that an expanded single hub would deliver.
- 4.6. We estimate the direct benefits to passengers are £18-19 billion PV. This reflects the additional journeys that passengers will be able to take that would not have occurred without the new capacity of a third runway. These benefits are comparable to those estimated for Crossrail. However, the wider economic benefits to the rest of the economy, particularly from international trade and inward investment to the UK, as well as from productivity and agglomeration, are much more valuable. Although it is not possible to quantify these effects precisely, we estimate that they will be in the range of £32-£137 billion (PV). This is well above the wider economic benefits claimed for either Crossrail (£7-8 billion) or HS2 (£5.3 billion).³ Overall the benefit will be in the range of £50-156 billion, with a central estimate of over £100 billion. The benefits of a third runway will be achieved by exploiting existing or planned infrastructure (for example, with the implementation of Crossrail in 2019, 75% of east London will be within 60 minutes travel time by public transport to Heathrow).

Figure 2: Benefits from a third runway at Heathrow

Benefit	Example	Value to UK (£bn PV)
Direct passenger and freight benefits		
More journeys	A businesswoman flies who would not otherwise	14
Direct journeys	A businessman flies direct, rather than via Dubai	2
Cargo volumes	Time critical freight is more likely to arrive at the optimal time	2-3
Airlines, airports and supply chains		
Airline GVA	Local staff employed by an airline	3-10
Airport GVA	Local resident hired to work as a baggage handler	5-15
Supply chain GVA	In-flight caterer develops bigger facilities to cater for more passengers	22-37
Wider economic benefits		
Trade	Rolls Royce wins more orders from China because of more direct contacts	5-35
Investment	A Chinese firm bases its European headquarters in west London	0-18
Inbound tourism	A tourist spends a week at a hotel in central London	6-11
Government revenues	Corporate tax revenues increase	5
Business clusters and productivity/innovation	HP and CISCO have HQs in Thames Valley, and benefit from each other's presence as a catalyst for further productivity and innovation	16-68
Total mid-point (excluding airline airport and supply chain GVA)		£100bn

³ See <http://www.go-hs2.com/BenefitsOfHS2/EconomicImprovements.aspx>

- 4.7. Heathrow is the most significant airport for freight in the UK – in fact it carries more freight each year than all other UK airports put together. Air freight is of vital importance as it serves major export industries such as electronics, telecoms, financial and business services. Air freight also serves industries where urgency is a key factor; pharmaceutical and biotech industries, as well as food producers, are heavy users of air freight, and UK manufacturing relies on air freight to import and export key components to keep factories working. Air freight is primarily carried in the holds of passenger planes and the additional long-haul routes resulting from a third runway will make it easier for British companies to deliver to emerging global markets.
- 4.8. Evidence shows that aviation connectivity plays a critical role in facilitating international trade, benefiting the UK by expanding export markets and providing greater import choice for UK consumers and businesses. Frontier Economics have estimated that a lack of direct connections could already be costing the UK up to £14 billion of lost trade a year, i.e. 0.9% of UK GDP. This figure could rise to £26 billion a year by 2030. We estimate that expanding Heathrow and its connectivity, by adding the third runway, might enable benefits of £5-35 billion of PV from new trade.
- 4.9. Foreign Direct Investment (FDI) is a recognised benefit of greater aviation connectivity, with some estimates suggesting that FDI increases by 50% after a first direct connection to a foreign region (Bannò, Mutinelli, & Redondi, September 2011). It is no coincidence that cities with the most long-haul flights have the most international headquarters. The more a firm relies on international flights, the more likely it is to locate in the immediate area of an airport with excellent connectivity. There are numerous specific examples of such decisions, including KPMG – which moved its European Headquarters from Canary Wharf, London and Marie Curie Strasse (north of Frankfurt) to a location adjacent to Frankfurt Airport (south of Frankfurt)
- 4.10. In the UK, we see similar effects in the Thames Valley which, compared to the UK average, has:
 - 50% more European businesses (Heathrow provides strong European connectivity)
 - 60% more foreign companies (Heathrow provides the majority of UK long-haul connectivity)
 - 100% more US companies (Heathrow provides a large majority of UK connectivity to the US)
 - 260% more Japanese companies (Japan is only accessible from Heathrow).
- 4.11. We estimate that expanding Heathrow and its connectivity, by adding the third runway, might generate up to £18 billion PV from new foreign investment.
- 4.12. Heathrow expansion would have a catalytic impact on tourism from inbound leisure and stopover passengers. In the global tourism market, the UK will increasingly have to compete and win against regional rivals in Europe. Part of any competitive advantage will be ease of access – enabled by direct flight connectivity to emerging areas of tourist origin – principally the long-haul markets in the Middle and Far East. We estimate benefits of £6-11 billion of PV from new inbound tourism.
- 4.13. Finally, aviation connectivity impacts the productivity of the economy generally. Econometric research commissioned by IATA quantifies the link between aviation

connectivity (along with a number of other explanatory factors such as investment and R&D) and labour productivity (as a proxy for productivity more generally). The statistically significant finding was that a 10% increase in connectivity to a country would boost labour productivity by 0.07%. There are a number of mechanisms at play here, for example: access to wider markets – allowing economies of scale in production; access to a greater range of suppliers – offering more competitive input materials and components, and improving the efficiency, robustness and timeliness of the supply chain and clustering of related businesses around a hub supported by aviation connectivity – acting as a spur to innovation by allowing greater networking and collaboration between companies. These effects are significantly more pronounced around major global aviation hubs, as evidenced by highly productive industry clusters. Industries participating in a strong cluster register higher employment growth, as well as higher wages growth, office expansion and increased patenting. Industry and cluster level growth also increase with the strength of other related clusters in the region, and with the strength of similar clusters in adjacent regions (Porter, 2011).

- 4.14. Based on a range of international examples, we estimate that these wider effects will lead to the creation of 70,000 to 150,000 jobs over time. This reflects an extension of the agglomeration effect that is clearly visible today across west London, the Thames Valley and beyond. For example Microsoft state that: *“Of the 2,000 people who are based in our Thames Valley HQ, only about half of them work in the UK business. The other 50% do jobs which are not UK-specific, they have roles which involve them in activities across Europe, and sometimes globally. One of the main reasons they are here is that they do need to travel more and they are in close proximity to the hub airport”* (Microsoft 2013). More connectivity will bring more of these jobs. We estimate that these new jobs deliver benefits of £16-68 billion of PV.

Regional and local benefits

- 4.15. Investment in hub capacity at Heathrow can deliver sustainable growth and jobs both locally and across the UK regions. Our proposal calls for significant investment in Heathrow's infrastructure. Such infrastructure will be built using an extensive UK supply chain based throughout the country.
- 4.16. Today, there are 111 foreign-owned businesses with headquarters in the Thames Valley that own 149 companies elsewhere in the UK employing between 45-75,000 workers. 3.7 million people in the UK work for foreign-owned companies. Companies from the US, Japan, Australia, Hong Kong, South Africa and Canada account for half of these jobs and employ 600,000 people outside London and the South East. More growth countries, like China, being better connected to the UK will support increased levels of foreign investment, in turn supporting more jobs across the UK.
- 4.17. Locally Heathrow supports 114,000 jobs – 75,000 directly on site and a further many thousands more indirectly. The number of indirectly supported jobs is estimated to increase by 70-150,000 over time following expansion.

- 4.18. Half of Heathrow's workforce lives in the five boroughs surrounding the airport. To ensure that local people continue to have the best opportunities to access employment, we will continue to work with airport companies to offer pre-employment training and apprenticeships.
- 4.19. By contrast, the impacts of closing or downsizing Heathrow would be significant for the local area – possibly resulting in 63,000 job losses locally, and potentially the loss of many more jobs indirectly reliant on Heathrow. The productivity of the wider economic area would be significantly damaged. The impacts of such unemployment would be devastating for the wellbeing of the local community. The direct job losses would be greater than those that occurred when the largest single redundancy in the UK took place at Shotton Steel in 1985 and MG Rover closed its factory in Longbridge in 2005 both involving 6,500 jobs, or the worst year of pit closures in the UK, 1984 (30,000 jobs).⁴

5. Sustainable Heathrow

Managing Heathrow sustainably is core to both the successful operation of the airport today and to our future growth.

- 5.1. As the UK's hub airport, we need to demonstrate that we can maximise the economic and social benefits that flow from the hub's connectivity, while at the same time reducing our negative environmental impacts, and meeting agreed environmental limits. In its recently published Aviation Policy Framework (APF), the Government acknowledges the benefits that aviation – and growth in aviation – bring, but makes it clear that the industry must play its part in delivering the UK's environmental goals and protecting the quality of life of local communities.
- 5.2. Heathrow has a strong track record of working sustainably. As part of our business strategy for Heathrow, we have defined long-term goals on key issues supported by detailed delivery action plans. These include:
- 50% of employees at the airport site to be from the local area
 - 100% of aircraft to meet the current highest international noise standard
 - 34% reduction in CO₂ emissions from energy use in airport infrastructure compared to 1990
 - increasing recycling of airport waste to 70%.
- 5.3. To make our sustainability plans and performance easier for stakeholders to access, we are planning to publish a comprehensive sustainability strategy – 'Heathrow's 2020 Sustainability Roadmap' – once the CAA has issued its final five-year regulatory settlement for the airport.
- 5.4. To support the sustainable development of Heathrow we will need to put forward a comprehensive set of measures to minimise our environmental impacts, protect the quality of life of local communities, and demonstrate that we can meet robust environmental performance targets.

⁴ See Best Placed for Britain, 2013

- 5.5. In developing plans for adding capacity at Heathrow, we have sought to avoid adverse impacts on local communities and the environment wherever possible. Where this has not been achievable, we have aimed to minimise any impacts through the layout of the airport and a range of operational measures. Where impacts are unavoidable, we have developed plans to provide comprehensive mitigation and compensation.
- 5.6. At this stage of the Airports Commission process, we have sought to set out as clearly as possible how we would tackle the impacts of growth at Heathrow. We also recognise that if Heathrow is short-listed as a location for expansion, we will need to undertake significant further work in consultation with the local community and other stakeholders.
- 5.7. In the remainder of this submission we set out our overall approach for tackling four of the most significant issues associated with growth: noise, community impacts, air quality and climate change. We provide, for each masterplan option we are putting forward, a more detailed environmental assessment for each of these as well as other relevant environmental topics.

6. More flights, less noise

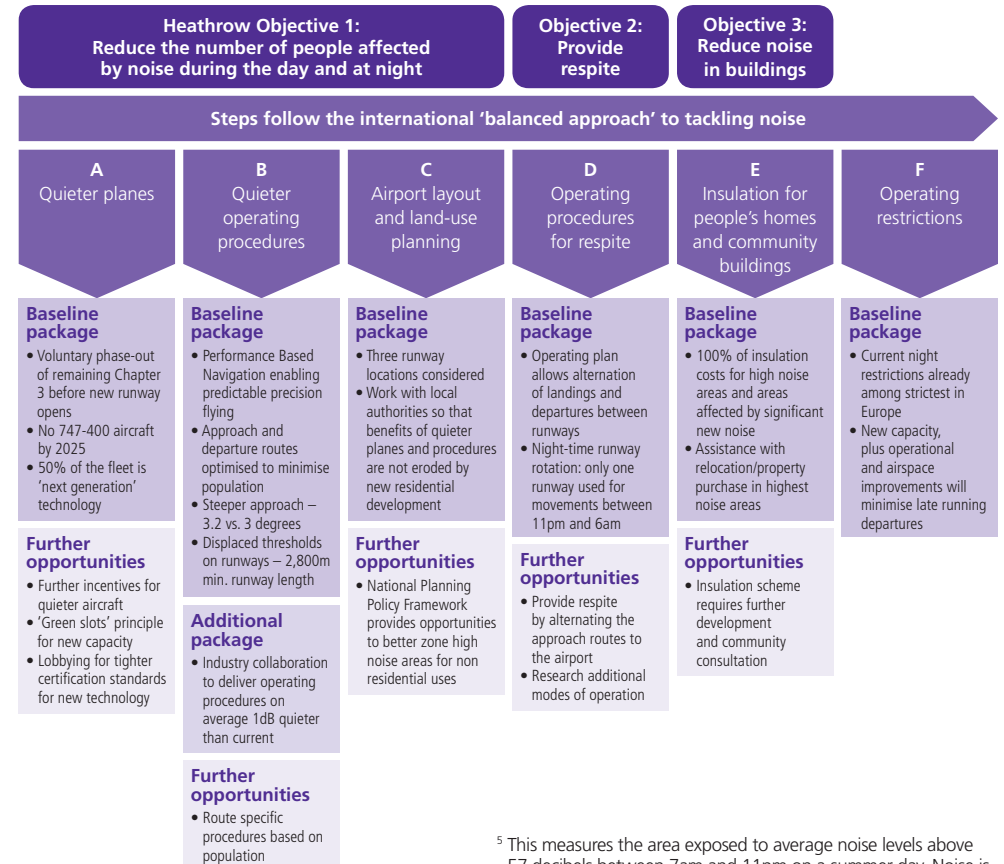
Even with a third runway, there will be 10-20% fewer people affected by air noise in 2030 than there are today. We have maintained the principle of runway alternation to provide periods of respite from noise for all communities around Heathrow.

- 6.1. Heathrow has been at the forefront of measures to tackle aircraft noise. As a result, even though the number of planes using the airport has gone up, fewer people fall within Heathrow's noise contour today than at any time since the 1970s.
- 6.2. However, despite these improvements, noise remains an issue. We need to demonstrate that Heathrow can grow quietly. There will not be a choice between more flights and less noise; we need to deliver both and we are confident that we can.
- 6.3. In this section we provide an overview of our strategy for tackling noise. We have based this on the internationally agreed 'balanced approach' to noise management. However, much of what we are proposing goes beyond current standards and sets out our ambition to be a world-leading airport in reducing its impacts.
- 6.4. The 'Aviation Policy Framework' (APF) sets out the Government's overall goal to "limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise". We support this goal.
- 6.5. There are a number of ways to measure the effects of noise, of which average noise exposure contours are one important method. The contour the Government uses to measure significant effects from aircraft noise is the '57dBA Leq 16hr summer day' contour.⁵ The APF continues to use this measure, but notes that: "this does not mean that all people within this contour will experience significant adverse effects from aircraft noise. Nor does it mean that no-one outside of this contour will consider

themselves annoyed by aircraft noise". As such, the APF concludes that this contour "does not necessarily reflect all aspects of the perception of aircraft noise". We concur with this view. From our engagement with people living close to Heathrow, we know that providing periods of respite from noise is also an important consideration, as is the impact of night flights.

- 6.6. In developing options for adding capacity at Heathrow, we have therefore set three overall noise objectives – namely to:
 - reduce the number of people affected by noise from Heathrow during the day and night
 - provide periods without overflight for all communities around the airport (known as 'respite')
 - limit noise levels inside homes and community buildings through sound insulation schemes.

Figure 3: Steps towards delivering our noise objectives



⁵ This measures the area exposed to average noise levels above 57 decibels between 7am and 11pm on a summer day. Noise is measured in the summer as it is when the airport is likely to be busiest and people are more likely to be outdoors.

- 6.7. Our strategy will allow us to increase the number of flights at Heathrow while reducing the overall number of people that fall within Heathrow's noise contours both during the day and at night. On balance, more people experience a reduction of noise levels than an increase. However, some will experience more flights than today. Our overall strategy aims to alleviate those impacts by providing respite for communities around the airport, and by providing noise insulation to homes and community buildings exposed to high noise and/or to significant new noise.
- 6.8. Our noise strategy is deliverable and practical. The 'baseline package' of noise measures to reduce the number of people affected is based on known aviation technologies and conservative, expert judgement of what will be possible in future. We believe further improvements are possible and have outlined those separately.
- 6.9. The success of the strategy will be dependent on a partnership approach between Heathrow and the rest of the aviation industry, including airlines, air navigation service providers and aircraft / engine manufacturers. It will also require the support of regulators and policy-makers, and on-going engagement with local communities around the airport, in particular to define the operating procedures for the airport that would be of most benefit in reducing noise.

Quieter planes

- 6.10. Aircraft today are significantly quieter than they were at the start of the jet age; aircraft and engine manufactures have set long-term goals to continue reducing noise in the future. Two of the newest aircraft coming into operation are the A380 and B787. Based on figures from their respective manufacturers, the A380 generates at least 50% less noise than its nearest competitor at take-off and on landing (Airbus), while for the B787, the noise footprint is some 60% smaller than for today's similarly-sized aircraft (Boeing).
- 6.11. Heathrow's noise standards play a role in influencing future technology as they are among the strictest in the world. The new Airbus A380, for example, was designed specifically to fall into one of the quietest categories for night operations at Heathrow. The aircraft that airlines operate at Heathrow are on average around 15% quieter than the total global fleets of those airlines, influenced in part by our variable landing charges to incentivise quieter planes.
- 6.12. We have forecast which aircraft types will be operating at Heathrow in 2030. We project that by 2030 around 50% of the fleet at Heathrow will be 'next generation' technology and that nearly all movements will be operated by known aircraft types. Some of these aircraft are already well established (e.g. B777 and A380), or have recently entered service (e.g. B787 'Dreamliner') whilst others are expected to enter service imminently (e.g. A350) or have been launched with significant orders already placed (e.g. A320 'NEO' [New Engine Option]).
- 6.13. Over half of the movements at Heathrow are forecast to be using A320 'family' aircraft. These aircraft play a significant role in the size and shape of the noise contours and we have assumed that 90% of these movements will be operated by A320 'NEO' or equivalent aircraft. The NEO was launched in 2010 and, by the end of 2012, had received over 1,700 orders. This aircraft is designed to be 25 dB quieter than the current ICAO Chapter 3 noise standard. CAA guidance has been used to

derive the noise performance of these aircraft in the context of the existing Airbus A320 family. Our overall assumptions on quieter planes are consistent with the Sustainable Aviation 'Noise Road-map'.

