

**Cost and Commercial Viability: Cost and Revenue  
Identification Update**

**Heathrow Airport Extended Northern Runway**

**30 June 2015**



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## Executive Summary

This report sets out the assessment of the capital cost of developing the Heathrow Airport Extended Northern Runway scheme, updated to take account as appropriate of responses to consultation. The assessment has been carried out in accordance with the Commission’s appraisal framework (see Airports Commission: Appraisal Framework). It provides the cost assumptions used in the financial analysis to assess the commercial viability and financeability of the scheme.

The scheme includes an additional runway, taxiways, and terminal infrastructure. The assessment has been undertaken in general accordance with HM Treasury’s The Green Book - Appraisal and Evaluation in Central Government, which advises the adjustment of base cost estimates to include risk and optimism bias.

The revised cost estimate for the scheme is £14.4 billion with mitigated optimism bias applied, compared to the previous estimate of £13.5 billion.

Scenario	Pre-consultation	Post-consultation
Assessment of Need Carbon Capped	13,539	14,435
Assessment of Need Carbon Traded	13,539	14,435
Low Cost is King Carbon Traded	13,539	14,435
Global Fragmentation Carbon Capped	13,539	14,435

***Total Scheme Capital Expenditure by Demand Scenario (2014 prices, £’million, including mitigated optimism bias)***

The report also sets out the updated estimate of the wider costs and revenues, including the underlying airport infrastructure that would be required irrespective of the third runway investment; the ongoing maintenance and replacement of the existing and developed asset; the ongoing operational expenditure relating to the existing and developed asset; the non-aeronautical revenue the existing and developed asset would generate; and the surface access works and associated ongoing costs required to facilitate the scheme.

## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Methodology</b>	<b>3</b>
2.1	Definitions	3
2.2	Scheme Capital Cost	3
2.3	Risk and Optimism Bias	5
2.4	Phasing	6
<b>3</b>	<b>Revisions Following Consultation</b>	<b>8</b>
<b>4</b>	<b>Revised Scheme Capital Expenditure Post Consultation</b>	<b>10</b>
4.1	Airports Commission Demand Scenarios: Capex Profiles	11
4.2	Annual Scheme Capital Expenditure Summaries	12
	Appendix A Glossary	
	Appendix B Optimism Bias	
	Appendix C Scheme Capital Cost Estimate Breakdown	
	Appendix D Approach to Core and Asset Replacement Capital Expenditure	
	Appendix E Core and Asset Replacement Capital Expenditure Summary	
	Appendix F Operational Expenditure	
	Appendix G Non-Aeronautical Revenue	
	Appendix H Surface Access Capital Expenditure, Operational Expenditure and Maintenance Cost	

## 1 Introduction

This report presents the revised estimate of the capital cost of developing the Heathrow Airport Extended Northern Runway scheme (hereafter “the scheme”). It should be read in conjunction with the report issued for consultation, *Appraisal Framework Module 13. Cost and Commercial Viability: Cost and Revenue Identification Heathrow Airport Extended Northern Runway* (HHL03). All costs and revenues are stated in 2014 prices.

Recognising that it is not possible to determine with accuracy a single cost estimate, and that a range of outcomes are possible, the objective was to establish a reasonable estimate to conduct the assessments within the Appraisal Framework Module 13: Cost and Commercial Viability. The estimates include separate provision for risk and optimism bias.

Section 2 of this report describes the methodology used to establish capital cost forecasts.

Responses to consultation relating to the cost estimates were systematically considered and addressed in one of the following ways:

- *comments highlighting errors in our estimation of a specific cost element, where we have subsequently made an adjustment;*
- *comments raising issues requiring further consideration, where we have subsequently considered it appropriate to make an amendment;*
- *comments making reasonable points concerning the potential under-estimation of cost elements, where we have subsequently reviewed these and consider them to be included in the estimate and/or adequately provided for within the category risk allocation; and*
- *comments and challenges upon which we have reflected, but determined that no change to our forecasts is necessary.*

Section 3 sets out an overview of the revisions made following consultation.

The revised estimates are presented in Section 4.

Details of the Scheme costs and supporting detail are presented in Appendices B and C.

In order to enable the Cost and Commercial Viability study to consider the viability of the investment in the scheme, it was necessary to understand the wider cost and revenue contexts of that investment. Therefore, assessments were also made of the following:

- *the underlying investment in airport infrastructure that would be required irrespective of the second runway investment, referred to as Core works in this report, as discussed in Appendix D;*
- *the ongoing replacement of the existing and developed asset, as also discussed in Appendix D. There are no changes to this section as a result of consultation;*
- *ongoing operational expenditure relating to the existing and developed asset, as also discussed in Appendix F;*

- *non-aeronautical revenue that the existing and developed asset would generate as discussed in Appendix G; and*
- *beyond the airport boundary, the surface access works required by the scheme along with the operational and maintenance costs of those surface access improvements as discussed in Appendix H.*

Throughout this report a consistent colour scheme has been adopted to present the cost and revenue estimates developed for each relevant demand scenario<sup>1</sup>. The scenarios and their respective colours are as shown in Table 1-1:

Scenario
Assessment of Need Carbon Capped
Assessment of Need Carbon Traded
Global Growth Carbon Traded
Global Fragmentation Carbon Capped

**Table 1-1 Demand Scenario Reference Colours**

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<sup>1</sup> The relevant scenarios are those included in Cost and Commercial Viability: Funding and Financing

**2.1 Definitions**

Throughout this report consistent nomenclature has been adopted. Estimates were developed for “Core” and “Scheme” costs, where the “Core” works relate to the investment in the airport irrespective of investment in the additional runway works, the additional cost of which is reported as the “Scheme” cost. The Scheme works were established from the promoter’s submission to the Airports Commission as updated based on the approach set out in this report and in response to consultation.

Details of the approach to the Core works and to asset replacement are presented in Appendix D.

**2.2 Scheme Capital Cost**

The approach we adopted prior to consultation remains unchanged and the additional points set out in this section are solely intended to provide clarification following consultation. Our approach was to assess the reasonableness of the estimate provided by Heathrow Hub Ltd (HH) in order to reach a view as to an appropriate estimate to be used within the Cost and Commercial Viability assessment.

This was undertaken by comparison of the provided costs, or any costs independently determined, with industry expectation. All costs were re-based as necessary to be consistently presented in 2014 values.

We took the following approach:

- *using the material provided by the scheme promoter, we determined the scope of work and disaggregated works into a level of detail reasonably possible and appropriate to this stage of analysis;*
- *for each element of the disaggregated works, we determined the effective unit rate;*
- *we assessed the unit rates to determine whether they were in accordance with our expectation of a reasonable market rate, taking into account the nature, site and location of the works;*
- *unit rates were aligned between HH and Heathrow Airport Ltd (HAL)<sup>2</sup>;*
- *by exception we made amendments to rates and quantities as appropriate;*
- *we established the base cost, made adjustments for ‘on costs’ and applied risk and optimism bias as discussed below.*

---

<sup>2</sup> In certain instances the rates proposed or implicit in HH’s analysis differed significantly from those determined for HAL for the same element of the scheme. The rates and costs for these elements were aligned between the two schemes.

‘On costs’ include enabling works, operational readiness, and project fees.

- *enabling works and operational readiness costs<sup>3</sup> were identified as separate cost line items, which we distributed in proportion across all other capital cost line items, with the exception of environment and community compensation costs.*
- *project fees (to allow for design and project management services) were calculated at 15% base cost and were applied to all cost categories.*

Following this methodology, any change to the base costs that we have made post-consultation has a proportionate impact on the project fees and on the distribution of enabling works costs between all other cost categories (except environment and community compensation costs).

Scheme base cost estimates are shown in full in Appendix C with on costs itemised separately.

Noting the inherent nature of capital expenditure projects to exhibit risk and uncertainty, the processes and guidance of HM Treasury’s The Green Book - Appraisal and Evaluation in Central Government<sup>4</sup>, and supplementary guidance with respect to optimism bias<sup>5</sup> were adopted. The guidance recommends making such adjustments on the basis that there is a demonstrated, systematic tendency for project appraisers to be overly optimistic. A risk premium was applied to address the unknown engineering detail of the identified works which would be expected to lead to an under estimate of the cost despite the scope being reasonably defined. For example, geological surveys may find that the tunnels (such as for baggage or transit systems) need to be bored through much harder rock than previously expected. Risk premiums of 20% on Scheme costs were adopted to take account of the risk of the costs to deliver the identified scope of works increasing. These allowances are in line with our expectation of typical allowances at this stage of project development.

Scheme costs were assessed based upon the extent of information presented by the promoter. Engineering judgement and experience were used to assess whether the detailed item rate, or a higher aggregate planning rate, was appropriate for the element of the works, its engineering context and the operational environment within which the works would be constructed. This judgement was based upon Jacobs’s experience of similar airport projects within London and within the UK.

Since there was insufficient information concerning the specific risk premiums added to each line item of capital expenditure, this approach entailed scheme promoters’ costs being reduced to what we would consider to be a risk-free rate. After review to ensure that it did not result in unequal treatment of the schemes, we added a risk premium of 20% to this risk-free rate (see Section 2.3.1).

<sup>3</sup> The approach to the costs of enabling works and operational readiness is unchanged from the report of 5 November 2014 but these costs were not separately identified in the methodology section. This commentary is provided for additional clarity following consultation comments.

<sup>4</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/220541/green\\_book\\_complete.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf)

<sup>5</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/191507/Optimism\\_bias.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191507/Optimism_bias.pdf)



## **2.3 Risk and Optimism Bias**

### **2.3.1 Risk**

Based upon our expectation of a reasonable allowance at this stage of project development, a 20% risk premium was applied. We would note that this allowance could be seen as being optimistic and that a higher allowance would not be considered inappropriate. We note, however, that the individual items of work within base costs (the risk and optimism bias unadjusted costs) make due allowance for the environments in which they will be delivered and/or the complexity of the items of work. Therefore, whilst we would observe 20% to be at the lower end of an expected range for projects at this relatively early stage of development, we consider it to be a reasonable base upon which to establish a reasonable cost estimate.

### **2.3.2 Optimism Bias**

HM Treasury's Supplementary Green Book Guidance sets out a detailed calculation method to establish the appropriate level of optimism bias to be applied taking into account a number of factors. Noting that these calculations require judgement across a range of factors, most of which are difficult to establish with accuracy from an external assessment to the organisation responsible for project delivery, and noting that those assessments are subjective in nature rather than demonstrably objective, the approach to optimism bias was to establish a reasonable allowance, rounded to the nearest 5%, applied consistently to each scheme.

For consultation, the scheme was characterised as a combination of Standard Buildings and Standard Civils, giving an unmitigated adjustment of 38%. We applied mitigation factors consistently to each scheme, recognising the absence of detailed knowledge on the capability, experience, and approach of each scheme promoter to deliver the Scheme. A mitigated adjustment of 20% was applied for consultation.

In response to consultation comments, we revisited the categorisation of Scheme capital costs and the mitigation factors applied to the derivation of mitigated optimism bias.

The revised approach involved categorising the Scheme works into Standard Buildings, Non-Standard Buildings, Standard Civils, Non-Standard Civils, and Equipment/Development. The categories not previously used (Non-Standard Buildings, Non-Standard Civils, and Engineering & Development) have higher recommended upper bound optimism bias values than Standard Buildings or Standard Civils, according to HM Treasury's Supplemental Green Book Guidance. As a result, the reassessed unmitigated optimism bias for Scheme capital expenditure is higher than the unmitigated optimism bias used at consultation. The re-categorisation of Scheme works resulted in a calculated value for unmitigated optimism bias of 45%, compared with 38% as used prior to consultation. However, the mitigation factors applying to those categories results in a lower value for mitigated optimism bias.

Appendix B sets out the calculation by which the value for mitigated optimism bias was derived. Following this analysis, we adopted an allowance of 15% for mitigated optimism, compared with 20% used at consultation.

The HM Treasury's Green Book Optimism Bias approach is by its nature imprecise, its purpose being to provide an appropriate cost contingency in forecasts for which

there is insufficient detail and where available data lack precision. Having regard to the ranges of calculated mitigated optimism bias for Scheme capital expenditure, we have adopted a rounded figure of 15% across all three schemes.

