Heathrow Expansion

Updated scheme design - Attachment 5-1 Addendum

Development Strategy submitted to the Airports Commission
by Runway Innovations Ltd and Heathrow Hub Ltd

June 2014

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APPENDICES

1 INTRODUCTION

Heathrow Hub Ltd and Runway Innovations Ltd (HH/RIL) are pleased to provide this further submission prepared in response to the Airports Commission's clarification questions submitted in June 2014.

This Addendum includes the following information in response to:

- Request for further detail and concept drawings/sketches in relation to the Water, Carbon and Place: Heritage & Townscape modules (sections 2 to 6 of this Addendum);
- Clarification queries received from the Airports Commission on 13th June 2014 (Appendix 1);
- Request for a consolidated assumptions register (Appendix 6); and
- Excel datasheets relied on within Air Quality Technical Note within Attachment 5-1 of the original submission (May 2014) (Appendix 7).

This Addendum aims to consolidate the response submitted on behalf of HH/RIL into a single document for greater ease of reference. It is recognised however that the Airports Commission and its consultant team may wish to pose further queries as the appraisal process progresses therefore the original Excel spreadsheet (completed) is submitted in an editable format.

Please note that not all drawings have been updated to include the latest master plan (as submitted in June 2014) at this point. Following confirmation by the Airports Commission that this has been accepted as the final master plan we will undertake a review of the conclusions submitted under Section 5: Mitigation Strategies and in Attachment 5-1 as part of the May submission and these responses to confirm they are still valid, or update where appropriate.

2 WATER AND FLOOD RISK

2.1 Clarification question: HUB-WATER-W-001

The design appears to have focused on the 1% (1 in 100) annual exceedance probability (AEP) event for fluvial flooding, and we note that this is consistent with the response from the Environment Agency; Can the promoter indicate whether any consideration has been given to the impact on infrastructure and operations up to the 0.5% (1 in 200) AEP event, which is more in line with government guidance with regard to flood risk for nationally significant critical infrastructure? If consideration has been given to the impact of over design events, what are the principal impacts?

2.1.1 *Assessment/calculations*

This response should be read in conjunction with the Water and Flood Risk chapter within the Stage 2 Submission, Attachment 5-1 document.

Whilst consideration has focused on the 1.0% (1 in 100) AEP plus climate change, the 0.1% (1 in 1000) has been considered. Based on experience with the River Bollin crossing for the second runway at Manchester Airport it is possible that more extreme events will need to be considered and that access for maintenance will be more onerous than the requirements state.

With regard to fluvial flooding existing modelled information was only available for 1.0%, 1.0% plus climate change and 0.1% events. The difference in peak levels between to 1.0% and 0.1% events is typically less than 200mm so the impacts of the 0.5% (1 in 200) AEP flood would not be significantly different from the 1.0% AEP flood.

Table 2.1 below and the Master Plan Concept Figure 1 (see Appendix 2) present the lowest channel level, flood levels and the indicative culvert soffit levels at the upstream end of each culverted section.

Table 2.1 Indicative flood and culvert soffit levels

Location Description	Lowest Channel Level (m AOD)	Node[1]	Flood Water Levels[2]			Soffit Level (m AOD)
Airport Site			**1.0% (100yr) (m AOD)**	**1.0% (100yr) + 20% CC (m AOD)**	**0.1% (1000yr) (m AOD)**	
River Colne Upstream	19.97	PBC059	21.81	21.90	21.98	23
Duke of Northumberland's River Upstream	21.50	DCD027	23.26	23.3	23.42	21.5
Longford River	20.9	LCD010	22.18	22.29	22.37	21.5
Wraysbury River Upstream	19.73	PB157	21.84	21.937	22.085	24

2.2 Clarification question: HUB-WATER-W-008

The use of rainwater harvesting, grey water recycling and removal of residential properties is noted in regard to the reduction in potable water demand that these elements would bring; Has any attempt been made to estimate the level of these reductions compared to the increase in potable water demand as a result of development? What consideration has been given to the increase in potable water demand, and how this water supply need will be met, tied into Affinity Water's water resources plan for the area? Similarly, what consideration has been given to the increased discharges to waste water treatment plants, and would this fit with Thames Water's strategic plans?

2.2.1 *Potable Water Supply*

The Heathrow 2012 Sustainability Performance Summary indicates that the existing airport occupies an area of over 1,200 hectares and that the average volume of water used by all sources between 2010 and 2012 is 2,238,128 cubic metres. This report also indicates that the volume of harvested rainwater has decreased from 31,183 cubic metres in 2010 to 0 cubic metres in 2012. As a consequence, the volume of water abstracted from boreholes has increased from 344,687 cubic metres in 2010 to 416,500 cubic metres in 2012.

The airport extension and associated hub has an area of approximately 400 hectares and therefore has potential to increase the water demand by up to 34 per cent or 746,000 cubic metres per year if water efficiency and recycling measures are not provided. However, the demolition of 242 existing dwellings and 64.5 hectares of employment land reduce the demand on the existing water supply network and the existing water resources by approximately 31,000 cubic metres per year based on an occupancy rate of 2.3 people per dwelling and an average daily demand of 150 litres per person per day for residential dwellings, and a discharge of 0.6l/s/ha for employment land applied over an 8 hour period.

[1] Refer to Appendix D of Chapter 2: Water and Flood Risk Stage 2 Submission Attachment 5-1 for locations
[2] Taken from Mott MacDonald for the Environment Agency Thames Region, April 2012, Lower Colne Modelling and Mapping Study, Draft Report

Where feasible, demand reduction measures, rainwater harvesting and grey water recycling measures will be incorporated to reduce the potable water demand of the airport extension further, as described below-

- Demand reduction measures such as low flush toilets, flow regulated showers, spray taps and auto shut off valves to toilet areas that suppress the automatic flush in the absence of movement have potential to reduce water demand by approximately 30 per cent (e.g. spray taps provide a flow rate of approximately 6 litres/minute, which is less than the 9 litre/minute flow rate from a standard tap, whilst low flush toilets allow the water demand to be reduced from 7 litres per flush to a dual 4/2 litre flush);
- Rainwater harvesting devices are proposed to intercept runoff from the roofs of new buildings that are proposed within the airport terminal, including Terminal 6, the remote piers and the hotel. The new buildings are likely to have a roof area of approximately 130,000 square metres. Calculations produced in accordance with intermediate approach defined within BS 8515:2009 – Rainwater Harvesting Systems indicate that it is likely to be practical to harvest approximately 48,000 cubic metres of water from the roofs of the buildings within the extended airport, assuming a yield coefficient of 0.8 for a flat roof without gravel, an annual average rainfall of 520mm and a filter efficiency of 0.9;
- Greywater recycling systems are proposed to intercept potable water that has already been used for other applications, such as hand washing and showering, and permit this water to be treated, stored and recycled for use in toilet flushing and irrigation; therefore yield and demand are closely aligned. The proportion of potable water that may be recycled from wash basins and showers will be dependent upon the range of appliances that are installed within the extended airport. However, CIRIA Project Report PR 80 Rainwater and grey water use in buildings indicates that approximately 27 per cent of water used in a comparable environment is likely to be discharged from hand basins and showers and that larger volumes of water are required for toilet flushing. The use of grey water recycling systems therefore has potential to reduce potable water demand by up to 27 per cent.

The figures presented above indicate that the demolition of existing properties and employment land combined with the use of demand reduction measures have potential to reduce the additional potable water demand to approximately 491,000 cubic metres per year and that rainwater and greywater recycling systems could potentially be used to supply approximately 9 per cent and 27 per cent of this demand, respectively. These calculations are based upon assumptions defined within the preceding text which will undergo further verification as the scheme develops. Water resource availability is set out in the Environment Agency's Catchment Abstraction Management Strategy (CAMS) publications. The Heathrow Hub and extension study area lies within two catchment areas, the Colne and the Maidenhead to Sunbury catchments, within which there are three potential sources of water for abstraction: (1) surface water, (2) a shallow superficial deposits aquifer which is likely to contribute significantly to surface water flows and (3) the deeper Chalk aquifer, which is confined beneath the London Clay and which is not connected to surface water in this area.

For surface water and the shallow superficial deposits aquifer: "Water is not available for licensing" and "no further consumptive licences will be granted" within the Colne catchment area (EA (2013), Colne Abstraction Licensing Strategy). Groundwater availability is guided by the surface water resource availability here.

In addition, there is "no water available at low flows" and "restricted water available" at higher flows within the Maidenhead to Sunbury catchment area (EA (2014), Thames Catchment Abstraction Licensing Strategy). There is a bespoke licensing strategy in this area as follows:

- For all new consumptive abstraction licences below 2Ml/d, no abstraction will take place when the average of the daily mean flows of the preceding 5 days in the River Thames as gauged at Kingston is equal to or less than Q50 (1780Ml/d).

- For all new consumptive abstractions of 2Ml/d or above, a Hands-off-flow (HOF) of between Q21 (7209Ml/d) and Q50 (1780Ml/d) will be applied, based on the perceived level of risk to the waterbody. The applicant must provide a WFD assessment to show the abstraction will not cause environmental deterioration under the WFD or prevent the waterbody achieving "Good ecological status/potential".
- For abstractions of all sizes, additional local HOFs may be applied to protect local features (such as a nearby protected area) or existing abstractors.
- Consumptive groundwater licences which do not have a direct impact upon river flows may be permitted, but may be subject to restrictions such as prescribed groundwater levels. Restrictions will be determined on a case-by-case basis, dependent upon the nature and scale of the abstraction. Any application will still be subject to the normal licence determination process.

For the confined Chalk aquifer: Water is "available for licensing" and "new licences can be considered depending on impacts on other abstractors and on surface water" in both the Colne and Maidenhead to Sunbury catchment areas (EA (2013), London Abstraction Licensing Strategy).

Hence, according to the Environment Agency's CAMS publications, it is likely to be feasible to meet the water demand of the extended airport by using surface water or shallow groundwater within the Maidenhead to Sunbury catchment area or by the confined Chalk aquifer across the entire area.

2.2.2 *Foul Water Treatment and Disposal*

The proposed airport extension will cause the peak rate and volume of foul water to increase. However, the demolition of 242 existing dwellings and 64.5 hectares of employment land will cause existing foul flows to be reduced and will therefore partially offset the additional flow and volume that will be generated by the airport extension. The preceding calculations indicate that the airport extension is still likely to increase the volume of foul water discharged by approximately 18 per cent, assuming that demand reduction measures are incorporated. Foul water from the extended airport would be treated at Mogden Sewage Treatment Works (STW). This STW has recently been subject to a £140m extension, which has enabled the capacity to be expanded by 54 per cent in order to reduce sewerage overflows to the River Thames and to improve the quality of treated wastewater to the environment. This significant extension will create additional treatment capacity, which may potentially be utilised to accommodate the additional volume of foul water generated by the airport extension.

Foul water generated by the airport will be distributed over a significant proportion of the day, whilst the existing foul sewers situated downstream of the airport will also receive a diurnal foul flow from residential dwellings; therefore the airport extension will not cause the peak discharge to be increased as significantly as an equivalent residential development. However, grey water harvesting is proposed to reduce the peak rate of foul discharge from the airport extension, as grey water from wash basins and showers will be stored, treated and reused before being discharged to the foul sewerage network.

As the scheme develops, a Thames Water Network Capacity Assessment will be required in order to determine the extent of off-site improvement works to the existing sewer network that are required to accommodate the increased foul flows and the cost of future upgrades will need to be factored into future AMP programmes. Alternatively, consideration could be given to the installation of a new foul pumping station that would intercept and balance the combined foul flows from the existing and extended airports in order to ensure that the peak discharge to the receiving sewerage network would not be increased. This new foul pumping station could incorporate controls in the form of ultrasonic level detectors within the receiving sewer network to ensure that pumps only discharge foul water at times when the receiving sewer is not surcharged in order to utilise residual capacity within the network. Further work would be required to verify the need for and feasibility of this alternative approach; however, the concept

would effectively mitigate the impact of the airport extension on the receiving sewerage network.

2.2.3 *Sustainable Urban Drainage (SuDS)*

An illustrative arrangement of the sustainable urban drainage system is attached as requested at Appendix 2, showing indicative locations of the likely SuDS features proposed as part of this scheme.

3 AIR QUALITY

3.1 Clarification question: HUB-AIR-A-002

Consideration of designated sites and their sensitivity to oxides of nitrogen does not appear to be included in this assessment; can the promoter clarify why this aspect has not been addressed at this time?

3.2 Assumptions

At this stage of our assessment a full set of traffic data for the existing situation are not available for use in a quantitative air quality assessment of public exposure and designated ecosystem sites. The assessment of designated sites is anticipated to be undertaken in the later stages of the promotion of the scheme (see section 3.5 below). This will then allow the calculation of total pollutant concentrations and changes in pollutant concentrations (e.g. oxides of nitrogen and nitrogen deposition) with the operation of the scheme.

Therefore, at this stage a risk based qualitative evaluation of air quality has been undertaken. This review has focused on likely future air quality and the effects of the scheme, with embedded mitigation, upon public exposure. This is because this aspect of exposure is considered to be the highest area of risk to the promotion of the scheme rather than indirect effects of changes in air quality on designated ecosystem sites.

However, some additional information considering designated ecosystem sites is provided below to provide some additional qualitative assessment of designated ecosystem sites in relation to the HH scheme.

3.3 Assessment/calculations

Increased numbers of aircraft and vehicles have the potential to lead to changes in air quality (including nitrogen oxides and dust). This can adversely affect nearby habitats by affecting acidity, photosynthesis, respiration and transpiration.

Table 3.1 below shows Statutory Designated Sites within 5km of the proposed HH scheme, detailing their distance from the site, designation and whether they are sensitive to nitrogen deposition. For those which are potentially sensitive to Nitrogen Deposition critical loads are presented.

Table 3.1 Statutory Designated Sites
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Site	Distance from site (km) and bearing	Designation	Vulnerable to Nitrogen Deposition?	Critical Loads
Staines Moor	Unit 1 would be traversed by the realigned M25 at Junction 14	SSSI	Potentially Vulnerable	20-30 kg N/ha/yr
South West London Waterbodies Wetland of International Importance	364m south (Wraysbury Reservoir component)	Ramsar	Not Vulnerable	N/A
South West London Waterbodies Special Protection Area	364m south (Wraysbury Reservoir component)	SPA	Not Vulnerable	N/A
Wraysbury Reservoir	364m south	SSSI	Not Vulnerable	N/A
Wraysbury & Hythe End Gravel Pits	2km south	SSSI	Not Vulnerable	N/A
Wraysbury No. 1 Gravel Pit	2km south-west	SSSI	Not Vulnerable	N/A
Langham Pond SSSI	4.4km south-west	SSSI	Potentially Vulnerable	5-15 kg N/ha/yr
Thorpe Hay Meadow	2.5km south of the 2 lane dual link from the M25	SSSI	Potentially Vulnerable	20-30 kg N/ha/yr
Windsor Forest and Great Park	4km west of the 2 lane dual link from the M25	SSSI/SAC	Potentially Vulnerable	5-15 kg N/ha/yr

3.3.1 ***Conclusions***

The majority of designated sites within 5km are not vulnerable to nitrogen deposition. The majority of the designated sites which are identified as being potentially vulnerable to nitrogen deposition are located further than 2.5km from the proposed HH site. At this distance, it is not anticipated that changes in traffic would lead to changes in concentration that would be sufficient enough to result in significant impacts on the acid deposition at the designated sites. For the Staines Moor site which would be traversed by the realigned M25, it would be necessary to complete air quality modelling in order to assess the impacts when sufficient traffic data becomes available at the detailed design stage. Any indirect air quality effects for this site would be addressed as part of any wider ecological mitigation package for this site.