- 6.14. In addition to the projected fleet replacement trends in our baseline package of noise measures, the introduction of new capacity provides a further opportunity to incentivise the use of quieter aircraft by specifying noise performance as a criterion for slot allocation.

Quieter operating procedures

- 6.15. The procedures used on individual aircraft, and how airspace is designed, can also reduce noise. Heathrow already employs a number of procedures that limit noise and we are committed to continuing to develop, trial and deploy new approaches, and to work with airlines to promote low-noise practices. During 2013 we are launching a 'Fly Quiet Programme' to support this work.
- 6.16. Looking ahead to 2030, we have based our baseline package of noise reduction measures on:
- **Displaced thresholds for all runways** – this means that aircraft land several hundred metres further inside the airport and are higher and therefore quieter on their approach
 - **Steeper approaches of 3.2 degrees** – compared to 3 degrees today. Like displaced thresholds, this means that aircraft are higher and therefore quieter on approach to the airport
 - **Approach and departure routes** – designed using new 'precision navigation' technology to avoid the most densely populated areas near the airport.
- 6.17. Although 'precision navigation' aligns with the Government's goal to reduce the number of people affected by noise, we recognise that it could further concentrate aircraft on specific tracks. To alleviate this impact, we believe that advances in navigational technology and airspace design will also mean that we can extend the concept of alternation from runways to flight-paths to provide communities with periods of respite from noise. There is further work to be done with both industry and community stakeholders to determine how best to utilise advances in navigational technology to minimise noise impacts.
- 6.18. In addition to our baseline package of measures, we believe that we can achieve further improvements, through collaborative working with airlines and industry partners, to identify and adopt best practice operating procedures with the lowest community impact. For the purposes of this analysis, we have assumed that these further improvements would result in an additional 1dBA improvement.

Airport layout and land-use planning

- 6.19. We have carefully considered the siting of a new runway. Two of our options locate the runway to the west of the existing airport which means that aircraft approaching over west London or departing towards London are higher, and therefore quieter, as they fly over the more densely populated areas to the east of the airport.
- 6.20. Land-use planning can also play an important role in reducing the impact of aircraft noise by restricting certain types of development in high noise areas. Progress at

Heathrow in reducing the size of noise contours has not been matched historically by limits on residential development around the airport. We will continue to actively explore with Government and local authorities how to best approach land use planning issues, particularly in high noise areas. The reductions in number of people exposed to noise are based on population data for 2011 and are dependent, in part, on planning policy limiting noise-sensitive development in the areas around the airport.

Operating procedures for respite

- 6.21. Local communities tell us that respite is important to them and so, in developing options for a third runway, one of our key objectives has been to maintain the principles of runway alternation. This maximises the opportunities for periods of respite for communities around the airport during easterly and westerly modes.
- 6.22. We also expect future aircraft and airspace technology to allow us to extend the concept of alternation from runways to flight paths, to help manage noise impacts both within and outside the traditional noise contours. For example, different approach routes to Heathrow could be used on different days of the week. Although our work on this is at an early stage, we believe that it offers the prospect of significant, positive changes in the noise impacts from Heathrow and are committed to fully exploring this. We recognise that such an approach will require significant further engagement with policy-makers, regulators and airspace managers. It would also need to be developed in dialogue with local communities in order that we understand and take into account their views on the kind of operating plan that would most benefit them. As part of the 'Operational Freedoms' trial at Heathrow, we have supported research to improve understanding of the value of respite and are committed to supporting on-going research in this area.

Insulation for homes and community buildings

- 6.23. Notwithstanding the steps above to reduce noise, in the future there will still be homes and community buildings in Heathrow's noise footprint. Noise insulation schemes will play an important role in reducing noise levels inside those properties.
- 6.24. The most generous noise schemes elsewhere in the world have typically been introduced when governments have given the go ahead for new airport capacity and they are often state-funded, at least in part. In areas where noise levels are high, or areas that experience significant new noise, noise insulation should be provided to homes and community buildings. In the highest noise areas, support should be provided for relocation and/or consideration given to purchasing properties. If Heathrow is short-listed for expansion, we would need to undertake significant further work on the detail of insulation, in consultation with the local community.

Noise at night

- 6.25. Operations at night are an important feature of a hub airport but also a significant concern for local residents. Of the major European hub airports, Heathrow has the strictest limits on operations between 11pm and 6am and the fewest flights. We have assumed that restrictions at Heathrow will continue to be strict in future and plan to operate only one runway for the small number of flights operating between

11pm and 6am. This means that local residents could benefit from significant breaks between nights when they experience overflight.

Community engagement

- 6.26. An effective aircraft noise management regime is underpinned by effective stakeholder engagement and consultation. We aim to provide clear and accessible information on noise around Heathrow, and to take local views into account in developing the best package of measures to reduce noise. We have regularly benchmarked our community engagement against other leading global airports to identify and act upon areas for improvement. We are working increasingly closely with local resident groups and local authorities to improve our communications and to trial new noise management procedures, and will continue and develop that approach. We are currently investigating ways to describe potential future changes to how Heathrow operates, and what this will mean for residents, in a more accessible way.

7. The UK's integrated transport hub

New public transport services could link Heathrow to the whole of the UK and allow more passengers to comfortably access Heathrow on public transport than ever before. Heathrow could deliver more flights without increasing airport-related traffic on the road.

- 7.1. Since the 1970s, around £20-25 billion of rail infrastructure with a connection to Heathrow has been invested or committed. On top of that, there is an extensive motorway network that serves the airport, including the M3, M4, M40 and M25, which would cost around £26 million per mile to build at today's prices. This extensive, and growing fabric of surface access infrastructure makes Heathrow highly accessible.
- 7.2. New public transport infrastructure, most of which is already planned or committed, could enable 15 million more passengers to use public transport to access Heathrow by 2030. This could increase Heathrow's public transport mode share from 40% today to more than 50% in 2030, despite the additional number of passengers using the airport. These public transport improvements will be complemented by a range of measures to encourage more sustainable travel by airport employees. These include expanding Heathrow's employee car share scheme (already the world's largest), but also reducing the proportion of employee car parking spaces. It is possible to deliver a third runway without increasing airport-related traffic on the roads.
- 7.3. Heathrow's surface access is unrivalled. It is extremely well located in relation to the strategic highway network with direct access from the M25 and M4, as well as being within ten miles of the M40 and M3. It is served by fast and frequent rail services into London, provided by Heathrow Express, Heathrow Connect and the Piccadilly Line, as well as operating as the busiest bus and coach hub in the UK.
- 7.4. Over 16 million people live within a 60-minute journey time, with 6 million having a public transport option. As a result, over 40% of passengers use public transport and 35% of employees use sustainable travel modes to access the airport.

7.5. With seven rail and tube stations at the airport, and over 540,000 annual bus and coach movements, neighbouring communities and businesses benefit from connections to London and the rest of the UK. For over 20 years we have supported and encouraged the wider role that Heathrow plays as an integrated transport hub. Additionally, there is an established logistics network around the airport which allows it to operate as a significant freight hub with over 1.5 million tonnes of cargo p.a.

Our objectives

- 7.6. We have developed ambitious objectives that our strategy can achieve at the traffic levels predicted by 2030 namely:
- No more airport-related cars on the roads than there are today
 - A continuous and significant improvement in airport passenger public transport mode share to over 50%.
- 7.7. The success of the strategy will be dependent on a partnership approach between Heathrow and key stakeholders and those agencies with a role in the delivery of public transport infrastructure and services.

Our surface access infrastructure strategy

- 7.8. Practical and deliverable, our strategy builds on existing committed projects and on our current significant surface access assets and services (such as Heathrow Express) to meet the needs of all users.
- 7.9. These improvements have been identified to enhance connectivity to Heathrow's largest catchments, as well as centres of business and population across the UK, benefiting aviation passengers, employees and people from the surrounding communities:
- **Crossrail** – a committed project.
In 2019, Crossrail will provide direct rail access to the West End, the City, Canary Wharf and east London. Crossrail will bring the heart of London's financial district and much of east London within a 60-minute catchment area for Heathrow. Journey times from Whitechapel, Canary Wharf and Stratford to Heathrow will be 36, 40, and 41 minutes respectively. In the longer term, an increase in frequency of services to the airport would be possible to support the growth in passenger and employee numbers.
 - **Piccadilly Line upgrade** – a committed project.
Transport for London's planned upgrade of the Piccadilly Line will see tube frequency and journey time improvements for all users, including those travelling to Heathrow. Even with the advent of Crossrail, it will remain a key mode of public transport access for connecting London to the UK's hub airport, particularly for catchments to the west of London.
 - **Western Rail Access** – a committed project.
By 2021, Western Rail Access will provide fast direct connections between Heathrow and Slough, Reading, and the wider Thames Valley, as well as improving journey times to the South West and South Wales.

- **High Speed Two** – Phase 1 is a committed project; Phase 2 has policy support, subject to the outcome of the Airports Commission. In 2026, HS2 Phase 1 will connect Heathrow to the Midlands via a new interchange at Old Oak Common which will be served by Heathrow Express and Crossrail services. In 2032, Phase 2 will provide direct connections to key cities in the Midlands, the North and Scotland – dramatically reducing journey times. Government anticipates that Heathrow would be served by an on-airport station at T5.
- **Southern Rail Access** – attracting strong policy support from Network Rail and stakeholders.
A new southern rail link into the airport would provide rail access to key catchments in south and south west London, Surrey and the south coast. Heathrow is committed to working closely with Network Rail and other key local stakeholders to identify the optimum route alignment for connecting these important catchments to Heathrow.
- We will also introduce new and enhanced bus and coach services, building on the 540,000 annual movements today.

Boosting the UK's connectivity and reducing journey times

- 7.10. Delivering only 17 miles of new railway (Southern Rail Access, Western Rail Access and HS2 Spur) can provide direct access between Heathrow and the southern, western and high speed rail networks. This would open up over 2,000 miles of the strategic rail network for Heathrow's passengers and staff.
- 7.11. The new rail connections will also provide wider UK connectivity. It will be quicker for people in areas to the south of Heathrow (such as Guildford, Southampton, Bournemouth and Portsmouth) to travel to Birmingham, Manchester and Leeds on HS2 via Heathrow. This will remove the need to travel via central London, helping to reduce the strain on key central London termini and the Underground network.

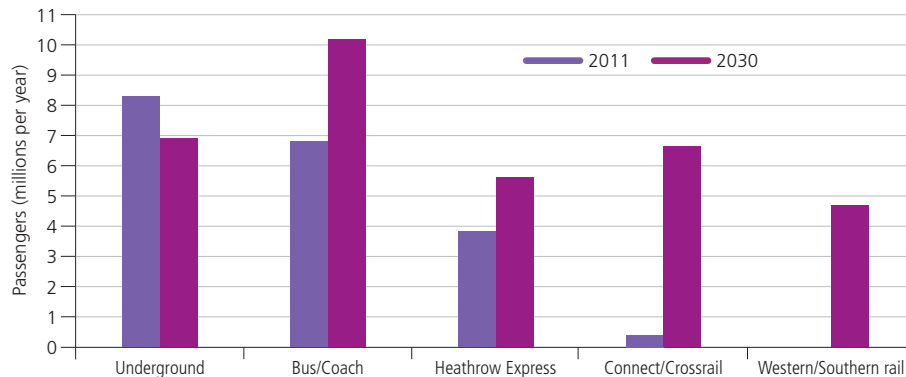
Figure 4: Improved journey times to Heathrow (mins)

Largest city	Journey times to Heathrow (mins)		
	Today	With new infrastructure and services in place	Journey time saving
Birmingham	130	49	81
Leeds	190	82	108
Glasgow	333	218	115
Sheffield	193	79	114
Bradford	215	107	108
Edinburgh	325	218	107
Liverpool	187	96	91
Manchester	190	68	122
Nottingham	170	68	102

Positively influencing travel behaviour

- 7.12. Our strategy will be supported by a range of incentives, behavioural measures and demand management – building on Heathrow’s award-winning sustainable travel initiatives including:
- supporting further improvements to Heathrow’s comprehensive bus and coach network, building on existing strong partnerships with bus and coach operators
 - information technology offering more real-time information and journey planning tools to inform and engage travellers
 - marketing, incentives and promotions for public transport use
 - reduction in staff car parking supply with further priority given to car sharing
 - systems and incentives to encourage more efficient taxi use amongst air passengers
 - improvements to the cycle network and further development of the existing Heathrow Cycle Hub to offer incentives and support to cyclists using the airport
 - collaboration with operators to deliver further consolidation of freight vehicle movements, more efficient use of vehicle fleets and available carrying capacity to minimise the impact of freight movement.
- 7.13. Our analysis indicates that through implementing our strategy, passenger public transport mode share will exceed 50% by 2030:

Figure 5: Annual airport passenger demand by public transport



- 7.14. Total passengers travelling by public transport would rise from 19 million p.a. today to 34 million in 2030. This will include approximately 24 million passengers using rail, which represents over a third of all non-transfer passengers using the airport.
- 7.15. Daily traffic levels have been assessed for a ‘busy day’. The 2011 baseline is approximately 150,000 vehicle movements, with 60% of vehicle movements passenger-related. Taxis and ‘kiss and fly’ represent less than 50% of passenger trips but they contribute over 90% of passenger-related vehicle movements. As a result, behavioural measures have been developed specifically to reduce these movements, resulting in only marginal increases in passenger-related vehicle trips, despite total passengers increasing from 70mppa to 100mppa.

- 7.16. There would also be a substantial shift in staff travel choices – as a result of the proposed improvements to the public transport offer, other incentives and limiting staff car parking supply. These measures will help to raise employee public transport mode share to 40%, increase car sharing, and reduce single occupancy car use to below 50%. Our traffic analysis shows that the forecast reduction in staff-related car movements would offset the marginal increase in passenger-related traffic expected in 2030.

Figure 6: Daily traffic levels in 2011 and 2030

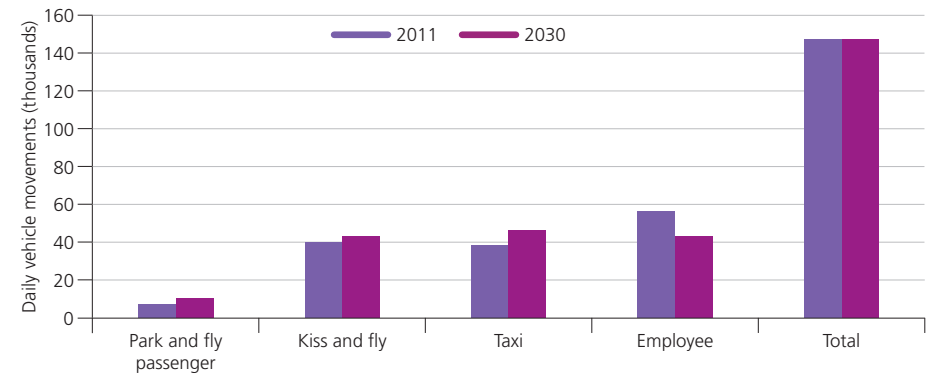
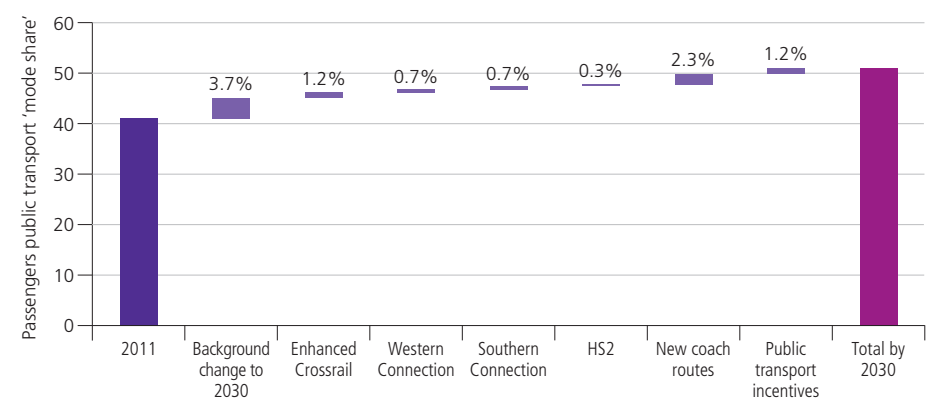


Figure 7: Drivers of public transport mode share change to 2030



- 7.17. Beyond 2030, we anticipate that there will be significant improvements in public transport vehicle technology, as well as changes in policy and attitudes to public transport. These are expected to deliver a further modal shift to public transport, better use of capacity and further reductions in transport-related emissions. The strategy will seek to maintain local traffic levels close to those experienced today at 130 million passengers p.a.