In summary, the following adjustments for risk and optimism bias were made:

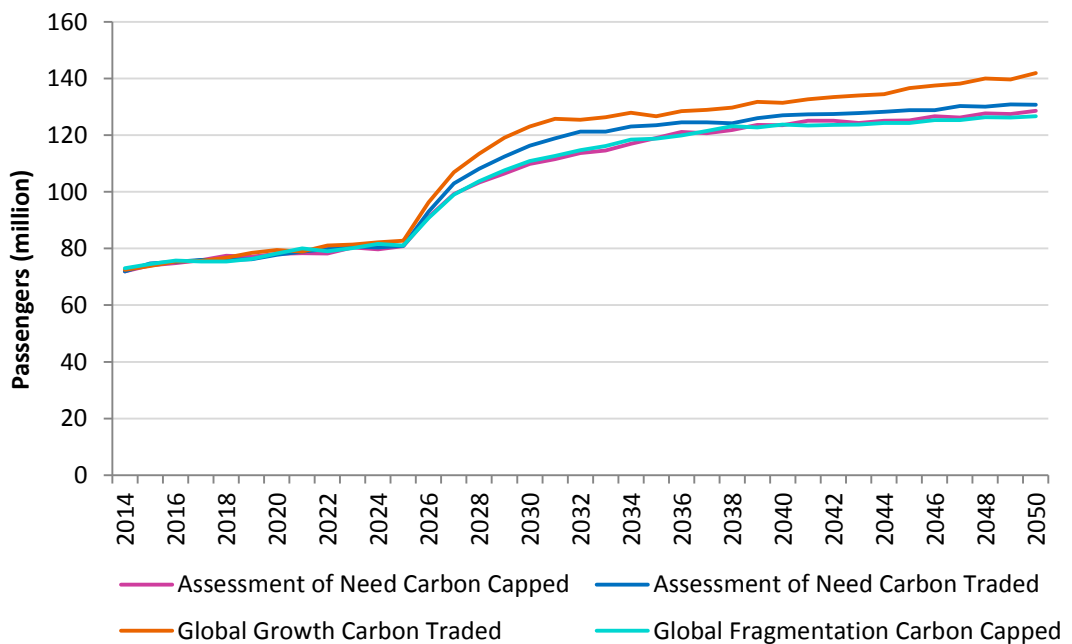
		Scheme	
		Pre-consultation	Post-consultation
<b>Risk</b>		20	20
<b>Optimism</b>	<b>Mitigated</b>	20	15
<b>Bias</b>	<b>Unmitigated</b>	38	45

**Table 2-1 Summary of Risk and Optimism Bias Adjustments to the Base Costs (%)**

## 2.4 Phasing

The Scheme cost estimate was determined in total and by build phase (see Figure 4-2 to Figure 4-5). Reference should be made to the Heathrow Airport Extended Northern Runway Appraisal Module 14: Operational Efficiency Ground Infrastructure report for detail of the individual phases. For the purposes of informing the Cost and Commercial Viability assessments, the capital costs of each build phase were triggered by demand against the requirements of four principal demand scenarios and as shown in Figure 2-1:

- *Assessment of Need Carbon Capped*
- *Assessment of Need Carbon Traded*
- *Global Growth Carbon Traded*
- *Global Fragmentation Carbon Capped*



**Figure 2-1 Airports Commission Demand Scenarios**

Opening of the extended runway was driven by air transport movement (ATM) demand exceeding the current capacity irrespective of passenger demand.

Although certain demand scenarios exceeded the current 480,000 ATM per annum cap of the existing runways before 2026, the earliest the extended runway was assumed to be opened was 2026, based upon the Airports Commission’s view of the likely timescale required for regulatory and planning processes.

Each phase was assumed to open at the end of the year before demand was forecast to exceed capacity. With reference to the Operational Efficiency Ground Infrastructure report, the following phase capacities were adopted.

<b>Phase</b>	<b>Capacity (mppa)</b>
<b>Existing</b>	80
<b>With T6 Phase 1</b>	85
<b>With T6 Phase 2</b>	100
<b>With T2 Phase 2</b>	110
<b>With T2D</b>	120
<b>With T2 Phase 3</b>	130

**Table 2-2 Capacity Provision by Phase**

In the years prior to opening of the phase, the estimated cost of the phase was incurred over a period of three to six years depending upon the value of expenditure, following a simplified, but typical sigmoidal curve (S-curve) profile.

### 3 Revisions Following Consultation

Responses to consultation indicated that a few elements of the Scheme capital cost estimate merited consideration and refinement. These are discussed in this section, with the resulting revised total capital estimate presented in Section 4.

A change was made to the calculation of the cost of the tracked transit system connecting the proposed Terminal 6 to its satellites. The length of tunnels has been revised upwards; the number of additional cars required was increased; and the station and maintenance base costs were revised upwards. This change also ensures consistent treatment with respect to the Heathrow Airport North West Runway scheme. In total the tracked transit system costs have increased by £584 million, before project fees, risk, and optimism bias.

Responding to comments raised during consultation, costs allocated to the following items were also reviewed and adjusted to ensure that both Heathrow schemes were treated consistently. The costs below are presented exclusive of risk and optimism bias:

- *costs for river diversions and culverts have been included at a cost of £121 million;*
- *utilities costs, which provide for utilities supply network infrastructure to serve new facilities, have been included at a cost of £198 million;*
- *landside connectivity which provides for various connections from the enlarged airfield to the local road infrastructure, has been included at a cost of £29 million; and*
- *flood water mitigation costs have been increased from £88 million to £127 million.*

There are no other changes to the Scheme capital costs.

Other responses to consultation included concerns that the construction rates differed from those adopted for the Gatwick scheme. We have reviewed the rates used for consultation and consider them to be reasonable, since the cost methodologies adopted by scheme promoters mean that direct comparison of the rates between schemes could give misleading results; e.g. rates are in some cases based on plan area and in other cases based on gross floor area. We have reviewed the cost rates in the context of site specific factors and the level of specification of the scheme as proposed, and consider them to be reasonable.

Responses to consultation highlighted the risk of programme delays to the Scheme resulting in increased costs. We consider this to be a material risk that is adequately provided for within the risk allocation.

Other comments asserted that various key infrastructure works such as the ongoing development of the eastern campus (e.g., Terminal 2 satellites) had been omitted from our cost estimates. These works will be undertaken in any event and as such they were included within Core capital costs, which are presented in Appendix E.

Sensitivity analyses on Community Compensation are as set out in the report *Cost and Commercial Viability: Additional Analysis*. Other sensitivity analyses on costs

are included in the report *Cost and Commercial Viability: Funding and Financing Update* and *Cost and Commercial Viability: Additional Sensitivities*.

## 4 Revised Scheme Capital Expenditure Post Consultation

The revised cost is estimated to be £14.4 billion with mitigated optimism bias applied and £18.2 billion with unmitigated optimism bias.

Appendix C presents the resulting build-up of the Scheme works (including mitigated optimism bias) for all phases.

Section 4.2 summarises the forecast Scheme capital expenditure by year against each of the Airports Commission’s demand scenarios considered for this scheme in the cost and commercial viability assessment.

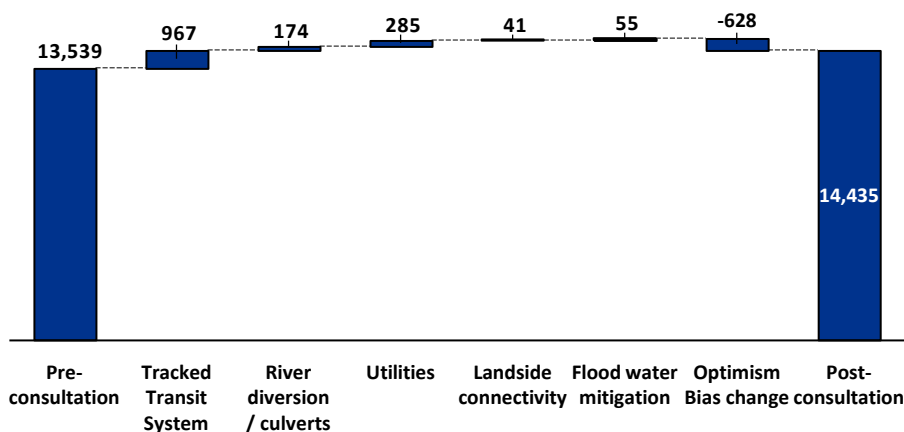
Table 4-2 to Table 4-5 present the data underlying Figure 4-2 to Figure 4-5 in the preceding sections.

In summary, for each scenario, Scheme capital expenditure is as shown in Table 4-1 with mitigated and unmitigated optimism bias.

Scenario	Pre-consultation	Post-consultation
Assessment of Need Carbon Capped	13,539	14,435
Assessment of Need Carbon Traded	13,539	14,435
Low Cost is King Carbon Traded	13,539	14,435
Global Fragmentation Carbon Capped	13,539	14,435

**Table 4-1 Total Scheme Capital Expenditure by Demand Scenario (2014 prices, £’million)**

Note that Figure 4-1 shows each change sequentially from total scheme cost at consultation to the cost post-consultation. The individual revisions to base costs are shown including optimism bias at the rate adopted at consultation stage (i.e. 20%). The final adjustment for the revision to the optimism bias assumption (from 20% to 15%) is stated after adjustment for those individual revisions.



**Figure 4-1 Pre-Consultation to Post-Consultation Scheme Capex Waterfall Chart (2014 prices, £’million, including mitigated optimism bias)**