3.4 Clarification question: HUB-AIR-A-003

The supporting information necessary to interpret the overall conclusions of the assessment has not been provided. Could the promoter please provide further detail regarding the assessment methodologies (including, if possible, supporting information such as traffic data, air quality monitoring data, emissions data and explanation and study areas)?

3.4.1 *Assumptions*

At this stage of our assessment a full set of traffic data for the existing situation are not available for use in a quantitative air quality assessment of public exposure and designated ecosystem sites. This is anticipated to be undertaken in the later stages of the promotion of the scheme (see section 3.5 below). This would then allow the calculation of total pollutant concentrations and changes in pollutant concentrations (i.e. nitrogen dioxide) with the operation of the scheme. This also therefore means that the relative improvements in any embedded mitigation cannot be individually quantified at this stage.

Therefore, at this stage a risk based qualitative evaluation of air quality has been undertaken. A key aspect of this evaluation has been the consideration of how good air quality and in particular NO2 concentrations are likely to be in the anticipated opening year of the scheme (2025).

This review has considered air quality monitoring across eight local authorities the scheme is either located in or could affect through changes in traffic etc. This review has considered data from a number of recent years (e.g. 2011, 2012 and 2013). We have then applied a rate of improvement in NO2 concentrations to this data. The rate of improvement is not based on the rates of improvement inherent in the Defra Local Air Quality Management (LAQM.TG(09) guidance, instead it is based on rates of improvement currently utilised in other large infrastructure projects promoted by the Highways Agency (i.e. Long Term Trends). These are more conservative rates of improvement than Defra, with improvements in air quality of approximately 3 to 4.5 per cent per year between 2015 and 2019 and 1 to 3 per cent per year between 2015 and 2019.

3.4.2 *Assessment/calculations*

A summary of our evaluation of likely air quality for the key pollutant NO2 is presented below. The data indicates that the vast majority of monitoring locations are anticipated to comply with the annual average air quality objective by 2025, with less than 10 per cent still exceeding the annual average objective. Those that do not comply are often in locations that are not representative of public exposure (e.g. 32 of 42 locations are within 5m of routes). Therefore, as previously outlined we anticipate that the scheme will be operational in an improved air quality environment with air quality complying with relevant air quality objectives at the majority of relevant exposure locations.

Additionally no locations of non-compliance against EU Limit Values within the nationwide model have been identified around Heathrow.

Table 3.2 Air Quality Monitoring Summary

Local Authority	Number of Locations Considered	Number above air quality objective in 2015[3]	Number above air quality objective in 2025	Number less than air quality objective.
London borough of Hillingdon	54	15	0	54
London Borough of Hounslow	67	32	4	63
South Bucks District Council	23	5	0	23
London borough of Ealing	131	66	25	106
Runnymede Borough Council	41	17	7	34
Slough Borough Council	46	30	4	42
Spelthorne Borough Council	77	9	0	77
Royal Borough of Windsor and Maidenhead	36	16	2	34
Total	**475**	**190**	**42**	**433**

The spreadsheets of the above calculations for individual monitoring locations are provided at Appendix 7.

The second part of the evaluation we have undertaken is the consideration of the likely effectiveness of mitigation measures on any changes in air quality with the proposed scheme. As described above traffic data is not available to quantify the effectiveness of elements of the scheme's embedded mitigation, nor the mitigation already being developed in and around Heathrow by HAL. Modelling data is also not yet available to demonstrate the improvements in aviation emissions from the re-location of take-off emissions to the centre of the airport rather than the boundaries.

However, one of the key mitigation measures of modal shift offered by the operation of HH is likely to reduce changes in air quality significantly by potentially removing thousands of vehicle trips from the road network. The level of reduction is likely to vary depending on the number

[3] Factored from most recent monitoring year using LTT factors

of trips removed and the distance of receptors from the road network but this may result in mitigation of 1 to 2 µg/m³, with greater mitigation for locations in particularly close proximity to key routes.

The use of the Heathrow Hub will also minimise the impact on the existing local road network by providing direct links from the Hub itself to the M25 and through use of an Automated People Mover (APM) to transport passengers once at the Hub.

Additionally, due to the nature of the supporting highways work required as part of the scheme there is the opportunity to adjust design alignments to maximise distances from receptors, which along with the above reductions in emissions should contribute to an acceptable level of change in NO2 at receptors.

3.4.3 *Conclusions*

It summary, a combination of future air quality improvements and embedded mitigation are anticipated to be sufficient to deliver an acceptable scheme for air quality at this concept design stage.

3.5 Further query from Airports Commission

In the minutes of the additional environmental meeting between the Airports Commission Secretariat and Heathrow Hub (19th June 2014) HH/RIL agreed to provide some additional information to the Commission.

HH to provide breakdown of what HH's preferred approach would be if sufficient information was available to undertake a full modelling exercise.

3.5.1 *Assumptions*

At this stage of our assessment a full set of traffic data for the existing situation are not available for use in a quantitative air quality assessment of public exposure and designated ecosystem sites. This is anticipated to be undertaken in the later stages of the promotion of the scheme. The below section outlines the approach we would envisage for a detailed stage of assessment.

3.5.2 *Proposed Assessment/calculations approach*

The next stages of any assessment of the HH scheme, following receipt of suitable traffic data would likely include the following:

Stage 1: Traffic Data Screening

- At this stage traffic data with and without the HH scheme would be compared and a study area defined by changes in flows (e.g. Highways Agency Guidance HA207/07).

Stage 2: Development of Emissions Inventories

- Existing, Opening Year without HH and With HH Heathrow Airport Emissions inventory would be collated for surface transport (including air-side vehicles), on-site energy generation and aviation;
- Existing, Opening Year without HH and With HH surrounding Motorway routes, A-Road and B-Road emissions would also be calculated.

Stage 3: Detailed Modelling using ADMS-Airport

- The emissions inventory for the baseline year would be detailed modelled using ADMS-Airports to establish the existing situation within the study area for sensitive receptors and to also confirm model performance.

- The future scenarios would then be modelled to establish the future situation without and with HH, including changes in road networks and take off and landings.
- Results would be post-processed using the latest Defra Local Air Quality Management Tools (re-issued in June 2014) and also use Long Term Trends information based on Highways Agency guidance (consistent with the qualitative approach utilised to date).

Stage 4: Evaluation of results

- The total predicted concentrations at sensitive receptors and the changes in pollutant concentrations would be utilised to evaluate the significance of scheme effects for air quality.
- This would likely be undertaken using professional judgement and guidance from the Institute of Air Quality Management and the Highways Agency, and also based on a review of relevant planning policy.

3.5.3 *Conclusions*

Until a suitable set of traffic data is available for use further quantitative air quality modelling works are not considered to be appropriate. This is due to the level of likely challenge to the results of any modelling on the basis of data quality.

4 CARBON

4.1 Clarification question: HUB-CARBON-004

To account for policies and technologies that could impact relative emissions over this period scenarios where developed accounting for 5% and 20% reductions. Could details be provided of the policies and technologies that are expected to impact this result be provided?

4.1.1 *Assumptions*

Due to the rapidly evolving nature of aviation technology as well as the complexities and uncertainties around future policy and regulation that may impact carbon emissions from the aviation sector it is difficult to predict with any confidence what the likely emissions per passenger travelled will be in 2030 compared with 2012.

As a result URS considered a reduction in carbon emissions of between 5 and 20 percent per passenger by 2030 to be a reasonable and potentially conservative estimate of carbon savings that may be achieved through airport operations and aircraft movements. If implemented, the various policies and supporting technologies detailed in this document would exceed the higher end of the 20 per cent range estimated.

It is recognised that the impacts of aviation on climate change are being increasingly accepted at both a state level and by the aviation industry resulting in a growing momentum to implement mitigating action through increasing policy and emerging technological advances.

To date significant investment has been made by aircraft and engine manufacturers to improve the fuel efficiency of their products in turn reducing carbon emissions that are contributing to climate change. The International Civil Aviation Organisation (ICAO), responsible for taking a lead in reducing global emissions from aviation, recognises that there has been significant technological progress made in the aviation sector, with current aircraft being around 80 per cent more fuel efficient per passenger kilometre than those flying in the 1960s.

The Air Transport Action Group (ATAG) states that while growth in air travel passenger numbers is increasing at an average of 5 per cent each year, aviation has acted to decouple growth in carbon emissions to around 3 per cent.

Key policy currently impacting aviation emissions is the EU Emissions Trading Scheme (EUETS). At a European level the EU acted to include aviation within the EUETS from January 2012. Following several attempts to introduce policy changes the scheme was limited to an intra-European Economic Area scheme in April 2014 which will be reviewed in 2020 in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emissions.

Further background on policies and technologies is detailed in section 4.1.2 below.

4.1.2 *Mitigation measures*

As previously stated estimating carbon emissions associated with airport operations and aircraft movements is complex. The following summary provides an overview of some of the key technologies and measures and how they may impact carbon reductions across the industry.

Globally the ICAO is working with Member States and the aviation industry to develop standards and recommend practices that are then implemented nationally through civil aviation regulations. Impacts of the aviation industry on climate change are recognised as a key area of concern that the ICAO must address. In response the ICAO has developed a number of policies and frameworks around environmental protection and climate change which are being considered by the global aviation industry. Specifically carbon reduction targets have been set to:

- Achieve a global annual average fuel efficiency improvement of 2 per cent until 2020 and an aspirational global fuel efficiency improvement rate of 2 per cent per annum from 2021 to 2050;
- A collective medium-term global aspirational goal of keeping the global net carbon emissions from international aviation from 2020 at the same level (i.e. any future growth beyond 2020 is carbon neutral); and
- By 2050, net aviation carbon emissions will be half of what they were in 2050.

The ICAO has also established a framework to increase the use of biofuels, a Global Air Navigation Plan enhancing operational efficiency of air travel and is currently considering a global CO_2 standard for aircraft.

To monitor progress towards these targets at a national level the ICAO is working with Member States to develop voluntary action plans that will outline national policies and actions to reduce carbon emissions from aviation. Plans will be submitted to the ICAO by June 2015 and then resubmitted every three years after that.

The ICAO notes in its most recent Assembly Resolution in Force (by 2013) that sustainable growth in aviation will require a comprehensive approach that consists of new technologies and standards along with improved operations and economic drivers.

In 2013[4] the ATAG[5] responded by publishing a paper endorsed by a number of the world's major aviation stakeholders, setting out goals for the aviation industry to reduce its contribution to climate change and meet the ICAO reduction targets. The ATAG approach is based on a four strand strategy to include[6]:

1. Improved technology (e.g. fuel efficient airframe and engine technologies, increased use of biofuels); ATAG state that:

[4] https://www.iata.org/policy/environment/Documents/atag-paper-on-cng2020-july2013.pdf
[5] The Air Transport Action Group (ATAG) represents over 1750 airport operators and 80 air navigation services
[6] http://aviationbenefits.org/environmental-efficiency 40 airlines, 8500 companies operating in the aviation industry and major aircraft and engine manufacturers.

a. Each generation of new aircraft is approximately 20 per cent more fuel efficient and that around $1.3 trillion dollars is expected to be invested in new aircraft in the next 10 years;
b. Alternative fuels have the potential to cut carbon emissions by up to 80 per cent compared with traditional fuel; and
c. Wingtip devices can reduce fuel use by up to 4 per cent.[7]

2. More efficient aircraft operations for example through better air traffic management; ATAG state:

    a. Landing using continuous decent can reduce emission by 150kg CO_2 per flight; and

    b. Shortening flight times by a minute can save 100kg CO_2 per flight.

3. New and upgraded airport infrastructure; and

4. A global market based measure e.g. an economic measure such as a carbon offsetting scheme, to meet any shortfall (to come into force by 2020).

At a local level HAL has published an action plan setting out policy and technology measures to reduce carbon emissions from airport operations[8]. Notable measures include:

- Heathrow Energy Centre containing biomass combined cooling heat and power installation and two high efficiency gas boilers;
- Increased use of the Airbus A380 that has new departure procedures saving an additional 300kg of fuel per flight, equating to one metric tonne of CO2 on a flight to Singapore;
- A new procedure developed where only one engine of an aircraft is used to taxi to and from the runways reducing carbon emissions by 7-36 per cent per taxi in and 7-35 per cent per taxi out depending on the aircraft (this may increase in time as new aircraft technology is introduced); and
- 100 per cent of the waste cooking oil produced at the airport is being recycled in some way, with over 85 per cent being recycled as biodiesel, and this figure is expected to increase over time.

In terms of policy and other initiatives HAL has stated:

- A target to achieve a 34 per cent reduction in CO_2 emissions from energy use in buildings by 2020 (from a 1990 baseline in line with government CO_2targets);
- Heathrow joined the Aircraft on the Ground CO_2Reduction Programme, launched by the Airport Operators Association (AoA), aiming to reduce emissions from aircraft as they taxi around the airport, and from power used to provide stationary planes with electricity and cool air; and
- Heathrow has established the Clean Vehicles Partnership to help Heathrow companies reduce emissions from airport vehicles.

Finally a key factor that may influence carbon emissions is the potential decarbonisation of the electricity grid. In 2013 the electricity conversion rate is 0.49426 kg CO_2e according to DEFRA/DECCs Government conversion factors for company reporting. This is estimated to fall to approximately 0.125 kg CO_2e (a 74 per cent decrease) according to Electricity Grid Decarbonisation Factors published by DECC/IAG for 2030.

[7] http://aviationbenefits.org/blog/2014/04/wingtips-every-little-helps/
[8] http://www.heathrowairport.com/about-us/community-and-environment/responsible-heathrow/case-studies

4.1.3 *Conclusions*

URS selected a range of between 5 and 20 per cent carbon emissions reduction based on a level of uncertainty as to what may be achieved through future policy and technological innovations. Should the ICAO targets be achieved through the implementation of increasingly efficient technologies and operations then 20 per cent may prove be an underestimate.

4.2 Clarification question: HUB-CARBON-008

Only construction and new facilities and surface access mitigation measures are noted, and in limited detail (e.g. "promotion of non-car access modes"); Does the promoter have any further detail to share regarding mitigation measures than are currently included here, both for measures noted in brief and for aviation related emissions (ground movements, LTO cycle, full flight)?

4.2.1 *Assumptions*

The following response refers to carbon emissions savings and mitigation measures to reduce emissions from ground movements, LTO cycle and full flight. Please note that due to data availability a quantitative assessment of carbon emissions savings has not been undertaken at this time; however percentage improvements in fuel efficiency can be used as proxy for carbon emissions savings.

4.2.2 *Surface Access (Passenger transport)*

Additional data has become available through the Surface Access Paper to allow for more detailed estimations of carbon emissions from passenger transportation to/from the airport. Previously estimations had been calculated through extrapolation of existing HAL surface access data for 2012. Carbon emissions calculations based on the passenger journey details provided in the Surface Access paper can be found on the 'Area 5 Calculations' tab of the 'Operational Footprint AC Version' excel document (see Appendix 3). Assumptions made around Passenger Transport can be found in the Surface Access Paper[9].

Table 4.1 below details the total contribution made by each transport mode for passenger travel. By 2030 it can be seen that there has been a 2 per cent decrease in the overall proportion travelling by coach travel, a 5 per cent decrease in the overall proportion travelling by car but a sharp increase of 7 per cent in the proportion arriving by rail.

Table 4.1 Modal shift

Year	Bus-Coach	Car	Rail	Total
2012	12%	59%	29%	100%
2030	10%	54%	36%	100%

4.2.3 *Baseline*

The carbon emission baseline year for passenger transportation was calculated using 2012 passenger journey data extracted from the Surface Access paper. The calculations present the variation in emissions between the 2012 baseline year and 2030 when the Hub is operational.

[9] Heathrow Hub Interchanges & Surface Access Strategy (June 2014)

4.2.4 *Assessment/calculations*

Passenger data were provided for four geographical regions (Greater London, Great Western, Southern Access and the rest of the country) and by mode of transport (car, national rail, bus/coach).