Making the best use of existing capacity

- 7.18. We have developed our strategy to ensure there will be no more airport-related cars on the roads in 2030 than there are today. Therefore, we expect no major improvements to highway capacity to be necessary as part of the proposals to expand Heathrow.
- 7.19. Beyond 2030, we will seek to limit traffic growth and there are a range of potential behavioural measures that can help achieve this. In addition, changes in public policy, attitudes to public transport and technology will provide further opportunity to minimise the traffic impacts of airport and background traffic growth.
- 7.20. As we develop the proposals further, localised improvements will need to be refined on certain of our proposed masterplan options. However, we envisage that solutions can be prepared working in partnership with the relevant highway authorities.
- 7.21. Our analysis shows that the proposed rail connections can provide sufficient capacity to support airport passengers and staff, as well as new demand generated as a result of the improved connectivity available to non-airport users. Based on the publicly available information on proposals for the rail network to 2030, it will be possible to accommodate the train paths for new and enhanced services to Heathrow.
- 7.22. The combination of Heathrow Express and Crossrail services will provide sufficient capacity to serve airport demand to London. Airport demand can complement other requirements on the Great Western mainline. Similarly, for the South West network we believe that opportunities exist to optimise capacity and meet different demands, with further opportunities potentially arising from other proposed schemes such as Crossrail 2. We look forward to exploring these opportunities further with Network Rail.
- 7.23. The Piccadilly Line upgrade will increase capacity across the entire route, including to and from Heathrow. At the same time, Crossrail will provide an attractive alternative to Heathrow travellers for accessing central London. This will deliver significant capacity relief, in particular on the central London section where crowding is predicted to be highest in 2030. Our analysis shows that Heathrow passengers using the Piccadilly Line in the morning and evening peak periods will reduce in the central sections by 2030 as a result of wider improvements such as Crossrail.
- 7.24. Comparing Heathrow's proposed transport infrastructure with other potential hub options, notably Stansted and a potential new hub airport in the estuary, Heathrow would have over four and a half million more people living within a 60-minute travel time catchment. As such, for most UK passengers, a hub airport to the east of London would be in the wrong place. Travel times, and by association carbon, would increase for 90% of hub passengers, with their average journey time increasing by 30 minutes. In terms of carbon therefore, expanding hub capacity in the east will come with a material carbon penalty. Any new hub would need to build vast new infrastructure from scratch – expending unnecessary carbon in the process.

Heathrow – the UK's Integrated Transport Hub

- 7.25. Heathrow is committed to promoting integrated transport. We have developed a strategy to support a third runway that is deliverable and practical. The

strategy represents a significant commitment from Heathrow, but also requires partnership from Government and other delivery partners. Through public transport improvements and other sustainable travel measures, we can deliver a step change in public transport mode share for passengers and employees, and limit traffic to today's levels in 2030. The strategy will also make best use of existing capacity on the wider network, transforming journey times and connectivity for both airport users and neighbouring communities.

8. Improving air quality around Heathrow

The use of cleaner vehicles and the increased proportion of passengers using public transport mean that capacity at Heathrow can be added while also improving local air quality in line with EU standards.

- 8.1. Limits on air pollution levels apply in residential areas in Europe. The principal pollutants of concern in London, in common with other towns and cities in Europe, are:
- nitrogen dioxide (NO₂)
 - particulate matter (PM10) i.e. particles with an aerodynamic diameter of less than 10 micrometres (µm).
- 8.2. Meeting the limits for NO₂ and PM10 is a challenge for local authorities across the UK and for Government. All 33 London boroughs have declared at least one Air Quality Management Area (AQMA) for which they have developed action plans with the aim of improving air quality. Heathrow is in the southern part of an AQMA in the borough of Hillingdon. Of the pollutants about which the EU is concerned, only nitrogen dioxide (NO₂) is above the limits, predominantly at residential properties located close to heavily trafficked roads. Particulate matter already meets air quality limits in this area and we expect that to remain the case.
- 8.3. It is road traffic emissions that contribute most to concentrations of NO₂ beyond the airport boundary, where air quality limits are currently exceeded. A proportion of these vehicles is driven by passengers and staff accessing the airport, although the majority of traffic on the major roads near Heathrow is not airport-related. At the M4 near Heathrow, for example, less than 25% of traffic is airport-related. Local air quality around Heathrow is also affected by local industry, domestic sources (household gas boilers) and emissions from more distant sources. Although aircraft and airside operations affect local air quality, their contribution falls quickly with distance from the airport and is at very low levels 2 kilometres away.
- 8.4. Air quality management is a key priority for Heathrow and we are committed to playing our part to help improve air quality to meet the limits. In 2011 we published our Air Quality Strategy setting out the steps we are taking to reduce Heathrow's impact locally. We work in partnership with Government and local authorities to reduce emissions from both airport and non-airport sources around Heathrow. Through this work, we currently expect the areas closest to Heathrow – i.e. where the airport's proportionate contribution to total NO₂ concentrations is higher – to meet the limits between 2015 and 2020.

8.5. To support the sustainable development of Heathrow, a package of actions have been identified to add capacity while also continuing to improve air quality, consistent with European standards. We have developed a 'baseline package' of mitigation measures that is deliverable and practical. These measures are based on known technologies and conservative, expert judgement of what will be possible. The success of these measures will be dependent on a partnership approach between Heathrow and the rest of the aviation industry, including other companies operating at and around Heathrow, and transport providers serving the airport. It will also require the support of national policy-makers, regulators, and neighbouring local authorities. The key measures are set out below.

Surface access to and from the airport

8.6. Exhaust emissions from road traffic around Heathrow are the primary contributor to breaches of the NO₂ limit. We are incentivising the use of more sustainable transport modes to manage both total vehicle numbers and emissions. To ensure that the contribution that Heathrow-related road traffic makes to air quality is limited, and as outlined in Section 6, we have set an objective of no more airport-related cars on the road in 2030 than today as a result of Heathrow expansion. To achieve this, we will increase the proportion of passengers using public transport to reach Heathrow to over 50%.

8.7. Meeting the air quality limits will require a holistic approach, as many journeys made on the busiest roads around Heathrow are not connected with travel to and from the airport. Our targets will be achieved by working with partners on major transport projects already committed – including the Piccadilly Line upgrade, Crossrail, the Western Extension and High Speed 2 – as well as from measures to incentivise their use and change travel behaviours. These include, for example, improving bus, coach and cycle infrastructure; integrating real-time information into journey planning tools; incentivising change through marketing and promotions; and further consolidation of freight movements. Where expansion of the airport requires new surface access infrastructure and improvements to existing road links and junctions, this will be designed to ensure that the air quality limits will not be breached.

Cleaner vehicles

8.8. In addition to our strategy of limiting the numbers of vehicles using the road network around Heathrow, European emission standards require that on-going reductions in emissions per vehicle are achieved. These standards for new vehicles have delivered some emission reductions from petrol and diesel vehicles in the local area and we expect the rate of reduction of vehicle emissions to increase with the introduction of more stringent European emission standards from 2014 onwards. We therefore expect average, fleet-wide vehicle emissions to further reduce.

8.9. In addition, new zero-emission technologies, particularly electric and hydrogen, will penetrate the market in greater volumes from now on. The current official Government forecasts of transport emissions which we have used to assess air quality in future do not factor in zero-emission technologies. However, we believe that there are significant opportunities for these technologies in the coming years. For example,

we note that the Committee on Climate Change has projected in its 2013 Progress Report that by 2022 5% of cars and 4% of vans could be using this technology. This creates a further opportunity to improve air quality beyond the results presented in this submission and is an area which we are actively researching.

8.10. We operate a Clean Vehicle Partnership which promotes low and zero-emission technology for airside operations. We are already actively testing increasing numbers of electric and hydrogen powered vehicles for use on the airport as we believe they have the potential to be a more durable and cleaner replacement for those powered by diesel. Through the Partnership, we are working closely with Heathrow-based companies to assess the fuel and efficiency savings that they can achieve through using these new vehicle technologies.

8.11. Through financial contributions, we are already facilitating the accelerated take-up of low emission vehicles that operate landside, either through contract or ownership. One example is hybrid buses: in 2013 we supported First Group's decision to buy ten hybrid buses⁶ for their route between Slough and Heathrow, reducing both fuel use and exhaust emissions. We also host supporting infrastructure, such as the first publicly available hydrogen fuelling station⁷, installed in 2012, and we are investigating how to further extend the number of electric charging points already installed for passenger use.

8.12. Given these developments, we are confident that we will be able to further increase the proportion of zero-emissions electric and hydrogen vehicles operating at Heathrow. Furthermore, we will also actively explore steps that we should take to provide additional support and incentives for the use of zero-emissions vehicles by staff and passengers, and to restrict the use of more polluting vehicles.

Cleaner planes and emission reduction procedures

8.13. The contribution that aircraft make to air quality impacts is lower relative to other emission sources, such as road traffic, where emissions occur closer to residential properties where the air quality limits apply. After an aircraft leaves the runway and starts to climb, the contribution of the engine emissions to ground-level concentrations decreases with increasing height. So, once the aircraft reaches a height of a few hundred metres, it makes little contribution to ground-level concentrations. However, there are currently locations close to the airport boundary where emissions from aircraft combine with those from other local sources, predominantly road traffic, and lead to breaches of the air quality limits. Therefore, in addition to reducing emissions from road traffic, it remains important to minimise emissions from aircraft in order to help achieve the limits.

⁶ Purchased through DfT's Green Bus Fund. First Group will buy a further five vehicles in 2013

⁷ Hydrogen filling station is a deliverable of the HyTEC Project. Funding support is provided from the EU's FP7 programme for the Fuel Cells & Hydrogen Joint Technology Initiative

- 8.14. ICAO's Committee on Aviation Environmental Protection (CAEP) sets limits on the emissions of NO_x in a standardised landing and take-off (LTO) cycle. Over the last 20 years, the Committee has set increasingly stringent emission standards for new aircraft which mirrors, to some extent, the EU's euro standards for new vehicles. The table below shows the current aircraft fleet profile at Heathrow, based on engine emissions and our current future projections of the CAEP standard of future aircraft using the airport in 2030. The newest aircraft operational in 2030 would also be compliant with any new emission standards that are in place beyond CAEP/8.

Figure 8: Projected improvements in aircraft compliance with NO_x emissions standards

CAEP standard	Year of introduction	% of Heathrow fleet meeting each standard in 2012	% of Heathrow fleet meeting each standard in 2030
CAEP/ 4	2000	47%	41%
CAEP/ 6	2008	43%	22%
CAEP/ 8	2014	0%	36%

- 8.15. In addition to the projected fleet replacement trends which we have assumed in our baseline package of air quality measures, introducing new capacity provides an opportunity to specify air quality performance as a criterion for slot allocation.
- 8.16. Mitigation measures, particularly in relation to the future airport layout, land-use planning and operational practices, will also lead to benefits for local air quality. In particular, runway(s), aprons and taxiways have been positioned to maximise the distance between operational aircraft and residential properties to avoid exceedences of the air quality limits.
- 8.17. To further reduce emissions from aircraft on the ground, we are continuing to work with airlines to minimise the use of 'Auxiliary Power Units' (APUs) by providing ground power at all stands and increasing the numbers of ground-based air-conditioning units for aircraft. Our baseline package also assumes that the time the majority of aircraft use APUs when on the ground is reduced by over 50% from today's levels by 2030.

9. Managing other effects on people and communities

Although the development of a third runway at Heathrow will bring real benefits for the travelling public, we are sensitive to the impacts that expansion will have on surrounding communities.

Greater ease of connecting for families, friends and businesses

- 9.1. A third runway will increase the range of direct and frequent long-haul destinations available to passengers, as capacity can be delivered more quickly at Heathrow. By building a new hub airport and extending existing network strengths, new routes are more likely to be delivered at Heathrow than at other airports. Our route modelling suggests that the extra take-off and landing slots delivered by a third runway would provide 40 new long-haul destinations by 2030, providing Heathrow with 130 total long-haul destinations.

Greater choice of airlines

- 9.2. Many airlines want to access slots at Heathrow and would fly to the UK if they could. Airlines such as China Southern would have flown to the UK sooner had there been slots available at Heathrow. Airlines that cannot access Heathrow do not automatically fly to another UK airport instead. A survey of scheduled airlines found that 53% are locating flights abroad that would have come to the UK, and 86% would put on more flights to the UK – if there were capacity at Heathrow.

Lower fares than a new hub airport

- 9.3. Airport infrastructure in the UK is currently privately funded and, ultimately, paid for by passengers through airport charges. The lower costs of building a third runway at Heathrow compared to building a new airport will translate into lower fares for passengers.

Greater choice of flights from UK regions

- 9.4. Many passengers in the UK nations and regions no longer have the choice of flying via Heathrow because domestic flights have been squeezed out, as capacity has become constrained. Heathrow offers flights to seven UK airports, while Amsterdam Schiphol has routes to 24 UK airports. For some UK regions, the only available option is to fly to Amsterdam. Spare capacity at Heathrow would increase competition, giving UK passengers more choice and leading to lower fares and better service.

Closer to passengers' home or business

- 9.5. For most existing passengers, a hub airport to the east of London would be in the wrong place. Travel time would increase for almost 90% of hub passengers. Even if major new transport infrastructure were constructed for a new Thames Estuary or Stansted hub airport, Heathrow would still have 4.5 million more people living within a 60-minute travel time.

Better choice of onward transport

- 9.6. Passengers travelling to a three-runway Heathrow will have a wide choice of transport options available from the outset, while a new hub airport would need to develop a limited number of new transport options from scratch. The choice would

include the Heathrow Express, Crossrail, London Underground, mainline rail, or road transport to access the airport – with a range of fares and service levels available.

Better communication with and better compensation for people impacted by expansion

9.7. However, we are also committed to communicating clearly and openly with those who may be affected by these options. We believe that there should be fair compensation for all those whose property is directly affected by the expansion of the airport and help for those who are significantly affected by aircraft noise.

We intend to publicly publish our options contained in this document simultaneously with our submission to the Commission. This will help to explain the rationale for how the runway options were developed, and the benefits and impacts of each of them to whomever may be interested – in particular the surrounding communities. This will include an explanation of what measures we have already taken to mitigate the adverse effects of the airport expansion within the designs. We will make it clear that these are options and not yet firm proposals, and that any further development of them will be dependent on the Commission's process.

9.8. We will seek feedback on the options to enable further optimisation of the mitigation design in a potential next stage of the Commission's process, and to understand key stakeholder views on how the options may be improved.

9.9. We are aware that options for the third runway involve significant land take, with impacts on homes, businesses and communities. Direct property loss associated with the airport expansion would include:

- land and buildings located within the redline of the enlarged airport, which need to be demolished
- buildings located within the 10-4 public safety zone⁸, which need to be demolished
- any buildings protruding through the Obstacle Limitation Surfaces (OLS) for the new runway(s), where demolition or alterations may be required.

9.10. It is important to recognise the effect on communities of uncertainty about their future and to do everything reasonable to minimise this. Even if Government were to give 'in principle' support to expansion of Heathrow in autumn 2015, it is likely that consultation on an emerging Airports National Policy Statement (NPS) would take place throughout 2016, leading to a designation at the earliest in mid-2017. This would enable a planning application to be submitted and signal the onset of statutory blight. However, in practice, communities are likely to have been affected for a much longer period than this.

9.11. Although prompt action by Government as outlined above will minimise this period of uncertainty, communities would need to be protected as far as possible from negative effects before any development begins. Accordingly, we believe that there should be a comprehensive and innovative package of measures for those communities directly affected, to ensure that they are fairly compensated in

a sensitive and timely manner. The package should extend beyond the footprint of direct land take to include those significantly and newly affected by aircraft noise, and also recognise the impacts on any communities that may be cut off from amenities which they previously enjoyed.

9.12. We believe that a property compensation scheme should be implemented at the appropriate opportunity, and preferably prior to any statutory blight obligations. We suggest the launch of a consultation process to determine an appropriate package of compensation within six months of any Government policy announcement.

9.13. We suggest that communities should be protected against blight through a Property Market Support Bond (PMSB) and Home Owner Support Scheme (HOSS), comparable to those formulated for use in the last third runway study. The PMSB would be a bond guaranteeing the value of the property indexed from a base date before the Government's decision. The HOSS would provide assurance for those properties forecast to be newly introduced into the 66dB contour and with an increase of more than 3dB, with a similar price guarantee. In recognition of the disruption caused, we believe a home loss payment higher than the normal best practice of 10% should be considered.

9.14. We are also aware of the need to address particular land use and property impacts arising from a third runway and see the need for the development of a comprehensive and specific package of compensation measures which might include the following:

- the early 'purchase and leaseback' of affordable homes to registered providers and of community facilities so that occupation can continue while the compensation is used to fund re-provision; this would be triggered earlier than the trigger for privately owned homes and properties under the PMSB
- the extension of the PMSB to those properties not directly affected by the airport expansion but nevertheless divorced from their existing communities as a result
- commitment to kick start funds for stalled housing and employment development sites locally or sub-regionally – similar to the Government's new Infrastructure Fund which is being used to unlock development sites which may otherwise be unviable and unlikely to come forward
- the establishment of a re-location bureau to work actively with affected homes and businesses to assist in their move to new accommodation.

9.15. In combination, these measures could add up to a comprehensive range of initiatives which exceed previous best practice and which recognise the appropriateness of compensating fairly those who would be most impacted by the new runway. The use of advance schemes to buy and leaseback specific properties early would allow those occupiers who are not able to meet their requirements in the normal operation of the market (such as those in affordable homes) to be re-provided with accommodation so that it is in place before they would need to move. The same approach to community facilities would ensure continuity of provision, so that community impacts are reduced. The inclusion of 'severed' property would also address community impacts, even though the properties are not directly affected. The provision of funds for the delivery of stalled housing sites or commercial floor space would not only

⁸ Risk contour based on the definition of CAA public safety zones, www.caa.co.uk

directly address the needs of affected parties, but also help to address the land use planning impact of the expanded airport.

10. Third runway: design principles

Major hub airports need to be able to deliver: safe and efficient operations; a high quality passenger experience; the capacity, hub infrastructure and minimum connection times (MCTs) to offer competitive connectivity; easy accessibility for passengers; competitive pricing and a reasonable balance of benefits and impacts for local communities.

