RiverOak Strategic Partners

Appendices to Answers to Fourth Written Questions

TR020002/D9/FWQ/Appendices

Examination Document

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Manston Airport Development Consent Order

Appendices to Applicant's Responses to the Examining Authority's Fourth Written Questions

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Technical note:
Manston Airport: Appendix to Ec.4.1

This technical note provides updated entries to Tables from the RIAA [REP7a-014] to reflect the screening process undertaken for, but accidentally omitted from, the RIAA, for the effects of dust deposition during the construction phase of the Proposed Development. Updated entries are provided as detailed below:

- Table 3.2 Screening Table (see Annex A to this Note); and
- Updated HRA Screening matrices, with changes to the RIAA (REP7a-014) related to dust deposition shown in bold (see Annex B to this Note).

Annex A Table 3.2 Screening Assessment

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
Thanet Coast and Sandwich Bay Ramsar site† (0m)	Turnstone (non-breeding) (Criterion 6)	Maintain and restore the extent, distribution, structure and function of habitats turnstone reply upon, and their supporting processes. Maintain and restore the population and distribution of turnstone‡	**Construction Phase (dust)** Deposition of dust resulting in loss of or damage to habitats that turnstone depend upon (rocky shorelines and mudflats) from smothering or enrichment.	Evidence from the desk study and survey indicate that turnstone do not utilise any habitats within the 200m of the airport boundary part of the Order Limits, or 500m of the construction works entrance (ZoI based on IAQM guidance (http://iaqm.co.uk/guidance) and consultation with Natural England.	In view of the lack of suitable habitat for turnstone within the ZoI (200m from the airport boundary, and 500m from its entrance): no adverse effects are predicted on the extent and structure of the habitat that turnstone depend upon, or the numbers and distribution of this species, due to dust from the construction works. No LSE is predicted.	Screened out
	15 British Red Data Book invertebrate species (Criterion 2)	Maintain and restore the extent, distribution, structure and function of habitats the qualifying feature invertebrate species reply upon, and their supporting processes.	**Construction Phase (dust)** Deposition of dust resulting in loss of or damage to habitats (that qualifying species of invertebrates depend upon) from smothering or enrichment	The wetland habitats support 15 British Red Data Book invertebrates.	The Ramsar site is located at its closest point, approximately 860m from the airport boundary (construction works area), and therefore outside the ZoI (200m from the airport boundary, and 500m from its entrance) within which effects of dust deposition on invertebrates might occur. In view of this, no adverse effects are predicted on the extent and structure of the habitats that the invertebrates depend upon, or the numbers and distribution of these species due to dust from the construction works.	Screened out

* Full designation information is provided in Appendix B of the RIAA (REP7a-014).
† Conservation objectives for all sites are listed in Appendix D of the RIAA (REP7a-014).
‡ The conservation objectives for turnstone for the Ramsar site have been taken as being the same as for the SPA of the same name, with which it shares a common boundary over much of its area.