## 4.1 Airports Commission Demand Scenarios: Capex Profiles

### 4.1.1 Assessment of Need Carbon Capped

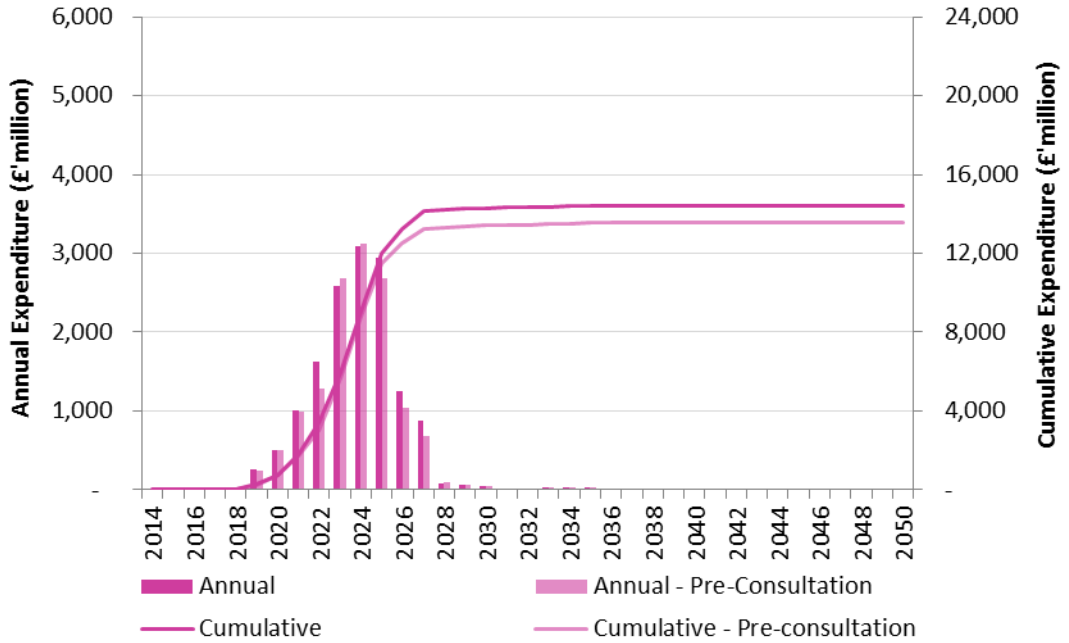


Figure 4-2 Assessment of Need Carbon Capped

### 4.1.2 Assessment of Need Carbon Traded

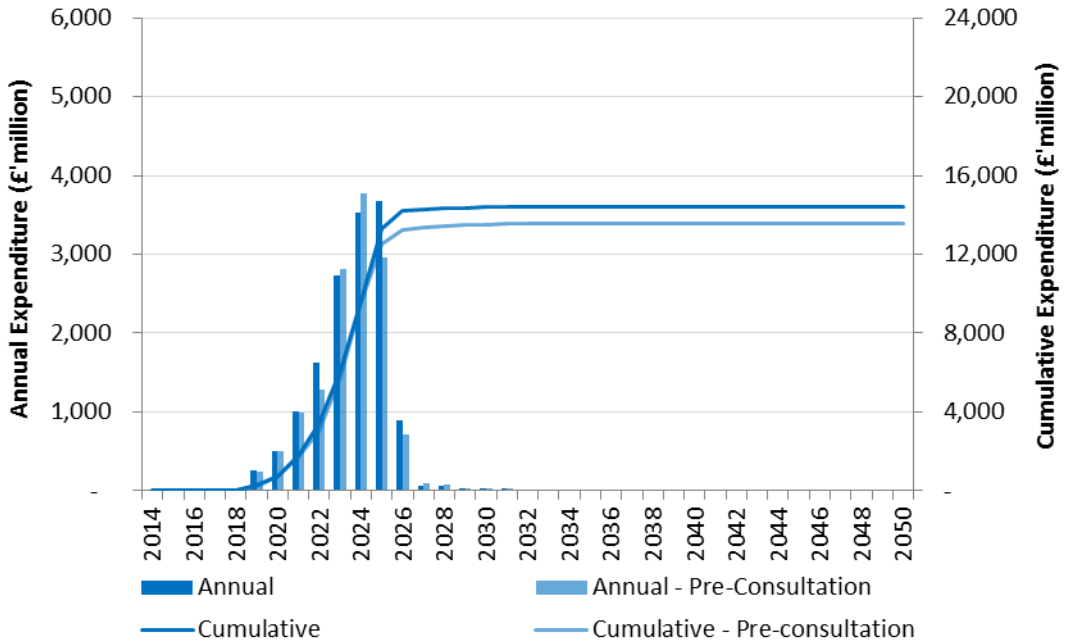


Figure 4-3 Assessment of Need Carbon Traded

### 4.1.3 Global Growth Carbon Traded

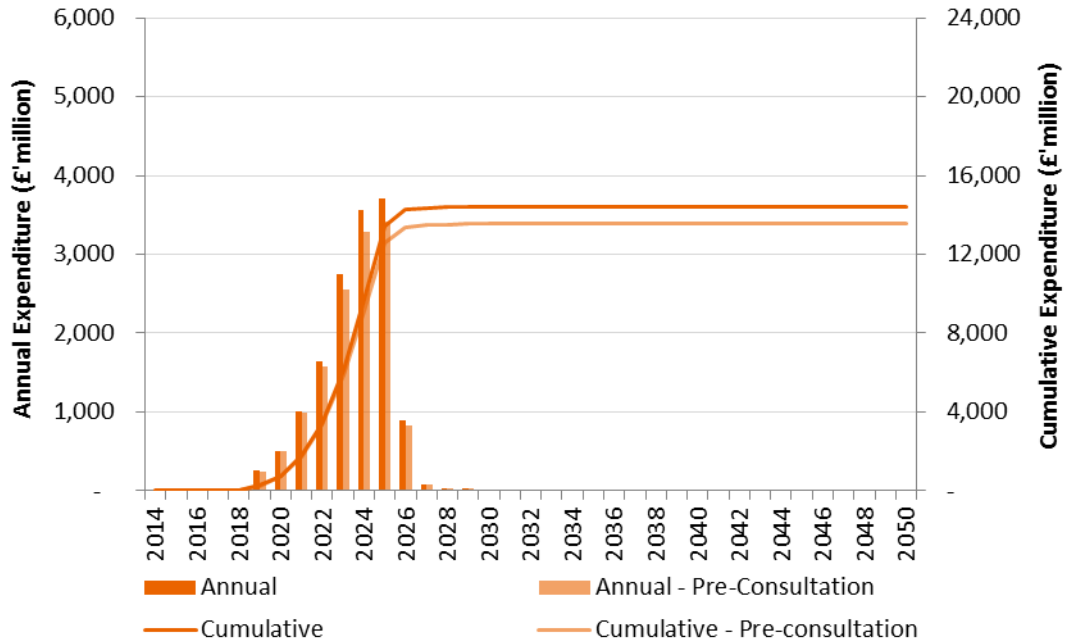


Figure 4-4 Global Growth Carbon Traded

### 4.1.4 Global Fragmentation Carbon Capped

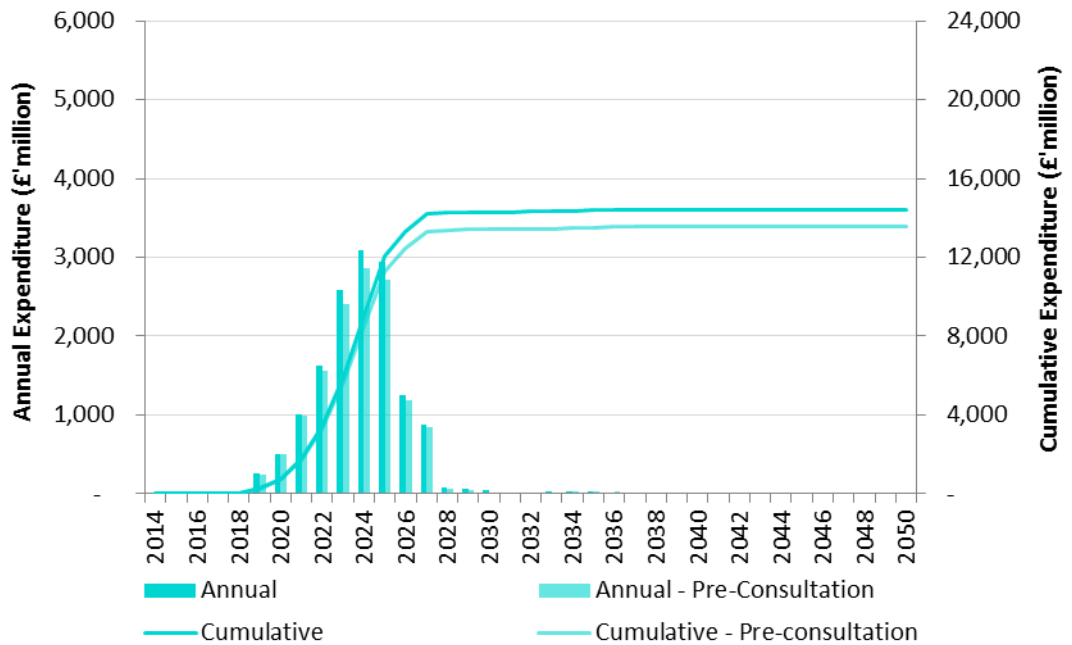


Figure 4-5 Global Fragmentation Carbon Capped

## 4.2 Annual Scheme Capital Expenditure Summaries

Table 4-2 to Table 4-5 on the following pages present the data underlying the previous figures with mitigated optimism bias. These tables are based upon the detailed breakdown presented in Appendix C, but, for the purpose of enabling the assessment of depreciation, summarises the total expenditure into the following



headings. General costs itemised separately within the breakdown presented in Appendix C (enabling works, project management on-cost, etc.) are distributed across the headings below in proportion to their contribution to the total.

- *Terminal buildings: passenger terminal buildings including piers and satellites*
- *Plant: building plant (e.g. air conditioning, etc.) including utilities and power generation*
- *Transit systems: passenger transit systems above or below ground*
- *Runways: runway and associated instrument landing systems*
- *Taxiways and aprons: taxiways, aprons and their associated systems*
- *Equipment: mobile equipment and baggage handling installations*
- *Land: acquisition of land including commercial businesses and residential properties*
- *Airfield ancillary: other infrastructure elements, for example control tower, rescue and firefighting facilities, fencing, airside roads, etc.*
- *Car parks: all car parks whether multi-storey or surface*
- *Third party land users: provision of serviced plots for third party development*
- *Environment: river diversions and environmental compensation and mitigation*
- *Community: community impact compensation*



2014 real prices in £million - including mitigated optimism bias

Scheme	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Terminal buildings	3,509	-	-	-	-	-	-	-	-	269	672	982	971	369	246	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant	590	-	-	-	-	-	-	-	-	50	125	179	168	41	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tunnels and bridges	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transit systems	1,033	-	-	-	-	-	3	5	11	78	179	259	269	138	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Runways	269	-	-	-	-	-	13	27	54	54	54	40	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Taxiways and aprons	781	-	-	-	-	-	31	61	123	132	145	127	104	35	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	999	-	-	-	-	-	-	-	-	47	117	190	246	239	159	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land	1,233	-	-	-	-	-	62	123	247	247	247	185	123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Airfield Ancillary	599	-	-	-	-	-	30	60	120	120	120	90	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Parks	580	-	-	-	-	-	-	-	-	15	36	68	93	106	104	40	30	-	-	4	13	26	26	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Third Party Land Users	74	-	-	-	-	-	4	7	15	15	15	11	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Environment	442	-	-	-	-	-	22	44	88	88	88	66	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	352	-	-	-	-	-	18	35	70	70	70	53	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Optimism Bias	1,883	-	-	-	-	-	33	65	131	213	336	405	387	167	117	7	5	-	-	1	2	5	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
Risk	2,092	-	-	-	-	-	36	73	145	237	374	450	429	186	130	8	6	-	-	1	3	5	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Total</b>	<b>14,435</b>	-	-	-	-	-	<b>251</b>	<b>502</b>	<b>1,004</b>	<b>1,633</b>	<b>2,578</b>	<b>3,107</b>	<b>2,963</b>	<b>1,281</b>	<b>900</b>	<b>56</b>	<b>42</b>	-	-	<b>6</b>	<b>18</b>	<b>36</b>	<b>36</b>	<b>24</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 4-5 Global Fragmentation Carbon Capped

## Appendix A Glossary

Core	Investment in the airport irrespective of investment in the additional runway works
Demand scenarios	Please refer to the Economics and Strategic Fit Workstream for further details
GAL	Gatwick Airport Limited
mppa	million passengers per annum
Optimism bias	Please refer to Cost and Commercial Viability: Additional Analysis for further technical details and references
Post-consultation	Refers to assumptions and costing taking account of consultation responses
Pre-consultation	Refers to assumptions and costing as provided in 13. <i>Cost and Commercial Viability: Cost and Revenue Identification</i>
Q6	Quinquennium 6 (2014 to 2018)
Q7	Quinquennium 7 (2019 to 2023)
Scheme	Investment in the additional runway works
TTS	Tracked transit system

## Appendix B Optimism Bias

Upper bound values for combined projects

Project Type	CAPEX (%)	Upper Bound OB (%)	OB Contribution (%)	Resulting OB (%)
Standard Buildings	70	24	17	
Non-Standard Buildings	0	51		
Standard Civils	25	44	11	
Non-Standard Civils	0	66		
Equipment & Development	5	200	10	
<b>Combined</b>				<b>38.2</b>

CAPEX Contributory Factors	Standard Building optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Non-Standard Building optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Standard Civil Engineering optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Non-Standard Civil Engineering optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Equipment/Development optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)
<b>Procurement</b>																				
Complexity of Contract Structure	-	0.8	-	-	1	0.8	0.8	0.2	-	0.8	-	-	-	0.8	-	-	7	0.8	5.6	1.4
Late Contractor Involvement in Design	2	0.95	1.9	0.1	2	0.95	1.9	0.1	3	0.95	2.9	0.2	-	0.95	-	-	7	0.95	6.7	0.4
Poor contractor Capabilities	9	0.95	8.6	0.5	5	0.95	4.8	0.3	-	0.95	-	-	-	0.95	-	-	4	0.95	3.8	0.2
Dispute and Claims Occurred	29	0.7	20.3	8.7	11	0.7	7.7	3.3	21	0.7	14.7	6.3	-	0.7	-	-	-	0.7	-	-
Information Management	-	0.8	-	-	-	0.8	-	-	-	0.8	-	-	-	0.8	-	-	5	0.8	4.0	1.0
Other (specify)	-	0.8	-	-	-	0.8	-	-	-	0.8	-	-	2	0.8	1.6	0.4	-	0.8	-	-
<b>Project Specific</b>																				
Design Complexity	1	0.9	0.9	0.1	3	0.9	2.7	0.3	-	0.9	-	-	8	0.9	7.2	0.8	10	0.9	9.0	1.0
Degree of Innovation	4	0.8	3.2	0.8	9	0.8	7.2	1.8	-	0.8	-	-	9	0.8	7.2	1.8	17	0.8	13.6	3.4
Environmental Impact	-	0.5	-	-	-	0.5	-	-	22	0.5	11.0	11.0	5	0.5	2.5	2.5	-	0.5	-	-
Other	-	0.5	-	-	5	0.5	2.5	2.5	18	0.5	9.0	9.0	-	0.5	-	-	-	0.5	-	-
<b>Client Specific</b>																				
Inadequacy of the Business Case	34	0.8	27.2	6.8	23	0.8	18.4	4.6	10	0.8	8.0	2.0	35	0.8	28.0	7.0	18	0.8	14.4	3.6
Funding Availability	-	0.8	-	-	-	0.8	-	-	-	0.8	-	-	5	0.8	4.0	1.0	-	0.8	-	-
Project Management Team	1	0.9	0.9	0.1	2	0.9	1.8	0.2	-	0.9	-	-	2	0.9	1.8	0.2	5	0.9	4.5	0.5
Poor Project Intelligence	2	0.8	1.6	0.4	6	0.8	4.8	1.2	7	0.8	5.6	1.4	9	0.8	7.2	1.8	4	0.8	3.2	0.8
Other - omitted (<1)	-	0.8	-	-	2	0.8	1.6	0.4	-	0.8	-	-	-	0.8	-	-	-	0.8	-	-
<b>Environment</b>																				
Public Relations	2	0.5	1.0	1.0	1	0.5	0.5	0.5	9	0.5	4.5	4.5	-	0.5	-	-	-	0.5	-	-
Site Characteristics	2	0.8	1.6	0.4	1	0.8	0.8	0.2	3	0.8	2.4	0.6	5	0.8	4.0	1.0	-	0.8	-	-
Permits/Consents/Approvals	-	0.8	-	-	3	0.8	2.4	0.6	-	0.8	-	-	-	0.8	-	-	-	0.8	-	-
<b>External Influences</b>																				
Economic	11	0.2	2.2	8.8	13	0.2	2.6	10.4	7	0.2	1.4	5.6	3	0.2	0.6	2.4	-	0.2	-	-
Legislation/Regulations	3	0.7	2.1	0.9	7	0.7	4.9	2.1	-	0.7	-	-	8	0.7	5.6	2.4	5	0.7	3.5	1.5
Technology	-	0.95	-	-	5	0.95	4.8	0.3	-	0.95	-	-	8	0.95	7.6	0.4	18	0.95	17.1	0.9
Other	-	0.5	-	-	2	0.5	1.0	1.0	-	0.5	-	-	1	0.5	0.5	0.5	-	0.5	-	-
<b>TOTAL</b>	<b>100</b>			<b>28.6</b>	<b>101</b>			<b>29.9</b>	<b>100</b>			<b>40.6</b>	<b>100</b>			<b>22.2</b>	<b>100</b>			<b>14.7</b>

Adjusted Optimism Bias

Project Type	Percentage of CAPEX (%)	Mitigated OB (%)	OB contribution (%)	Resulting OB (%)
Standard Buildings	70	6.9	4.8	
Standard Civils	25	17.8	4.5	
Equipment & Development	5	29.3	1.5	
<b>Combined</b>				<b>10.8</b>

Rounded to 10% for all schemes

Figure B-1 Core Works

Upper bound values for combined projects

Project Type	CAPEX (%)	Upper Bound OB (%)	OB Contribution (%)	Resulting OB (%)
Standard Buildings	51	24	12	0
Non-Standard Buildings	5	51	3	0
Standard Civils	31	44	14	0
Non-Standard Civils	5	66	3	0
Equipment & Development	8	200	16	0
<b>Combined</b>				<b>48.1</b>