10.1. We anticipate that all of our proposed options will be capable of delivering against key operating measures:

- a 'hub of choice' passenger experience, rated better by passengers than our European competitor hubs
- the capability for airlines to offer highly competitive intra-terminal MCTs of 45 minutes
- punctuality that matches or exceeds European competitor hubs.

10.2. To support delivery of these operational outcomes and wider objectives, an additional runway and associated infrastructure need to be:

- able to permit operating modes that offer meaningful respite to the surrounding communities
- far enough away from the existing runways to avoid constraining their current capacity
- parallel in direction to the existing runways to optimise the use of airspace
- long enough to enable the runway system to accommodate all the aircraft in the forecast schedule
- linked to the existing airfield by a taxiway system that can operate efficiently and safely, avoiding the need for aircraft to cross the centre runway
- supported by efficient, accessible terminal infrastructure.

We have developed our options against a series of detailed design principles to achieve these goals – as follows:

10.3. **Runway separation** – we have provided a minimum separation of 1,035 metres in the north/south direction between a third runway and the nearest existing runway. This accords with guidance given by the International Civil Aviation Organisation (ICAO), and enables us to optimise the capacity of the runways, as it allows twin independent departures or arrival streams on these runways. A lesser separation could lead to dependent operations with constrained runway capacity, in which the position of an aircraft on one runway or approach dictates the position of an aircraft on the adjacent one. On some schemes, we have increased the separation above the 1035 metres minimum where we have identified that this is beneficial (e.g. avoiding the flight path passing over a noise sensitive area).

10.4. **Runway length** – the existing runways at Heathrow are 3,751 metres (27L/09R) and 3,902 metres (27R/09L) long. The ideal length for the new runway is 3,500 metres. From this length, all currently anticipated aircraft types can take off – even on hot days – without payload restrictions. For landings, all aircraft types expected in the future Heathrow fleet can land on a 2,800 metres runway in all conditions. For runway lengths of less than 3,500 metres (down to 2,800 metres), some larger aircraft would have to be directed to one of the existing runways for take-off. This adds more taxiing movements on the ground and more track miles in the air in order to reposition aircraft. The result is a greater carbon footprint over the life of the airport, greater operating costs for airlines and the possibility that taxiway congestion may eventually impact on the effective capacity of the airport. For this reason, we have generally shown the new runway length at 3,500 metres.

10.5. At the same time, we recognise that there needs to be a careful balancing of the impact of the airport footprint with the needs of the surrounding communities, an issue that we will continue to explore in future stages of the development of the options (if they are short-listed). We have judged that the additional impacts of a 3,500 metre runway in our North option, removing most of Harmondsworth, are significantly greater and have therefore shown this as only 2,800 metres long. This may have an effect on the eventual runway capacity which may be closer to 700,000 ATMs rather than the 740,000 for the longer options.

10.6. **Runway operating patterns and respite** – we have made it a central tenet of our approach that all schemes which we propose at Heathrow, whether for short- or long-term solutions, should provide those living near the airport with periods of respite from overflight by any aircraft, with this respite distributed on as equitable a basis as possible.

10.7. We have developed runway operating patterns for both westerly and easterly operations which are rotated on a cyclical basis to allow all communities in turn a period of respite from any overflight. The following four patterns of operation are viable for a three-runway system:

Figure 9: Runway operating patterns

	1	2	3	4
Runway 1	DL	DL	D	L
Runway 2	L	D	L	D
Runway 3	D	L	DL	DL

Each runway has at least one D and one L mode of operation when reading horizontally across the patterns in order to ensure both arrivals and departures respite under the flight path for the runway

D = Departures mode, L = Landing mode, DL= Departures and Landing mode

10.8. We have not shown patterns with dual use on the centre runway as it would not be possible to make full use of the runway's capacity in this mode. This is because the missed approach procedure for landing aircraft on the centre runway would need to continue straight ahead whilst climbing, bringing the aircraft into potential conflict with an aircraft recently departed from the same runway. To resolve this potential

conflict, the aircraft would need to be significantly more widely spaced, leading to a decrease in runway throughput. By contrast, an aircraft on a missed approach to one of the outer runways can route to the north or south, diverging rapidly from a recently departed aircraft ahead and thereby avoiding any potential conflict.

10.9. **Runway capacity** – we have assumed maximum hourly runway capacities as follows:

Figure 10: Hourly runway capacities of a three-runway Heathrow

Runway 1	Runway 2	Runway 3 (in dual use)		
Arrivals	Departures	Dual use	Arrivals component	Departures component
38 per hour	42 per hour	48 per hour	Up to 28 per hour	Up to 28 per hour

10.10. We have reduced the landing and departure maximum capacities from today's scheduled limits of 44 landings and 46 departures to reflect anticipated growth in average aircraft size over time and to increase future operational resilience. Similarly, we have made a dual use runway capacity assumption of 48 movements per hour, which is about 10% less than other major dual use runways operating near to capacity today and reflects the larger average aircraft size in use at Heathrow. This provides a combined sustainable capacity for the three-runway system of 128 movements per hour.

10.11. **Future airspace operating procedures** - all our options require some changes in procedure approvals over today's operation. These range from simple changes, such as operating independent approaches and departures, to implementing more complex changes which have little reference in ICAO or other regulatory documents, but which NATS believes are possible to achieve in the timescales being considered. NATS identifies that future navigational accuracy will be key to several modes of operation. For example, where the centre runway is used for arrivals, a missed approach procedure will need to be devised to allow the aircraft to continue straight ahead. It is foreseeable that, by 2030, avionics technology and subsequent navigational performance will have advanced to a level where some of today's regulatory safeguards and restrictions, which currently ensure airborne separation, will not be required. To enable the operation of some of the modes proposed, the use of such advanced technology and flight paths would have to be matched by appropriate regulatory changes.

10.12. **Designing to reduce air noise impact** – we have designed an initial set of Standard Instrument Departures (SIDs) and Standard Terminal Arrivals Routes (STARs) that avoid heavily populated areas, yet allow optimal departures runway capacity by enabling early divergence (at 1-2 nautical miles) of aircraft in the departure stream from the same runway. This early divergence is critical for achieving the one-minute departures intervals that have been assumed in the calculation of potential throughput. Some routes have assumed high-performance SIDs for short-haul aircraft. We have explored the development of current operational practices to minimise air noise impact from

arriving aircraft using three methods have been employed.

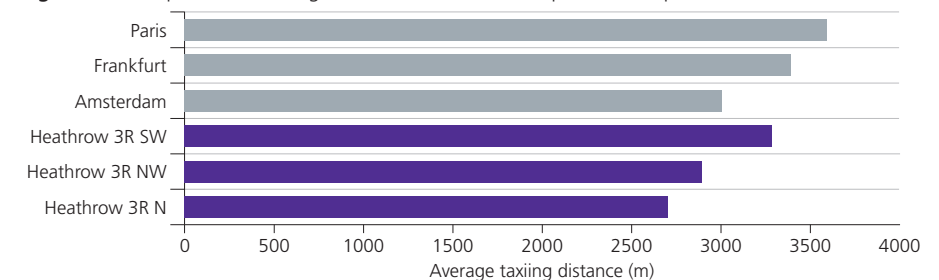
10.13. STARs have been designed which use steeper glide slopes than the currently standard 3 degree approach, thus placing aircraft higher over surrounding communities, particularly those at some distance from the airport.

Angled approaches have been investigated to a final 4.5 nautical mile straight-in final approach giving two benefits. Firstly, these angled approaches may be placed to avoid the most densely populated areas, and secondly there may be multiple angled approaches to one final approach, providing opportunities to provide further respite for those communities who currently find themselves underneath the 10 mile long existing final approaches.

Finally, we have considered the use of inseting the runway thresholds which moves the touch-down zone up to 600 metres further into the airport, again placing aircraft slightly higher over many noise affected areas. Whilst this work has been carried out in conjunction with NATS, who endorse the principles adopted so far and the results produced, SIDs and STARs are currently at a concept level and will require further work to reach the next level of navigational accuracy.

10.14. **Taxiways and Around The End Taxiways (ATETs)** – we have provided taxiways around the end of the central runway in all of our schemes. These ATETs allow aircraft to move to and from the third runway without crossing the live central runway. This allows unimpeded operation of the central runway at full capacity and reflects modern good practice in operational safety as it avoids the possibility of unintended runway incursion by crossing aircraft. We have therefore avoided all crossings of live runways in the operation of the airport, except for the few existing crossings to and from Terminal 4 where this is situated to the south of the southernmost runway. Aircraft operating to and from Terminal 4 generally use the closest runway when the operating mode permits, which reduces the potential number of crossings; this can continue in a three-runway airport. We have judged that there would be a disproportionate impact on local residential property if we sought to eliminate these few existing crossings by providing ATETs to and from Terminal 4. We have benchmarked average taxiing distances to the new runways against other European hub airports and this shows comparable or better performance.

Figure 11: Comparison of taxiing distances with other European hub airports



- 10.15. **The existing airport** – the masterplans for the options show the airport in its final 130 million passengers per annum configuration and include those upgrades to the existing two-runway airport necessary to achieve this, as well as the new infrastructure associated with the third runway itself. In the reporting of costs we have included those elements associated with the third runway, its taxiways and aprons, and the pier and terminal infrastructure required to serve it. We have not included the planned upgrading of the existing airport facilities in these costs.
- 10.16. **Apron sizing** – we have sized the aprons such that their capacity is in balance with the capacity of their associated terminal. This minimises the need to tow aircraft around the airport and consequently relieves traffic on the taxiways. We have developed a layout of aircraft parking stands and their associated piers which is at right angles to the runways (i.e. similar to the current Terminal 5 apron arrangement). This uses space as efficiently as possible within the airport boundary and minimises the additional land-take of the expanded airport. This arrangement also provides a highly efficient taxiway layout, avoiding the cul-de-sacs which are currently a feature of the older parts of Heathrow and which contribute significantly to current taxiway congestion and the negative impact on passenger experience. We have assumed the use of Multi Access Ramp System (MARS) stands, where two smaller aircraft can park on a larger stand, in order to meet the changing profiles in demand across the day.
- 10.17. **Terminal strategy** – a passenger processing strategy has been adopted with a preference for fewer, larger terminals. Such facilities provide greater efficiency (the processing power of a larger building is more than twice that of two buildings half its size); flexibility for dealing with the uncertainty inherent in the future shape of airline alliances; and the increased ability to maximise intra-terminal connectivity at the hub. This reduces connection times and improves passenger experience and choice of transfer destinations. To maximise public transport mode share, we have placed the terminals along the public transport spine (Crossrail, Hex, London Underground) between the existing runways.
- 10.18. **Other hub supporting infrastructure** – an effective global hub airport also requires well integrated systems for moving both baggage and passengers airside between planes in the shortest possible time – including the ability for transfer passengers to reach their departure gate without having to pass through the main terminal buildings. These systems create a competitive product for transfer passengers, giving both a broader range of transfer options within a shorter time window and a seamless passenger experience in a high quality environment. We have begun this investment in automated baggage and tracked transit systems in Terminal 5 and this will continue in Phase 2 of the new Terminal 2. The third runway infrastructure will extend these systems to the new airport areas and the capability for airlines to offer 45 minute intra-terminal and 60 minute inter-terminal transfer times on its completion.
- 10.19. **Ancillary areas strategy** – we have assumed at this stage that ancillary areas, including cargo and maintenance facilities, grow in line with annual passenger and ATM growth. Our strategy has been to make best use of the existing infrastructure and to allocate broad areas of land where additional space will be required for new

or displaced facilities. The detail within these areas, and their precise placement, has not been developed at this stage but we have considered it important to show the currently estimated quantum of these elements to avoid underestimating the land-take required.

- 10.20. **Surface access strategy** – see earlier, dedicated section.
- 10.21. **Land use strategy** – an expanded Heathrow would also be served by additional airport-related uses such as car parking, hotels, offices, industry, warehousing, and directly related support functions such as cargo and aircraft maintenance areas. The options in our report have not planned these areas in detail but have identified the quantity of land required for such facilities to ensure that we have fully understood the impact of airport growth. A detailed strategy would need to be developed for any preferred option, to optimise the exact scale and location of such facilities.
- 10.22. **Airport boundary** – we have defined the airport boundary with the aim of minimising the impacts on the surrounding communities while accommodating the demands of an expanded three-runway operation. Some of the key impacts we have sought to mitigate include residential property and community loss, important heritage sites such as Grade II* listed buildings/Scheduled Ancient Monuments and Special Protection Area (SPA) ecological sites. We will need to do more work to further optimise the boundaries of the shortlisted options and we will also take into account community feedback on the development of the runway design.

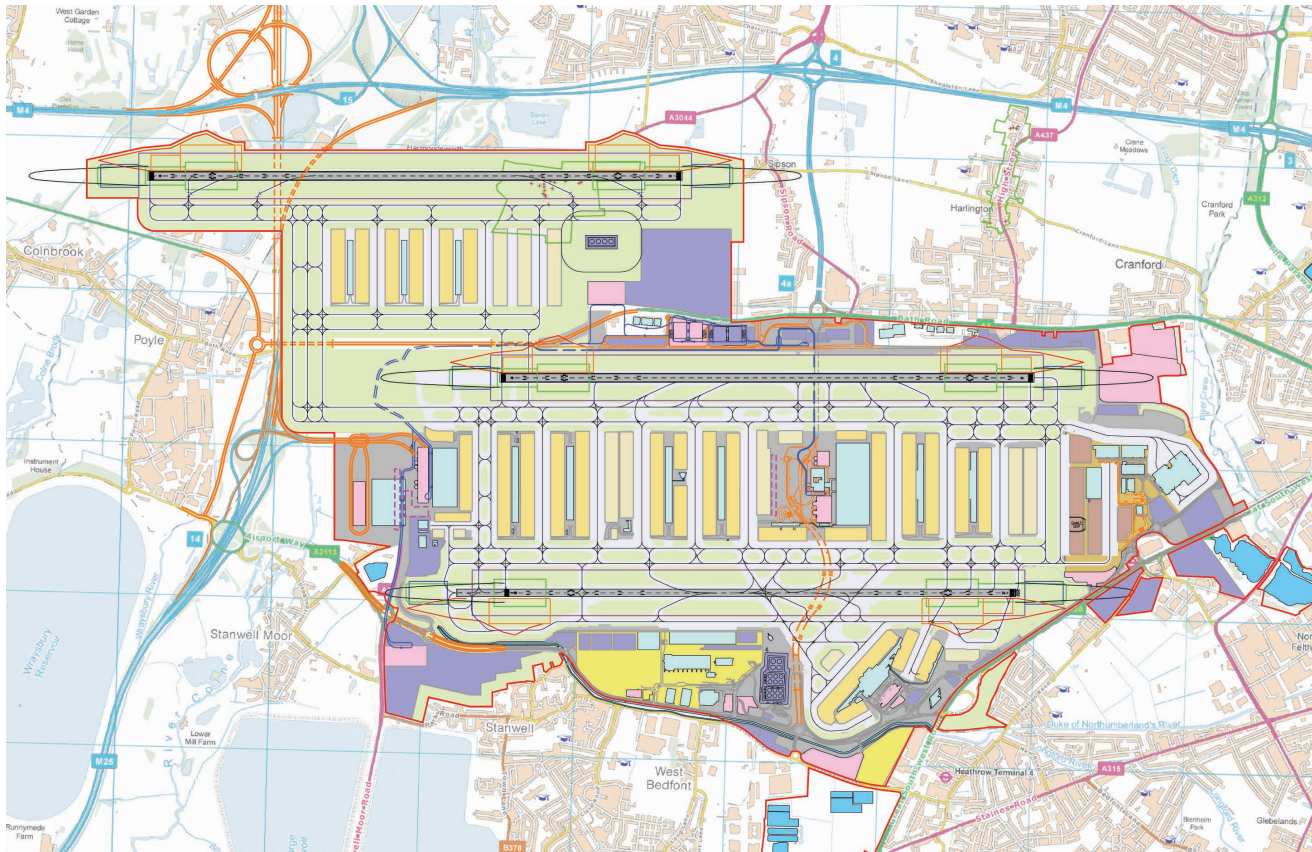
11. Third runway: proposed options

We are rejecting the previous proposal and are putting forward new options which balance the need for growth with the impact on local communities.

- 11.1. We are offering new thinking and new solutions:
- that will connect the UK to the growth it needs more quickly than any other option
 - that can meet the UK's long-term needs, not just the short-term
 - that will continue to reduce the total number of people affected by noise from Heathrow
 - that deliver periods of respite from noise for every community under a flight path
 - that can be delivered within the UK's climate change and air pollution limits.
- 11.2. We have considered a wide range of options for expanding Heathrow, in effect starting with a 'blank sheet of paper' and putting aside any preconceptions formed in the last exercise of this nature that we undertook in 2009/10 in response to the Government's Project for the Sustainable Development of Heathrow (PSDH) study.
- 11.3. The air noise issue has been a major shaping factor in our new thinking along with, in particular, Tim Leunig's paper on behalf of the Policy Exchange on the possibility of expanding Heathrow westward to potentially improve the noise impact over the densely populated areas of west London. Ideas like this have encouraged us to think broadly and to consider options beyond the context of the previous PSDH-based thinking.