Emissions factors for national rail, bus/coach and car have been taken from the Defra/DECC emissions factors for 2012.

The following process was used to calculate carbon emissions:

1. Identifying an average journey length (km) for each passenger journey (based on a central location point within each region). The distance was multiplied by 2 to account for return journeys;
2. Multiplying the total number of passenger journeys by each transport mode in each region by the average journey distance to calculate passenger kilometres travelled;
3. Multiplying passenger kilometres travelled by the relevant Defra/DECC emissions factor for each transport mode to calculate total carbon emissions.
4. The resulting total carbon emissions for all journeys were reduced by 5 per cent and 20 per cent to model the different estimated emissions scenarios highlighted previously to take account of future technology and policy.

Carbon emissions were calculated for 2012 (baseline) and 2030 which assumed the Hub is fully operational. The total increase in emissions per annum by 2030 from passenger travel is estimated to be approximately 430,000 tCO_2 per annum with car transport accounting for the greatest amount.

Table 4.2 Emissions variation 2012-2030 (tCO_2)[10]

Area	Bus-Coach	Car	Rail	Total
Greater London Area	1 000	27 000	29 600	57 800
Great Western Area	1 600	6 700	30 400	38 700
Southern Access Area	-203	7 800	6 900	14 500
Rest of Country	6 600	276 000	36 400	319 000
Total emissions (tCO_2)				**430 000**
5% reduction scenario (tCO_2)				**409 000**
20% reduction scenario (tCO_2)				**344 000**

NB: Prior to receiving the Surface Access Paper, emissions for passenger travel to/from the airport were extrapolated from existing HAL emissions data for 2012. As a result of the method used (please see the 'Operational Footprint' excel document at Appendix 3), this has altered the emissions calculations for airside and airport operations. Passenger access journeys were previously included in the total for 'Non-aviation transport additional emissions'.

[10] Numbers may not add up exactly due to rounding. Please see accompanying Excel spreadsheet for detailed calculations.

Table 4.3 Additional carbon emissions (million tCO_2) 2012 to 2030

Emissions source	5% reduction scenario	20% reduction scenario
Airside Ground Movements and Airport Operations Additional Emissions (2012 full capacity to 2030) (million tonnes)	0.628	0.271
Non-aviation transport Additional Emissions (2012 full capacity to 2030) (million tonnes)	0.086	0.037
Passenger transportation	0.408	0.344
Total emissions (million tCO_2	**1.122**	**0.652**

The use of the revised passenger transportation data from the Surface Access Paper has seen an increase in the 5 per cent (minimum reduction) scenario from 0.863 million tonnes CO_2 to 1.122 while the 20 per cent (maximum reduction) scenario has increased from 0.373 to 0.652 million tonnes CO_2.

4.2.5 *Mitigation*

Heathrow HUB – a catalyst for modal shift[11]

The surface access networks around Heathrow Airport are busy at peak periods. In order to best manage air passenger demand growth at Heathrow and facilitate improved and low carbon surface access to Heathrow, the proposed Heathrow Hub is the only solution.

The driving force behind our surface access strategy is to increase the public transport mode share by dramatically improving public transport accessibility, from the regions as well as London, with fast, frequent and reliable services, providing a real and attractive public transport alternative to the use of the private car. No other airport in the UK can achieve such geographic connectivity, delivering the maximum possible public transport surface access mode share in a sustainable manner.

Key benefits of the HUB

1. The HUB will make public transport the mode of choice – it aims to deliver a major modal shift from road to rail, with public transport models reaching a mode share above 50 per cent by 2030, compared to 41 per cent in the business as usual case. It is worth noting that these are considered conservative figures.
2. The proposal includes eliminating the premium fare for the Heathrow Express which will increase its share of passenger numbers to the airport whilst simultaneously freeing up the Piccadilly line. The Heathrow to Staines and Waterloo service will provide direct access from south London and through connections at Clapham Junction links directly to the south coast. We expect 95 per cent of UK origin and destination passengers to Heathrow will have direct or one station change access to Heathrow via rail. The Woking branch is also a whole new area for rail. The HUB connection from the South-West and Wales will increase rail capacity to London, as well as to the north via HS2. In short the HUB will dramatically increase options for public transport to Heathrow and deliver significant emissions reductions opportunities compared to other schemes.

[11] For further information please see Heathrow Hub Interchanges & Surface Access Strategy (June 2014)

3. The HUB will be an integral part of the airport and the airport experience. Once you arrive at the HUB you are already at the airport. The efficiency and frequency of the APM will only enhance this experience.
4. The HUB may provide the opportunity to act as a subsidiary coach interchange reducing congestion within central London and associated carbon emissions while providing greater capacity to serve wider destinations. The HUB would enable all coaches to arrive at one destination rather that currently serving the central terminal and T5 separately delivering a more efficient and effective service.
5. It is expected that 95 per cent of airport passengers within 120 minutes and the vast majority within 90 minutes journey time of the airport will travel by rail
6. The HUB and transport strategy will help reduce airport related traffic on the most congested parts of the M25 between Junction 13 and 15 by enabling all traffic from the north, east and west to access the airport via the HUB and from the south via Junction 13.
7. No overall increase in the number of cars (passenger + employees) accessing the airport compared to 2014
8. Significant increase in public transport mode share for employees - reducing the employees' car mode share to 25 per cent by 2030, from 59 per cent in 2011.

In order to reduce landside related emissions a number of interventions to encourage modal shift include:

1. Capping future number of taxi and mini-bus vehicle movements at their current levels (2014)
2. Priority lanes and controls for busses and coaches within Heathrow, and connecting the Heathrow Hub to the other Terminal areas, will enable a seamless road-based public transport offering within the airport.
3. In addition to existing plans to reduce transport emissions from employees we will further incentivise and improve measures regarding free travel zones, supporting bus services, travel planning and car sharing etc.
4. Work to more closely integrate ticketing of air/rail to incentivise rail access to the airport
5. Support and actively promote a cordon/congestion charge to access the airport significantly reducing emissions associated with kiss-and-fly and taxi journeys

Airside operations

HH/RIL are committed to reducing air-side emissions. Recognising that Heathrow already has various schemes to reduce greenhouse gases (GHG) it is assumed that these will continue to be implemented. However, HH/RIL will endeavour to speed up this process by actively seeking to, for example, maximise the use of electric vehicles powered by on-site renewable energy generation. New infrastructure will be designed with energy efficiency as a principal objective, maximising solar gain and minimise cooling requirements.

LTO Cycle

The proposed runway layout will result in reduced average taxi times compared to current operations. Combined with extensive use of on ground electric vehicles powered by on-site renewable energy generation and more sophisticated release times from the gate for out-going aircraft we anticipate a significant reduction in airside operations emissions compared to business-as-usual. At present the average departing taxi time is 18 mins. We expect that this will be reduced to 13 minutes with a corresponding approximate 28 per cent reduction in taxiing emissions.

Angle of descent will increase from 3 degrees to 3.2 degrees improving fuel efficiency for the landing cycle.

As part of future operations we will work to achieve significant carbon emissions during the LTO cycle. For example we recognise that the Airbus A380 new departure procedures utilised at Heathrow saves an additional 300kg of fuel per flight, equating to one metric tonne of CO_2 on a flight to Singapore, as well as reducing NOx emissions. We expect and will encourage such measures to be rolled out to other aircraft types in the future.

HH/RIL also support procedures to reduce the number of engines used to taxi to and from the runways recognising the emissions reductions potential of implementing such operations. Improved taxiing efficiency is strongly supported by HH/RIL and it is expected that such measures will be rolled out to all aircrafts using Heathrow in the future.

Full flight

RIL's proposal will provide similar capacity to Heathrow's north-west third runway proposal and in doing so provide an opportunity to rationalise and reduce the need for stacking operations with consequential reductions in fuel consumption and GHG emissions.

We assume that there will be a 90 per cent fleet renewal rate over the medium to long term. As noted above each generation of new aircraft is approximately 20 per cent more fuel efficient which will contribute to significant emissions savings during full flight operations.

The newly formed concept the 'Perfect Flight', which NATS, British Airways and Heathrow worked out through the 'Sustainable Aviation' partnership has been used flying on the Heathrow to Edinburgh route. This has demonstrated how in the future flights could be more fuel-efficient and reduce their environmental impact. Between Heathrow and Edinburgh it was demonstrated that 350kg less fuel was used than normal, saving the equivalent of almost 1 tonne of CO_2. We will work to promote 'Perfect Flight' as goal for all flights in order to deliver wider carbon reduction benefits for the proposed scheme.

4.2.6 *Conclusions*

The surface access strategy demonstrates that the HUB provides a compelling option for the expansion of Heathrow that offers tangible sustainability benefits. The HUB offers a real alternative to use of the private car by making the alternative option of public transport both feasible and attractive to airport users.

4.3 Recalculated carbon footprint

The submission of the Surface Access Paper has provided additional data on passenger transportation to/from the airport. We have therefore re-calculated the carbon footprint associated with this and include in Appendix 3.

5 PLACE: HERITAGE

5.1 Reason for provision of additional information

Following late changes to the proposed highways design in April 2014 following discussions with the Highways Agency, Historic Environment Record (HER) data were requested for heritage assets, for the area between M25 Junction 13 and just to the south of Heathrow, from Surrey County Council. Due to the timing of the request, data were not available in time for submission in May 2014. An assessment is provided below to supplement that submitted in May and should be read in conjunction with the Chapter 6: Place – Heritage of the Stage 2 Submission Attachment 5-1 report.

5.2 Assumptions

- All work to date has been purely desk-based, no site visits have been undertaken;
- All assumptions are based on searches of the relevant HER undertaken in May-June 2014 and the data that was provided at that date;

- The methodology follows that previously undertaken for the Heathrow Hub project as outlined in Chapter 6: Place – Heritage of the Stage 2 Submission Attachment 5-1;
- All work is based on a rapid review of the data provided by the HER and other online source.

5.2.1 *Baseline - Close to New Road Realignment / route*

Non-designated heritage assets, identified from the Surrey County Council Historic environment Record (SCCHER) include heritage assets from a number of periods.

The free draining gravels of the Colne and Thames Valleys, that underlie the area, have attracted settlement from the earliest times. Excavations in advance of gravel extraction and road construction have revealed extensive evidence for settlement from the prehistoric period onwards.

A Neolithic causewayed camp (2412 and 774), which also contained evidence for Bronze Age and Roman occupation (2413), has been excavated in an area immediately to the south of Junction 13 (J13) on the M25. The area has subsequently been subject to gravel quarrying and road construction. To the south-east of J13 a prehistoric pit and other undated features (5373) were located by archaeological evaluation works and this suggests that further prehistoric activity may be uncovered in the wider vicinity of J13, where not previously disturbed.

Prehistoric occupation evidence, dating to the Neolithic and Bronze Age and middle Iron Age (15284, 4221, 793, 5059 and 4309) have also been excavated in the vicinity of Lower Mill Farm, Stanwell Moor including several ring gullies for Iron Age round houses. To the southwest of Lower Mill Farm, a Bronze Age and Iron Age enclosure with settlement evidence (646 and 611) was excavated in the 1980s in advance of gravel extraction on Staines Moor. A prehistoric jadeite axe (1995) was also recovered during fieldwalking to the west of this site.

Lower Mill Farm, Stanwell Moor is also the location of a post-medieval Gunpowder Mill (19860), whilst to the south, on Staines Moor, a 19th century shooting butt earthwork (15378 and 15379) and associated remains have been identified close to the M25.

The Windsor, Staines and South Western Railway (later part of the Southern Region Railway) was constructed in 1848 and crosses the scheme heading north-west from Staines. The 19th century Staines and West Drayton branch line (part of the Great Western Region Railway) (15385) also survives as an earthwork embankment crossing Staines Moor, running parallel to the M25.

A number of undated cropmarks of enclosures and ring ditches (613, 615 and 635) have also been identified in close proximity to the new road alignments. These appear to have been already destroyed by the construction of a reservoir and gravel quarrying, but it is possible that pockets of archaeological remains may survive outside the areas that have been previously impacted.

Extensive gravel extraction operations have taken place to the west and south-west of Stanwell Moor and close to J13 on the M25. The construction of the M25 and a number of reservoirs will also have had an impact on archaeological remains.

The archaeological potential of the proposed road network improvements south of Heathrow is as follows:

- High archaeological potential for palaeo-environmental remains associated with the River Colne and River Thames including former river channels, flood and peat deposits;
- High archaeological potential for the prehistoric periods, where these have not been removed by modern gravel extraction, infrastructure or development;

- Low to moderate archaeological potential for the Roman period (due to increasing potential to the south towards Staines and the Roman road from London to Silchester (see below)), where these have not been removed by modern gravel extraction, infrastructure or development;
- Low to moderate archaeological potential for the early medieval period (due to increasing potential to the south towards Staines and the Roman road from London to Silchester (see below)), where these have not been removed by modern gravel extraction, infrastructure or development;
- High archaeological potential for the medieval period where these have not been removed by modern gravel extraction, infrastructure or development; and
- High archaeological potential for the post-medieval period, where these have not been removed by modern gravel extraction, infrastructure or development.

Archaeological remains are likely to be of low to medium significance where these are encountered, however, it should be noted that the potential on Staines Moor for previously unknown archaeological remains of medium or high significance is increased due to limited previous impacts from gravel extraction, infrastructure or development.

Non-designated heritage assets, identified from the SCCHER within the 250m buffer zone include heritage assets from a number of periods.

An Upper Palaeolithic flint working and animal processing site (5008) was located to the south of the Staines Bypass (A30) in an area subject to gravel extraction. A Bronze Age enclosure (15281) and two successive field systems (5004) were also excavated here in the early 1990s.

To the south-west, in an area where cropmarks (605) had been identified, a small assemblage of Mesolithic flints (5037) were recovered during an archaeological investigation prior to development work. The same development area also produced Bronze Age and Iron Age pits (5039 and 5040) and fragments of Neolithic pottery (5038).

On the northern edge of Staines, further Bronze Age activity including an enclosure and field system (5048) was recorded in evaluation and subsequent excavation works. A Roman enclosure and field system (5049) was also recorded on the same site as well as agricultural features from the medieval period (5050).

South-west of Lower Mill Farm, Stanwell Moor, a Bronze Age and Iron Age enclosure (646) was excavated in the 1980s. Further Bronze Age activity (5064) has also been recorded south-west of Stanwell Moor village.

The Roman road from London to Silchester (3727) traverses the south-eastern edge of the buffer zone, crossing the River Thames at Staines, where a Roman settlement, known as ‘Pontes’ (the bridges) is known.

North and south of the Roman road, to the north-east of the Roman town of Pontes and of Staines, Roman activity has been located including inhumation burials (5102) and a ditch (3794). Prehistoric flints (3800) were also recovered during these investigations. On the north side of Staines, Roman boundary ditches (5052) and a Roman ditch and associated features (5041) have been recorded as part of redevelopment work as well as undated features (5043).

Off Moor Lane, also on the northern edge of Staines, evidence for late Saxon occupation (5055) and features of Saxo-Norman date (5056) were recorded suggesting activity to the north of the former Roman town and river crossing.

Archaeological excavations in the early 1980s, in advance of gravel extraction on Stanwell Moor, revealed the remains of medieval buildings including a possible mill, dye works and hamlet (2924), dating to c. 1250-1350, thought to belong to Yeoveney Manor. Yeoveney Chapel (764) and Yeoveney Mill (15282) are also known from documentary sources.

Archaeological investigations on the north and north-east edges of Staines have revealed extensive medieval activity (pits, postholes and ditches) (5129), burgage plots (5053), occupation (5103) and a ditch (5042) following a number of investigations.

The late medieval and post-medieval Stanwell Place historic house (19810) was situated midway between the villages of Stanwell and Stanwell Moor. This historic house and associated grounds, had associations with Henry VIII and Guy Fawkes. It also was the residence of King Feisel II of Iraq in the 1950s prior to his assassination. The house then laid empty, prior to being bought and demolished by a gravel company in the 1960s.