CAPEX Contributory Factors	Standard Building optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Non-Standard Building optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Standard Civil Engineering optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Non-Standard Civil Engineering optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)	Equipment/Development optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)
<b>Procurement</b>																				
Complexity of Contract Structure	-	0.7	-	-	1	0.7	0.7	0.3	-	0.7	-	-	-	0.7	-	-	7	0.7	4.9	2.1
Late Contractor Involvement in Design	2	0.95	1.9	0.1	2	0.95	1.9	0.1	3	0.95	2.9	0.2	-	0.95	-	-	7	0.95	6.7	0.4
Poor contractor Capabilities	9	0.95	8.6	0.5	5	0.95	4.8	0.3	-	0.95	-	-	-	0.95	-	-	4	0.95	3.8	0.2
Dispute and Claims Occurred	29	0.7	20.3	8.7	11	0.7	7.7	3.3	21	0.7	14.7	6.3	-	0.7	-	-	-	0.7	-	-
Information Management	-	0.7	-	-	-	0.7	-	-	-	0.7	-	-	-	0.7	-	-	5	0.7	3.5	1.5
Other (specify)	-	0.6	-	-	-	0.6	-	-	-	0.6	-	-	2	0.6	1.2	0.8	-	0.6	-	-
<b>Project Specific</b>																				
Design Complexity	1	0.8	0.8	0.2	3	0.8	2.4	0.6	-	0.8	-	-	8	0.8	6.4	1.6	10	0.8	8.0	2.0
Degree of Innovation	4	0.9	3.6	0.4	9	0.9	8.1	0.9	-	0.9	-	-	9	0.9	8.1	0.9	17	0.9	15.3	1.7
Environmental Impact	-	0.5	-	-	-	0.5	-	-	22	0.5	11.0	11.0	5	0.5	2.5	2.5	-	0.5	-	-
Other	-	0.5	-	-	5	0.5	2.5	2.5	18	0.5	9.0	9.0	-	0.5	-	-	-	0.5	-	-
<b>Client Specific</b>																				
Inadequacy of the Business Case	34	0.7	23.8	10.2	23	0.7	16.1	6.9	10	0.7	7.0	3.0	35	0.7	24.5	10.5	18	0.7	12.6	5.4
Funding Availability	-	0.7	-	-	-	0.7	-	-	-	0.7	-	-	5	0.7	3.5	1.5	-	0.7	-	-
Project Management Team	1	0.9	0.9	0.1	2	0.9	1.8	0.2	-	0.9	-	-	2	0.9	1.8	0.2	5	0.9	4.5	0.5
Poor Project Intelligence	2	0.7	1.4	0.6	6	0.7	4.2	1.8	7	0.7	4.9	2.1	9	0.7	6.3	2.7	4	0.7	2.8	1.2
Other - omitted (<1)	-	0.6	-	-	2	0.6	1.2	0.8	-	0.6	-	-	-	0.6	-	-	-	0.6	-	-
<b>Environment</b>																				
Public Relations	2	0.2	0.4	1.6	1	0.2	0.2	0.8	9	0.2	1.8	7.2	-	0.2	-	-	-	0.2	-	-
Site Characteristics	2	0.5	1.0	1.0	1	0.5	0.5	0.5	3	0.5	1.5	1.5	5	0.5	2.5	2.5	-	0.5	-	-
Permits/Consents/Approvals	-	0.2	-	-	3	0.2	0.6	2.4	-	0.2	-	-	-	0.2	-	-	-	0.2	-	-
<b>External Influences</b>																				
Economic	11	0.2	2.2	8.8	13	0.2	2.6	10.4	7	0.2	1.4	5.6	3	0.2	0.6	2.4	-	0.2	-	-
Legislation/Regulations	3	0.7	2.1	0.9	7	0.7	4.9	2.1	-	0.7	-	-	8	0.7	5.6	2.4	5	0.7	3.5	1.5
Technology	-	0.95	-	-	5	0.95	4.8	0.3	-	0.95	-	-	8	0.95	7.6	0.4	18	0.95	17.1	0.9
Other	-	0.6	-	-	2	0.6	1.2	0.8	-	0.6	-	-	1	0.6	0.6	0.4	-	0.6	-	-
<b>Weighted Total</b>	<b>100</b>			<b>33.1</b>	<b>101</b>			<b>34.9</b>	<b>100</b>			<b>45.9</b>	<b>100</b>			<b>28.8</b>	<b>100</b>			<b>17.4</b>

Adjusted Optimism Bias

Project Type	Percentage of CAPEX (%)	Mitigated OB (%)	OB contribution (%)	Resulting OB (%)
Standard Buildings	51	7.9	4.0	
Non-Standard Buildings	5	17.8	0.9	
Standard Civils	31	20.2	6.2	
Non-Standard Civils	5	19.0	1.0	
Equipment & Development	8	34.7	2.8	
<b>Combined</b>				<b>15.0</b>

Rounded to 15% for all schemes

Figure B-2 Scheme Works

## Appendix C Scheme Capital Cost Estimate Breakdown

The table on the following pages (C-2 to C-4) sets out the revised Scheme capital cost estimates following comments received during consultation. Total costs for all phases of construction are shown. Base costs are presented, exclusive of ‘On costs’, risk, and optimism bias which are itemised separately. The components of ‘On costs’ include enabling works (01.01.01), operational readiness (01.01.08 and 01.01.09), and project fees (01.06). Their treatment is described in Section 2.2.

As described in Section 3, the changes to Scheme costs concern the quantities used to calculate the cost of the civil works and fit out of the Tracked Transit System tunnels. These are shown in Table C-1 below.

ENR - Consultation Values					ENR - Revised Values			Difference	
Cost Category		Unit	Qty	Rate	Cost (£)	Qty	Rate		Cost (£)
01.01.05.0003.	TTS Tunnels				100,095,552			220,273,696	120,178,144
01.01.05.0003.0050	TTS Tunnels Civils	m	1,200	57,856	69,426,624	2,600	57,856	150,424,352	80,997,728
01.01.05.0003.0070	TTS Tunnels Fit Out	m	1,200	22,157	26,588,928	2,600	22,157	57,609,344	31,020,416
01.01.05.0003.0080	Additional TTS Cars	nr	2	2,040,000	4,080,000	6	2,040,000	12,240,000	8,160,000
01.01.05.0004.	TTS Station / Depot				156,983,946			621,183,675	464,199,729
01.01.05.0004.0050	TTS Stations	nr	1	74,190,476	74,190,476	1	296,761,906	356,114,287	281,923,811
01.01.05.0004.0060	TTS Station Fit Out	sum	0.34	107,795,918	36,650,612	1.20	107,795,918	129,355,102	92,704,490
01.01.05.0004.0080	TTS Maintenance Ba	sum	0.34	103,142,857	35,068,571	1.00	103,142,857	103,142,857	68,074,286
01.01.05.0004.0090	TTS Maintenance Ba	sum	0.34	32,571,429	11,074,286	1.00	32,571,429	32,571,429	21,497,143
	<b>Total</b>				<b>257,079,498</b>			<b>841,457,371</b>	<b>584,377,873</b>

**Table C-1 Revised Tracked Transit System Costs**

Ref No	Description	Quantity	Unit	Unit Rate	Total (£)
<b>HHL</b>	<b>Heathrow Hub (Jacobs Estimate)</b>				<b>14,435,339,806</b>
<b>01.</b>	<b>Investment Costs</b>				<b>14,435,339,806</b>
<b>01.01.</b>	<b>Airport Infrastructure Construction</b>				<b>7,930,965,328</b>
01.01.01.	Enabling Works				1,064,784,817
01.01.01.0001.	Advanced Enabling Works, Clearing Site and Preparation				1,064,784,817
01.01.01.0001.0010	Site clearance	358.16	ha	156,326.82	55,990,201
01.01.01.0001.0020	Demolition / Enabling works	0.91		170,612,244.90	154,456,920
01.01.01.0001.0030	Remediation works	192.79	ha	454,974.30	87,714,495
01.01.01.0001.0040	Ground stabilisation works				
01.01.01.0001.0050	Earthworks, cut, fill, grading of imported fill	21,903,520.00	m3	35.00	766,623,200
01.01.01.0002.	Landscaping				0
01.01.01.0002.0120	Grassed Areas & carriage drainage		m2		
01.01.01.0002.0130	Landscaping		m2		
01.01.02.	Airfield				557,642,572
01.01.02.0001.	Runway				81,630,792
01.01.02.0001.0010	Runway including shoulders	221,600.00	m2	368.37	81,630,792
01.01.02.0002.	Taxiways & Aprons				210,766,948
01.01.02.0002.0030	Parallel Taxiway Links, Rapid Exit Taxiway (RETs), Taxiway Hold incl. fillets to support new runways.	185,576.00	m2	368.37	68,360,631
01.01.02.0002.0040	Taxiway shoulders	386,585.00	m2	368.37	142,406,316
01.01.02.0003.	Stands				220,724,112
01.01.02.0003.0050	Stands	460,830.77	m2	478.97	220,724,112
01.01.02.0004.	Airfield Instrumentation				44,520,720
01.01.02.0004.0120	Navigational Equipment / Lighting	1,463,053.58	m2	30.43	44,520,720
01.01.03.	Airfield Ancillary Facilities				203,787,733
01.01.03.0001.	Air Traffic Control				
01.01.03.0002.	Security				18,579,184
01.01.03.0002.0090	Fencing and CCTV to Terminal Area	7,700.00	m	600.00	4,620,000
01.01.03.0002.0100	Police Facilities	0.00	item	15,300,000.00	0
01.01.03.0002.0110	Control posts	1.00	item	13,959,183.67	13,959,184
01.01.03.0003.	Rescue and Fire Fighting				3,060,000
01.01.03.0003.0030	Fire Station	1.00	Nr	3,060,000.00	3,060,000
01.01.03.0004.	Fuel Systems				49,219,049
01.01.03.0004.0060	Fuel Farm	7.00	Nr	7,031,292.78	49,219,049
01.01.03.0004.0070	Diversion of existing fuel line	0.00	m	2,040.00	0
01.01.03.0005.	De-icing & Snow Clearance				20,000,000
01.01.03.0005.0050	De-icing pads	1.00	item	20,000,000.00	20,000,000
01.01.03.0006.	Serviced areas for ancillary facilities e.g. Hotels, Offices, Cargo Buildings, Hangars, etc				34,969,500
01.01.03.0006.0010	Serviced areas for ancillary facilities e.g. Hotels, Offices, Cargo Buildings, Hangars, etc	349,695.00	m2	100.00	34,969,500
01.01.03.0007.	Surface Water Drainage				29,160,000
01.01.03.0007.0030	Balancing Ponds incl. equipment, pumping, controls * instrumentation, oil interceptors, pipework, etc	97.20	ha	300,000.00	29,160,000
01.01.03.0008.	Noise Control Measures				48,800,000
01.01.03.0008.0080	Noise walls	4,800.00	m	6,000.00	28,800,000
01.01.03.0008.0090	Boundary Treatment - Environmental bund	4,000.00	m	5,000.00	20,000,000
01.01.04.	Terminal Buildings				3,350,360,417
01.01.04.0001.	Terminals				1,559,368,141
01.01.04.0001.0010	T6 Terminal building, Substructure	67,605.00	m2	3,572.65	241,529,003
01.01.04.0001.0020	T6 Terminal building, Superstructure	67,605.00	m2	6,732.20	455,130,381
01.01.04.0001.0030	T6 Terminal building, Fit Out	67,605.00	m2	12,761.02	862,708,757
01.01.04.0002.	Piers & Satellites				1,600,083,184
01.01.04.0002.0010	Satellite Substructure	53,081.00	m2	2,684.16	142,477,897
01.01.04.0002.0020	Satellite Superstructure	53,081.00	m2	8,128.90	431,490,141
01.01.04.0002.0030	Satellite Fit Out	53,081.00	m2	5,612.37	297,910,212
01.01.04.0002.0040	T2E Satellite	21,780.00	m2	33,434.57	728,204,935
01.01.04.0002.0050	T2D Satellite	0.00	m2	33,434.57	0
01.01.04.0002.0060	T2C Satellite	0.00	m2	33,434.57	0
01.01.04.0002.0070	T2A Phase 2	0.00	m2	33,434.57	0
01.01.04.0002.0080	T2A Phase 3	0.00	m2	33,434.57	0
01.01.04.0003.	Fixed Links, VCC, Rotunda/Nodes, PCA and Airbridges				190,909,091
01.01.04.0003.0030	VCC, Airbridge, PCA, nodes and fixed links to new stands	60.00	Nr	3,181,818.18	190,909,091