- 11.4. Accordingly, we have looked at options in all four quadrants around the existing airport boundary, using variations on the north-south spacing of the new runway vis-a-vis the existing runways and also on the degree of east-west stagger. We have considered some options that relocate the existing runways as well as adding a third one, to capitalise as much as possible on the potential air noise benefits for west London of biasing the airport further west. In designing these options, we have born in mind how further expansion to a four-runway airport might be achieved were it to become required in the much longer term. From the long-list of options created we have carried out a selection process which has narrowed the third runway options down to three – taking into account the need to achieve a balance between operability, maximising hub capacity, and environmental / community impact.
- 11.5. The original PSDH option for a 2,200 metre long runway situated to the north of the existing runways does not feature in our proposed list of options. We do not believe this plan is a suitable answer to the question that the Commission is currently seeking to address – for the following reasons:
- **The loss of respite from aircraft noise for local people living under the third runway flightpath** – the short 2,200 metre runway length prevents the use of the third runway as a main departures runway, forcing its use either as a dual use runway or a landing runway and thereby ruling out landing respite under its flight path. This contravenes the principle which we are seeking to apply to all our options of providing respite to overflowed communities.
 - **Hub capacity and business case** – the short runway length constrains the total airport capability from 740,000 ATMs per annum to 670,000 – limiting the ability to maximise additional hub capacity from a three-runway airport, the PV benefit to the UK, and the competitiveness of the hub.
 - **Connectivity** – the short runway imposes payload constraints on aircraft using it, limiting the cargo potential of each movement and hence the ability of an airline to operate the route profitably. This potentially rules out marginal routes that rely heavily on cargo income to support the viability of the service and reduces the number of new markets that the UK can be connected to via its hub airport.
 - **Slot allocation rules** – airlines hold the grandfather rights to their slots at Heathrow and have the right to upgrade the size of the aircraft they use to service a slot as they require. The constraints of this runway length mean some slots would need designating as short-haul only – and no mechanism currently exists to facilitate this designation.
 - **Carbon footprint and air quality** – both taxiing on the ground and SID structures in the air become more complex in order to route short-haul aircraft to and from the northern runway. This leads to greater ground and air emissions – and the potential for taxiway congestion.
- 11.6. We have included the performance data for this option in the summary table – see Figure 19. This places our current options performance in the context of what was previously considered achievable.
- 11.7. Although much work has been carried out to date, the options we are presenting here are early studies in an on-going process of optimisation. This will continue to evolve in consultation with the local community and other key stakeholders if Heathrow is considered to be a potential option for the UK's hub airport. The described impacts are therefore a first level understanding of the likely effects and more detailed work would be needed to confirm these with more certainty and to support Strategic Environmental Assessment (SEA) if required. This is particularly true of commercial property impacts and, to some extent, residential property too where, without very detailed survey work, the available data can only yield a good approximation of the numbers involved.
- 11.8. If Heathrow is selected as a short-listed option following publication of the Commission's Interim Report, we will continue the process of refining appropriate plans during the next stage of the Commission process, during which we will seek to optimise the balance between hub capacity and environmental and community impacts at a more detailed level. This future work will include such issues as the need to closely test the precise length and location of the runways to minimise impacts and maximise operational benefit, plus detailed land use studies to determine disposition of airport support facilities, commercial and industrial areas, hotel facilities etc. All of these factors will affect the exact placement of the airport boundary line.
- 11.9. As an example of this further optimisation, we are already investigating a revised version of our North-West option which moves the new runway further south to its minimum spacing. This serves a double purpose – to allow the potential future addition of a fourth runway in the north-west and to minimise the impact of a third runway in that area. Initial analysis shows that this new third runway location will preserve the most important heritage sites in Harmondsworth – St. Mary's Church and its cemetery, the Tithe Barn and the village green and its surrounding properties and have considerably less residential property impact (600 as opposed to 950 properties). It would also avoid the need to rebuild the M4 / M25 junction. We intend to continue to explore this variation, which we have included in Appendix A, with our other option plans (entitled 3R North-West: Potential Optimisation) and will share this information as it emerges if requested to do so by the Commission.

11.10 North-West option



Objective

To place the new runway as far west as possible to reduce the impact of air noise over central London and to reduce the number of residential properties lost, while avoiding moving reservoirs and impacting on their associated Special Protection Area.

Location

- Sipson and Harlington are retained to the east, as are Colnbrook and Poyle to the west, but this option runs through the River Colne valley, also affecting a number of other adjacent watercourses. The expanded airport boundary requires the purchase and demolition of residential properties in Harmondsworth and Longford. The listed buildings of the Tithe Barn and St Mary's Church, Harmondsworth are also directly impacted and would require careful mitigation solutions, although an optimised version of this option may allow these to be retained.

Airfield

- Third runway length – 3,500 metres
- Separation from existing northern runway – 1,330 metres in order to align with the M4 corridor which contains fewer residential properties, thus reducing the noise impact
- Taxiways – linked to the existing airport using 'around the end taxiways' to the west of the existing northern runway, which permit the existing runway to operate independently and at full capacity.

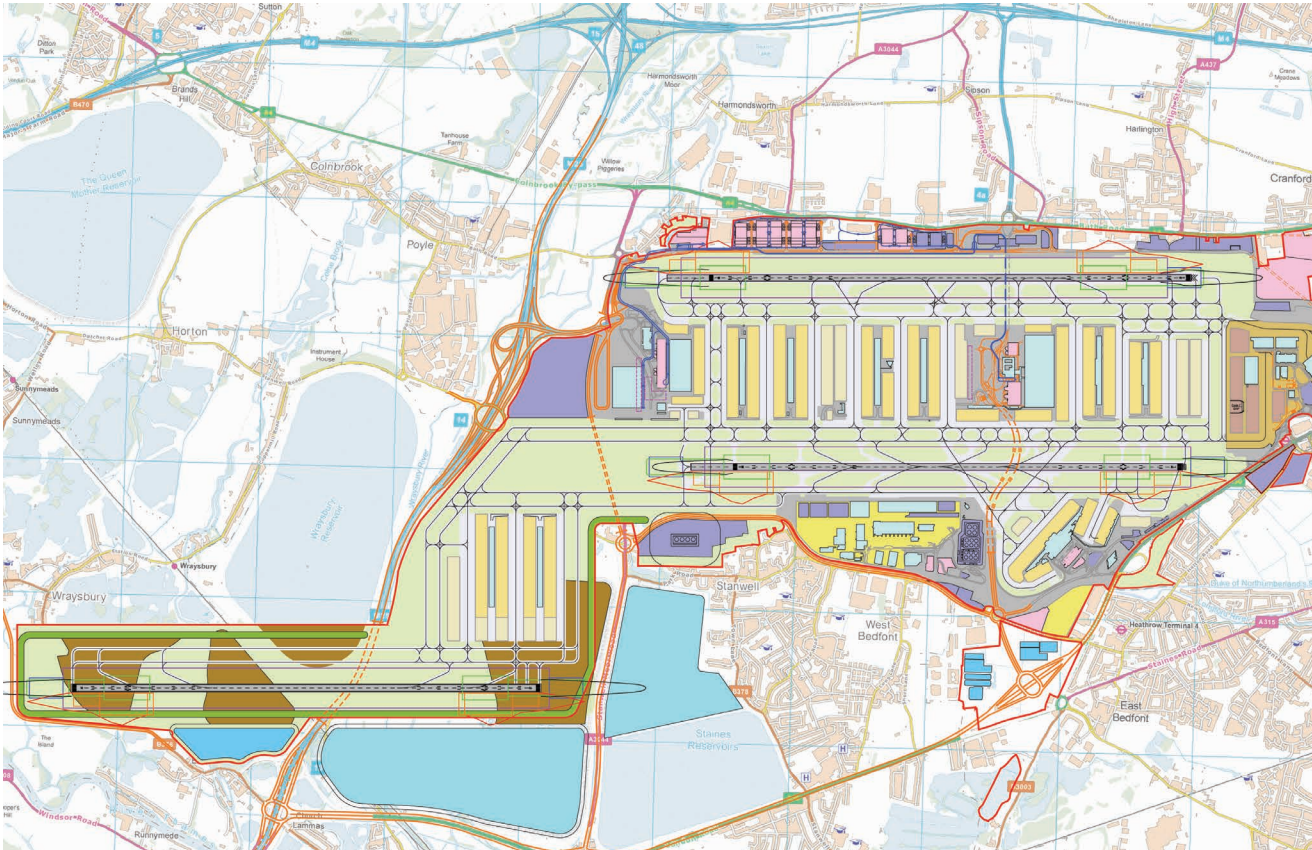
Terminals and aprons

- Terminal 5 (c30-35mppa) – continues to serve the existing Terminal 5 apron and piers (T5B and T5C)
- Terminal 6 (c20-25mppa) – a new terminal building to the west of Terminal 5 to serve the new north-west apron
- Terminal 2 (c55-60mppa) – terminal building is extended to the north of the Phase 1 building currently under construction, serving both the eastern apron within the current airport boundary and a redeveloped rectilinear apron on the old Terminal 3 site
- Terminal 4 (c10mppa) – continues to operate as it does today.

Land use and roads

- The M4/M25 motorway junction requires major reconfiguration to accommodate the third runway
- Car parking has been re-developed to the north of the A4 Bath Road and to the south-west of the airport
- Additional ancillary development has been zoned between the new runway and existing northern runway, as well as to the south-west of the existing airport.

11.11 South-West option



Objective

To place the new runway as far west as possible, to reduce the impact of air noise over central London and to minimise the residential property loss required by the airport boundary.

Location

- To the west of Staines Reservoir and between Wrybury to the north and the Thames river at Runnymede to the south. Although the expanded airport boundary requires the purchase and demolition of residential properties in Stanwell Moor, the overall residential impact of the option is relatively lower than other options. Impacts on the reservoir and the SPA would require compensatory replacement.

Airfield

- Third runway length – 3,500 metres
- Separation from existing southern runway – 1,650 metres, in order to reduce the impact upon Wrybury Reservoir and to avoid the Wrybury community, whilst avoiding the Thames river, Runnymede memorial site and high ground to the south
- Taxiways – linked to the existing airport using ‘around the end taxiways’ to the west of the existing southern runway, which permit the existing runway to operate independently and at full capacity.

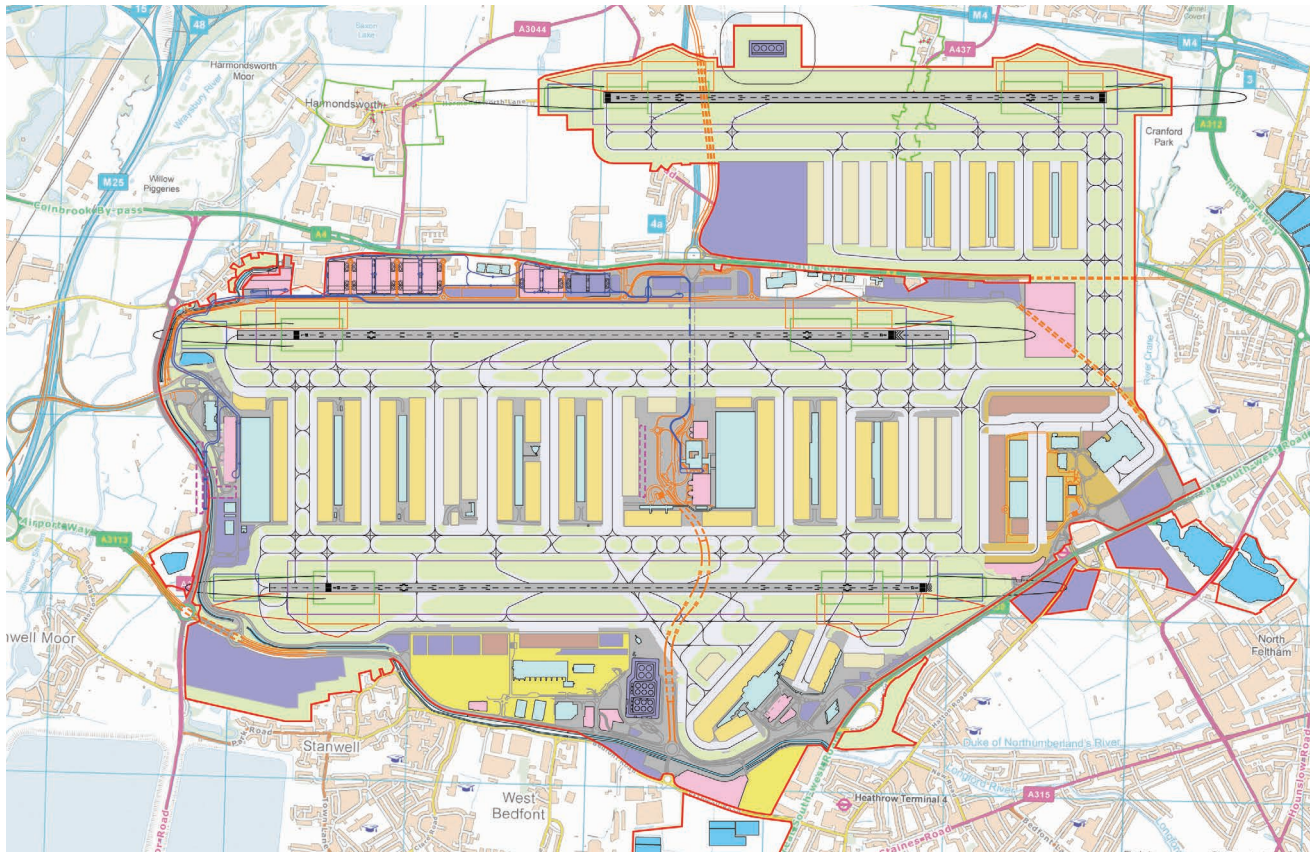
Terminals and aprons

- Terminal 5 (c30-35mppa) – continues to serve the existing Terminal 5 apron and piers (T5B and T5C)
- Terminal 6 (c20-25mppa) – a new terminal building to the west of Terminal 5 to serve the new north-west apron
- Terminal 2 (c55-60mppa) – terminal building is extended to the north of the Phase 1 building currently under construction, serving both the eastern apron within the current airport boundary and a redeveloped rectilinear apron on the old Terminal 3 site
- Terminal 4 (c10mppa) – continues to operate as it does today.

Land use and roads

- M25 motorway relocated in tunnel between Junctions 13 and 14 to pass underneath the third runway
- Wrybury and King George VI reservoirs require modifying or rebuilding. Staines Reservoir is retained but detailed analysis is required of the reservoir embankment height and the overall reservoir re-provision strategy
- Car parking has been consolidated along the A4 Bath Road corridor
- Additional ancillary development has been zoned to the west of Terminal 5 and to the south-west of the existing airport.

11.12 North option



Objective

To place the new runway where no disruption to the motorway network or reservoir infrastructure is required, while also attempting to minimise the impact on important heritage sites.

Location

- Harmondsworth can be retained to the west, avoids the River Crane to the east and enables listed buildings such as St Mary's Church, Harlington and St Dunstan's Church, Cranford to remain. The expanded airport boundary requires the purchase and demolition of residential properties in Sipson and Harlington.

Airfield

- Runway length – 2,800 metres, because of the impact a 3,500 metre runway would have on Harmondsworth
- Separation from existing northern runway – 1330 metres, to align it with the M4 corridor which contains fewer residential properties, thereby reducing the noise impact. This could potentially be reduced further in future optimisation, which would reduce the impacts on both Harlington and Cranford Park
- Taxiways – linked to the existing airport using 'around the end taxiways' to the east of the existing northern runway, which permit the existing runway to operate independently and at full capacity.

Terminals and aprons

- Terminal 5 (c50-55mppa) – extended to the south and serving an expanded western apron built over the redeveloped Terminal 3 site
- Terminal 2 (c60-65mppa) – extended to the north of the Phase 1 building under construction, serving both the eastern apron within the current airport boundary and a new apron to the north
- Terminal 4 (c10mppa) – continues to operate as it does today.

Land use and roads

- M4 spur to be realigned into a tunnel underneath the new third runway
- Car parking has been consolidated along the A4 Bath Road corridor
- Additional ancillary development has been zoned between the new runway and existing northern runway as well as to the south-west of the existing airport.

12. Third runway: environmental and local community assessment

These are the initial results of our environmental analysis of our options. We will continue to improve their performance through subsequent stages if short-listed, particularly through engagement with local communities.

- 12.1 In Section 5 we set out our overall approach to developing Heathrow sustainably: seeking to avoid impacts on local communities and the environment wherever possible; minimising any impacts where this is not possible; and, where impacts are unavoidable, providing appropriate mitigation and compensation. Section 5 also set out our overall approach on four of the most significant issues related to airport expansion: noise, local communities, air quality and climate change.
- 12.2 This section sets out our approach to meeting these objectives in relation to the three masterplan options described previously in Section 10. Recognising that all modelling brings inherent uncertainties, we have provided ranges of impacts where appropriate.

Noise

- 12.3 As outlined in Section 5, we set three main noise objectives to guide the development of options for adding capacity at Heathrow:
- to reduce the number of people affected by noise from Heathrow during the day and at night
 - to provide periods without overflight for all communities around the airport (known as 'respite')
 - to limit noise levels in homes and community buildings through sound insulation schemes.

In this section we provide our initial analysis of the noise performance of each masterplan option.

Assessment methodology

- 12.4 To assess the number of people affected by noise during the day, we have used the Summer 57dBA Leq contour as our primary measure, as this is the current UK Government preferred metric. We have also assessed noise using the 69dBA Leq contour, which measures areas exposed to high levels of noise. To assess those affected by noise at night, we have used the 48dB Lnight 6.5 hour contour, the metric used by the Government for describing the impact of flights during the night quota period from 11:30pm to 6am.
- 12.5 To produce noise contours, we have used the latest available version of the US Federal Aviation Authority's 'Integrated Noise Model' (INM 7dB). We have developed the standard INM model to better reflect operations and conditions at Heathrow, in particular basing our set-up on analysis of existing flight track performance data for aircraft types. INM is different to the ANCON⁹ model used by the CAA to calculate the annual noise contours and strategic noise maps for Heathrow. Consequently, the two models will not produce outputs of exactly the same magnitude. However, we would expect trends identified to be consistent. As a result, we have presented the

results in terms of percentage change to avoid future confusion in comparing outputs from different models.