The earthwork relating to a post-medieval causeway (15380) has been identified on Staines Moor, to the north of Staines Bypass (A30), whilst to the south of the bypass a post-medieval enclosure (5005) was excavated in 1994 in advance of gravel quarrying. The foundations of a post-medieval farm building (6001) of 17th or 18th century date have also been discovered during building works in the village of Stanwell Moor.

The Windsor, Staines and South Western Railway (later known as the Southern Region Railway) was constructed in 1848. Three 19th century railway bridges (15383) survive in association with it. A railway post (obelisk) (19806) is also noted within the 250m buffer zone area. The Renshaw Iron Foundry (19818) and an Oil Depot (19833) had connections to the railway.

Stanwell Moor village contained two post-medieval corn mills on the River Colne known as Stanwell Lower Mill (19858) and Stanwell Upper Mill (19847). Stanwell Lower Mill (19858) was demolished at the end of the 19th century and the remains of the foundations and a weir were removed in the early 1990s.

A post-medieval Mustard Mill (19788), which has been demolished and the foundations removed, is known to have existed on the northern side of Staines.

A 19th century coal tax post (3891) has also been identified within the study area as well as a 19th century drinking fountain and water trough (19864).

The 20th century house (15381) for the Staines Moor Keeper survives on the northern edge of Staines adjacent to a former animal pound (15382).

A number of undated cropmarks have also been identified across the area, including marks identified west of the M25 (604) and on Staines and Stanwell Moors (606, 607, 608, 609, 610, 612, 613, 615, 634 and 793). Some areas have already been destroyed by development, quarrying and the construction of reservoirs, but it is noted that Staines Moor appears relatively untouched from gravel extraction activities.

Several undated palaeochannels (15361 and 5014) have been located to the south of the Staines Bypass (A30), in Staines (5051) and north-east of J13 on the M25 (5374). Flood deposits (5061 – 5063 and 5100) have also been located to the southwest of Stanwell Moor as well as undated peat deposits (5002) located during works close to the River Thames.

There is extensive evidence for modern development, gravel extraction and infrastructure to the north of Staines and surrounding J13 on the M25. The Wraysbury, King George VI and Staines reservoirs have also caused the removal of archaeological remains as will have the construction of the M25 and gravel extraction to the west and east of Stanwell Moor. As has been noted above, Staines Moor is a remarkably untouched survivor, within a wider landscape subject to extensive change in the modern period. It is possible, therefore, that archaeological remains will survive here in good condition. The remnants of a number of mills and their water management features may also survive in places along the River Colne, within Stanwell Moor and at Lower Mill Farm.

A gazetteer of heritage assets associated with this search area is attached at Appendix 4. Each heritage asset is numbered within this to correspond to the number in Figure 6.5.

5.2.2 *Assessment- Construction: Road Network Improvements South of Heathrow*

Construction work will involve the construction of new roads and associated infrastructure.

Undesignated archaeological remains of prehistoric, Roman, early medieval, medieval and post-medieval date may be impacted, where these have not been removed by modern gravel extraction, infrastructure or development, particularly on Staines Moor.

5.2.3 *Assessment - Operation*

Operation may have negative impacts on the setting of archaeological remains and heritage assets on Staines Moor (earthworks for a dismantled railway and 19th century shooting butt).

There is an opportunity to enhance the settings of Stanwell Moor and Lower Mill Farm and their associated heritage assets, by reinstating a moor environment to the west and south-west of Stanwell Moor.

5.2.4 *Mitigation measures*

Reinstatement of a moor environment to the west and south-west of Stanwell Moor will enable improvements to the setting of heritage assets in Stanwell Moor and Lower Mill Farm and offset negative impacts on the setting of heritage assets on Staines Moor.

Archaeological excavation and recording will be undertaken prior to construction in all areas to be impacted by construction works and that have not previously been disturbed / removed by modern construction, development or minerals extraction activities. The archaeological results will be assessed, analysed, published and disseminated to provide a lasting benefit and legacy to the construction of the scheme.

Public outreach and displays, dependent on the results and health and safety considerations, will be undertaken concurrent with the archaeological works.

Where previously unknown archaeological remains of national importance are identified, these will be preserved in situ through design where feasible.

5.2.5 *Conclusions*

Enhancement to the historic landscape to the west and south-west of Stanwell Moor to reinstate historic moorland environment will enhance the setting of heritage assets in Stanwell Moor and Lower Mill Farm, whilst offsetting the negative impact of the construction of the new road across Staines Moor.

Undesignated archaeological remains of low to medium importance may be impacted by scheme construction, where these have not been previously impacted and removed. Mitigation will involve archaeological recording prior to construction, post-excavation assessment, publication, dissemination and public outreach.

Preservation in situ of previously unknown nationally important archaeological remains will be implemented through changes in the design, where this is feasible.

A comprehensive desk-based assessment will be undertaken at detailed design stage to identify areas where there is a likelihood for the survival of buried archaeological remains and areas where archaeological remains have been previously disturbed or removed / destroyed.

The proposed scheme offers an effective solution, for the expansion of airport capacity at Heathrow and for London and the south-east as a whole, in terms of its minimal impacts on designated heritage assets of high significance, its impacts on designated assets of medium significance and of undesignated archaeological remains of low to high significance. Solutions are put forward to mitigate impacts and provide public benefit.

6 PLACE: TOWNSCAPE

A concept landscape design figure was requested at the additional environmental meeting between the Airports Commission Secretariat and Heathrow Hub (19th June 2014). This is provided as Figure 7.4 at Appendix 5 and should be reviewed in conjunction with Chapter 7: Place – Townscape of the Stage 2 Submission Attachment 5-1 report.

7 RESPONSE TO COMMISSION'S QUESTIONS

Our response to the Commission's questions, issued by email on 13th June 2014 is attached at Appendix 1.

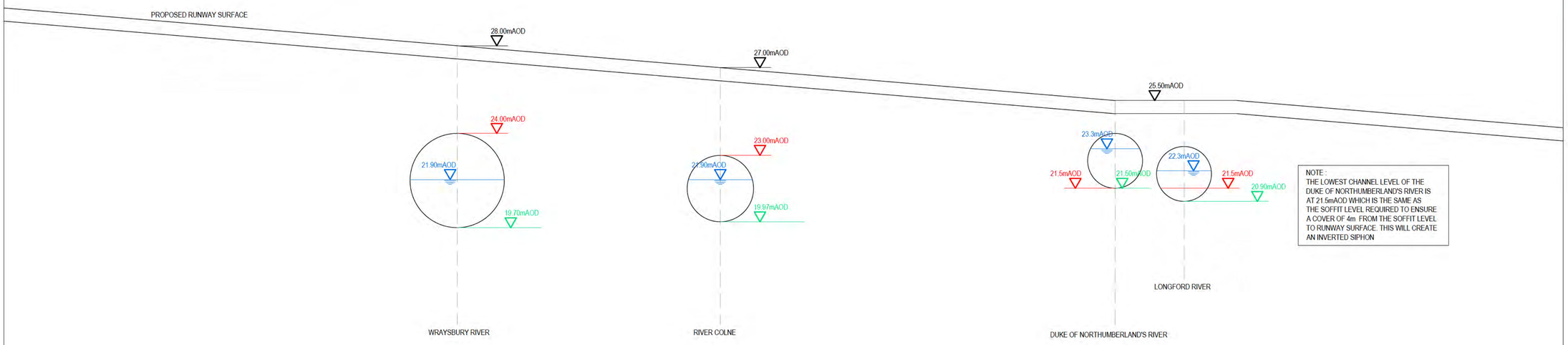
1 COMPLETED CLARIFICATION QUERIES SPREADSHEET

Submitted as Excel spreadsheet (separate document)

2 WATER & FLOOD RISK

Master Plan Concept Figure 1

Concept SuDS master plan



NOTE :
THE LOWEST CHANNEL LEVEL OF THE DUKE OF NORTHUMBERLAND'S RIVER IS AT 21.5mAOD WHICH IS THE SAME AS THE SOFFIT LEVEL REQUIRED TO ENSURE A COVER OF 4m FROM THE SOFFIT LEVEL TO RUNWAY SURFACE. THIS WILL CREATE AN INVERTED SIPHON

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.
2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS IN MILLIMETRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE PROJECT HEALTH & SAFETY FILE FOR ANY IDENTIFIED POTENTIAL RISKS.

LEGEND

20.0mAOD — 1.0 / AEP+ CC FLOOD LEVEL

28.00mAOD — LEVEL OF RUNWAY SURFACE

24.0mAOD — REQUIRED SOFFIT LEVEL (ASSUMING 4m COVER)

19.70mAOD — THE LOWEST CHANNEL LEVEL

Purpose of issue
P-PRELIMINARY

Client
HEATHROW HUB LTD

Project Title
SUBMISSION TO THE AIRPORTS COMMISSION - SHORTLISTED OPTIONS

Drawing Title
MASTER PLAN CONCEPT FIGURE 1

Designed	Drawn	Checked	Approved	Date
MN	MNE	GH	GH	JUN 14

URS Internal Project No.	Suitability
Scale @ A1: N.T.S	Zone

URS Infrastructure & Environment UK Limited
Building name
Address, part 1
County, Post Code
Tel:+44 (0)8888 888 888
Fax:+44 (0)8888 888 888
www.ursglobal.com

Drawing Number	Rev
47067372 - HUB-WATER-W-001	01

Plot Date: 6/26/2014 3:11 PM
File Name: - 47067372 HUB-WATER-W-001 FIGURE1

Xref HEAutocad\Borders\URS_DEBIV.dwg

PERMAVOID SYSTEM BELOW POROUS PAVING ON THE ROOF OF THE MULTI-STOREY CAR PARK TO ATTENUATE AND IMPROVE THE QUALITY OF SURFACE RUNOFF (3,000m3)

PROPOSED POND TO ATTENUATE RUNOFF FROM HEATHROW HUB (10,000 m3)

PROPOSED POND OR BASIN TO ATTENUATE RUNOFF FROM M25/HEATHROW JUNCTION (1,000 m3)

RAINWATER HARVESTING FROM ROOF OF HEATHROW HUB TO PROVIDE APPROXIMATELY 1,200 m3 OF LONG TERM STORAGE

PROPOSED POND OR BASIN TO ATTENUATE RUNOFF FROM HEATHROW HUB (6,000 m3)

PROPOSED POND OR BASIN TO ATTENUATE RUNOFF PROPOSED NORTHBOUND SLIP ROADS (1,500 m3)

PROPOSED POND OR BASIN TO ATTENUATE RUNOFF PROPOSED SOUTHBOUND SLIP ROADS (2,000 M3)

SWALES WITH CHECK DAMS PROVIDED ALONG A4 COLNBROOK BYPASS AND A3044 AS OTHER FORMS OF STORAGE WILL BE IMPRACTICAL AS THE ROAD EXTENDS THROUGH THE FLOODPLAIN (1,750 m3)

PROPOSED POLLUTED WATER HOLDING TANK AND UNDERGROUND WATER STORAGE TANK TO ATTENUATE AND IMPROVE THE QUALITY OF RUNOFF FROM THE RUNWAY, TAXIWAY AND APRON (195,000 m3)

THE QUEEN MOTHER RESERVOIR

POSSIBLE FLOOD COMPENSATION AREA

POSSIBLE FLOOD COMPENSATION AREA

EXISTING BALANCING RESERVOIR TO BE REPOSITIONED TO AVOID CONFLICT WITH PROPOSED RUNWAY EXTENSION AND EXISTING DRAINAGE TO BE RECONFIGURED

T2 DEVELOPMENT AS PER MASTERPLAN

RAINWATER HARVESTING FROM ROOFS OF NEW BUILDINGS TO PROVIDE APPROXIMATELY 9,000 CUBIC METRES OF LONG TERM STORAGE

PERMAVOID SYSTEM BELOW POROUS PAVING ON THE ROOF OF THE MULTI-STOREY CAR PARK TO ATTENUATE AND IMPROVE THE QUALITY OF SURFACE RUNOFF (750m3)

LONG TERM STORAGE WITH A VOLUME OF APPROXIMATELY 58,300 m3 PROVIDED IN THE FORM OF OVERSIZED PIPES TO INTERCEPT RUNOFF AND RESTRICT THE DISCHARGE TO 2L/S/HA

SWALES WITH CHECK DAMS PROVIDED ALONG NEW LINK ROAD AS OTHER FORMS OF STORAGE WILL BE IMPRACTICAL AS THE ROAD EXTENDS THROUGH THE FLOODPLAIN (8,000 m3)

PROPOSED PONDS OR BASINS TO ATTENUATE RUNOFF FROM STRATEGIC HIGHWAY (21,000 m3)

WRAYSBURY RESERVOIR

KING GEORGE VI RESERVOIR

STAINES RESERVOIR

STAINES RESERVOIR

REFER ASS TO 5 LANE DUAL

CONSTRUCTION RISKS | MAINTENANCE / CLEANING RISK | DEMOLITION RISKS

In addition to the hazard/risks normally associated with the types of work detailed on this drawing, take note of above, it is assumed that all works on site drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

This drawing is for preliminary purposes only and is subject to amendment during design development. UNDER NO CIRCUMSTANCES MUST THIS DRAWING BE USED FOR CONSTRUCTION PURPOSES

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS, SERVICES AND SPECIALIST DRAWINGS AND SPECIFICATION.
2. ANY DISCREPANCIES IN DIMENSIONS OR DETAILS ON OR BETWEEN THESE DRAWINGS SHOULD BE DRAWN TO THE ATTENTION OF THE ARCHITECT AND / OR THE ENGINEER FOR CLARIFICATION.
3. THIS DRAWING IS PROVIDED TO ILLUSTRATE THE LOCATION OF PROPOSED SUDS THAT ARE REQUIRED TO RESTRICT THE PEAK RATE OF SURFACE WATER DISCHARGE TO EXISTING GREENFIELD RATES IN ORDER TO DEMONSTRATE THAT THERE IS SUFFICIENT SPACE TO ACCOMMODATE THE RANGE OF PROPOSED FEATURES. THE LOCATION AND SIZE OF PROPOSED SUDS WILL BE REFINED AS THE SCHEME PROGRESSES TO ALLOW FOR CHANGES IN THE MASTERPLAN.
4. ALL SUDS FEATURES SHALL BE POSITIONED WITHIN FLOOD ZONE 1 TO ENSURE THAT THEY ARE NOT AFFECTED BY FLUVIAL FLOODING.

KEY

- PROPOSED AIRSIDE SECURITY FENCE
- POTENTIAL PERMAVOID SYSTEM BELOW POROUS PAVING TO ATTENUATE AND IMPROVE THE QUALITY OF RUNOFF FROM THE ROOFS OF MULTI STOREY CAR PARKS
- POTENTIAL RETENTION POND OR DETENTION BASIN TO ATTENUATED AND IMPROVE THE QUALITY OF RUNOFF FROM STRATEGIC HIGHWAYS
- POTENTIAL RAINWATER HARVESTING SYSTEM TO INTERCEPT AND RECYCLE RUNOFF FROM THE ROOFS OF NEW BUILDINGS
- POTENTIAL UNDERGROUND STORAGE TO INTERCEPT AND STORE POLLUTED WATER OR TO STORE ATTENUATED RUNOFF

Purpose of Issue: PRELIMINARY

Client: RUNWAY INNOVATIONS LTD

Project Title: HEATHROW RUNWAY EXPANSION PROPOSAL

Drawing Title: ILLUSTRATIVE ARRANGEMENT OF SUSTAINABLE DRAINAGE SYSTEMS

Designed	Drawn	Checked	Approved	Date
JR	LA	JR	NB	JUNE 2014

URS Internal Project No.: 47067372 | Suitability: S1

Scale @ A1: 1:12,500

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3 CARBON

Carbon Sequestration Calculations

Construction Footprint

Operational Footprint (submitted as Excel spreadsheet (separate document))

Recalculated carbon footprint

This worksheet summarises the embedded and transport emissions associated with the main construction elements of the proposed scheme.