01.01.05.	Airside Infrastructure				1,079,564,593
01.01.05.0001.	Access Roads				112,697,250
01.01.05.0001.0010	Service / Circulatory roads within airport	5,000.00	m	4,080.00	20,400,000
01.01.05.0001.0070	Airside roads, perimeter track (actually access road)	103,250.00	m2	153.00	15,797,250
01.01.05.0001.0080	Airside Road - C&C Tunnel	1,000.00	m	76,500.00	76,500,000
01.01.05.0002.	Baggage Tunnels				125,409,972
01.01.05.0002.0040	Baggage Tunnels Civils	1,200.00	m	30,864.14	37,036,968
01.01.05.0002.0050	Baggage Tunnels Fit Out	1,200.00	m	73,644.17	88,373,004
01.01.05.0003.	TTS Tunnels				220,273,696
01.01.05.0003.0010	TTS - Tunnel Civils	2,600.00	m	57,855.52	150,424,352
01.01.05.0003.0020	TTS - System and Fit-out	2,600.00	m	22,157.44	57,609,344
01.01.05.0003.0070	Additional TTS Cars	6.00	Nr	2,040,000.00	12,240,000
01.01.05.0004.	TTS Station / Depot				621,183,675
01.01.05.0004.0030	TTS Station	1.20	Nr	296,761,906.00	356,114,287
01.01.05.0004.0060	TTS Station Fit Out	1.20	sum	107,795,918.37	129,355,102
01.01.05.0004.0070	TTS Maintenance Base Substructure	1.00	sum	103,142,857.14	103,142,857
01.01.05.0004.0080	TTS Maintenance Base Fit Out	1.00	sum	32,571,428.57	32,571,429
01.01.05.0005.	Facilities				0
01.01.05.0005.0070	Coaching Facility - Terminal		item	3,876,000.00	0
01.01.06.	Landside Infrastructure				802,376,217
01.01.06.0001.	Connectivity				25,000,000
01.01.06.0001.0040	Landside connectivity systems	1.00	sum	25,000,000.00	25,000,000
01.01.06.0002.	Car Parks				500,204,082
01.01.06.0002.0020	Car Park - Surface & Multi Storey Parking	1.00	sum	500,204,081.63	500,204,082
01.01.06.0003.	Power Generation				0
01.01.06.0003.0020	Energy and Infrastructure	0.00	sum	0.00	0
01.01.06.0004.	Utilities				172,163,265
01.01.06.0004.0030	Utilities	1.00	sum	172,163,265.31	172,163,265
01.01.06.0005.	River Diversion / Culverts				105,008,870
01.01.06.0005.0020	Culverts	1.00	sum	28,460,347.83	28,460,348
01.01.06.0005.0030	Waterways	1.00	sum	76,548,521.74	76,548,522
01.01.07.	Equipment				729,755,102
01.01.07.0001.	De-Icing & Snow Clearance Equipment				
01.01.07.0002.	Rescue & Fire Fighting				
01.01.07.0003.	Baggage Handling Systems				729,755,102
01.01.07.0003.0010	Baggage Equipment Terminal	1.00	sum	299,346,938.78	299,346,939
01.01.07.0003.0050	Baggage Equipment Satellite	1.00	sum	430,408,163.27	430,408,163
01.01.08.	Operational Commissioning				139,591,837
01.01.08.0001.	Operational Commissioning				139,591,837
01.01.08.0001.0010	Operational Commissioning	0.80	sum	155,102,041.00	124,081,633
01.01.08.0001.0020	Operational Readiness	0.80	sum	19,387,755.10	15,510,204
01.01.09.	Operational Handover				3,102,041
01.01.09.0001.	Operational Handover				3,102,041
01.01.09.0001.0010	Operational Handover	0.80	sum	3,877,551.00	3,102,041
01.02.	Purchase of Land & Existing Infrastructure				579,326,988
01.02.01.	Purchase of Land & Existing Infrastructure				579,326,988
01.02.01.0001.	Purchase of Land & Existing Infrastructure				579,326,988
01.02.01.0001.0010			sum		0
01.02.01.0001.0020			sum		0
01.02.01.0001.0030	Land Purchase		sum	579,326,988.00	579,326,988
01.04.	Environmental Compensation & Mitigation				279,700,000
01.04.01.	Airport Infrastructure Construction				218,500,000
01.04.01.0001.	Airport - Ecology / Environmental / Archaeological				193,000,000
01.04.01.0001.0010	Ecology - allowance for mitigation and monitoring of ecological impact	1.00	sum	51,000,000.00	51,000,000
01.04.01.0001.0020	Air quality - allowance for monitoring and mitigation	1.00	sum	0.00	0
01.04.01.0001.0030	Noise - allowance for noise monitoring	1.00	sum	0.00	0
01.04.01.0001.0040	Allowance for costs associated with Archaeological	1.00	sum	0.00	0
01.04.01.0001.0050	Noise mitigation measures to nearby houses	4,000.00	Nr	8,000.00	32,000,000
01.04.01.0001.0060	Flood water mitigation	1.00	sum	110,000,000.00	110,000,000
01.04.01.0002.	M25 Diversion / Other Road Works - Ecology / Environmental / Archaeological				25,500,000
01.04.01.0002.0010	Ecology - Allowance for mitigation and monitoring of ecological impact	1.00	item	25,500,000.00	25,500,000
01.04.01.0002.0020	Air quality - Allowance for monitoring	0.00		0.00	0
01.04.01.0002.0030	Noise - Allowance for noise monitoring and control measures	0.00		0.00	0
01.04.01.0002.0040	Allowance for costs associated with Archaeological	0.00		0.00	0

01.04.02.	Associated Road Works				25,500,000
01.04.02.0001.	Airport - Ecology / Environmental / Archaeological				25,500,000
01.04.02.0001.0010	Ecology - allowance for mitigation and monitoring of ecological impact		1.00	sum	25,500,000.00
01.04.02.0001.0020	Air quality - allowance for monitoring and mitigation		1.00	sum	0.00
01.04.02.0001.0030	Noise - allowance for noise monitoring		1.00	sum	0.00
01.04.02.0001.0040	Allowance for costs associated with Archaeological		1.00	sum	0.00
01.04.03.	Southern Rail Access - T5 to Staines				14,280,000
01.04.03.0001.	Airport - Ecology / Environmental / Archaeological				14,280,000
01.04.03.0001.0010	Ecology - allowance for mitigation and monitoring of ecological impact		1.00	sum	14,280,000.00
01.04.03.0001.0020	Air quality - allowance for monitoring and mitigation		1.00	sum	0.00
01.04.03.0001.0030	Noise - allowance for noise monitoring		1.00	sum	0.00
01.04.03.0001.0040	Allowance for costs associated with Archaeological		1.00	sum	0.00
01.04.04.	Southern Rail Access - M25 Junction 13 to Ruxbury Road Junction				21,420,000
01.04.04.0001.	Airport - Ecology / Environmental / Archaeological				21,420,000
01.04.04.0001.0010	Ecology - allowance for mitigation and monitoring of ecological impact		1.00	sum	21,420,000.00
01.04.04.0001.0020	Air quality - allowance for monitoring and mitigation		1.00	sum	0.00
01.04.04.0001.0030	Noise - allowance for noise monitoring		1.00	sum	0.00
01.04.04.0001.0040	Allowance for costs associated with Archaeological		1.00	sum	0.00
<b>01.05.</b>	<b>Community Impacts</b>				<b>306,000,000</b>
01.05.01.	Community Impacts				306,000,000
01.05.01.0001.	Community Impacts				306,000,000
01.05.01.0001.0010	Residential - noise		1.00	sum	255,000,000.00
01.05.01.0001.0020	Community Infrastructure Levy		1.00	sum	51,000,000.00
<b>01.06.</b>	<b>Project / Design Team Fees</b>				<b>1,364,398,847</b>
01.06.01.	Project / Design Team Fees				1,364,398,847
01.06.01.0001.	Project / Design Team Fees	15%			1,364,398,847
01.06.01.0001.0010	Project / Design Team Fees on 01.01				1,189,644,799
01.06.01.0001.0020	Project / Design Team Fees on 01.02				86,899,048
01.06.01.0001.0030	Project / Design Team Fees on 01.03				0
01.06.01.0001.0040	Project / Design Team Fees on 01.04				41,955,000
01.06.01.0001.0050	Project / Design Team Fees on 01.05				45,900,000
<b>03.</b>	<b>Risks &amp; Optimism Bias</b>				<b>3,974,948,642</b>
03.01.	Risks (Design, Construction & Employer Risk)				2,092,078,233
03.01.01.	Risks (Design, Construction & Employer Risk)				2,092,078,233
03.01.01.0001.	Risks (Design, Construction & Employer Risk)	20%			2,092,078,233
03.01.01.0001.0010	Risk Contingency on 01.01				1,824,122,025
03.01.01.0001.0020	Risk Contingency on 01.02				133,245,207
03.01.01.0001.0030	Risk Contingency on 01.03				0
03.01.01.0001.0040	Risk Contingency on 01.04				64,331,000
03.01.01.0001.0050	Risk Contingency on 01.05				70,380,000
<b>03.02.</b>	<b>Optimism Bias</b>				<b>1,882,870,409</b>
03.02.01.	Optimism Bias				1,882,870,409
03.02.01.0001.	Optimism Bias	15%			1,882,870,409
03.02.01.0001.0010	Optimism Bias on 01.01				1,641,709,823
03.02.01.0001.0020	Optimism Bias on 01.02				119,920,687
03.02.01.0001.0030	Optimism Bias on 01.03				0
03.02.01.0001.0040	Optimism Bias on 01.04				57,897,900
03.02.01.0001.0050	Optimism Bias on 01.05				63,342,000

## Appendix D Approach to Core and Asset Replacement Capital Expenditure

### D.1 Core Works

The approach to the Core works and Asset Replacement estimates was based upon the estimates provided by HH and HAL. This approach recognised that HAL has greater knowledge relating to the condition of the current assets and the detail of its plans in the absence of the extended runway Scheme works. However, recognising the Green Book guidance to correct for the systematic tendency for project appraisers to be overly optimistic, HAL and HH's estimates post Q6 were adjusted for optimism bias.

As published in January 2015, a revision to the underlying indexation of Core capital expenditure has been made to bring it into 2014 Q1 prices. Total Core capital expenditure has increased by £290 million excluding optimism bias.

Following consultation, it was determined that the Southern Road Tunnel project, which had previously been included within surface access costs, should instead be included under Core airport capital expenditure. The Southern Road Tunnel is a Core project (i.e., it is planned regardless of airport expansion) and the works are located within the existing airport perimeter. The project's forecast cost before optimism bias is £520 million.

In response to comments received during consultation, we have revisited the categorisation of Core capital costs and the mitigation factors applied to the derivation of mitigated optimism bias.

For consultation, Core works were categorised as 50% Standard Buildings and 50% Standard Civils. Following consultation, the works have been reassessed and categorised as 70% Standard Buildings, 25% Standard Civils, and 5% Equipment/Development.

As a result, the mitigated optimism bias assumption for Core capital expenditure following the Q6 period (rounded to the nearest 5%) has reduced to 10% from the 15% previously used. The detailed calculation is shown in Appendix B.

Unmitigated optimism bias is unchanged at 15% for all schemes.

The HM Treasury's Green Book Optimism Bias approach is by its nature imprecise, its purpose being to provide comfort in forecasts for which there is insufficient detail and where available data lack precision. Having regard to the ranges of calculated mitigated optimism bias for Core capital expenditure, we have adopted a rounded figure of 10% across all three schemes.

### D.2 Asset Replacement

The allowance for asset replacement sought to cover expenditure relating to:

- *routine maintenance of asset condition and capacity;*
- *periodic major investment to restore the assets' deteriorated condition and capacity; and*

- *investments in improvements to condition and capacity of the existing infrastructure.*

As published in January 2015, a revision to the underlying indexation of Asset Replacement capital expenditure has been made to bring it into 2014 Q1 prices. Q6 capital expenditure, which was classified under Asset Replacement, had already been inflated to 2014 prices for consultation; therefore only Asset Replacement costs after Q6 were adjusted. Consequently, under the Assessment of Need Carbon Capped demand scenario, total Asset Replacement costs have increased by £285 million before optimism bias.

The Asset Replacement forecast is assumed to include adequate provision for the Southern Road Tunnel and no adjustment has been made accordingly.

In line with the approach taken for consultation, Asset Replacement expenditure following the Q6 period is treated similarly to Scheme capital expenditure with regard to risk and optimism bias. Therefore, asset replacement costs are adjusted by 20% for risk and by 15% for mitigated optimism bias or 45% for unmitigated optimism bias.

**Appendix E Core and Asset Replacement Capital Expenditure Summary**

The tables on the following pages summarise the annual capital expenditure relating to the Core and asset replacement works under each of the demand scenarios set out in Section 1. The summaries are presented with mitigated optimism bias applied.

2014 real prices in £million - including mitigated optimism bias

Core	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Terminal buildings	7,033	-	-	-	-	-	-	25	53	103	408	652	742	839	735	333	107	79	474	816	836	605	225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tunnels and bridges	520	-	-	-	-	-	87	173	173	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transit systems	967	-	-	-	-	-	-	-	-	55	116	150	182	189	151	72	45	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Runways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Taxiways and aprons	1,328	-	-	10	20	26	-	32	108	126	138	132	107	64	-	-	237	265	-	27	23	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	636	-	-	-	-	-	-	3	7	9	11	12	26	136	152	40	26	22	36	46	47	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Airfield Ancillary	1,442	-	-	-	-	-	-	93	229	319	339	290	172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Parks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Third Party Land Users	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environment	256	-	-	-	-	-	-	16	34	46	50	48	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optimism Bias	1,213	-	-	-	-	-	9	21	42	53	67	106	126	122	119	104	68	44	11	54	88	90	64	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Risk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>13,394</b>	-	-	<b>10</b>	<b>20</b>	<b>26</b>	<b>95</b>	<b>226</b>	<b>461</b>	<b>588</b>	<b>737</b>	<b>1,163</b>	<b>1,386</b>	<b>1,347</b>	<b>1,306</b>	<b>1,141</b>	<b>752</b>	<b>487</b>	<b>118</b>	<b>590</b>	<b>972</b>	<b>986</b>	<b>709</b>	<b>273</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	

Asset Replacement	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Asset Replacement	12,653	614	702	668	534	534	211	214	214	214	220	218	221	249	271	283	291	300	305	311	313	320	325	331	330	333	338	338	342	342	340	342	342	346	345	349	349	352	
Risk	1,920	-	-	-	-	-	42	43	43	43	44	44	44	50	54	57	58	60	61	62	63	64	65	66	66	67	68	68	68	68	68	68	68	69	69	70	70	70	
Optimism Bias	1,728	-	-	-	-	-	38	38	39	39	40	39	40	45	49	51	52	54	55	56	56	58	59	60	59	60	61	61	62	62	61	62	62	62	62	62	63	63	63
<b>Total</b>	<b>16,301</b>	<b>614</b>	<b>702</b>	<b>668</b>	<b>534</b>	<b>534</b>	<b>291</b>	<b>295</b>	<b>296</b>	<b>295</b>	<b>303</b>	<b>301</b>	<b>305</b>	<b>344</b>	<b>375</b>	<b>390</b>	<b>402</b>	<b>414</b>	<b>421</b>	<b>429</b>	<b>432</b>	<b>441</b>	<b>449</b>	<b>457</b>	<b>455</b>	<b>460</b>	<b>466</b>	<b>466</b>	<b>472</b>	<b>472</b>	<b>469</b>	<b>472</b>	<b>472</b>	<b>478</b>	<b>477</b>	<b>482</b>	<b>481</b>	<b>485</b>	