- 12.6 We have compared future noise levels of Heathrow to those in 2011, the latest year for which official CAA noise contours for Heathrow are available. To ensure that we are comparing like for like, we have derived noise contours for Heathrow for 2011 using INM (the last year for which the CAA have published the airport's annual contours). It is important to note that the population change is related to the latest available figures and does not account for any population growth, or noise-sensitive development, within Heathrow's noise footprint.

Performance

- 12.7 **Reducing the number of people affected by noise during the day and at night**

The table below shows the changes in the area and population within Heathrow's noise contour relative to today, using the standard Government metric (57dBA Leq 16 hour summer day) and also the metric used to measure high levels of noise (69dBA Leq).

Figure 12: Changes in air noise impact by 2030

Runway option for 2030/100mppa	Package of noise reduction measures	57dBA Leq noise exposure contour		69dBA Leq noise exposure contour	
		Area % change from 2011*	Population % change from 2011*	Area % change from 2011*	Population % change from 2011*
3R NW 2030	Baseline measures	4%	-15%	-19%	-45%
	Further operational procedures	-11%	-30%	-33%	-75%
3R SW 2030	Baseline measures	5%	-21%	-20%	-71%
	Further operational procedures	-11%	-37%	-34%	-90%
3R N 2030	Baseline measures	4%	-10%	-18%	-63%
	Further operational procedures	-12%	-29%	-33%	-82%

- 12.8 In terms of the area within the 57dBA Leq noise contour in 2030, the range is from 5% larger to 12% smaller than today. In terms of population, the level of reduction is more substantial. Based on the 'baseline' noise strategy in Section 6, there are between c.10 and 20% fewer people within the noise contour. With optimum operating procedures in addition, this figure rises to over 30%. The above population data also illustrate the benefit of locating a new runway further to the west. The North-West and South-West runway options reduce the number of people exposed to noise by around 5% and 10% respectively compared to the North option.

⁹ ANCON is not available to use by others than the CAA. INM is a proprietary product developed by the US FAA and is generally recognised internationally as the de facto standard for noise modelling. All modelling has been conducted in accordance with relevant international standards.

12.9 Reductions in both the area and population within the 69dBA Leq contour are more significant, as they benefit particularly from the introduction of quieter aircraft.

The table below shows the changes in the area and population within Heathrow's night noise contour relative to today, based on the metric used by the Government for describing the impact of flights during the night quota period (11:30pm to 6:00am).

Figure 13: Changes in night noise impact by 2030

Runway option for 2030/100mppa and package of noise reduction measures	Area within the 48dB Lnight 6.5 hour noise exposure contour (% change from 2011)*	Population within the 48dB Lnight 6.5 hour noise exposure contour (% change from 2011)*
3R NW 2030 baseline technology and procedures	-53%	-77%
3R NW 2030 baseline + additional procedures	-64%	-85%
3R SW 2030 baseline technology and procedures	-55%	-77%
3R SW 2030 baseline + additional procedures	-65%	-86%
3R N 2030 baseline technology and procedures	-53%	-76%
3R N 2030 baseline + additional procedures	-64%	-84%

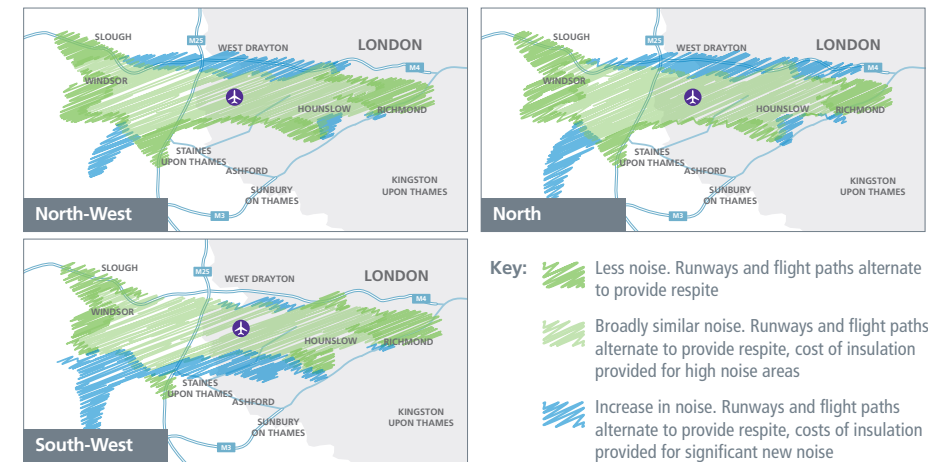
12.10 In terms of both area and population within the night noise contour in 2030, the combination of quieter aircraft and operating procedures results in a significant reduction. Based on the 'baseline' package of noise reduction measures in Section 5, there are over 75% fewer people within the noise contour. With optimum operating procedures in addition, this figures falls by a further c.5%. The two main drivers of this change are the continued introduction of quieter aircraft, and on-going improvements to 'operate the airport to a plan'.

12.11 We have also assessed the 55dB Lden noise contour, a composite metric for day and night noise which is the standard European measure. Given that the 55dB Lden contour has a larger area than the other metrics used above, the results for the number of people within the contour are more sensitive to the exact design of approach routes to the airport. As significant further work would need to be done to develop those routes, we have not included data on the 55dB Lden contour in this submission. However, our initial results indicate that a combination of new aircraft and operational procedures, as well as optimised approach routes to avoid more densely populated areas and no late running departures, together offer the opportunity of significant reductions in the number of people within this contour of around 20%, with reductions in area of up to 30% compared with 2011.

12.12 On balance, although more people experience a reduction of noise levels than an increase, some people will experience more flights than today. Our overall strategy aims to alleviate those impact by providing times without overflight (known as 'respite') for all communities around the airport, and by providing noise insulation to homes and community buildings exposed to high noise and/or to significant new

noise. The Figure below provides an illustration of how in patterns of noise change around the airport. The following paragraphs provide further information on respite and insulation.

Figure 14: Changes in patterns of air noise



Providing periods of respite from noise

12.13 Our operating plan for the airport seeks to maximise respite for all communities around the airport by providing a regular pattern of runway alternation. We have identified runway operating patterns for both easterly and westerly operations which we would plan to alternate on an even basis (see Section 9.6 for more information). We are currently investigating ways to help describe, in the most accessible way possible, what the changes outlined in this paper could mean for residents around the airport.

12.14 Studies are underway to establish the value of respite to local communities, and we propose to investigate options for implementing the most appropriate means to deliver the maximum respite possible. This could include respite through rotation of airspace routes, in addition to the runway rotation.

12.15 We plan to operate only one runway for the small number of flights operating between 11pm and 6am. This means that local residents will benefit from significant breaks between nights when they experience night operations.

Noise from aircraft on the ground and surface access

12.16 We have assessed the area and population exposed to noise from aircraft operations on the ground, and from surface access to and from the airport.

12.17 Ground noise generated by aircraft will affect no more properties than those which are already significantly affected by air noise. However, we still propose mitigation to reduce the impacts of noise generated by aircraft operations on the ground. The measures that we will take include strategic placement and design of acoustic bunding or fencing and the use of Fixed Electrical Ground Power (FEGP).

12.18 Although population exposure to surface access noise is likely to reduce, for options requiring new junctions and road re-alignments, there will be a number of properties which will be affected. The steps we will look to incorporate, to limit and reduce road traffic noise for these properties, will include the building of cuttings, road side barriers / bunding and the use of quieter road surfaces.

Beyond 2030

12.19 We have assessed the noise effects of a three-runway airport operating at a higher capacity (130mppa by 2040). The Sustainable Aviation Noise Road-Map projects a central case rate of improvement of 0.1dB per year in aircraft technology over the period 2030 to 2040. Based on the continued development and deployment of quieter technology, we estimate that the reductions in the number of people affected by noise achieved in 2030 can be maintained to 2040.

Air quality

- 12.20 In developing options for adding capacity at Heathrow, we have undertaken a dispersion modelling assessment to enable us to quantify the air quality considerations of each of the potential runway options and assess whether we can deliver additional capacity at Heathrow while meeting air quality limits.
- 12.21 Our mitigation strategy demonstrates that emissions from aircraft/airside operations and, local surface access associated with an expanded Heathrow, can be reduced. Our on-going role in supporting our partners on major transport projects, and improving other local transport infrastructure and services, will also lead to wider improvements in local air quality and support the local authorities in terms of meeting their obligations to achieve air quality limits across the boroughs.
- 12.22 Despite some current exceedences of the NO₂ limits around Heathrow that are contributed to by both airport and non-airport sources, air quality is forecast to improve in the future. As such, by 2030 we are confident that with our proposed air quality strategy and package of mitigation measures, we can deliver additional capacity at Heathrow while meeting air quality standards.
- 12.23 We have also assessed the air quality effects of a three-runway airport operating at a higher capacity (130mppa by 2040). Our modelling shows that the additional emissions from an increase in aircraft movements are offset by reductions in emissions from other local sources that are forecast from 2030-2040; the air quality limits are not compromised.

Climate change

12.24 In this section we provide data to demonstrate that our options meet Government climate change policy and align with long-term carbon commitments. This section also covers other sources of emissions, including embodied emissions, vehicles (both airside and for passenger/staff travel to and from the airport), and the generation of energy.

Emissions from flights

12.25 By 2030, a three-runway Heathrow operating at 100mppa would generate 26 million tonnes of CO₂ from aircraft operations if technology were 'frozen' at today's levels.

Assuming improvements in carbon efficiency of aviation to 2050 in line with those of Sustainable Aviation, these emissions are forecast to be around 17.6 million tonnes by 2050. This compares to 18.8 million tonnes in 2010 calculated by the DfT in its latest CO₂ forecast.

- 12.26 Limiting the UK's net aviation emissions to those of 2005 (37.5 million tonnes) by 2050 has been proposed by the Committee on Climate Change as a prudent planning assumption consistent with meeting UK climate change policy commitment enshrined in the 2008 Climate Change Act. Our analysis shows that, on a gross basis, Heathrow's percentage of the UK's 2005 emissions in 2050 will be between 47% and 53% depending on its future capacity which compares to 50% in 2010.
- 12.27 We acknowledge that alternative forecasts on future carbon efficiency of aviation exist, including those from the Committee on Climate Change, which could imply higher carbon emissions in 2050 than those presented here. However, these would not be such as to breach the Committee's own planning assumption. As we outlined in our response to the Commission's paper on climate change, even with more pessimistic assumptions on future carbon efficiency, it is possible to accommodate the Government's forecasts of 'unconstrained hub demand' within the Committee's prudent planning assumption. Furthermore, should an international agreement on aviation be agreed covering UK international aviation, then it is the level of the cap agreed that will govern UK aviation's net emissions, rather than future carbon efficiency of the industry.
- 12.28 Finally, analysis by Frontier Economics demonstrates that on economic value added per tonne of carbon, the value from Heathrow flights is twice as high as from other UK airports.¹⁰

Embodied carbon

12.29 With approximately 60% of the proposed three-runway airport infrastructure already in place, and with Heathrow already supporting just under 480,000 ATMs annually, much less new infrastructure would be needed than for a new or even a smaller existing airport. This means much less new embodied carbon (the carbon dioxide emitted at all stages of the construction process) would be associated with our construction than would be the case elsewhere. It is our view that, depending on the specific design, a new terminal building could result in between 11Kt and 100Kt of CO₂. Any new runway and associated taxiways would result in approximately 60Kt.¹¹ Surface access infrastructure would result in CO₂ emissions of (all numbers approximate¹²) of: 1.3Kt per kilometre for new roadways; 10Kt per road bridge per kilometre (tunnels have even higher rates); 1.9Kt per kilometre for rail links; 2.5Kt for each rail bridge. We are therefore confident that Heathrow's embodied carbon in existing infrastructure provides significant additional carbon efficiencies relative to other hub capacity options where increased development is required.

¹⁰ Frontier Economics (2011) The impact on the UK economy of reducing carbon emissions in aviation. www.heathrowairport.com/mediacentre

¹¹ Sansom M. & Pope R. J. (2012) A comparative embodied carbon assessment of commercial buildings, The Structural Engineer Research, October 2012

¹² <http://www.transportscotland.gov.uk/stag/td/Part2/Environment/7.4.2.7> (note that four lanes assumed for roadways and dual track assumed for rail)

Carbon from surface access

12.30 Heathrow is within easy reach of populations in London and surrounding areas being positioned just 12 miles from the 'demand centroid' for south-east air passengers. Over 16 million people live within a one-hour journey time, including 6 million within one hour by public transport. This excellent location brings with it potentially significant carbon savings when compared with other potential hub locations. In addition it is already served by a choice of well-established public transport types (fast and frequent rail services into London, provided by Heathrow Express, Heathrow Connect and the Piccadilly Line, as well as the busiest bus and coach hub in the UK). It is also extremely well located in relation to the strategic highway network with direct access from the M25 and M4, as well as being within 10 miles of the M40 and M3. With relatively little intervention in the public transport offer compared to other proposals, new connections could bring over 3 million more people within a one-hour public transport journey of the airport. Furthermore, through expansion we would put in place a series of measures to increase the public transport mode share from today, where just over 40% of passengers use public transport and 35% of employees use sustainable travel modes, to 50% or more for both. Of course, the higher proportion of public transport mode share we achieve, the bigger the carbon savings we will make.

Carbon from energy use in buildings

12.31 All new buildings developed as a result of the expansion plans will be zero carbon. As a result of this, and the introduction of a series of other energy-saving measures for energy, waste and water, the energy consumption and, therefore, energy generated CO₂ at the airport, will be subject in 2030 to around a 70% reduction from today when we predict the airport will be serving approximately 100mppa.

12.32 In addition, our assessment shows that even as the airport grows to serve 130mppa in 2040, because of advancements in technologies, CO₂ emissions per passenger from fixed energy will fall from 2030 figures. The measures we will implement to reduce energy include the use of: smart buildings and AM&T; Heathrow smart grid; thin film photovoltaics; energy efficient baggage handling; night time purging (via high level louvres); liquid desiccant cooling; Lakeside EfW Plant waste heat utilisation and district heating; ground source heat pumps; and combined heat and power.

Figure 15: Predicted CO₂ impacts

Key Indicator	Impacts in 2030 and 2040		
	North-West	South-West	North
Million tonnes CO ₂ p.a. from surface access (staff and passengers)	2030: 0.75	2030: 0.75	2030: 0.75
	2040: 0.73	2040: 0.73	2040: 0.73
Million tonnes of CO ₂ p.a. from energy used at the airport	2030: <0.1	2030: <0.1	2030: <0.1
	2040: <0.1	2040: <0.1	2040: <0.1

People

Residential property loss

12.33 The table below sets out the numbers of residential properties lost for the three-runway options:

Figure 16: Residential property impact

Key Indicator	Impacts in 2030 (numbers are approximations based on current outline designs)		
	North-West	South-West	North
Number of residential properties lost	950	850	2,700

12.34 Limiting and compensating for the loss of residential property is one of our key challenges. We have developed layouts that reduce the number of residential properties that would be lost as a direct result of the new development. If Heathrow is short-listed as a location for expansion, significant further work will need to be undertaken, in consultation with the local community. It is likely that further refinement will reduce the numbers shown above. A compensation package for those communities directly affected will be put in place, which ensures that they are fully and fairly compensated in a sensitive and timely manner, as outlined earlier in this document.

Impacts to health, quality of life and vulnerable groups

12.35 We have already undertaken a high-level health study which concluded that the development of Heathrow could have both positive and negative effects on health and local people's quality of life.

12.36 There is good evidence linking employment and a strong economy to improved health and life expectancy. A positive effect of expansion at Heathrow is therefore the generation of employment and economic benefits. This includes increased employment opportunities in the local area, which also strengthens local communities and supports local public services. It also includes indirect employment and economic benefits in the regional and national economy, as outlined in Section 3. In terms of quality of life, maintaining and developing the UK's global connectivity contributes to maintaining networks of interpersonal relationships in an increasingly globalised world.

12.37 Increases in noise, physical impacts through loss of properties and changes to the physical nature of communities are some of the negative impacts that could affect the health and quality of life of some communities close to the airport.

12.38 However, comparing these positive and negative impacts is not straightforward: they can affect different geographic areas and have different timescales; the metrics used to measure them are different; and there are different degrees of certainty over the impacts.

- 12.39 Overall, our options have sought to maximise the positive impacts of development at Heathrow and to minimise the negatives, in particular by reducing the number of people affected by noise and by meeting air quality limits. We are committed to continue to examine the health effects of our options and plan to prepare a detailed 'Health Impact Assessment' on any Heathrow option that is short-listed.
- 12.40 Furthermore, before any expansion occurs, we propose to assess and benchmark the quality life of communities that live in and around the airport. This will inform a series of strategies and programmes that will aim to address any potential impacts to quality of life. Our aim will be an enhanced quality of life for those that live locally to Heathrow.
- 12.41 Also note that all strategies and programmes will be developed in consultation with appropriate, expert and independent stakeholders. We will be guided by their recommendations which will help ensure that the strategies we put in place are relevant and do all they can to address all local people's health and quality of life needs.
- 12.42 We also understand that there are various groups of residents who could be disproportionately affected both directly and indirectly, by the expansion of Heathrow. These include the elderly, the young, the infirm and the deprived, all of whom are often less mobile, are more dependent on local service provision and can have more complex needs. We are committed to understanding exactly how such vulnerable groups may be affected and propose to implement strategies to address any effects that may occur. We will do this while working closely with relevant stakeholders who will ensure that the measures we take are most appropriate and are targeted specifically at the vulnerable group in question. If Heathrow options are short-listed, the quality of life of remaining communities around the airport will be benchmarked. We will then undertake an assessment to inform a series of strategies and programmes to address any impacts that are identified against the benchmarked baseline. These will be developed in consultation with user groups and providers.