A drop down menu is provided to toggle between different carbon factors for concrete and reinforced concrete in order to identify potential ranges as a result of selecting either "Bath ICE (2011) Simapro (2013)" factors "MPA Concrete Centre Factors" which provide alernative factors for concrete and reinforced concrete for 2011 and 2020 (based on two carbon reduction scenarios); and 2020 Central and Stretching scenarios which incorporate future target factors from the concrete and steel industries

Please select concrete carbon factor source
Bath (2011) Simapro (2013) (Worst Case)

Construction Materials (Embedded)		
Runway and Runway Shoulders	49,210	tCO2e
Taxiway and Taxiway Shoulders	137,680	tCO2e
Apron	164,542	tCO2e
Roads	29,636	tCO2e
Tunnel	51,937	tCO2
Heathrow Hub Carparks	9,401	tCO2
Total Embedded	442,405	tCO2e
Transport		
Construction Material	36,253	tCO2e
Infill Material	110,336	tCO2e
Total transport	146,589	tCO2e
TOTAL	**588,994**	**tCO2e**

	Bath (2011) Simapro (2013) (Worst Case)	MPA Concrete Centre (2011) Worst Case Comparison)	2020 Central	2020 Stretching
Runway and Runway Shoulders	49,210	37,253	34,174	32,704
Taxiway and Taxiway Shoulders	137,680	104,226	95,612	91,498
Apron	164,542	90,121	79,218	74,011
Roads	29,636	29,636	29,636	29,636
M25 Tunnel	51,937	44,906	39,560	36,980
Heathrow Hub Carparks	9,401	8,621	7,681	7,111
Total Embedded	442,405	314,762	285,880	271,941
Transport				
Construction Material	36,253			
Infill Material	110,336			
Total transport	146,589			
TOTAL (Embedded+Transport) (tCO2e)	**588,994**	**461,351**	**432,469**	**418,529**

FOR INFORMATION ONLY The table below details the carbon footprint as presented in Table 5.2 in Stage 2 Submission (14 May 2014)) prior to response to Airport Commissions queries.
ref. "Table 5.2 Embedded and Material Transport Emissions" on p.175 of Runway Innovations Limitited Stage 2 Submission Attachment 5-1

Embedded (tCO2e)	MPA The Concrete Centre	University of Bath ICE
Runway and Runway Shoulders	39,000	51,000
Taxiway and Taxiway Shoulders	56,000	74,000
Apron	89,000	162,000
Roads	33,000	33,000
M25 Tunnel	45,000	45,000
Heathrow Hub Carparks	9,000	9,000
Total Embedded	270,000	374,000
Transport (tCO2e)		
Construction Material	32,000	
Infill Material	79,000	
Total transport	110,000	
TOTAL (tCO2e)	**381,000**	**484,000**

UPDATED CARBON FOOTPRINT CALCULATIONS

Further to the follow up meeting with the AC (19.6.14) carbon emissions have been reviewed and updated to account for the assumptions set out in the Surface Access Paper submitted 18th June.

1.1 Assumptions

All assumptions made around Passenger Transport can be found in the Surface Access Paper.

1.2 Baseline

Based on data in the Surface Access Paper, 2012 was selected as the baseline year.

1.2.1 *Changes to scheme/information available (where applicable)*

A Surface Access paper was submitted to the AC on 18 June which has some further detail on the Heathrow Hub. This can be found here: https://projects.ursglobal.com/bc/generic_main.cgi/d27164953/HH_RIL%20SA%20Report%20140618.pdf

Detailed calculations based on the Passenger Transport Data taken from the Surface Access Paper can be found on the 'Area 5 Calculations' tab of the 'Operational Footprint AC Version' excel document.

1.3 Assessment/calculations

Passenger data was provided by 4 geographical regions (Greater London, Great Western, Southern Access and the rest of the country) and by mode of transport (car, national rail, bus/coach).

Emissions factors for national rail, bus/coach and car have been taken from the Defra/DECC emissions factors.

The following process was used to calculate carbon emissions:

1. Identifying an average journey length (km) for each passenger journey (based on a central location point within each region). The distance was multiplied by 2 to account for return journeys;
2. Multiplying the total number of passenger journeys by each transport mode in each region by the average journey distance to calculate passenger kilometres travelled;
3. Multiplying passenger kilometres travelled by the relevant Defra/DECC emissions factor for each transport mode to calculate total carbon emissions.
4. The resulting total carbon emissions for all journeys were reduced by 5 per cent and 20 per cent to model the different estimated emissions scenarios highlighted previously to take account of future technology and policy.

Carbon emissions were calculated for 2012 (baseline) and 2030 which assumed the Hub is fully operational.

The table below details the total contribution made by each transport mode for passenger travel. By 2030 it can be seen that there has been a 2 per cent decrease in the proportion travelling by coach travel, a 5 per cent decrease in the proportion travelling by car but a sharp increase in the proportion arriving by rail.

Table 1: Modal shift

Year	Bus-Coach	Car	Rail	Total
2012	12%	59%	29%	100%
2030	10%	54%	36%	100%

The total increase in emissions per annum by 2030 from passenger travel is estimated to be approximately 430,000 tCO_2 per annum with car transport accounting for the greatest amount.

Table 2 Emissions variation 2012-2030 (tCO_2)

Area	Bus-Coach	Car	Rail	Total
Greater London Area	1 000	27 000	29 600	57 800
Great Western Area	1 600	6 700	30 400	38 700
Southern Access Area	-203	7 800	6 900	14 500
Rest of Country	6 600	276 000	36 400	319 000
Total emissions (tCO_2)				**430 000**
5% reduction scenario (tCO_2)				**409 000**
20% reduction scenario (tCO_2)				**344 000**

NB: Prior to receiving the Surface Access Paper, emissions for passenger travel to/from the airport were extrapolated from existing HAL emissions data for 2012. As a result of the method used (please see the 'Operational Footprint' excel document at Appendix 3), this has altered the emissions calculations for airside and airport operations. Passenger access journeys were previously included in the total for 'Non-aviation transport additional emissions'.

Table 3 Additional carbon emissions (million tCO_2) 2012 to 2030

Emissions source	5% reduction scenario	20% reduction scenario
Airside Ground Movements and Airport Operations Additional Emissions (2012 full capacity to 2030) (million tonnes)	0.628	0.271
Non-aviation transport Additional Emissions (2012 full capacity to 2030) (million tonnes)	0.086	0.037
Passenger transportation	0.408	0.344
Total emissions (million tCO_2	**1.122**	**0.652**

1.4 Conclusions

The use of the revised passenger transportation data from the Surface Access Paper has seen an increase in the 5% (minimum reduction) scenario from 0.863 million tonnes CO2 to 1.122 while the 20% (maximum reduction) scenario has increased from 0.373 to 0.652 million tonnes CO2.

Gazetteer of heritage assets

Figure 6.5 - Location of Non-Designated Heritage Assets

Appendix 12-1, Table 12-6. Cultural Heritage Gazetteer - Heritage Assets identified from Historic Environment Records

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
15281	TQ 027720 721900	Enclosure, Church Lammas, nr Staines	Undesignated	Excavation by SCAU of the enclosure in 1990 found it to be rectangular, bounded by a ditch on three sides with a small entrance in both the north and east sides. Within this enclosure was a ditched feature, 10m square, roughly central to which was a large near-vertical sided, flat bottomed pit. Finds from these features were relatively few, but consisted of struck flints and pot sherds, which indicated an early to middle Bronze Age date.	Bronze Age	SCCHER
15282	TQ 034410 741480	Yeoveney Mill	Undesignated	Reference to Yeoveney Mill in the medieval accounts in Westminster Abbey. The first reference noted was in 1275, although this implied that the mill was already in existence.	Medieval	SCCHER
15284	TQ 035 739 (area)	Lower Mill Farm, Stanwell	Undesignated	Continued archaeological monitoring and evaluation in advance of gravel extraction by SCAU led to the discovery of prehistoric material. Subsequent excavation produced features and finds suggestive of a small farmstead, occupied from the end of the Neolitic into the early Bronze Age.	Late Neolithic / Early Bronze Age	SCCHER
15361	TQ 03377 72287	Moormede Defences, Staines	Undesignated	Evaluation and trial trenching by SCAU located a silted up stream channel, possibly a former course of the River Colne, but no artefacts.	Undated	SCCHER
15378	TQ 0302 7361	Earthwork	Undesignated	An earthwork of 19th century date representing a butt from former shooting ranges.	Post-medieval	SCCHER
15379	TQ 0302 7361	Earthwork	Undesignated	The earthwork remains of a quarry used for the construction of the shooting butt (HER 15378).	Post-medieval	SCCHER
15380	TQ 0324 7252 to TQ 0329 7241	Causeway	Undesignated	An earthwork causeway leading to the River Colne from one of the moor entrances. Probably post-medieval in date.	Post-medieval	SCCHER
15381	TQ 0307 7227	House	Undesignated	An early 20th century brick built house, Moor Lodge. Originally built for the Moor Keeper.	Modern	SCCHER
15382	TQ 0309 7225	Pound	Undesignated	A timber animal pound. Used originally for the impounding of stray cattle and horses.	Post-medieval	SCCHER
15383	TQ 0314 7230	Bridge	Undesignated	A linked series of three 19th century bridges crossing two railway lines and a reservoir feeder channel. The original bridge was used for cattle access to Staines Moor.	Post-medieval	SCCHER
15384	TQ 0258 7300 to TQ 0316 7233	Railway	Undesignated	the line of the 1848 Windsor, Staines and South Western Railway (later Southern region). Still in regular use.	Post-medieval	SCCHER
15385	TQ 0290 7363 to TQ 0313 7231	Railway	Undesignated	Disused railway line of the Staines and West Drayton Railway (part of the Great Western Region). The line has been removed, but the alignment of the railway can be followed as an earthwork embankment.	Post-medieval	SCCHER
19775	TQ 0168 7267	House and Garden	Undesignated	The site of this house and garden is uncertain, but a description recorded by Thomas Mawson may refer to a house c. 1890 by Thomas Collcutt. An illustration in a book on Victorian Gardens is annotated as 'Rivernook' with a terrace imposed on grounds formerly in the naturalesque or landscape style, and decorated with perennial beds and clipped yews and junipers.	Post-medieval	SCCHER
19806	TQ 026 720	Obelisk	Undesignated	Railway post. Approximately 3m high, a cast iron obelisk originally sited at TQ 018 738.	Post-medieval	SCCHER
19810	TQ 0401 7400	Stanwell Place Gravel Pit	Undesignated	Stanwell Place has historic associations with Henry VIII and Guy Fawkes. In 1948 it became the home of King Feisal II of Iraq when he was at Harrow School. He remained king until 1957 when he was assassinated. Stanwell Place remained empty until the 1960s when it was sold to a gravel company and was demolished. The flooded area in 1993 was 4ha.	Post-medieval / Modern	SCCHER
19818	TQ 036 719	Renshaw iron Foundry (demolished)	Undesignated	Iron foundry on the Windsor railway line opposite a former linoleum factory. It flourished for many years but is now closed and the Renshaw Industrial Estate occupies the site.	Post-medieval / Modern	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
19833	TQ 033 718	Cory's Oil Depot (demolished)	Undesignated	An oil depot adjoined the former Staines West Station (HER 19787) and until it closed c. 1992 was the only reason for continued rail access from the Western Region of British Rail. In 1981 when the line was removed to make way for the M25 motorway, a connection with the Windsor line was made.	Post-medieval / Modern	SCCHER
19858	TQ 039 749	Stanwell Lower Mill (demolished)	Undesignated	Cornmill on the River Colne a few hundred metres downstream from Stanwell Upper Mill (HER 19847) demolished at the end of the 19th century. It was near a weir where Leylands Lane crosses the River Colne and until 1992 only the mill foundations and some sluices were left. In that year the National Rivers Authority decided to remove the remains to guard against flooding.	Post-medieval	SCCHER
19860	TQ 034 741 - Area	Gunpwder Mill	Undesignated	A gunpowder mill operating in the late 18th century. Situated about 1km downstream from Stanwell Lower Mill. The remains are now known as Lower Mill Farm. The powder mill was bought in 1820 by Curtis & Harvey. Later it became a snuff mill and finally a corn mill until it burnt down in 1925.	Post-medieval / Modern	SCCHER
19864	TQ 027 726	Drinking Fountain and Cattle Trough	Undesignated	Metropolitan drinking fountain and cattle trough in Staines Market Square from 1883 to the 1950s when it was moved to Moor Lane opposite the Swan. It is made of concrete and engraved to mark it is the property of Staines UDC.	Post-medieval / Modern	SCCHER
1995	TQ 02960 73670	Axe	Undesignated	A jadeite axe (butt fragment) found by Mr Wood whilst fieldwalking on gravel at Stanton Moor. Axe is of brown altered jadeite, ground and well polished. The butt is pointed and of a form more common to northern England. Such axes are extremely rare and likely to represent prestige or ritual item. First such find from Surrey, the nearest parallels coming from Hendon and the Thames at Mortlake and Vauxhall. Dating is problematical, though the recent find sealed by the Sweet Track in the Somerset Levels suggests use of jadeite from at least 3200 BC.	Prehistoric	SCCHER
2412	TQ 02400 72600	Settlement	Undesignated	At TQ 0240 7260 is a causewayed camp (see SMR No. 774). Beaker occupation was also found here at the site. It was excavated by R Robertson-Mackay for the MPBOW 1961-3, after its discovery on an aerial photograph. See HER 2413 for Roman occupation in the area.	Neolithic / Bronze Age	SCCHER
2413	TQ 02400 72600	Roman occupation	Undesignated	Roman occupation of the 1st century AD was found to overlie the site excavated by R Robertson-Mackay for the MPBOW 1961-3.	Roman	SCCHER
2924	TQ 03210 73700	Medieval occupation	Undesignated	Hithermoor Gravel Pit. Excavation by R Poulton, P Jones and M O'Connell in 1982 for SCC of remains of medieval buildings during gravel extraction. Salvage excavation revealed stratified deposits dating to c. 1250-1350 which are believed to represent the remains of a mill and dye works or hamlet belonging to Yeoveney Manor, together with rubbish deposits belonging to the Manor itself.	Medieval	SCCHER
3794	TQ 0399 7368	Roman ditch	Undesignated	Excavation by Spelthorne Archaeological Field Group, c. 1992. A trench 20m by 2m was set out parallel to George Street. In Area A a Victorian well and a silt-like deposit were recorded below rubble and rubble/topsoil. A number of Roman pot sherds were found. In Area B, a gravel surface was revealed, where a few animal bones were found. The area was then excavated to the silt deposits, which produced a feature, which may have been the Roman ditch (previously located on the other side of George Street).	Roman	SCCHER
3800	TQ 0399 7368	Flints	Undesignated	A few prehistoric flints were found in trench A of an excavation at the development site of Richmond House, Kingston Road. The excavation was carried out by the Spelthorne Archaeological Field Group c. 1992.	Prehistoric	SCCHER
3801	TQ 0399 7368	Finds	Undesignated	A late medieval roof tile and a few sherds of pottery were found during excavation of Area B, at the development site at Richmond House, Kingston Road. The excavation was carried out by Spelthorne Archaeological Field Group c. 1992.	Medieval	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
3891	TQ 022 749	Coal Tax Post	Undesignated	The London Coal and Wine Duties (Continuance) Act of 1861 redefined the boundary, corresponding to that of the Metropolitan Police District, at which duty was payable on such goods entering London. Posts were set up on transport routes. Most were newly cast, others were earlier markers relocated. This post was a Type 2e. It was in a field fence east of Moor Farm, Horton but was moved and is now in the custody of Staines UDC. Originally at TQ 022 749 but moved when Wraysbury Reservoir was built and restored. It was re-erected by Spelthorne Borough Council on the Wraysbury Road where it crosses the County Ditch, formerly the boundary of the coal tax area. Cast in the base of the post and picked out in black is the name of the maker, Henry Brissell of the Regents Canal Iron Works and the date of 1862.	Post-medieval	SCCHER
4221	TQ 03441 74148	Settlement	Undesignated	Archaeological watching brief and rescue excavation by R. J. Poulton and P. M. G. Jones for SCC revealed some prehistoric features. In one area three interlinked ring gullies were planned and sampled and several sherds of associated prehistoric pottery were recovered. This area appears to have been a settlement site.	Mid-Iron Age	SCCHER
4222	TQ 03441 74148	Findspot	Undesignated	Archaeological watching brief by R. J. Poulton and P. M. G. Jones for SCC revealed scattered medieval pottery at Lower Mill Farm, Stanwell.	Medieval	SCCHER
4309	TQ 035 741	Findspot	Undesignated	Archaeological watching brief by R. J. Poulton and P. M. G. Jones for SCC revealed some worked flints.	Prehistoric	SCCHER
5002	TQ 026 718 to TQ 027 725	Peat deposits	Undesignated	Evaluation by TVAS on behalf of the National River Authority, in advance of the construction of a flood alleviation channel. No features or finds of archaeological significance were revealed during the evaluation. Samples were taken from peat deposits uncovered.	Undated	SCCHER
5003	TQ 02772 72190	Settlement	Undesignated	A watching brief on mineral extraction works was carried out by SCAU. In late 1994, flint blades were recovered. These were dated to the Upper Palaeolithic and they were associated with animal bones. English Heritage therefore funded excavation by Phil Jones of SCAU. Ditches of two successive field systems and the southern arm of an early post-medieval rectilinear stock enclosure were revealed. The concentration of Upper Palaeolithic material previously disturbed proved to be the only such concentration present. A few Upper Palaeolithic-type flints and animal bone fragments were discovered to the northwest of the main concentration, in association with a hollow which probably represents the remains of a watercourse; its fill was sampled for environmental evidence. Altogether 326 struck flints were recovered, at least 24 of the flakes, more than 10 of the blades and a few fragments of bone are burnt, which may indicate that as well as being a flint-knapping and animal dismemberment site, a fire was set for the further preparation of food.	Palaeolithic	SCCHER
5004	TQ 02772 72190	Enclosure	Undesignated	A watching brief on mineral extraction works was carried out by SCAU. In late 1994, flint blades were recovered (see HER 5003). Ditches of two successive field systems were uncovered.	Bronze Age / Undated	SCCHER
5005	TQ 02772 72190	Enclosure	Undesignated	A watching brief on mineral extraction works was carried out by SCAU. In late 1994, flint blades were recovered (see HER 5003). An early post-medieval rectilinear stock enclosure was uncovered.	Post-medieval	SCCHER
5014	TQ 0337 7228	Palaeo-channel	Undesignated	A watching brief by Steve Dyer of SCAU for the National Rivers Authority of works to form the Mormede Flood Defences recorded a palaeo-channel. The line of the channel was found to run northwest to southeast through the site but no dating evidence was recovered from the upper silts, which were all that were removed by the construction works.	Undated	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
5037	TQ 0295 7210	Flint scatter	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. A small assemblage of Mesolithic flints was recovered as well as some sherds of Neolithic and early Bronze Age pottery. The earliest features recorded were a number of small pits containing middle Bronze Age pottery, as well as some struck and burnt flints. A large shallow pit dating to the early Iron Age was the only certain feature of that date. A number of features containing Romano-British pottery were located at the southern end of the site, including a large ditch which may have acted as a boundary - perhaps for settlement outside the area of excavation. A large medieval ditch (13th - 14th century) followed a similar alignment. A number of features could not be securely dated, including a large square enclosure.	Mesolithic	SCCHER
5038	TQ 0295 7210	Findspot	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. Sherds of Neolithic pottery were recovered.	Neolithic	SCCHER
5039	TQ 0295 7210	Settlement	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. Sherds of Bronze Age pottery were recovered. The earliest features recorded were a number of small pits containing middle Bronze Age pottery, as well as some struck and burnt flints.	Bronze Age	SCCHER
5040	TQ 0295 7210	Pit	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. A large shallow pit dating to the early Iron Age was the only certain feature of that date.	Iron Age	SCCHER
5041	TQ 0295 7210	Ditch and associated features	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. A number of features containing Romano-British pottery were located at the southern end of the site, including a large ditch which may have acted as a boundary - perhaps for settlement outside the area of excavation.	Roman	SCCHER
5042	TQ 0295 7210	Ditch	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. A large medieval ditch (13th - 14th century) followed a similar alignment.	Medieval	SCCHER
5043	TQ 0295 7210	Enclosure and other features	Undesignated	Evaluation by D Hopkinson of AOC in advance of residential development revealed a number of features including a possible cultivation mark containing a sherd of mid-to late Bronze Age pottery. Subsequently an area excavation was carried out by R Entwistle of AOC and a watching brief was also maintained on the development. A number of features could not be securely dated, including a large square enclosure.	Undated	SCCHER