Table E-1 Assessment of Need Carbon Capped

2014 real prices in £million - including mitigated optimism bias

Core	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Terminal buildings	7,033	-	-	-	-	-	-	25	61	84	364	717	1,011	1,060	720	509	816	836	605	225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tunnels and bridges	520	-	-	-	-	-	87	173	173	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transit systems	967	-	-	-	-	-	-	4	60	119	179	212	200	143	45	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Runways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Taxiways and aprons	1,328	-	-	10	20	26	-	32	108	126	138	132	107	64	237	292	23	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	636	-	-	-	-	-	-	3	7	9	11	26	41	142	165	64	54	52	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Airfield Ancillary	1,442	-	-	-	-	-	-	93	196	284	326	298	201	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Parks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Third Party Land Users	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environment	256	-	-	-	-	-	-	16	34	46	50	48	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optimism Bias	1,213	-	-	-	-	-	9	33	56	68	100	140	162	155	129	91	90	90	64	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Risk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>13,394</b>	-	-	<b>10</b>	<b>20</b>	<b>26</b>	<b>95</b>	<b>360</b>	<b>621</b>	<b>752</b>	<b>1,105</b>	<b>1,542</b>	<b>1,782</b>	<b>1,702</b>	<b>1,418</b>	<b>1,000</b>	<b>987</b>	<b>992</b>	<b>709</b>	<b>273</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Asset Replacement	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Asset Replacement	12,931	614	702	668	534	534	208	213	216	218	221	220	221	254	282	296	308	318	325	332	332	337	338	341	341	340	344	347	348	349	350	351	352	352	356	356	358	358
Risk	1,976	-																																				

2014 real prices in \$million - including mitigated optimism bias

Core	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Terminal buildings	7,033	-	-	-	-	-	8	42	77	110	426	955	1,178	1,353	1,218	836	605	225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tunnels and bridges	520	-	-	-	-	-	87	173	173	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transit systems	967	-	-	-	-	-	-	4	8	63	148	208	223	192	116	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Runways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Taxiways and aprons	1,328	-	-	10	20	26	32	108	126	138	132	107	64	264	288	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equipment	636	-	-	-	-	-	3	7	9	11	26	41	63	173	180	55	45	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Airfield Ancillary	1,442	-	-	-	-	-	-	93	196	284	326	298	201	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Parks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Third Party Land Users	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environment	256	-	-	-	-	-	-	-	16	34	46	50	48	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optimism Bias	1,213	-	-	-	-	-	13	43	61	73	110	166	178	206	182	91	65	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Risk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>13,394</b>	<b>-</b>	<b>-</b>	<b>10</b>	<b>20</b>	<b>26</b>	<b>143</b>	<b>469</b>	<b>666</b>	<b>799</b>	<b>1,214</b>	<b>1,826</b>	<b>1,954</b>	<b>2,270</b>	<b>2,007</b>	<b>1,001</b>	<b>714</b>	<b>273</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	

Asset Replacement	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Asset Replacement	13,373	614	702	668	534	534	215	217	216	222	222	225	226	263	292	310	326	337	344	343	345	350	346	351	353	355	360	359	363	365	366	368	374	376	378	383	382	388	
Risk	2,064	-	-	-	-	-	43	43	43	44	44	45	45	53	58	62	65	67	69	69	70	69	70	71	71	72	72	73	73	74	75	75	76	77	76	78	78	78	
Optimism Bias	1,858	-	-	-	-	-	39	39	39	40	40	40	41	47	53	56	59	61	62	62	62	63	62	63	63	64	65	65	65	66	66	66	67	68	68	69	69	70	70
<b>Total</b>	<b>17,295</b>	<b>614</b>	<b>702</b>	<b>668</b>	<b>534</b>	<b>534</b>	<b>296</b>	<b>300</b>	<b>298</b>	<b>306</b>	<b>307</b>	<b>310</b>	<b>312</b>	<b>363</b>	<b>404</b>	<b>428</b>	<b>449</b>	<b>465</b>	<b>475</b>	<b>473</b>	<b>477</b>	<b>483</b>	<b>478</b>	<b>485</b>	<b>486</b>	<b>490</b>	<b>497</b>	<b>496</b>	<b>500</b>	<b>504</b>	<b>506</b>	<b>508</b>	<b>516</b>	<b>519</b>	<b>522</b>	<b>529</b>	<b>527</b>	<b>535</b>	

Table E-3 Global Growth Carbon Traded

2014 real prices in \$million - including mitigated optimism bias

Core	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Terminal buildings	7,033	-	-	-	-	-	-	-	25	53	103	417	687	957	1,005	644	107	79	474	816	836	605	225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tunnels and bridges	520	-	-	-	-	-	87	173	173	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transit systems	967	-	-	-	-	-	-	-	-	4	60	119	179	212	200	143	45	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Runways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Taxiways and aprons	1,328	-	-	10	20	26	-	32	108	126	138	132	107	64	-	237	265	-	27	23	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Equipment	636	-	-	-	-	-	3	7	9	11	12	26	41	141	147	26	22	36	46	47	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Airfield Ancillary	1,442	-	-	-	-	-	-	93	229	319	339	290	172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Parks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Third Party Land Users	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Environment	256	-	-	-	-	-	-	16	34	46	50	48	39	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Community	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Optimism Bias	1,213	-	-	-	-	-	9	21	42	54	68	107	134	148	137	117	44	11	54	88	90	64	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Risk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Total</b>	<b>13,394</b>	<b>-</b>	<b>-</b>	<b>10</b>	<b>20</b>	<b>26</b>	<b>95</b>	<b>229</b>	<b>464</b>	<b>596</b>	<b>744</b>	<b>1,177</b>	<b>1,471</b>	<b>1,632</b>	<b>1,505</b>	<b>1,288</b>	<b>487</b>	<b>118</b>	<b>590</b>	<b>972</b>	<b>986</b>	<b>709</b>	<b>273</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	

Asset Replacement	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Asset Replacement	12,650	614	702	668	534	534	209	214	219	216	219	223	221	248	271	284	294	303	308	314	318	324	325	328	332	337	336	338	337	338	338	340	340					

## Appendix F Operational Expenditure

### F.1 Introduction

This appendix sets out the changes made to the independent forecast of operational expenditure for the period 2014 to 2050 for the Heathrow Airport Extended Northern Runway scheme following consultation (see Table F-3).

### F.2 Revisions to Operating Cost Forecasts

Further to consultation, modelling refinements were made, resulting in the following minor changes to operational expenditure forecasts:

- *the allowance for Optimism Bias has increased as a result of a refinement to the modelling of terminal gross floor area:*
  - *Optimism Bias is only applied to costs associated with operating Scheme infrastructure and not Core infrastructure.*
  - *Previously, the incremental operating costs associated with operating Terminal 6 were being offset by the reduced operating costs associated with the closure of Terminal 3.*
  - *Refinements to the model allowed the full costs of operating Terminal 6 to be properly attributed to the Scheme, and hence the calculation of optimism bias.*
  - *The result is that while there is no change to base operating costs, the costs including mitigated optimism bias have increased marginally (<1% cumulatively).*
- *a correction has been made to the capacity assumptions applied to the Global Fragmentation Carbon Capped demand scenario. This leads to a minor change in the years 2027, 2029, and 2032-2034 (0.1% cumulatively).*

The airport operating cost estimate is considered to have adequate provision to cover any costs associated with the inclusion of the Southern Road Tunnel in Core works, and therefore no adjustment has been made.

### F.3 Treatment of Risk and Optimism Bias

There is no change to the approach to calculating risk for operational expenditure.

In response to comments received during consultation, we have revisited the mitigation factors applied to the derivation of the mitigated optimism bias allowance for operational expenditure.

As before, all works are categorised under Outsourcing, following the guidance set out in HM Treasury's Green Book.

The HM Treasury's Green Book Optimism Bias approach is by its nature imprecise, its purpose being to provide an appropriate cost contingency in forecasts for which there is insufficient detail and where available data lack precision. Having regard to the ranges of calculated mitigated optimism bias for Scheme capital expenditure, we have adopted a rounded figure of 15% across all three schemes.



Table F-1, below, sets out the revised calculation used to derive an appropriate level of mitigated optimism bias used consistently for all schemes.

OPEX Contributory Factors	Outsourcing optimism bias (%)	Mitigation Factor (0<x<1)	Reduction in optimism bias	Mitigated optimism bias (%)
<b>Procurement</b>				
Late Contractor Involvement in Design	5	0.95	4.8	0.3
Poor contractor Capabilities	15	0.95	14.3	0.8
<b>Project Specific</b>				
Design Complexity	5	0.8	4.0	1.0
Degree of Innovation	5	0.8	4.0	1.0
<b>Client Specific</b>				
Project Management Team	20	0.9	18.0	2.0
Poor Project Intelligence	10	0.7	7.0	3.0
<b>Environment</b>				
Site Characteristics	5	0.5	2.5	2.5
<b>External Influences</b>				
Economic	20	0.2	4.0	16.0
Legislation/Regulations	15	0.5	7.5	7.5
<b>Weighted Total</b>	<b>100</b>			<b>34.0</b>
<b>Adjusted Optimism Bias</b> = 34.0 x 41% Upper Bound				<b>14%</b>

**Table F-1 Revised Optimism Bias Mitigations**

### F.4 Summary of Adjustments

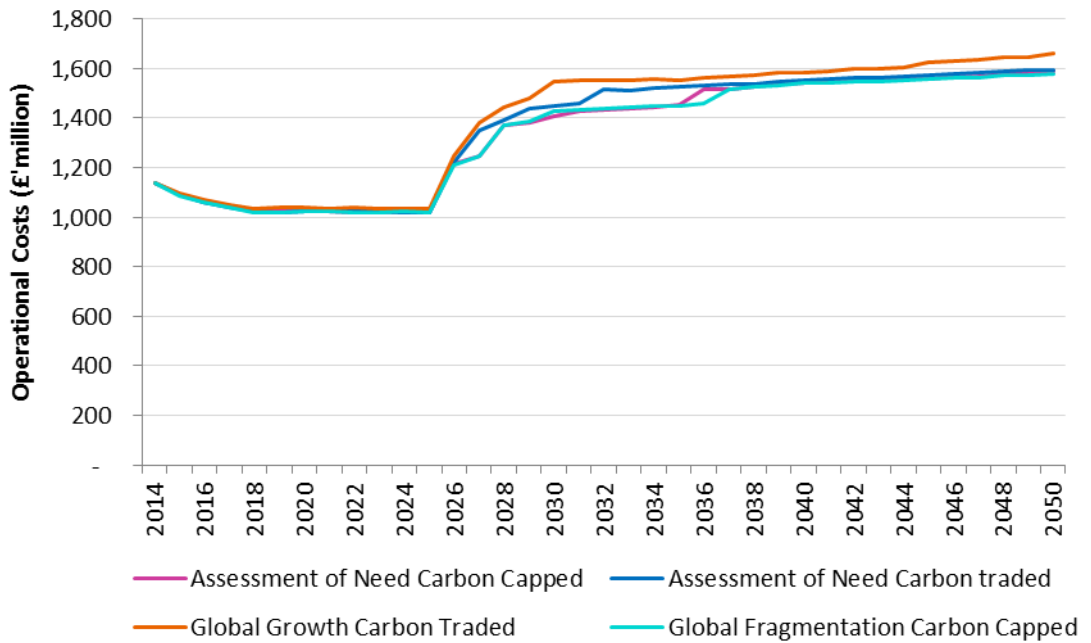
In summary, the following adjustments for risk and optimism bias were made:

		Scheme	
		Pre-consultation	Post-consultation
<b>Risk</b>		20	20
<b>Optimism Bias</b>	<b>Mitigated</b>	20	15
	<b>Unmitigated</b>	41	41

**Table F-2 Summary of Risk and Optimism Bias Adjustments to the Base Costs (%)**

### F.5 Revised Independent Operational Expenditure Forecast

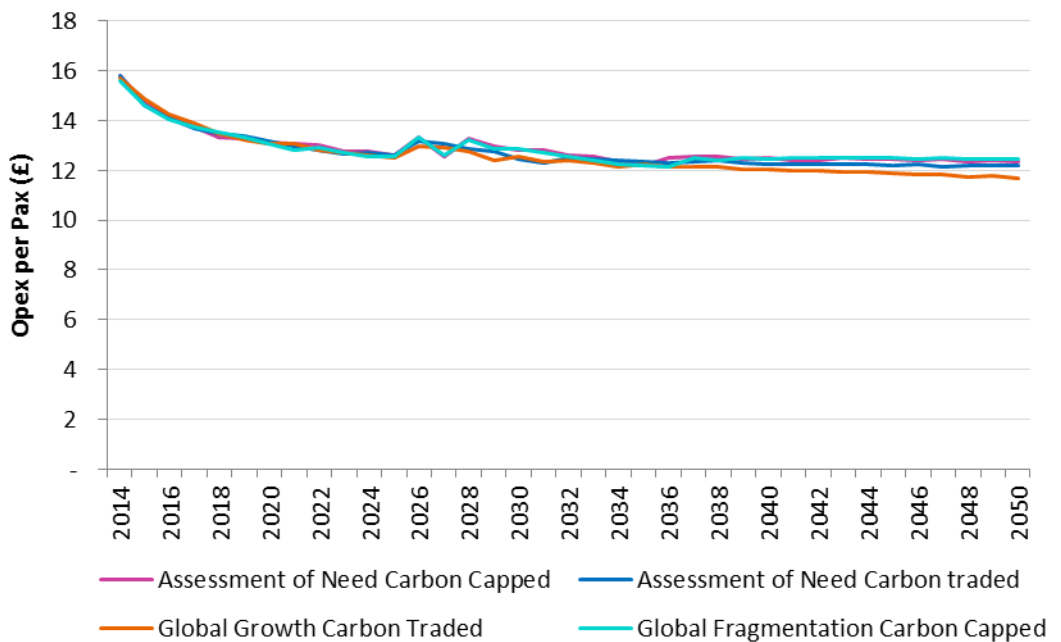
This section presents graphical outputs of the revised independent operating cost model and summary tables.