Other environmental effects: designated sites/other biodiversity, water courses and flood zones, built heritage

12.43 Our assessment of other environmental effects has focused on determining the direct and indirect effects on designated sites protected by statute for biodiversity/other biodiversity, Water Framework Directive protected watercourses and flood zones, and losses/impacts to built heritage features. We recognise that there are other environmental considerations, for example impacts on landscape resources. However, we believe, based on our research so far, that none are so significant that they would influence the Airport Commission's decision-making process at this stage.

Figure 17: Other environmental effects

Key Indicator	Impacts in 2030 and 2040		
	North-West	South-West	North
Area (ha) of designated land directly affected	0	716	0
Volume (m3) of flood zone storage lost	116,000	1,416,000	6,000
Amount (km) of WFD watercourse affected	10.4	11.4	0
Number of Grade I & II* buildings lost	2	0	0
Number of Grade II buildings lost	29	8	16
Number of scheduled ancient monuments or registered historic parks and gardens lost	0	2	0

Designated sites/other biodiversity

- 12.44 We believe that neither the North-West nor the North options would be likely to significantly affect the integrity of any statutory designated sites. However, development of the South-West option could lead to a loss of integrity of part of the South West London Waterbodies Special Protection Area (SPA) and Ramsar site (sub-sites of which are also Sites of Special Scientific Interest). This collection of SPA components, measuring 716 hectares in total, is often referred to as the 'Wraysbury Complex'. The loss of complex integrity would occur as a result of both direct habitat loss and indirect habitat disturbance caused by increased air traffic movements and the potential need to implement bird strike control measures.
- 12.45 For the South-West option we understand that the scale of direct and indirect habitat loss to the South West London Waterbodies would require compensation at a scale that is currently unprecedented in the UK. However, our research has shown that the creation of a new wetland complex 'off-site' to compensate for the impacts caused to the South West London Waterbodies, provides a significant opportunity to create a far richer and more complex ecological network of freshwater and associated habitats than that which currently exists at the SPA. This is because the SPA appears to be currently compromised by other uses, particularly recreation. Any new site we were to construct would be at least as large as that which is to be lost. It would also be designed specifically to support the important birds that currently inhabit the SPA (unlike those that currently form the SPA which were built for other functions namely water storage and as a product of mineral extraction) and would be managed in perpetuity for wildlife only. In addition, because the waterbodies that are lost are man-made, an enhanced resource could be recreated much more easily than would be the case if the site lost were more natural.

- 12.46 The cost to create such a wetland complex has been calculated and included within our costings by benchmarking construction costs against similar (albeit smaller) schemes, and including a cost for the purchase of agricultural land upon which the site would be built.
- 12.47 We consider that significant impacts to the integrity of other designated sites that occur within the vicinity of Heathrow (e.g. Windsor Forest and Great Park SAC, Richmond Park SAC) are unlikely to occur as a result of development of any of the options. However, further detailed consideration will likely be needed at a later stage.
- 12.48 In addition, we believe that no other biodiversity issues would occur as a result of the development of any of the options we propose that could be a significant influence in selecting the site for the hub airport. We recognise that mitigation/compensation measures for impacts to protected species or locally designated sites will be required. However, no issue we believe based on the research that we have already undertaken is likely to result in any option being deemed unfeasible. Our ultimate aim will be, in line with policy, to ensure that the development ultimately makes a positive contribution to biodiversity.

Water courses and flood zones

- 12.49 Development of the North-West or particularly the South-West option will require significant levels of mitigation and/or compensation to ensure that Water Framework Directive and flood risk storage requirements are met. We have undertaken an assessment and developed a high level mitigation/compensation strategy which leads us to believe that this is achievable through the:
- creation of new channels and by increasing the capacity of existing channels to allow watercourse diversions
 - provision of new compensatory flood storage and flow/flood control structures
 - introduction of measures to ensure no deterioration of WFD waterbody status and to ensure continuation of flow through every catchment.
- 12.50 Our strategy has been costed and these costs have been benchmarked against other schemes and Environment Agency guidance.
- 12.51 Our aim will be to ensure that our mitigation/compensation options lead to an enhanced water environment. Particularly we will look to: improve flood risk condition by designing the storage areas to hold additional volumes to that specifically needed for compensation only; and incorporate landscape and water-sensitive design features including amenity open space, areas for biodiversity and for outdoor sports and recreation.

Heritage

- 12.52 In heritage terms the South-West option is likely to have least impact on important built heritage assets. North-West has the greatest direct effect because it results in the total loss of the Harmondsworth Conservation Area, which includes two Grade I/II* buildings - the Grade I Harmondsworth Barn and the Grade II* St Mary's Church. Both are significant community and heritage assets.

- 12.53 The South-West and North options may have additional setting impacts on important built heritage assets, especially as a result of increased air noise. In particular Grade I and II* churches that otherwise avoid direct loss may experience effects that compromise their viability as places of worship, amounting to substantial harm and resulting in an uncertain future. For the South-West option this effect is limited to a single church at Wraysbury, but the North option could affect up to four Grade I and II* assets at Harmondsworth, Harlington and Cranford Park. These effects may warrant similar mitigation measures to those proposed for assets subject to total loss.
- 12.54 We are proposing mitigation that focuses on managing change to sustain heritage significance. This may not always ensure physical preservation or the retention of all historic buildings in their current location and our priority is strengthening viable uses for particularly significant heritage assets. Some assets already face an uncertain future and airport expansion plans could secure a more viable use, or support wider community needs, through their relocation to other places. For instance, Harmondsworth Barn, might be suitably relocated to an established local rural museum dedicated to the preservation and public presentation of threatened buildings. Similarly, growing Anglican, non-Anglican and non-Christian religious congregations, especially those associated with London's urban ethnic minority communities, have need for suitable faith buildings and a relocated church could become such.
- 12.55 The options we are presenting here are early studies in an on-going process of optimisation. If Heathrow is selected as a short-listed option following publication of the Commission's Interim Report, we will continue the process of refining appropriate plans during the next stage of the Commission process. This future work will include such issues as the need to closely test the precise length and location of the runways to minimise impacts and maximise operational benefit. As an example of this further optimisation, we are already investigating a revised version of our North-West option which moves the new runway further south to its minimum spacing. Initial analysis shows that this new third runway location will preserve the most important heritage sites in Harmondsworth – St. Mary's Church and its cemetery, the Tithe Barn and the village green and its surrounding properties and have considerably less residential property impact (600 as opposed to 950 properties).

13. Third runway: costs

The cost of a third runway at Heathrow is estimated to range from £14 –18 billion. Options that place the runway further west, in order to mitigate air noise effects, attract greater cost due to the impact on the surrounding motorways and reservoirs.

- 13.1 Heathrow offers the fastest, most cost-effective and most practical route to meeting the UK's international connectivity needs. A third runway can be delivered at less cost to the taxpayer than building a new hub airport.
- 13.2 The options for a third runway that we are putting forward could be delivered from 2025-2029 for £14 -18 billion (varies by option). This compares favourably with a new Thames Estuary airport which we do not believe could be operational before 2034 and which its promoters admit could cost £70–80 billion, of which at least £25 billion would need to be funded by the taxpayer. More new runways, more new terminals and more new road and rail links would be needed at a new airport than at Heathrow.
- 13.3 Adding capacity at Heathrow avoids the transition costs of moving to a new airport. The developers of a new hub airport would need to compensate the owners of Heathrow, airlines and airport companies, as well as build new towns, schools, and hospitals to service the new airport's workforce.

Approach

- 13.4 We have taken a pragmatic, but thorough approach to analysing the capital costs of the options for delivering the third runway which appropriately reflects the level of detail to which the options have currently been developed. Cost consultants have produced single point estimates based on appropriate benchmarks: on-costs and internal costs have been included; inflation has been excluded as this would be adjusted within the future business case model; the cost base date is 2013; and risk has been included at 15%.
- 13.5 Airport infrastructure and building costs have been calculated at a facility level and have been benchmarked in line with the principles agreed in the current regulatory review of Heathrow's capital efficiency. These reflect a quality of construction and finish commensurate with the new Heathrow environment demonstrated by Terminal 5 and Terminal 2. While acknowledging that future innovation in design and procurement has the potential to reduce costs, our assessment has taken a robust position and not applied a reduction on this basis at present.

Off-airport infrastructure

- 13.6 We have estimated highways and motorways at a facility level and benchmarked them against current schemes using the Highways Agency cost database. Rail has been estimated at a facility level and benchmarked against the High Speed 2 project numbers. Reservoir estimates have been built up from elemental level based upon current data from other reservoir schemes in the south east.

Scope

- 13.7 The capital costs quoted are for all infrastructure necessary to support the third runway both inside and outside the airport boundary. We have grouped them into the following four categories:
 - Airport**
 - 13.8 **Infrastructure to serve the third runway** – the cost estimates include providing the following facilities associated with the third runway: demolitions; earthworks; enabling works; runway; taxiways; apron area and aircraft stands; pier buildings; terminal capacity; underground tracked transit system; baggage systems connecting pier buildings to the terminal and also to the existing airport facilities; airside and landside access roads; multi-storey car parks; balancing ponds; ancillary and maintenance areas; an additional control tower and navigational equipment; plus the extension of heavy services to the new airport area including fuel mains, fire mains, storm water, high voltage network and sewers.
 - 13.9 **Infrastructure to upgrade the current airport** – if areas are displaced, demolished or reconfigured to provide the third-runway infrastructure, allowance has been made for asset replacement costs and refurbishment of the existing Heathrow facilities within the numbers quoted here. We have not included the cost of the current plan for upgrading the facilities within the existing two-runway airport in these costs.

Surface access

- 13.10 **Roads, highways and motorways** – the costs include modifying and extending the existing road network including tunnelling where required (this has been assumed as cut and cover); all associated enabling and diversions have been included.
- 13.11 **Rail** – the costs include an estimate for the uncommitted rail schemes which we have proposed (Southern Rail Access). Costs for currently committed rail schemes (Crossrail, Western Rail Access, Piccadilly Line upgrade and High Speed 2 spur) have been assumed to be already funded. The full costs of modifications required to the Windsor and Eton line due to relocation of the reservoirs have been included.

Environmental

- 13.12 **Reprovision of wildlife habitat** – the costs include mitigating the impact on the Special Protection Area, where this is affected by options, by reproviding an alternative habitat in an appropriate location.
- 13.13 **Surface water flood mitigation** – the costs include providing alternative flood storage facilities where there is impact on the current capability caused by the airport extension.
- 13.14 **Reprovision of reservoirs** – where this is required, the cost has been estimated on a similar volume basis and included in this section.

Community

- 13.15 **Residential property CPO** – the cost of compulsory purchase of those residential properties that fall within the airport boundary are included, together with appropriate additional compensation for those affected. A risk factor has been

added to allow for the presence of multiple occupancy properties which can only be detected by detailed survey work. Where that part of a community left outside the airport boundary is considered to be too severely compromised for its sustainable survival, the cost of purchasing these residual properties has been assumed too, although they may still appear on the plans.

- 13.16 **Commercial property CPO** – the cost of compulsory purchase of those commercial properties that fall within the airport boundary are included, together with appropriate additional compensation for those affected. We have based this on a professional average value assessment of three main commercial types: hotels, offices and industrial, and applied the costing on a per hectare basis to significant plots. An additional allowance has been made for smaller commercial concerns not covered by the foregoing methodology.
- 13.17 **Community facilities re-provision** – costs for the early re-provision of affordable housing and other community facilities – e.g. schools, libraries etc. – upon which communities depend, and which would otherwise be removed in the airport development, have been included.
- 13.18 **General land purchase under CPO** – costs include compulsory purchase of that remaining land not covered by the previous categories, largely of agricultural designation, that falls within the new airport boundary.
- 13.19 **Community Infrastructure Levy (CIL)** – the cost of levies payable both to the Mayoral fund and to the local authority fund have been included. We have not currently assumed an ability to pay CIL in kind through infrastructure or the potential for collecting authorities to apply CIL receipts to Heathrow-related infrastructure.
- 13.20 **Air noise mitigation** – the cost of mitigating the effects of air noise is included. The measures covered will vary from minor home improvements to improve noise insulation, through to offers to buy those properties worst affected. The degree of mitigation offered will depend upon the noise contour into which the property falls and, in some instances, the existing noise insulation performance of the property. We have used average values based on existing data for houses affected by the current airport configuration.

Comparative costs of third runway options

- 13.21 The table below summarises the option costs within the four categories previously described:

Figure 18: Costs of third runway options

	North	North-West	South-West
Airport	9.3	11.0	11.0
Surface access	1.8	2.1	3.7
Environmental	0.01	0.13	0.7
Community	3.2	3.7	2.2
Total	£14.3 bn	£16.9 bn	£17.6 bn

- 13.22 The airport infrastructure for the third runway varies between the options, with the North option relying on extensions to Terminal 2 and Terminal 5, whereas the western-biased options use a new Terminal 6 building opposite Terminal 5. This introduces a cost premium for these options.
- 13.23 Surface access cost differences between the options are largely driven by the road infrastructure (as the rail scheme is the same for all options) with generally higher costs for the western options because of the level of intervention required with the M25 versus the cost of diverting the M4 spur road for the North option. A significant addition in the South-West option is the cost of the Windsor and Eton line tunnelling necessitated by the runway placement.
- 13.24 Environmental costs in the North option are minimal in comparison to the other options, with North-West requiring significant flood storage re-provision and South-West having, in addition to a greater flood impact, the need to remodel a large area of reservoirs and to replace the Special Protection Area habitat off-site that would be lost in this process.
- 13.25 Community costs are lower in the South-West option, driven by its lesser impact on existing residential and commercial property.

14. Comparing our third runway options

- 14.1 The performance of the three-runway options against key indicators can be summarised as follows:

Figure 19: Summary of third runway options

	PSDH study ¹³	North	North-West	South-West
Passenger capacity	115m	123m	130m	130m
Maximum annual aircraft movements	670k	702k	740k	740k
Cost	£15bn	£14.3bn	£16.9bn	£17.6bn
Length of new runway	2,200m	2,800m	3,500m	3,500m
Noise (population within the 57 dBA Leq contour)	Not calculated	-10%	-15%	-20%
Residential properties lost	730	2,700	950	850
Opening date	2025	2025	2026	2029
Ecology impact (Ha)	0	0	0	716
Historic environment – Grade I & II* buildings lost	0	0	2	0
Volume of flood zone storage lost (m3)	Not calculated	6,000	116,000	1,416,000
Construction complexity	Low	Low	Medium	High

¹³ PSDH – Project for the Sustainable Development of Heathrow

- 14.2 The **North option**, while avoiding impacting on the motorway network and reservoirs, and having 10% fewer people affected by noise than today, has a higher residential property impact which will require the application of a comprehensive strategy of mitigation and early re-provision of key facilities. However, the option would be readily deliverable and cost-effective, with limited other environmental and heritage impacts.
- 14.3 The **South-West option** has the fewest people affected by air noise – 20% fewer than today – and substantially reduced residential and commercial property loss. However, its high impact on surrounding motorway and reservoir infrastructure makes it more costly and more complex to deliver, as well as requiring the re-provision of the Special Protection Area.
- 14.4 The **North-West option** has 15% fewer people affected by noise than today and a lower residential property loss figure than the North option. Its impacts on the M25 and the extent of commercial property loss make it more costly and more complex to deliver than North, but not to the same extent as South-West.
- 14.5 All of these effects would be subject to further optimisation in future stages but this gives a good indication of performance at this first level of analysis. Each option achieves a reduction in noise impacts compared to the current situation and meets air quality standards, without increasing road traffic levels. We have considered all impacts specific to the individual options that we believe capable of mitigation. However, dialogue with the principal stakeholders is on-going to explore the next level of detail.

15. Deliverability and risks

Building from our existing hub airport strength can connect the UK to growth more quickly and at lower cost. Starting again from scratch will cost the taxpayer more, take longer and will not deliver an airport that is in the right location to help the UK win the global race. Similarly, providing more point-to-point capacity will not provide the connectivity required.

Timescale for delivery of options

- 15.1 The timing for delivery of the three-runway options is set out in the table below.

Figure 20: Delivery timescales for a third runway

	North	North-West	South-West
Runway open date	2025	2026	2029
Construction complexity	Low	Medium	High

- 15.2 These dates assume that, following the Commission's final report, the Government consults on a National Policy Statement (NPS) for aviation from spring 2016, with adoption in spring 2018. However, it is recognised that there are other courses open to the Government instead of pursuing an NPS. We have assumed that it is possible,

following examination by the Secretary of State, that development consent could have been granted for a third runway by spring 2019, with construction commencing shortly afterwards and lasting 5½-10 years depending on the option. The length of this process harms UK competitiveness by limiting our ability to connect to growth. We would encourage Government and the Airports Commission to urgently consider how this timeline could be accelerated. Timely progress would be assisted by airport operators working closely with the Commission to provide the evidence base and the assessments which would enable a National Policy Statement process to move forward quickly following a Government decision.