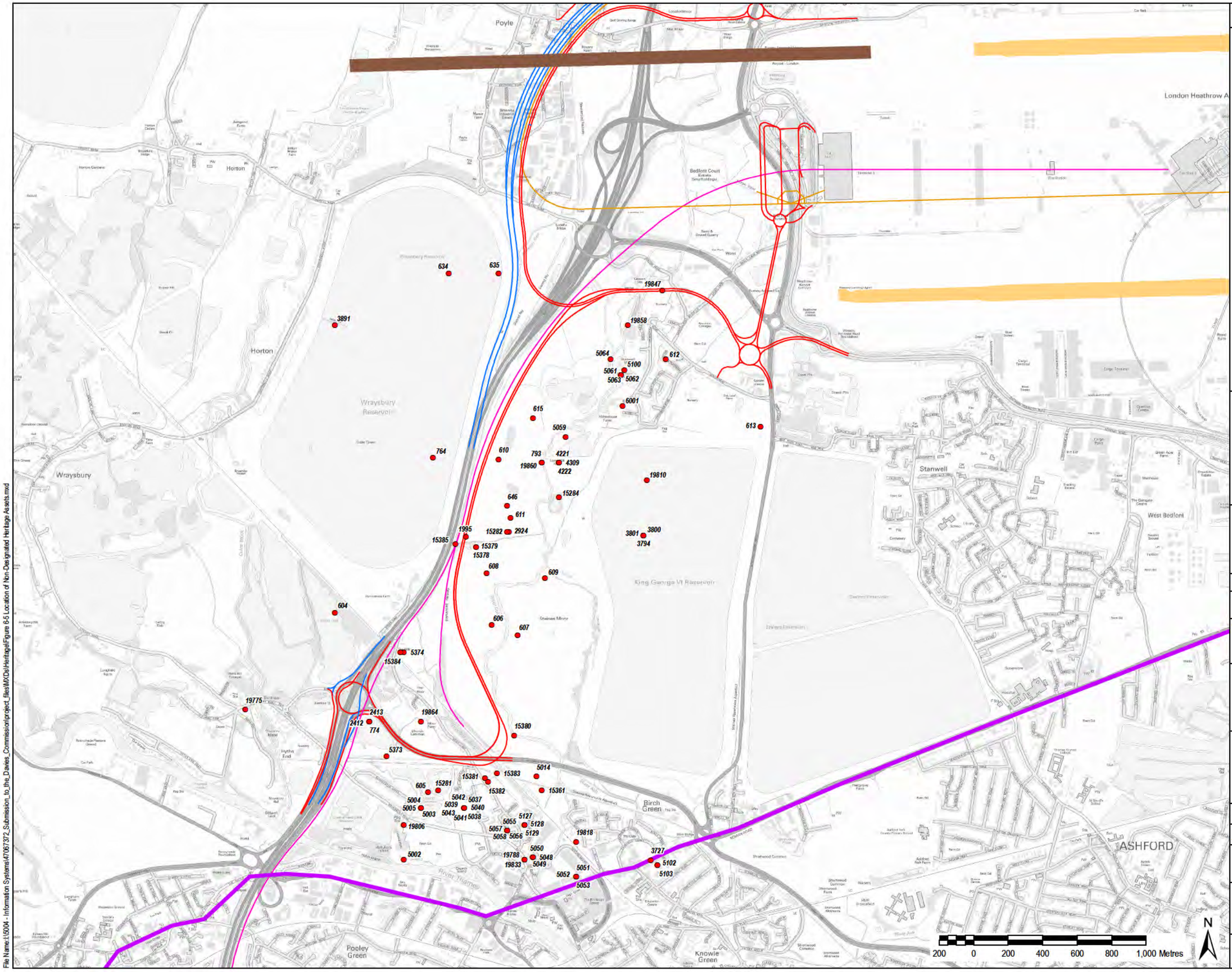
ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
5048	TQ 03348 71811	Enclosure and field system	Undesignated	Evaluation and subsequent excavation by Wessex was carried out in advance of the redevelopment of the estate. The evaluation identified three broad zones within the site: the edge of town gravel island, a broad alluvium filled channel to the north and, beyond this, a second gravel island. Subsequent work concentrated on the two islands. Excavation on the northern island (centred at TQ 033 719) recorded part of an enclosure / field system of Bronze Age date and another of Roman date, as well as agricultural features from the medieval period.	Bronze Age	SCCHER
5049	TQ 03348 71811	Enclosure and field system	Undesignated	Evaluation and subsequent excavation by Wessex was carried out in advance of the redevelopment of the estate. The evaluation identified three broad zones within the site: the edge of town gravel island, a broad alluvium filled channel to the north and, beyond this, a second gravel island. Subsequent work concentrated on the two islands. Excavation on the northern island (centred at TQ 033 719) recorded part of an enclosure / field system of Bronze Age date and another of Roman date, as well as agricultural features from the medieval period.	Roman	SCCHER
5050	TQ 03348 71811	Farmstead	Undesignated	Evaluation and subsequent excavation by Wessex was carried out in advance of the redevelopment of the estate. The evaluation identified three broad zones within the site: the edge of town gravel island, a broad alluvium filled channel to the north and, beyond this, a second gravel island. Subsequent work concentrated on the two islands. Excavation on the northern island (centred at TQ 033 719) recorded part of an enclosure / field system of Bronze Age date and another of Roman date, as well as agricultural features from the medieval period.	Medieval	SCCHER
5055	TQ 03216 71941	Settlement	Undesignated	Evaluation and subsequent excavation was carried out by SCAU before residential development of the school grounds. The site lies outside the Roman and medieval settlement of Staines but in close proximity to the parish church. Numerous features of late Saxon date were revealed, confirming that there had been some shift of settlement during that period away from the site of the Roman town. Some features of Saxo-Norman date were identified, but insufficient to establish whether Duncroft was the site of Staines' Manor House. A number of features of prehistoric, possible Bronze Age date, were also recorded. In addition, residual pieces of Roman pottery were recovered.	Early medieval	SCCHER
5056	TQ 03216 71941	Settlement	Undesignated	Evaluation and subsequent excavation was carried out by SCAU before residential development of the school grounds. The site lies outside the Roman and medieval settlement of Staines but in close proximity to the parish church. Some features of Saxo-Norman date were identified, but insufficient to establish whether Duncroft was the site of Staines' Manor House.	Early medieval / Medieval	SCCHER
5057	TQ 03216 71941	Findspot	Undesignated	Evaluation and subsequent excavation was carried out by SCAU before residential development of the school grounds. The site lies outside the Roman and medieval settlement of Staines but in close proximity to the parish church. A number of features of prehistoric, possible Bronze Age date, were also recorded.	Bronze Age	SCCHER
5058	TQ 03216 71941	Findspot	Undesignated	Evaluation and subsequent excavation was carried out by SCAU before residential development of the school grounds. The site lies outside the Roman and medieval settlement of Staines but in close proximity to the parish church. In addition, residual pieces of Roman pottery were recovered.	Roman	SCCHER
5059	TQ 03539 74254	Ditch	Undesignated	Evaluation by SCAU on a site proposed for mineral extraction in the vicinity of a previously excavated Iron Age site. One ditch was noted, but no finds were recovered.	Undated	SCCHER
5061	TQ 0386 7461	Findspot	Undesignated	Evaluation by SCAU of an area proposed for mineral extraction (and a flood relief channel) identified a silty deposit containing worked flint, sherds of prehistoric (probably Bronze Age) pottery and a couple of sherds of Roman pottery, which overlay a buried river channel.	Bronze Age	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
5062	TQ 0386 7461	Findspot	Undesignated	Evaluation by SCAU of an area proposed for mineral extraction (and a flood relief channel) identified a silty deposit containing worked flint, sherds of prehistoric (probably Bronze Age) pottery and a couple of sherds of Roman pottery, which overlay a buried river channel.	Prehistoric	SCCHER
5063	TQ 0386 7461	Findspot	Undesignated	Evaluation by SCAU of an area proposed for mineral extraction (and a flood relief channel) identified a silty deposit containing worked flint, sherds of prehistoric (probably Bronze Age) pottery and a couple of sherds of Roman pottery, which overlay a buried river channel.	Roman	SCCHER
5064	TQ 0380 7470	Pits and Findspots	Undesignated	Evaluation by TVAS of an area proposed for a flood relief channel adjacent to the River Colne. Most of the trial trenches were negative, but at the northern end of the proposed channel a pit containing burnt flint and a fragment of prehistoric, possibly Bronze Age pottery, was identified. A spread of burnt flint and charcioal adjoining this feature produced a similar sherd of pottery.	Bronze Age	SCCHER
5100	TQ 0388 7464	Findspot	Undesignated	Watching Brief by SCAU during the construction of a lake. Although no features were discovered, this barreness is likely to be a result of repeated flooding scouring the landscape and effectively washing such evidence away. There was certainly past activity on the site, as evidenced by the number of finds, albeit redeposited, ranging from the Neolithic to medieval recovered during the watching brief.	Prehistoric / Roman / Medieval	SCCHER
5127	TQ 03310 71968	Moor Lane, Staines - Findspot	Undesignated	Evaluation by TVAS in advance of redevelopment revealed a concentration of features in one part of the site. The features comprised pits, postholes and two possible ditches and may represent several phases of activity. The features that could be dated appear to be from the early part of the medieval period (11th - 12th century), but the discovery of pottery of Roman and early to middle Saxon date suggests activity of those dates in the near vicinity. Elsewhere on the site, the evaluation revealed peat deposits.	Roman	SCCHER
5128	TQ 03310 71968	Moor Lane, Staines - Findspot	Undesignated	Evaluation by TVAS in advance of redevelopment revealed a concentration of features in one part of the site. The features comprised pits, postholes and two possible ditches and may represent several phases of activity. The features that could be dated appear to be from the early part of the medieval period (11th - 12th century), but the discovery of pottery of Roman and early to middle Saxon date suggests activity of those dates in the near vicinity. Elsewhere on the site, the evaluation revealed peat deposits.	Early Medieval	SCCHER
5129	TQ 03310 71968	Moor Lane, Staines - Settlement	Undesignated	Evaluation by TVAS in advance of redevelopment revealed a concentration of features in one part of the site. The features comprised pits, postholes and two possible ditches and may represent several phases of activity. The features that could be dated appear to be from the early part of the medieval period (11th - 12th century), but the discovery of pottery of Roman and early to middle Saxon date suggests activity of those dates in the near vicinity. Elsewhere on the site, the evaluation revealed peat deposits.	Medieval	SCCHER
5373	TQ02440 72775	Yeoveney Lodge - Settlement	Undesignated	Evaluation by OAU along the line of the proposed link roads beside the M25. At Yeoveney Lodge (TQ 025 724): a ditch containing a substantial quantity of struck and burnt flint and a few sherds of prehistoric pottery was discovered as well as a pit and posthole without finds.	Prehistoric	SCCHER
5374	TQ02610 73036	Ditches and palaeo-channel	Undesignated	Evaluation by OAU along the line of the proposed link roads beside the M25. At Cambridge Kennels (TQ 026 730): a north-south aligned palaeo-channel containing waterlogged worked wood and two ditches, also waterlogged, but without finds was discovered. These were palaeo-environmentally assessed; the macroscopic plant and invertebrate remains record generally open conditions, no later than Anglo-Saxon in date.	Undated	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
6001	TQ 03870 74429	Building	Undesignated	Discovery of the foundations of a structure, possibly a building, and a fireplace whilst building a house extension at 5 Farm Way, Stanwell Moor. Although the date of the structure is unclear, the building materials appear similar to those used in the nearby listed buildings in Hithermoor Road, which date to the 17th and 18th centuries.	Post-medieval	SCCHER
604	TQ 02200 73230	Cropmarks of ring ditches and linear features	Undesignated	Ring ditches; parallel linear ditches. Largely destroyed by gravel extraction.	Undated	SCCHER
605	TQ 02740 72190	Cropmark of a rectangular enclosure	Undesignated	Rectangular ditched enclosure, shallow ditch visible on the ground. Possible moated site or medieval stock enclosure.	Undated	SCCHER
606	TQ 03110 73160	Cropmark of a ring ditch	Undesignated	Ring ditch visible as a cropmark on aerial photographs.	Undated	SCCHER
607	TQ 03260 73100	Cropmarks of ring ditches	Undesignated	Ring ditches visible as cropmarks on aerial photographs.	Undated	SCCHER
608	TQ 03080 73460	Cropmark of a ring ditch	Undesignated	Ring ditch visible as cropmarks on aerial photographs.	Undated	SCCHER
609	TQ 03420 73430	Cropmark of a ring ditch	Undesignated	Ring ditch visible as cropmarks on aerial photographs.	Undated	SCCHER
610	TQ 03150 74120	Cropmarks of a linear ditch and a ring ditch	Undesignated	Linear ditches; ring ditch visible as cropmarks on aerial photographs. Partly destroyed by gravel extraction.	Undated	SCCHER
611	TQ 03220 73780	Cropmarks of ring ditches and sub-rectangular enclosure	Undesignated	Ring ditches and sub-rectangular enclosure visible as cropmarks on aerial photographs. Within a gravel permission but not yet worked.	Undated	SCCHER
612	TQ 04120 74700	Cropmark of a rectangular enclosure	Undesignated	Rectangular enclosure visible as cropmarks on aerial photographs.	Undated	SCCHER
613	TQ 04670 74310	Cropmark of a ring ditch	Undesignated	Large ring ditch with central feature visible as cropmarks on aerial photographs. Destroyed by gravel extraction.	Undated	SCCHER
615	TQ 03350 74360	Cropmarks of a field system and ring ditches	Undesignated	Rectilinear ditch system and ring ditch(es) visible as cropmarks on aerial photographs. Destroyed by gravel extraction.	Undated	SCCHER
634	TQ 02860 75200	Cropmark of a rectangular enclosure	Undesignated	Rectangular enclosure with widely spaced double ditch visible as cropmarks on aerial photographs. Now under reservoir?	Undated	SCCHER
635	TQ 03150 75200	Cropmarks of a sub-rectangular enclosure and a ring ditch	Undesignated	Sub-rectangular enclosure and ring ditch visible as cropmark on aerial photographs. Now under reservoir.	Undated	SCCHER
646	TQ 03200 73850	Settlement	Undesignated	A Bronze Age and Iron Age enclosure on Staines Moor. The settlement was excavated by A E Brown in the 1980s.	Bronze Age / Iron Age	SCCHER
764	TQ 02770 74130	Chapel	Undesignated	Site of a chapel endowment of the vicarage of Staines. Yeoveney is mentioned among the chapelries to which the vicar was to present. The chapel at this hamlet has long been dilapidated. The vicarage of Staines was endowed in the time on William (Courtney or Gray) Bishop of London.	Medieval	SCCHER
774	TQ 0240 7260	Causewayed camp	Undesignated	Causewayed camp. Excavated in 1961-3 by R Robertson-Mackay after its discovery on aerial photographs. The concentric causewayed ditches had inner banks which had been ploughed flat. The ditches, flat bottomed, averaged 4.5-5.5 ft deep and 8.5-13 ft wide. A large complex of postholes, pits and palisade tenches was found within the interior and all contained fagments of Windmill Hill pottery and flints. Neolithic Peterborough ware pottery was only found in one section of the outer ditch. A single flat oval grave found in the interior contained an unaccompanied contracted inhumation burial. The finds included leaf arrowheads, polished axes, stone axes, saddle querns and an hour glass mace. Romano-British occupation of the 1st century overlay the whole site.	Neolithic	SCCHER
793	TQ 03400 74100	Cropmarks	Undesignated	Unspecified cropmarks / soilmarks (Roman?) visible on aerial photographs.	Undated	SCCHER
19788	TQ 033 718 - Area	Mustard Mill	Undesignated	Mustard Mill on the Wraysbury River, first mentioned in 1682 as Pound Mill because of the adjacent parish pound and was bought by John Finch in 1747. He probably used it to mill flour and meal, but by the 19th century the business had become Finch, Rickman & Co whose main product was mustard. By 1900 the business had declined so much that it was sold but continued as a mill under the name of Mainsbridges Crushing & Grinding Mill, or simply the Old Mill, Staines. It continued in use until 1916 when the Linoleum Company bought it to demolish. The foundations survived and could still be seen until early 1933 when the National Rivers Authority demolished them as part of a scheme to guard against flooding.	Post-medieval	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
19847	TQ 041 751	Stanwell Upper Mill	Undesignated	Water mill situated on a bridge over the River Colne. It is a substantial three storey brick building currently used as offices. It was the largest of three mills at Stanwell Moor. A mill called the North Mill is recorded as having been on this site in the 16th cetury. At the very end of the 18th century it was sold by the Lord of the Manor. It continued to be used under various ownership as a paper mill and corn-mill until the 20th century and in the late 19th century was powered by steam as well as water. Although electric power was thereafter used, the mill wheel and machinery were still there in 1956. Part of the building was damaged by a bomb in WWII.	Post-medieval	SCCHER
5051	TQ 036 717	Findspot	Undesignated	Evaluation and subsequent excavation by Wessex was carried out in advance of the redevelopment of the estate. The evaluation identified three broad zones within the site: the edge of town gravel island, a broad alluvium filled channel to the north and, beyond this, a second gravel island. Subsequent work concentrated on the two islands. Excavation on the edge of the town island (centred at TQ 036 717) identified two major episodes of alluviation, in between which a substantial palaeo-channel formed. The upper fills of this feature are thought to be Neolithic in date; a preliminary examination of samples indicates that it flowed through an open rather than wooded environment. A small number of features containing no dateable finds can also be attributed to the prehistoric period on stratigraphic grounds. A series of Roman boundary ditches roughly parallel with the High Street were identified, presumably separating the settlement area from marginal land to the north. In the medieval period the land appears to have been divided into burgage plots; the different plots showed evidence for different usage.	Prehistoric / Neolithic	SCCHER
5052	TQ 036 717	Ditches	Undesignated	Evaluation and subsequent excavation by Wessex was carried out in advance of the redevelopment of the estate. The evaluation identified three broad zones within the site: the edge of town gravel island, a broad alluvium filled channel to the north and, beyond this, a second gravel island. Subsequent work concentrated on the two islands. Excavation on the edge of the town island (centred at TQ 036 717) identified two major episodes of alluviation, in between which a substantial palaeo-channel formed. A series of Roman boundary ditches roughly parallel with the High Street were identified, presumably separating the settlement area from marginal land to the north.	Roman	SCCHER
5053	TQ 036 717	Burgage Plots	Undesignated	Evaluation and subsequent excavation by Wessex was carried out in advance of the redevelopment of the estate. The evaluation identified three broad zones within the site: the edge of town gravel island, a broad alluvium filled channel to the north and, beyond this, a second gravel island. Subsequent work concentrated on the two islands. Excavation on the edge of the town island (centred at TQ 036 717) identified two major episodes of alluviation, in between which a substantial palaeo-channel formed. In the medieval period the land appears to have been divided into burgage plots; the different plots showed evidence for different usage.	Medieval	SCCHER
5102	TQ 04072 71768	Burials	Undesignated	Excavation by SCAU in advance of redevelopment of a site that was partially evaluated in 1994. The work produced a number of interesting results: a number of stray finds and one feature of prehistoric date testifies to their being activity and probably settlement in the vicinity at least during the Bronze Age; features, including two inhumation burials of Roman date indicate activity alongside the Roman road to London leading from the Roman town at Staines; there was occupation in the vicinity in the 11th - mid-14th centuries, presumably a result of the nearby town again flourishing. The periods of inactivity on the site (between the late 14th and 18th centuries) are probably the result of increased flooding locally, making the area less attractive to settlement.	Roman	SCCHER