**Figure F-1 Heathrow Airport Extended Northern Runway Scheme Forecast Operating Expenditure (Risk Adjusted and Mitigated)**

On a per passenger basis, operating costs are forecast to decrease over the longer term in all demand scenarios. Figure F-2, below, shows operating costs on a per passenger basis.

Temporary increases occur during the period following the opening of new infrastructure. When new terminal buildings open, there is a marked increase in fixed costs. Over time, as passenger numbers increase to fill the terminal buildings, costs become more efficient on a per passenger basis.



**Figure F-2 Heathrow Airport Extended Northern Runway Scheme Forecast Operating Expenditure per Passenger (Risk Adjusted and Mitigated Optimism Bias)**

2014 real prices in E'million

Assessment of Need Carbon Capped	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Staff	16,894	449	425	410	400	395	390	389	385	381	381	376	375	435	447	482	483	485	489	488	484	484	485	503	500	499	500	497	497	495	491	490	487	487	484	484	481	481	
Routine maintenance	6,347	168	161	155	152	150	148	147	146	145	145	143	142	148	152	171	171	185	184	183	185	184	185	185	184	190	190	189	189	188	187	187	186	186	185	184	183	183	
Utilities	3,846	94	94	93	92	91	90	89	88	87	87	86	85	101	101	113	112	111	113	112	111	110	109	116	115	114	114	113	113	112	112	111	111	110	110	109	109	108	
Rent and rates	6,312	129	128	127	125	124	124	124	124	124	124	124	124	159	159	183	183	183	187	187	187	187	187	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201
Rail	2,078	69	58	57	57	56	55	55	55	54	54	53	53	55	57	57	57	57	57	57	57	57	57	57	56	56	56	56	56	56	55	55	55	55	55	55	54	54	
Other	9,330	228	223	220	217	214	212	211	209	207	207	205	205	234	241	258	259	261	264	265	264	265	267	276	276	277	279	278	280	280	279	280	280	281	281	282	282	283	
Opex	44,806	1,137	1,089	1,061	1,042	1,030	1,020	1,015	1,007	998	998	987	984	1,133	1,156	1,264	1,266	1,282	1,294	1,292	1,288	1,286	1,289	1,338	1,332	1,338	1,340	1,335	1,336	1,332	1,325	1,323	1,319	1,320	1,315	1,315	1,310	1,310	
Opex (incl. Risk & OB)	49,612	1,137	1,089	1,061	1,042	1,030	1,025	1,025	1,022	1,018	1,023	1,017	1,019	1,214	1,248	1,372	1,383	1,407	1,427	1,433	1,436	1,442	1,453	1,513	1,514	1,528	1,538	1,541	1,550	1,553	1,551	1,557	1,559	1,569	1,569	1,578	1,581	1,588	
Opex/pax (£)		15.81	14.69	14.18	13.73	13.30	13.28	13.12	13.05	13.00	12.73	12.76	12.60	13.32	12.57	13.27	12.98	12.81	12.80	12.61	12.53	12.33	12.21	12.49	12.54	12.54	12.44	12.47	12.39	12.41	12.48	12.44	12.45	12.38	12.42	12.36	12.39	12.35	

Assessment of Need Carbon traded	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Staff	17,106	449	425	409	399	391	387	387	385	383	381	376	374	437	484	489	498	500	499	516	511	509	507	506	504	501	501	500	498	496	494	492	491	488	488	485	484	481	
Routine maintenance	6,460	168	162	156	152	149	147	147	146	145	143	142	149	154	174	188	189	191	191	189	195	194	194	193	192	192	192	191	190	189	189	188	187	187	186	185	184		
Utilities	3,896	94	94	93	92	91	90	89	88	88	87	86	85	102	114	113	115	114	113	119	118	117	116	116	115	115	114	114	113	112	112	111	111	110	110	109	109	108	
Rent and rates	6,399	129	128	127	125	124	124	124	124	124	124	124	124	159	183	187	187	187	187	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201
Rail	2,113	69	58	57	57	56	56	55	55	55	55	54	54	56	58	59	59	59	59	59	58	58	58	58	58	57	57	57	57	57	56	56	56	56	56	56	55	55	
Other	9,468	228	224	221	217	213	211	210	209	208	207	206	205	236	258	262	267	270	271	279	278	278	278	279	279	279	281	281	282	282	282	283	283	283	283	284	284	285	285
Opex	45,442	1,137	1,090	1,062	1,042	1,023	1,015	1,013	1,009	1,004	998	989	984	1,139	1,251	1,280	1,315	1,319	1,320	1,365	1,355	1,358	1,355	1,354	1,350	1,344	1,346	1,345	1,342	1,338	1,335	1,332	1,329	1,325	1,326	1,321	1,319	1,315	
Opex (incl. Risk & OB)	50,354	1,137	1,090	1,062	1,042	1,023	1,020	1,023	1,024	1,024	1,024	1,019	1,019	1,222	1,348	1,392	1,437	1,450	1,460	1,515	1,511	1,522	1,527	1,534	1,536	1,537	1,547	1,553	1,557	1,560	1,564	1,568	1,573	1,576	1,585	1,587	1,592	1,595	
Opex/pax (£)		15.81	14.59	14.10	13.70	13.46	13.38	13.15	12.97	12.82	12.67	12.68	12.58	13.14	13.09	12.87	12.78	12.47	12.28	12.49	12.46	12.37	12.35	12.31	12.33	12.37	12.27	12.23	12.22	12.24	12.23	12.23	12.21	12.23	12.16	12.19	12.17	12.19	

Global Growth Carbon Traded	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Staff	17,867	449	434	421	409	403	402	400	395	396	392	390	387	455	505	518	523	544	544	537	534	531	526	527	525	523	524	521	520	519	517	515	516	515	513	513	510	511	
Routine maintenance	6,552	168	161	155	151	149	149	148	146	146	145	144	143	151	156	177	192	195	195	200	198	197	196	196	195	195	195	194	193	193	192	192	192	191	191	191	190	190	
Utilities	3,919	94	94	93	92	91	90	89	88	88	87	86	85	102	114	116	115	122	120	119	118	117	116	116	115	115	114	114	113	113	112	112	111	111	110	110	109	109	
Rent and rates	6,431	129	128	127	125	124	124	124	124	124	124	124	124	159	183	187	187	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201
Rail	2,136	69	58	57	57	56	56	55	55	55	55	54	54	56	58	59	60	60	60	60	60	59	59	58	58	58	58	58	58	58	58	58	58	58	57	57	57	57	57
Other	9,597	228	222	220	216	213	212	211	209	209	207	207	206	239	261	269	273	283	284	282	281	281	280	282	282	283	285	284	285	286	287	287	289	290	290	290	292	291	293
Opex	46,503	1,137	1,096	1,072	1,049	1,036	1,034	1,029	1,018	1,017	1,010	1,005	1,000	1,163	1,278	1,327	1,351	1,405	1,404	1,399	1,391	1,386	1,378	1,379	1,376	1,375	1,377	1,371	1,371	1,369	1,366	1,363	1,366	1,364	1,362	1,363	1,358	1,360	
Opex (incl. Risk & OB)	51,596	1,137	1,096	1,072	1,049	1,036	1,039	1,039	1,033	1,038	1,035	1,036	1,035	1,248	1,379	1,446	1,479	1,545	1,552	1,553	1,553	1,555	1,551	1,561	1,566	1,572	1,583	1,583	1,589	1,596	1,601	1,606	1,622	1,629	1,635	1,645	1,646	1,658	
Opex/pax (£)		15.68	14.84	14.22	13.88	13.48	13.24	13.08	13.08	12.81	12.72	12.60	12.50	12.96	12.89	12.73	12.42	12.55	12.34	12.38	12.29	12.16	12.24	12.15	12.14	12.11	12.01	12.04	11.98	11.96	11.94	11.94	11.87	11.84	11.82	11.74	11.78	11.68	

Global Fragmentation Carbon Capped	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Staff	16,842	449	425	411	398	390	388	388	387	382	380	379	374	434	445	482	484	491	490	488	486	485	483	482	500	500	497	496	493	491	489	487	485	484	482	481	478	477	
Routine maintenance	6,300	168	161	155	150	147	147	147	146	144	144	143	141	147	151	170	171	184	183	185	184	184	183	183	183	183	189	188	187	186	185	185	184	184	183	182	181	181	
Utilities	3,838	94	94	93	92	91	90	89	88	87	87	86	85	101	101	113	112	114	113	112	111	110	109	109	115	114	114	113	113	112	112	111	111	110	109	109	108	108	
Rent and rates	6,303	129	128	127	125	124	124	124	124	124	124	124	124	159	159	183	183	187	187	187	187	187	187	187	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201
Rail	2,097	69	58	57	57	56	56	56	56	55	55	54	54	56	57	58	58	58	58	58	58	58	57	57	57	57	57	57	56	56	56	56	55	55	55	55	55	55	
Other	9,265	228	223	219	215	210	209																																

## Appendix G Non-Aeronautical Revenue

### G.1 Introduction

This appendix sets out the changes made to the independent forecast of non-aeronautical revenues for the period 2014 to 2050 for the Heathrow Airport Extended Northern Runway scheme following consultation.

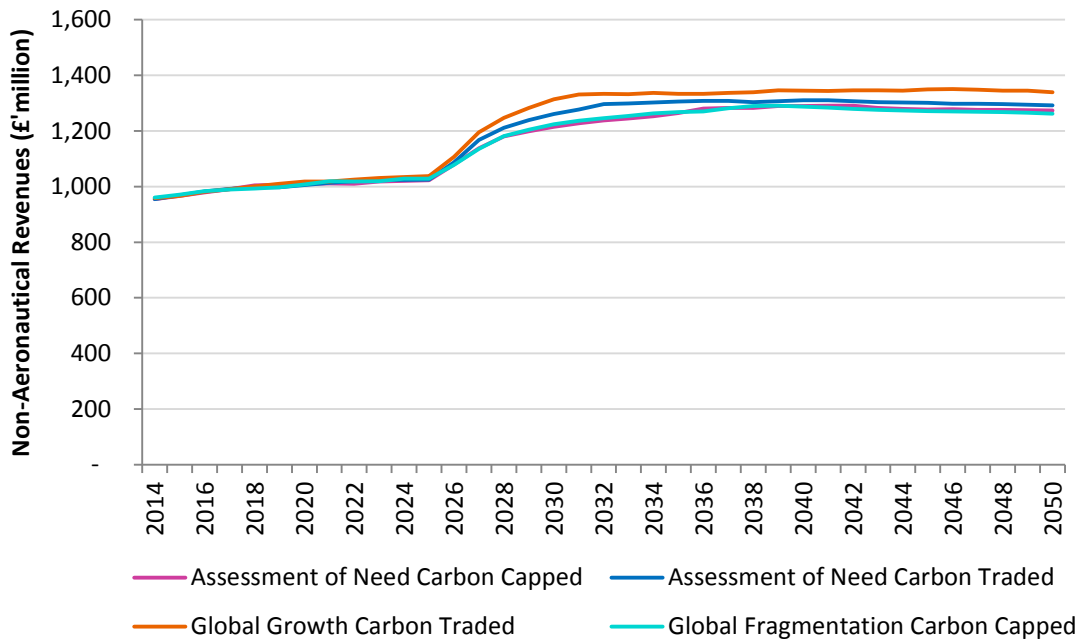
### G.2 Revisions to Non-Aeronautical Revenue Forecasts

During consultation, modelling refinements have been made, resulting in minor changes (less than 0.1%) to non-aeronautical revenue forecasts:

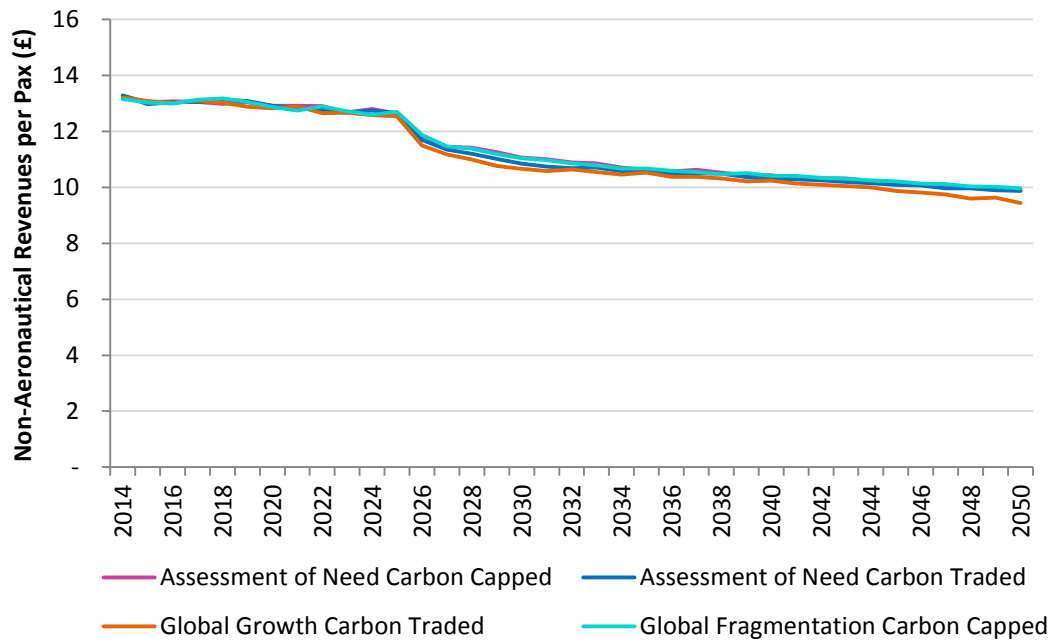
- *certain non-aeronautical revenue categories have been amended so that uplifts are triggered in line with phases of terminal development. This has resulted in decreases in non-aeronautical revenue in 2027, 2029, and 2032-2034 under the Global Fragmentation Carbon Capped demand scenario; and*
- *in the Global Growth Carbon Traded scenario, a correction to passenger numbers has been made for the Q6 period.*

### G.3 Revised Independent Non-aeronautical Revenue Forecasts

This section presents graphical outputs of the revised independent non-aeronautical revenue model (Figures G-1 and G-2) and summary tables (Table G-1). We assumed a reduction in the real compounded growth rate of 0.25% per year for risk and a similar reduction of 0.25% for optimism bias



**Figure G-1 Heathrow Airport Northern Runway Extension Scheme Forecast Non-Aeronautical Revenue (Risk Adjusted and Optimism Bias)**



**Figure G-2 Heathrow Airport Northern Runway Extension Scheme Forecast Non-Aeronautical Revenue per Passenger (Risk Adjusted and Optimism Bias)**

Table G-1, on the following page, sets out the independent forecasts for each demand scenario.