- 15.3 **Construction complexity risk** – there is inherently more risk in those options that involve significant degrees of change to complex existing infrastructure, such as to motorways and reservoirs. Although dialogue has already been initiated with the key stakeholders – Thames Water, the Environment Agency, the Highways Agency, Natural England and English Heritage – it will require considerable further work in certain areas, particularly on the motorway and reservoir elements, before a joint level of understanding can be reached to allow a more detailed picture of the financial and delivery risk for each option to be developed.
- 15.4 **Airport resilience** – with the implementation of the proposals envisaged for a three-runway Heathrow the airport will be more resilient than it is today. The nature of having three runways rather than two means that in the event of one of them being unusable (for example, an emergency landing) it is still possible to fly two-thirds of the planned schedule from the other two rather than only half. With the addition of a second road tunnel into the Central Terminal Area, traffic levels in the current tunnel will be reduced and the potential operational impact of the loss of the current tunnel will be significantly reduced.
- 15.5 **Political risk** – this is high. For 40 years the debate about runway capacity has been characterised by delay, prevarication and indecision. There is a high degree of risk associated with the policy changes of Governments over time and their ability or desire to endorse the Commission's findings or any subsequent national aviation policy statement. This has implications for the appetite of investors for the early risking of the capital that is necessary to bring forward and develop high quality, considered proposals. These on-going risks can be mitigated to some extent by prompt Government action once the Commission has reported to ensure that any solution has been approved and initiated before the 2020 general election.
- 15.6 **Funding and regulation risk** – for any airport development to be privately funded, there must be a clear business case that will deliver an attractive and predictable return for investors. The total cost of new infrastructure, the complexity of construction and the uncertainty of future demand are all factors that affect the risk. Returns need to be commensurate to risk to attract investment. The UK operates in a competitive global marketplace and investors can choose to employ their capital anywhere in the world. Financing additional capacity at Heathrow entirely from the private sector will need an appropriate investment. The CAA's recent initial Q6 proposals, for Heathrow's five-yearly regulatory settlement, have significantly raised the level of regulatory risk faced by any scheme to develop new hub capacity.

- 15.7 **Traffic risk** – there are risks to future passenger traffic numbers, e.g. from increasing foreign hub competition, and uncertainties around forecasting model variables – in particular, oil prices. Traffic risk is somewhat mitigated at Heathrow versus other options. This is because the passenger charge to add hub capacity at Heathrow will be lower than for any other hub airport solution, and the incremental nature of the way additional capacity can be introduced at Heathrow will be a natural guard against over-investment in redundant facilities.
- 15.8 **Transition risk** – adding capacity at Heathrow avoids the transition costs and risks inherent in moving to a new airport. The developers of a new hub airport would need to compensate the owners of Heathrow, the airlines and airport companies, as well as await or guarantee the building of new towns, schools, and hospitals to service the new airport’s workforce.
- 15.9 **Climate change and flood risk** – we recognise that any development must be able to adapt and be resilient to climate change. Dealing with this has already been a driver in the outline option designs that we have developed. In particular they have evolved to ensure we appropriately manage impacts both on and from the water environment. We understand that climate change has the potential to increase peak flood flows, and the detailed mitigation that has been developed, and will continue to be refined for flood risk impacts, has accounted for this. Drier summers may also result in reduced flows in watercourses, which in turn may have impacts on aquatic ecology and water quality. The mitigation we develop to meet the requirements of the Water Framework Directive will also ensure that low flow effects of climate change are minimised.
- 15.10 **Water supply** – we know that there will be impacts arising from the South-West option on water resources infrastructure and that dealing with these will require the implementation of new water supply solutions. We will work with the appropriate authorities to ensure that these solutions are resilient and adaptable in the face of climate change, and we will look beyond typical planning horizons to identify them. There are specific risks associated with the proximity of a new runway for existing or remodelled reservoirs. For example, these include the risk of an aircraft crashing catastrophically and damaging an embankment – or runway spills running off into surrounding reservoirs. These would be the subject of more detailed assessment in future stages and mitigation measures designed if risk levels indicate that this is appropriate.
- 15.11 **Bird strike** – Heathrow currently adheres to performance standards which ensure that all reasonable steps are taken to mitigate the risk that birds present to aircraft. Key elements include: training, logging, reporting, licensing, risk assessment and inspection. In addition, there is a local Bird Hazard Management Working Group. Periodic audits by the Health Safety and Security Executive (HSSE), Civil Aviation Authority (CAA), Food and Environment Research Authority (FERA) and Heathrow all verify that performance standards elements are met.
- 15.12 **Adverse weather** – extra runway capacity will provide increased resilience against the effects of weather e.g. strong winds. Low Visibility Procedure (LVP) occurrences, which NATS implements when either the cloud cover or visibility reach certain

conditions, should reduce in frequency as technology on-board aircraft and on the ground improves using Ground Based Augmentation System (GBAS) technologies.

16. Funding model

Adding hub capacity at Heathrow will cost the taxpayer less than any other option. We believe that the core airport infrastructure for all three of Heathrow’s scenarios are potentially privately fundable if the right regulatory regime is put in place which gives long-term visibility of a return to investors that is commensurate with the risk involved.

- 16.1 However, there is a limit to what can reasonably be funded by the private sector. While ideally we will want to minimise Government involvement, a degree of public funding may be necessary. This is for the following reasons:
- **High level of political and regulatory risk:** For 40 years, the debate about runway capacity has been characterised by delay, prevarication and indecision. The aviation industry has been subject to political U-turns on hub capacity decisions over this period, most recently in 2010. The U-turns have costs. For example, Heathrow made significant investment in planning and property acquisitions in support of PSDH. Investors will not be prepared to carry this significant pre-construction risk again.
 - **Economic benefits:** A third runway at Heathrow would deliver greater economic benefits to the UK than any other currently proposed major transport infrastructure project. It will create jobs, facilitate trade and inward investment, boost spending in the wider economy and improve public finances. We estimate that benefits of £100 billion Present Value (PV) would accrue to the UK from expanding Heathrow. By delivering a third runway the current trade and investment advantages which the UK enjoys – and London’s status as a world city – will be preserved and enhanced.
 - **Air Passenger Duty:** The UK has by far the highest aviation taxes in the world. So while our aviation industry is one of Britain’s success stories, the increases in APD have damaged its competitiveness on the global stage. Heathrow’s passengers bear most of the burden, paying ~£2 billion p.a. in APD, with the vast majority of monies raised from long-haul APD accounted for by Heathrow passengers.
 - **Supports lower environmental and community impacts:** Developing a scheme with significantly lower noise impacts at Heathrow comes with higher costs. For example: a longer runway to enable runway alternation that offers respite for communities under flightpaths; and higher infrastructure costs of the new locations that would require building over reservoirs and the M25 to reduce noise levels for west London communities.
 - **Embedded surface access to Heathrow:** It is estimated that since the 1970s, around £20–25 billion has been invested or committed in rail infrastructure with a connection to Heathrow. Conversely, any new hub would need to build vast new infrastructure from scratch at significant cost to the taxpayer.
- 16.2 Government support might be targeted at certain categories of expenditure that are

associated with developing a scheme that offers significantly lower noise impacts. These might extend to property and noise compensation, and mitigation and flood and ecology impact mitigation, and the infrastructure costs of building over reservoirs or the M25.

- 16.3 Government funding would also be required for additional surface access. However, this surface access investment for Southern Rail Access would be a relatively low incremental investment, as Heathrow already benefits from extensive embedded and committed surface access.
- 16.4 The third runway and its associated terminal and apron infrastructure are estimated to cost between £14 billion and £18 billion, depending on the option selected. Of this, it is estimated that £4-6 billion might be more appropriately funded by Government. We also anticipate that some form of Government guaranteed loan scheme may be required to cover a residual risk that the market may not be able to completely meet the funding requirement of the more expensive options. Recognising the significant wider economic benefits of a third runway at Heathrow, it might also be appropriate to consider a business rates levy similar to Crossrail.
- 16.5 A regulatory model structured around a Regulatory Asset Base (RAB), that includes payment for new infrastructure commenced during the construction phase, is the most appropriate model to support the further development of Heathrow. This would point to a pre-funded RAB based model as the most appropriate way forward. It offers the following distinct combination of advantages as it:
- supports provision of affordable hub capacity for passengers and airlines:
 - providing investors with the assurance of an asset base recognised by the regulator in all future pricing determinations. This optimises overall cost of capital, as well as providing more scope to optimise the capital structure during the construction phase
 - enabling preservation of efficiency incentives in design, delivery and operation
 - is compatible with Heathrow's existing financing structure, which is an important consideration given the potential costs of having to move to a radically different regulatory model
 - lowers project risk profile, increasing the probability that the project is successfully delivered
 - more easily enables a phased approach to investment in additional infrastructure / capacity. This could enable some mitigation of traffic and construction risk
 - is privately funded, with the returns on those funds ultimately being paid for by passengers
 - helps minimise the need for public funding
 - could be consistent with a government guarantee to ensure low-cost funding, even in the event that debt markets considered the risk to be too great
 - would be consistent with Government funding of early sunk costs e.g. for compulsory purchase and noise mitigation
 - is proven and understood by UK Government, regulators and the financial community – and was the preferred model in 2009
 - is consistent with the private ownership of Heathrow and supports compatibility

with the existing two runway business and regulatory model at Heathrow

- provides a broad structure that can offer investors sufficiently attractive returns for them to invest.

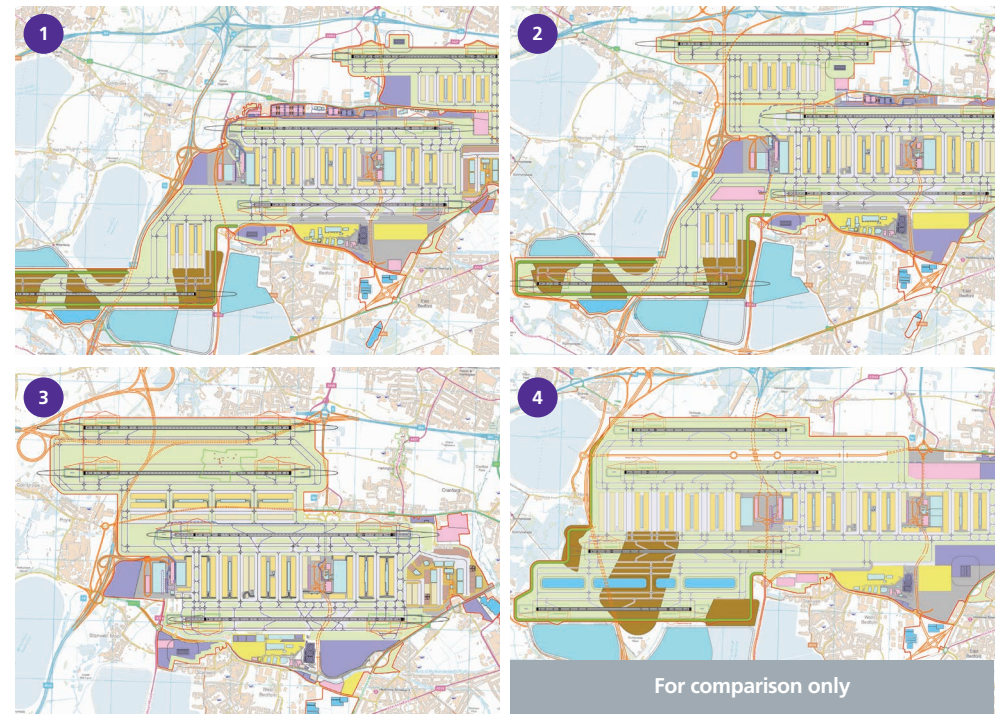
- 16.6 However, the current RAB model would require several adjustments to reflect the different nature of any investment in a third runway and to be attractive to investors – particularly given the considerably higher level of regulatory risk now faced by investors as a result of the CAA's recent initial Q6 proposals. The precise nature of any regulatory and funding model will require significant further work -- for example the duration of the regulatory period.
- 16.7 Financing additional capacity at Heathrow entirely from the private sector will need an appropriate investment framework. The third runway options which have the least impact on local communities are more expensive but do not provide any additional benefit to the passengers who will ultimately pay. In developing its final recommendations to Government, we encourage the Airports Commission to consult on whether the existing model for financing airport development is appropriate for such a major investment and what role public funding or Government guarantees should play.
- 16.8 Although our proposals have varying degrees of construction challenge, the risk of building a new airport in the sea would be greater than building an extra runway at Heathrow. The commercial risks of building a hub airport anywhere else is significantly higher than at Heathrow and investors would be likely to require higher levels of return, government guarantee and public funding than at Heathrow.

17. Heathrow can have a four-runway future if required

We believe Heathrow can accommodate four runways successfully if required to do so and that the impacts of such a plan can be successfully mitigated.

- 17.1 We believe that a third runway provides sufficient capacity to maintain UK's global hub status for the foreseeable future. The 740,000 flights that a third runway could deliver would allow Heathrow to compete effectively with other European hubs. Long-term demand forecasts are inherently uncertain. It is impossible to accurately predict demand beyond 2040 and say that a fourth runway would be definitely required. One of the advantages of the Heathrow option is that additional capacity could be added gradually as demand requires and financing allows, whereas a new hub airport would require most investment upfront based on uncertain future demand.
- 17.2 All of the options we are putting forward for three runways have been designed to evolve to four runways if ever required to do so. We have developed a number of options to show this and have evaluated them to present a similar level of understanding of their performance as for the three-runway options. We believe, should the Commission conclude that a four-runway hub airport is the appropriate long-term solution, that through careful option refinement, Heathrow is capable of being developed into a four-runway airport with manageable costs, impacts and benefits.

- 17.3 Our westerly options for new runways have been influenced by the thinking of Tim Leunig and his Policy Exchange report 'Bigger and Quieter'. However, we do not believe the proposal to move all four runways at Heathrow to the west is the best answer to a four-runway Heathrow.
- 17.4 Our analysis shows the Leunig proposal would see the destruction of 1,700 more homes than some of our four-runway options, while the development of any additional runway capacity at Heathrow would cost around £10 billion more and take five years longer to deliver. We believe our proposals for only the new runways to be sited to the west are better than the Leunig proposal. They deliver many of the noise benefits of the Leunig proposal, while performing better on local community impact, cost, timing, flood zone impact, construction risk and operational feasibility.
- 17.5 We believe that 4R NW/SW, 4R N/SW and 4R Dual NW are viable four-runway airport solutions. We have included detailed drawings of the options in Appendix A. The nature of any clear four-runway option preference may inform the configuration of the three-runway airport that precedes it.
- 17.6 Our initial analysis shows that it would be possible to have four runways at Heathrow, while still reducing the total number of people within Heathrow's noise footprint compared to today. We estimate the cost of developing a fourth runway at Heathrow at an additional £8-14 billion depending on the option. Developing from a three-runway to a four-runway Heathrow would require the compulsory purchase of 850-950 additional properties under the North-West/South-West option, 850-2,700 additional properties under the North/South-West option or 200 additional properties under the dual North-West option.
- 17.7 Four-runway options have the intrinsic characteristic of delivering respite for 50% of the time. This is similar to the respite provided today by runway alternation at the two-runway airport and would enable us to improve further on the level of respite that is achievable with three runways which generally averages to 33% of the time. The simplicity of the alternation pattern is likely to improve the degree of predictability of the respite that can be offered with changing wind patterns, when compared to three runways.
- 17.8 If the Commission requires more detailed evidence on the nature and performance of any or all of these four-runway options, we would be pleased to provide it, and to develop these further where required in order to inform the Commission.



Four-runway options:

- 1 – North/South-West
- 2 – North-West/South-West
- 3 – Dual North-West
- 4 – Leunig Proposal, for comparison only

18. Conclusion

- 18.1 The focus of the global economy is shifting with the rise of fast-growing emerging markets such as Brazil, Russia, India and China. The UK is in a global race with our major competitors, including other European hubs, for trade with these markets, and the jobs and economic growth that will result. There are only six hub airports worldwide that have regular, direct connections to more than 50 long-haul destinations. No country has more than one major long-haul hub. In Heathrow, London has one of these 'Premier League' intercontinental hubs. London also has the natural advantages of geographic location and local demand, which should mean that the UK is a winner. However, unlike its competitors, the UK is hampered by a lack of hub capacity.
- 18.2 While European competitor countries have added new runways at their hub airports, the UK has not built a new full-length runway in the South East since the Second World War. To maintain its global aviation hub status, the UK needs a single hub airport with the size and scale to provide the long-haul connectivity on which jobs and growth depend.
- 18.3 Building from our existing hub airport strength can connect the UK to growth more quickly and at lower cost. Starting again from scratch will cost the taxpayer more, take longer and will not deliver an airport that is in the right location to help the UK win the global race. Similarly, providing more point-to-point capacity will not provide the connectivity required.
- 18.4 We believe there is a compelling case for growth at Heathrow. All our options deliver more flights while reducing the total number of people exposed to high levels of noise. All could operate within climate and air quality limits. Heathrow offers the fastest, most cost-effective and most practical route to growth.
- 18.5 Three runways will deliver enough capacity to maintain UK's global hub status for the foreseeable future – and four runways at Heathrow is a practical and deliverable long-term answer if passenger demand requires it.
- 18.6 If the UK is to maintain its global hub status then it must build from strength and support the development of a third runway at Heathrow.



19. References

Further reference data can be found in our recent publications and submissions to the Airports Commission, namely:

- Heathrow's submission to the Airports Commission - Paper 01: Aviation Demand Forecasting, March 2013
- Heathrow's submission to the Airports Commission - Paper 02: Aviation Connectivity and the Economy, April 2013
- Heathrow's Submission to the Airports Commission - Paper 03: Aviation and Climate Change, May 2013
- Heathrow's Submission to the Airports Commission - Paper 04: Airport Operational Models, July 2013
- Best Placed for Britain, Heathrow, www.heathrow.com, June 2013
- A Quieter Heathrow, Heathrow, www.heathrow.com, May 2013
- One hub or none, Heathrow, www.heathrow.com, November 2012
- The value of aviation connectivity to the UK, Oxford Economics, 2012
- Connecting for Growth, Frontier Economics, September 2011

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