ASSET ID.	NGR	Site Name	Designation	Description	Period	Source
5103	TQ 04072 71768	Settlement	Undesignated	Excavation by SCAU in advance of redevelopment of a site that was partially evaluated in 1994. The work produced a number of interesting results: there was occupation in the vicinity in the 11th - mid-14th centuries, presumably a result of the nearby town again flourishing. The periods of inactivity on the site (between the late 14th and 18th centuries) are probably the result of increased flooding locally, making the area less attractive to settlement.	Medieval	SCCHER
3727	TQ 0728 7308 to SU 9105 6486	Roman road	Undesignated	This road was the most important thoroughfare from London to the western parts of the Province (London to Silchester). It left the city at Newgate, passed just to the north of the Thames at Brentford, through Hounslow, to enter Surrey at East Bedfont. From East Bedfont to Staines the route is closely followed by the modern road. The road crossed the Thames at Staines, the name for the settlement then being Pontes, "The Bridges". The position of the Bridges and the course of the road are not known, but the alignment points to Bakeham House on the ridge beyond, just south of Holloway College. As the alignment from Sunningdale also points to Bakeham House, it seems reasonable to assume that the two alignments met at this very suitable hilltop point.	Roman	SCCHER



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LEGEND

- Proposed Automated People Mover Route
- Proposed Motorway Route
- Proposed Public Highway
- Proposed Rail Corridor
- Safeguarded Railway Corridor
- Existing Runway
- Proposed Runway
- Historic Environment Record - Point Data
- London to Silchester Roman Road

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: DRAFT

Client: RUNWAY INNOVATIONS LIMITED

Project Title: SUBMISSION TO THE AIRPORTS COMMISSION - SHORTLISTED OPTIONS

Drawing Title: LOCATION OF NON-DESIGNATED HERITAGE ASSETS (HEATHROW HUB)

Drawn	Checked	Approved	Date
BB	NM	NM	27/06/2014

URS Internal Project No.: 47067372

Scale @ A3: 1:20,000

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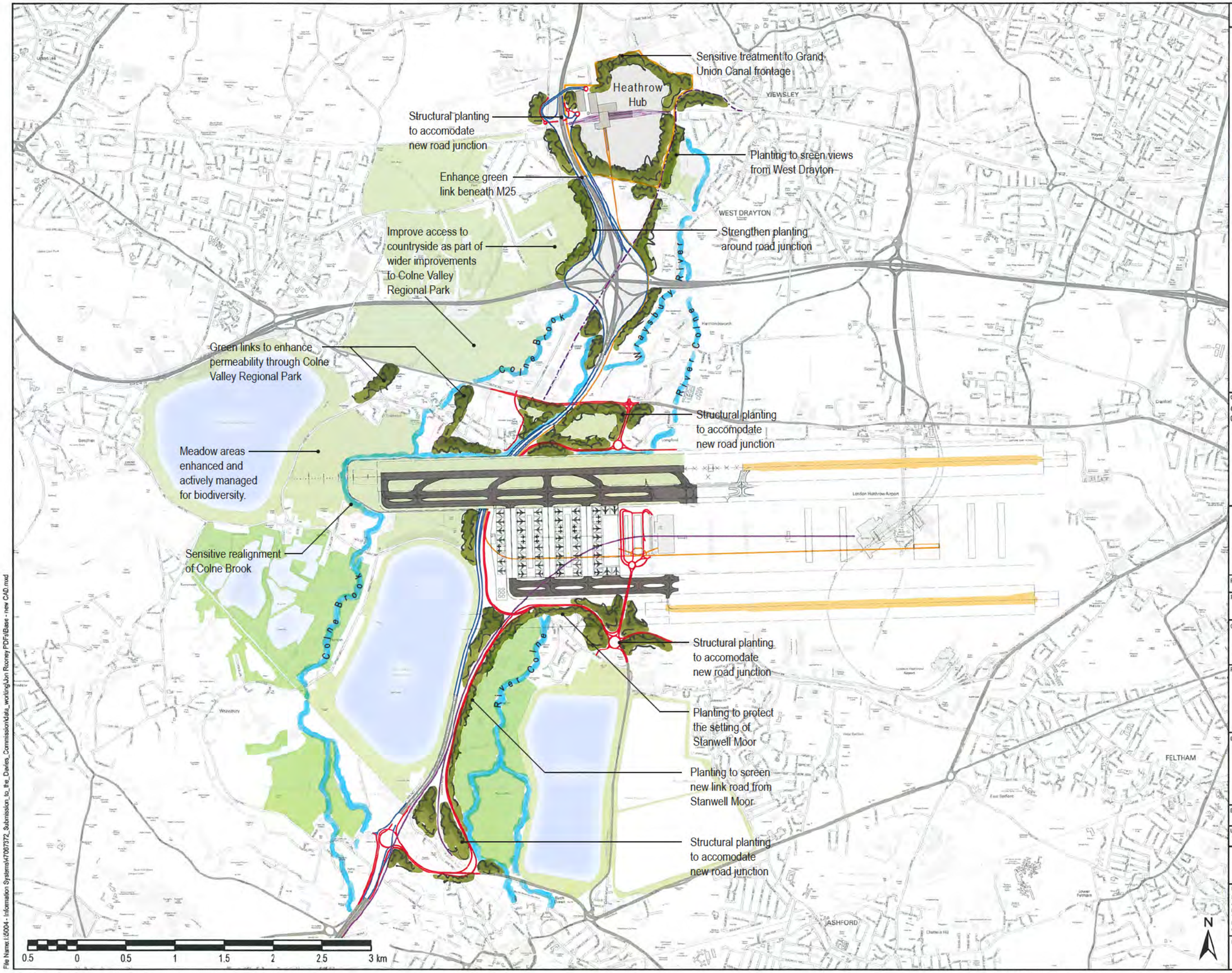
Drawing Number: FIGURE 6.5

Rev: 0

File Name:L:\5004 - Information Systems\47067372_Submission_to_the_Davies_Commission\project_files\MXDs\Heritage\Figure 6-5 Location of Non-Designated Heritage Assets.mxd

Figure 7.4- Heathrow Hub Landscape Concept



THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

LEGEND

- Proposed Automated People Mover Route
- Proposed Motorway Route
- Proposed Public Highway
- Proposed Rail Corridor
- Safeguarded Railway Corridor
- Proposed Heathrow Hub
- Existing Runways
- Proposed Runway / Taxiway
- Parkland / Meadow Areas
- Proposed / Enhanced Native Planting

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: FINAL

Client: RUNWAY INNOVATIONS LIMITED

Project Title: SUBMISSION TO THE AIRPORTS COMMISSION - SHORTLISTED OPTIONS

Drawing Title: LANDSCAPE CONCEPT

Drawn	Checked	Approved	Date
LK	JR	CP	27/06/2014

URS Internal Project No	Scale @ A3
47067372	NTS

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Drawing Number: FIGURE 7.4

Rev:

File Name: I:\5004 - Information Systems\47067372_Submission_to_the_Davies_Commission\data_working\Jon Rooney PDFs\Base - new CAD.mxd

6 CONSOLIDATED ASSUMPTIONS REGISTER

Baseline assumptions

Topic	Issue/sub-topic	Baseline year	Assumption	Reason (if applicable)	Reference (if applicable)
Surface Access Noise	General approach to appraisal		At this stage a high level desk-based qualitative appraisal of potential impacts has been undertaken as detailed information is not currently available upon which to undertake detailed modelling. The key to being able to undertake quantitative receptor specific appraisal is the availability of detailed road and rail traffic data for the relevant opening and future year baseline and with scheme scenarios		
	Construction noise and vibration		It is assumed that there will need to be a net import of 9,000,000 cubic metres of fill for construction of runway and apron		
	Construction noise and vibration		It is assumed that construction materials are will be brought to site using the same methods used for T5 (i.e. freight line into the south of the airport, near T4) then use of local roads		
	Construction noise and vibration		It is assumed that the M25 tunnel will be constructed by cut and cover and not using tunnel boring machines		
	Scheme proposals		It is assumed that the Heathrow Hub site comprises a new train station, 10,000 car parking spaces, a hotel and APM terminal		
	Scheme proposals		It is assumed that the new station is likely to increase the number of trains on connecting lines but no specific information is available		
	Scheme proposals		It is assumed that the APM (monorail type system) will generally be overground and follow the route of the M25, an elevated section is proposed from the Heathrow Hub site over the M4		
	Current surface access modes of transport		It is assumed that the approximate current split of road and rail traffic accessing Heathrow Airport is 80:20		
	Effects of scheme proposals on modal shift		The modal shift of additional passengers, due to the new station, is assumed to be 38-50% from road to rail		
	Effects of scheme proposals on modal shift		It is assumed that no change in operational freight mode will occur as part of the scheme		
	Baseline noise levels	2006	It is assumed that the Defra Noise Mapping England Noise Maps accessed though the Defra website, including those for the year 2006, provide a representative view of current baseline noise levels with respect to road and rail. This was considered the best source of widespread baseline noise level data for the study area, within the timescale of the appraisal		http://archive.defra.gov.uk/environment/quality/noise/environment/mapping/roads.htm http://archive.defra.gov.uk/environment/quality/noise/environment/actionplan/locations.htm http://services.defra.gov.uk/wps/portal/noise/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3hnd0cPE3MfAwMD42BTA093f1Nvk2ATAwNnA6B8JG55A2MCusNB9uHXD5I3wAEcDfT9PPJzU_ULciMMskwcFQHW4PMe/dl3/d3/L3dDb0EvUU5RTGtBISEvWUZSdndBISEvNl9DR0FINDdMMDAwM1M1MElHTzVLNFM0MDBDMA!!/
Aviation Noise	Baseline noise levels	2012	Noise Action Plan Contours for Heathrow Airport from 2012 have been taken as representative of current baseline air traffic noise levels in the vicinity of Heathrow. This was latest source of baseline noise level data for the Heathrow Airport representative of current conditions		ERCD REPORT 1305: Noise Action Plan Contours for Heathrow Airport 2012, 2012, Environmental Research and Consultancy Department Civil Aviation Authority http://www.heathrowairport.com/static/Heathrow_Noise/Downloads/PDF/LHR_2012_Noise_Action_Plan_Contours%20FINAL.pdf
Water and Flood Risk			Pedestrian access will be required for inspection and maintenance of crossings and diversions		
			Vehicular access will be required for maintenance of crossings and diversions. Access possibly required an both bank with adequate headroom or 4m+.		

Topic	Issue/sub-topic	Baseline year	Assumption	Reason (if applicable)	Reference (if applicable)
	Watercourse crossings		Crossings and diversions designed for the 1% AEP flood, with allowance for climate change. May need to considered more severe floods, possibly the probable maximum flood		
			All crossings will be straight between entrance and exit (no buried bends)		
			Single barrel crossings, rather than multiple small culverts Each watercourse will be provided with an independent crossing		
			Water course crossings and diversions are constrained to tie in with the existing channel upstream and downstream without the use of weir or other artificial structures to control levels		
	Heathrow Hub		No crossings over watercourses will be constructed at the Heathrow Hub other than normal highway bridges		
			No diversion of watercourses will be required for the construction of the Heathrow Hub		
			Abstraction and discharge to relocated water treatment works at Heathrow Hub will be at the same location as at present		
	Pollution and Groundwater		Construction Environment Management Plan (Elements of plan related to water pollution are included in Appendix E, Environmental Technical Note)	The Construction Environment Management Plan will put in place controls which will be followed, in regards to the release of sediment, controls on use of construction chemicals, procedures to reduce the risk of accidental spillage, provision of temporary attenuation to prevent an increase in runoff during construction phase. To prevent impacts from construction such as contamination by silt, oils, cement and other chemicals.	
			The M25 permanent underpass will require dewatering during construction and permanent groundwater control during operation		
			Culverting River Colne, Wraysbury River, Duke of Northumberland River, Longford River will require temporary cutting to extend few metres below existing ground surface and will require temporary dewatering during construction		
			Dewatering will impact on at least some of the identified groundwater abstractions within the superficial deposit aquifer		
			Any historic or authorised landfills will pose a risk to groundwater quality if they are disturbed during construction		
	Surface water drainage		Drainage strategy prepared assuming a new drainge system will be provided for the runway extenstion to remove the requirement for existing drainage infrastructure to be utilised		
Ecology	Habitats and species present on site	2013		No surveys have been undertaken. Therefore, all evaluations of site baseline are based upon desk study	Desk study data provided by local records centres and use of website www.magic.gov.uk
	General approach to appraisal	2012/ 2013/ 2014	At this stage a high level desk-based qualitative appraisal of potential impacts has been undertaken as detailed information is not currently available upon which to undertake detailed modelling. The key to being able to undertake quantitative receptor specific appraisal is the availability of detailed road traffic data for the relevant opening and future year baseline and with scheme scenarios		
			It is assumed that there will need to be a net import of 9,000,000 cubic metres of fill for construction of runway and apron		

Topic	Issue/sub-topic	Baseline year	Assumption	Reason (if applicable)	Reference (if applicable)
Air Quality	Construction Phase		It is assumed that construction materials are will be brought to site using the same methods used for T5 (i.e. freight line into the south of the airport, near T4) then use of local roads		
			It is assumed that the M25 tunnel will be constructed by cut and cover and not using tunnel boring machines		
	Scheme proposals		It is assumed that the Heathrow Hub site comprises a new train station, 10,000 car parking spaces, a hotel and APM terminal an that the provision of a hub will provide a modal shift from access by car to access by public transport infastructure.		
	Current surface access modes of transport		It is assumed that the approximate current split of road and rail traffic accessing Heathrow Airport is 80:20		
	Effects of scheme proposals on modal shift		The modal shift of additional passengers, due to the hub, is assumed to be 38-50% from road to rail		
	Effects of scheme proposals on modal shift		It is assumed that no change in operational freight mode will occur as part of the scheme		
	Baseline air quality		It is assumed that baseline air quality is well represented by the montioring completed by local councils.		
	Future Air Quality		It is assumed that in the absense of detailed traffic information with and without the scheme in place, future air quality can be estimated using Long Term Trends predicted by the Highways Agency to factor forward local authority monitoring data to future years.		
Place - Heritage	All work to date has been purely desk-based, no site visits have been undertaken;	2014		The study was focussed at a strategic level.	
	All assumptions are based on searches of relevant Historic environment Records and the National Heritage List undertaken in April and June 2014 and the data that was provided at this date;				
	All work undertaken is based on a strategic assessment of the baseline and the likely impacts from construction and operation at this stage.			A strategic assessment was felt to be most apprpriate at this stage. A more detailed assessment will be undertaken at the detailed design stage.	
Place - Landscape	Landscape and visual impact	2014		It is assumed that likely significant landscape and visual effects would be limited to an area approximately 2km from the proposed development.	
	Construction	2014		It is assumed that construction compounds etc would be located in close proximity to the proposed development site	
	Replacement dwellings and commercial buildings	2014		It is assumed that replacement dwellings and commerical buildings would not be replaced in close proximity to the airport.	
Place - Waste	London commercial and industrial waste arisings	2020		Waste arisings forecasts are at 5 year intervals	Mayor of London's Business Waste Strategy (2011) http://www.london.gov.uk/sites/default/files/Business%20Waste_FINAL.pdf
	Waste facility capacity - London and the South East	2012		Waste facility capacity data is published retrospectively by the Environment Agency: future predictions are not available	Environment Agency Waste Data Tables 2012 http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/research/library/data/150326.aspx

Mitigation assumptions

Topic	Mitigation measures	Assumptions	Reason (if applicable)	Reference (if applicable)
Water and Flood Risk (Construction)	Construction will take place in the dry with only limited temporary diversion of watercourses to permit construction of the final tie-ins.	The planned location of culverts are off the line of the existing watercourses	Construction can be completed more safely if in the dry and this will reduce negative ecological impacts.	
	Temporary dewatering may be required during the construction of the M25 underpass and of the river culverts.	Ground water is at a shallow depth within the superficial deposit aquifer	This would lower ground water levels and reduce the available resource within this aquifer	
	Site drainage, including surface runoff and dewatering effluents, will generally be discharged to sewers or local water courses as appropriate. Construction stage SuDS should be designed to allow runoff to be treated and attenuated to green field runoff rates.	The relevant section of BS6031: Code of Practice for Earthworks will be followed. Where drainage is discharged to a sewer the relevant permissions will be obtained from the sewerage or statutory undertaker. Where runoff from the construction site is to be discharged to a receiving watercourse any necessary consents will be obtained from the Environment Agency.		
Water and Flood Risk (Operational)	Culverts and diversions will be designed to readily accommodate a 1.0% annual event probability (1 in 100 year) plus an appropriate allowance for climate change.	Future flood levels, including an increase due to climate change will be considered when modelling elements of the scheme.		
	All designs should comply with the Environment Agency's design criteria and advice on best practice when designing culverts.	Single openings will be used in preference to multiple barrels. Bends and changes within culverts will be avoided. The use of trash screens will be avoided where possible. Water levels and flow conditions at the entrance and exits shall be considered to reduce the risk of changing erosion patterns upstream or downstream.		
	Access is required to all culverts for inspection and maintenance. For watercourse crossings the final finished surface needs to be high enough to allow sufficient depth for construction and sufficient headroom within any crossing for maintenance.	At any crossing, that there will be about 4m from the finished surface of the runway to the soffit of the crossing. 2m headroom would be required for pedestrian access, 4 m access to most vehicles and mechanical plant for maintenance; and 6m would provide access for all vehicles and most plant for maintenance.		
	Culverts through the crossing will include a natural substrate in the bed and banks	Substrate will encourage diversity and the formation of quiescent zones where passing fish and eels can rest.	Smooth uniform bed channels lead to uniform fast flow without quiescent zones where fish can rest.	
	Dense planting at the entrance and exit of each crossing can help to reduce the sudden change from light to dark. Light wells may be included within the crossing.	If light wells were to be included, consideration would need to be given to maintaining airside security, the safety of pedestrians walking over the light wells and either preventing aircraft or vehicles passing over the light wells or ensuring their safety if they can drive over.		

Topic	Mitigation measures	Assumptions	Reason (if applicable)	Reference (if applicable)
	Compensation flood plain storage areas have been identified in the same catchment and as close as practical to the flood plain and that exceed the volume of flood plain storage areas lost to the development	The compensation storage areas will be sufficient to hold the volume of flood water during a flood event.	There will be a loss of flood plain due to the development which will have to be compensated for elsewhere.	
	Offsite Fluvial Water Framework Directive Compensation	Compensation measures outside of the footprint of the development will be considered if it is not possible to provide adequate mitigation within the footprint.		
	Long term storage will be provided outside flood compensation areas to prevent or delay additional surface water runoff from discharging into the watercourses	The log term storage requirement is based on the 'Rainfall Runoff Management for Developments' (Environment Agency, October 2013)		
	It is proposed to drain the extended airport site at rates equivalent to the greenfield runoff of the 1, 30 and 100 year key return period events, with an additional 30% allowance for climate change.	The attenuated discharge will be conveyed to the receiving watercourse to mimic existing regime, as the underlying ground conditions are generally unsuitable for infiltration.		
Ecology	Habitat Creation	No surveys have been undertaken and no landowners have been contacted. Therefore the availability of land and its suitability for mitigation have been assumed	Agreed with Commission secretariat that actual surveys were not expected for this exercise	
	Protected and notable species mitigation	No surveys have been undertaken such that the size and distribution of populations of protected species cannot be determined and have therefore been assumed		
Air Quality	Application of all current air quality actions implemented at heathrow to any expansion of the site Local Authority based air quality plan measures	It is assumed that any current air quality mitigation measures within the Heathrow Air Quality Strategy would continue to be applied accros the expanded site. Assumed improvements would continue to be sought under the Local Air Quality Management Regime.	To ensure any impact on air quality is minimised. To ensure any impact on air quality is minimised.	http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/air-quality-strategy_LHR.pdf
	Historic Building Recording prior to the demolition or removal of listed buildings	Contractor to follow EH and IfA standards and guidance	To ensure good practice is followed to high standards	English Heritage (2006a) Understanding Historic Buildings. A Guide to Good Recording Practice. English Heritage, Swindon. Institute for Archaeologists (2008) Standard and Guidance for the archaeological investigation and recording of standing buildings or structures. IfA, Reading.

Topic	Mitigation measures	Assumptions	Reason (if applicable)	Reference (if applicable)
Place - Heritage	Relocation of grade II listed milestone, waterpump and city post where feasible	Contractor to follow EH and IfA standards and guidance	To ensure good practice is followed to high standards	English Heritage (2006a) Understanding Historic Buildings. A Guide to Good Recording Practice. English Heritage, Swindon. Institute for Archaeologists (2008) Standard and Guidance for the archaeological investigation and recording of standing buildings or structures. IfA, Reading.
		Contractors to ensure suitable provision for safe transport, storage and preservation, prior to resiting.	To ensure preservation of listed structures prior to resiting	
	Archaeological excavation and recording, public outreach and dissemination	Contractor to follow EH and IfA standards and guidance	To ensure good practice is followed to high standards	http://www.archaeologists.net/codes/ifa http://www.english-heritage.org.uk/publications/guidelines-and-standards/
	Enhancement to the landscape to the west and southwest of Stanwell Moor	Design will allow integration of moorland along the River Colne on Staines Moor with areas to the north that have been changed dramatically by gravel extraction and the construction of the M25.	To improve the setting of heritage assets in Stanwell Moor and at Lower Mill Farm. To offset negative impacts on the setting of heritage assets on Staines Moor.	
Place - Landscape	Planting, grassland creation / enhancement and recreation provision	It is assumed that it would be possible to either secure land through compulsory purchase or third-party agreement to achieve the area required to mitigate impacts on landscape, views and recreation provision.	Additional land will be required to offet the loss of land for recreation.	
Place - Waste	An integrated design approach will be developed to use excavated material to satisfy the fill material requirements wherever reasonably practicable	Designers will take waste management into account during all stages of the design.	The project proponent and/or HAL will have the ability to require the designers to follow best practice methods of designing out construction waste.	
	The proposed development will follow the waste hierarchy and seek to minimise the quantities of waste sent for disposal	Contractors will be obligated to follow sustainable waste management approaches during construction.	The project proponent and/or HAL will have the ability to require the contractor to follow best practice methods of construction waste management.	
	The established approach to managing wastes as sustainably as possible at Heathrow will be extended to the proposed development	Existing practices for managing waste at HAL will be extended to the proposed development.	Waste from proposed development will be managed by HAL's contractors or subject to the influence of HAL's sustainability policies, and will be similar in type to that currently managed.	

7 AIR QUALITY EXCEL DATASHEETS

Submitted as Excel spreadsheet (separate document)