2014 real prices in £'million

Assessment of Need Carbon Capped	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Car parking	3,569	65	66	68	70	72	73	74	76	77	79	80	82	87	95	99	101	102	104	105	106	107	108	110	110	110	111	111	112	112	112	111	112	112	112	112	113	113	113
Total retail	21,520	404	409	417	423	431	435	438	442	444	450	455	458	486	530	559	578	595	608	620	629	639	652	665	672	676	686	690	694	698	696	697	699	703	706	709	712	715	
<i>Duty and tax-free</i>	7,695	129	131	135	137	141	143	144	146	147	150	152	154	166	184	197	205	213	219	224	228	233	239	245	248	250	255	257	258	260	259	260	261	262	264	265	266	268	
<i>Other retail</i>	11,701	236	238	242	244	248	250	251	253	254	256	258	260	272	292	306	315	322	329	334	338	343	348	354	357	359	364	366	367	369	368	369	370	371	373	374	376	377	
<i>Food and beverage</i>	2,125	40	40	41	42	42	42	43	43	43	44	44	44	48	53	56	58	60	61	62	63	64	65	66	66	67	68	68	69	68	69	69	69	69	70	70	70		
Property rental	4,240	108	111	111	111	111	111	111	111	111	111	111	111	114	114	116	116	116	116	116	116	116	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	
Rail	7,536	124	126	130	134	138	140	143	145	147	152	153	157	172	187	194	199	204	209	214	217	222	227	232	234	237	242	245	249	252	253	256	258	263	265	269	272	275	
Other revenue	9,884	253	253	253	253	253	253	253	253	253	252	252	252	264	264	272	272	272	274	274	274	273	273	277	277	277	277	277	276	276	276	275	275	275	275	275	275	275	
<b>Non-aero</b>	<b>46,750</b>	<b>955</b>	<b>966</b>	<b>979</b>	<b>990</b>	<b>1,005</b>	<b>1,011</b>	<b>1,019</b>	<b>1,027</b>	<b>1,031</b>	<b>1,044</b>	<b>1,051</b>	<b>1,059</b>	<b>1,123</b>	<b>1,190</b>	<b>1,241</b>	<b>1,266</b>	<b>1,290</b>	<b>1,311</b>	<b>1,328</b>	<b>1,341</b>	<b>1,357</b>	<b>1,377</b>	<b>1,401</b>	<b>1,410</b>	<b>1,417</b>	<b>1,433</b>	<b>1,440</b>	<b>1,448</b>	<b>1,455</b>	<b>1,454</b>	<b>1,457</b>	<b>1,462</b>	<b>1,471</b>	<b>1,476</b>	<b>1,483</b>	<b>1,489</b>	<b>1,495</b>	
<b>Non-aero (incl. Risk &amp; OB)</b>	<b>43,253</b>	<b>955</b>	<b>966</b>	<b>979</b>	<b>990</b>	<b>1,005</b>	<b>1,006</b>	<b>1,009</b>	<b>1,012</b>	<b>1,011</b>	<b>1,018</b>	<b>1,020</b>	<b>1,022</b>	<b>1,079</b>	<b>1,137</b>	<b>1,180</b>	<b>1,198</b>	<b>1,214</b>	<b>1,228</b>	<b>1,238</b>	<b>1,244</b>	<b>1,253</b>	<b>1,264</b>	<b>1,281</b>	<b>1,282</b>	<b>1,282</b>	<b>1,290</b>	<b>1,289</b>	<b>1,290</b>	<b>1,283</b>	<b>1,279</b>	<b>1,277</b>	<b>1,278</b>	<b>1,276</b>	<b>1,276</b>	<b>1,275</b>	<b>1,275</b>		
Non-aero/pax (£)		13.28	13.04	13.08	13.05	12.98	13.04	12.91	12.91	12.91	12.67	12.80	12.64	11.84	11.45	11.42	11.25	11.06	11.01	10.89	10.86	10.71	10.62	10.57	10.62	10.52	10.43	10.44	10.32	10.31	10.32	10.22	10.20	10.09	10.11	9.99	9.99		

Assessment of Need Carbon Traded	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Car parking	3,661	65	66	68	70	71	72	74	76	78	80	81	82	88	98	103	106	108	110	112	112	113	113	113	113	113	113	114	114	114	114	114	115	115	115	115	115	115	
Total retail	21,998	404	411	420	424	427	430	435	443	449	455	457	459	491	543	579	603	624	641	655	663	670	678	684	689	691	697	704	708	709	711	713	716	717	721	724	726	728	
<i>Duty and tax-free</i>	7,898	129	132	136	138	140	141	143	147	149	152	153	154	167	190	205	216	225	232	239	243	246	250	253	255	257	260	263	264	265	266	267	268	268	270	272	272	273	
<i>Other retail</i>	11,919	236	239	243	245	246	247	250	253	256	258	260	261	274	298	315	326	335	343	350	353	356	360	363	365	366	369	372	374	374	375	376	377	378	380	381	382	383	
<i>Food and beverage</i>	2,180	40	41	41	42	42	42	42	43	44	44	44	44	49	55	59	61	63	65	66	67	67	68	68	68	68	69	70	70	70	70	71	71	71	71	71	72	72	
Property rental	4,247	108	111	111	111	111	111	111	111	111	111	111	111	114	116	116	116	116	116	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	
Rail	7,734	124	127	131	134	136	138	142	146	150	153	155	157	175	193	203	210	216	222	228	230	234	236	239	242	243	247	251	254	257	259	262	266	268	272	275	278	281	
Other revenue	9,921	253	253	253	253	253	253	253	253	252	252	252	252	264	273	273	274	274	274	278	278	278	278	278	278	277	277	277	277	277	276	276	276	276	275	275	275	275	275
<b>Non-aero</b>	<b>47,561</b>	<b>955</b>	<b>969</b>	<b>983</b>	<b>992</b>	<b>998</b>	<b>1,003</b>	<b>1,015</b>	<b>1,029</b>	<b>1,040</b>	<b>1,051</b>	<b>1,056</b>	<b>1,061</b>	<b>1,132</b>	<b>1,222</b>	<b>1,274</b>	<b>1,310</b>	<b>1,339</b>	<b>1,363</b>	<b>1,390</b>	<b>1,401</b>	<b>1,411</b>	<b>1,422</b>	<b>1,432</b>	<b>1,439</b>	<b>1,441</b>	<b>1,451</b>	<b>1,463</b>	<b>1,470</b>	<b>1,474</b>	<b>1,478</b>	<b>1,483</b>	<b>1,489</b>	<b>1,493</b>	<b>1,501</b>	<b>1,507</b>	<b>1,512</b>	<b>1,516</b>	
<b>Non-aero (incl. Risk &amp; OB)</b>	<b>43,993</b>	<b>955</b>	<b>969</b>	<b>983</b>	<b>992</b>	<b>998</b>	<b>998</b>	<b>1,005</b>	<b>1,013</b>	<b>1,020</b>	<b>1,025</b>	<b>1,024</b>	<b>1,025</b>	<b>1,087</b>	<b>1,168</b>	<b>1,212</b>	<b>1,239</b>	<b>1,261</b>	<b>1,278</b>	<b>1,296</b>	<b>1,299</b>	<b>1,302</b>	<b>1,306</b>	<b>1,308</b>	<b>1,308</b>	<b>1,303</b>	<b>1,307</b>	<b>1,311</b>	<b>1,310</b>	<b>1,307</b>	<b>1,304</b>	<b>1,302</b>	<b>1,301</b>	<b>1,297</b>	<b>1,298</b>	<b>1,297</b>	<b>1,295</b>	<b>1,292</b>	
Non-aero/pax (£)		13.28	12.97	13.04	13.05	13.14	13.09	12.92	12.84	12.77	12.69	12.74	12.65	11.69	11.35	11.20	11.02	10.84	10.74	10.69	10.71	10.58	10.57	10.50	10.50	10.49	10.37	10.31	10.28	10.25	10.20	10.15	10.09	10.07	9.96	9.97	9.89	9.87	

Global Growth Carbon Traded	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
Car parking	3,805	66	66	68	70	71	73	76	77	79	81	82	84	91	101	108	112	115	117	117	117	117	117	116	117	117	118	118	119	119	120	120	121	122	123	123	124	124	
Total retail	22,673	405	410	418	424	429	437	444	446	452	458	463	468	503	560	601	631	655	673	680	684	693	696	701	709	715	725	729	731	736	740	743	749	753	754	752	757	752	
<i>Duty and tax-free</i>	8,189	129	132	135	138	140	144	147	148	150	154	156	158	172	197	214	227	238	246	250	252	256	258	260	264	267	271	273	274	277	278	279	282	284	285	284	286	285	
<i>Other retail</i>	12,223	236	238	242	244	247	250	254	255	257	260	262	264	280	306	325	339	350	358	362	363	367	369	371	374	377	381	383	384	387	388	390	392	394	394	393	395	392	
<i>Food and beverage</i>	2,260	40	40	41	41	42	43	43	43	44	45	45	45	51	57	61	64	67	69	69	69	70	70	70	71	71	72	72	73	73	74	74	75	75	75	75	75	75	
Property rental	4,250	108	111	111	111	111	111	111	111	111	111	111	111	114	116	116	116	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	
Rail	8,051	125	126	131	133	137	142	145	147	152	154	158	161	181	201	212	222	229	235	237	239	243	243	246	250	253	258	260	264	268	272	275	281	286	290	295	298	303	
Other revenue	9,944	253	253	253	253	253	253	253	253	253	252	252	252	264	273	275	275	279	279	279	279	278	278	278	278	278	278	277	277	277	276	276	276	276	275	275	275	275	276
<b>Non-aero</b>	<b>48,722</b>	<b>958</b>	<b>966</b>	<b>981</b>	<b>990</b>	<b>1,001</b>	<b>1,016</b>	<b>1,029</b>	<b>1,033</b>	<b>1,046</b>	<b>1,057</b>	<b>1,066</b>	<b>1,075</b>	<b>1,153</b>	<b>1,250</b>	<b>1,312</b>	<b>1,356</b>	<b>1,395</b>	<b>1,421</b>	<b>1,430</b>	<b>1,436</b>	<b>1,449</b>	<b>1,451</b>	<b>1,459</b>	<b>1,471</b>	<b>1,480</b>	<b>1,496</b>	<b>1,502</b>	<b>1,508</b>	<b>1,518</b>	<b>1,525</b>	<b>1,532</b>	<b>1,544</b>	<b>1,554</b>	<b>1,559</b>	<b>1,563</b>	<b>1,571</b>	<b>1,572</b>	
<b>Non</b>																																							

## Appendix H Surface Access Capital Expenditure, Operational Expenditure and Maintenance Cost

### H.1 Introduction

This appendix sets out the changes made to the independent forecast of non-aeronautical revenues for the period 2014 to 2050 for the Heathrow Extended Northern Runway scheme following consultation.

### H.2 Adjustment for Risk and Optimism Bias

There is no change to the adjustment for risk and optimism bias.

### H.3 Capital Expenditure and Asset Replacement

Following consultation, it was determined that the Southern Road Tunnel project, which had previously been included within surface access costs, should instead be included under Core airport capital expenditure. The Southern Road Tunnel is a Core project (i.e., it is planned regardless of airport expansion) and the works are located within the existing airport perimeter.

Surface access costs have been reduced by £520 million plus 44% Optimism Bias (Total: £748 million).

### H.4 Operational Expenditure

Operating expenditure associated with the Southern Road Tunnel has been removed, reducing costs by £6 million.

### H.5 Asset Replacement

Asset replacement associated with the Southern Road Tunnel has been removed, reducing costs by £12 million.

### H.6 Outputs

Tables H-1 and H-2, on the following page, set out summaries of the capital, operational and asset replacement costs by road and rail project, including adjustments for risk and optimism bias.