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
		Maintain and restore the populations and distributions of the qualifying feature invertebrate species.			No LSE is predicted.	
Thanet Coast and Sandwich Bay SPA (0m)	Golden plover (non-breeding)	Maintain and restore the extent, distribution, structure and function of habitats golden plover reply upon. Maintain and restore the population and distribution of golden plover	**Construction Phase (dust)** Deposition of dust resulting in loss of or damage to habitats that golden plover depend upon (arable farmland) from smothering or enrichment	Evidence from the desk study and survey indicate that golden plover utilise the arable farmland within 200m of the airport boundary and 500m of its entrance, albeit in low numbers.	Golden plover forage on arable farmland (primarily winter wheat) with the ZoIs; a habitat that receives intensive agricultural management (it is routinely ploughed and applied with pesticides and herbicides) and therefore would not be adversely affected by dust deposition. In view of the intensive agricultural management of the habitat: no adverse effects are predicted on the extent and structure of the habitats golden plover depend upon, or the numbers and distribution of this species due to dust deposition from the construction works. No LSE is predicted.	Screened out
	Little tern (breeding)	Maintain and restore the extent, distribution, structure and function of habitats little tern reply upon. Maintain and restore the population and distribution of little tern.	**Construction Phase (dust)** Deposition of dust resulting in loss of or damage to habitats that nesting little tern depend upon (bare or sparsely vegetated shingle and sandy beaches), from smothering or enrichment.	The nearest potential nest site for recolonization of little tern is at Shell Ness, 1.2km south of the outfall route.	Suitable habitat for nesting little tern does not occur within the ZoI (200m of the construction area or 500m from its entrance) and therefore dust deposition during the construction phase would not result in damage to potential nesting sites for little tern. No LSE is predicted.	Screened out
	Turnstone (non-breeding)	Maintain and restore the extent, distribution,	**Construction Phase (dust)**	Evidence from the desk study and survey indicate that turnstone do not utilise	In view of the lack of suitable habitat for turnstone within the ZoI (200m from the airport boundary, and 500m from its entrance): no adverse effects are	Screened out

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
		structure and function of habitats turnstone reply upon and their supporting processes. Maintain and restore the population and distribution of turnstone.	Deposition of dust resulting in loss of or damage to habitats that turnstone depend upon (rocky shorelines and mudflats) from smothering or enrichment.	any habitats within the 200m of the airport boundary part of the Order Limits, or 500m of the construction works entrance (ZoI based on IAQM guidance (http://iaqm.co.uk/guidance) and consultation with Natural England.	predicted on the extent and structure of the habitat that turnstone depend upon, or the numbers and distribution of this species, due to dust from the construction works. No LSE is predicted.	
Sandwich Bay SAC (0m)	Annex I habitats	Maintain and restore the extent, distribution, structure and function of the qualifying habitats (and their typical flora), and the supporting processes they rely upon.	**Construction Phase (dust)** Deposition of dust resulting in loss of or damage to qualifying SAC habitats (sand dunes) from smothering or enrichment.	Annex I (sand dune) habitats occur at their closest, 2.5km south of the area in which construction works would occur (within the airport boundary part of the Order Limits).	Qualifying sand dune habitats do not occur within the ZoI (200m from the airport boundary, and 500m from its entrance) within which effects of dust deposition might occur. In view of this, no adverse effects are predicted on the distribution, structure and function of the habitats due to dust from the construction works. No LSE is predicted.	Screened out
Thanet Coast SAC (330m SE)	Annex 1 habitats	Maintain and restore the extent, distribution, structure and function of the qualifying habitats (and the typical species they support), and the supporting	**Construction Phase (dust)** Deposition of dust resulting in loss of or damage to qualifying habitats from smothering or enrichment.	The Annex I habitats (reefs and submerged or partially submerged sea caves) are located, at their closest, 860m from the area in which construction works would occur (within the airport boundary part of the Order Limits.	The SAC is located at its closest point, approximately 860m from the airport boundary (construction works area), and therefore outside the ZoI (200m from the airport boundary, and 500m from its entrance) within which effects of dust deposition on qualifying habitats might occur. In view of this, no adverse effects are predicted on the distribution, structure and function of the habitats due to dust from the construction works. No LSE is predicted.	Screened out

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
		processed they rely upon.				

Annex B HRA Stage 1 Screening Matrices

The Screening Matrices for the following European Sites required update (indicated by **emboldened text**):

- Thanet Coast and Sandwich Bay SPA;
- Thanet Coast and Sandwich Bay Ramsar;
- Thanet Coast SAC;
- Sandwich Bay SAC;

The Screening Matrices for the European Sites listed below are unchanged from the RIAA [REP7a-014], as these sites lie well beyond the ZoI (200m from the construction site and 500m from its entrance) within which adverse effects could occur. The matrices have therefore not been provided in this note.

- Outer Thames Estuary SPA;
- Margate & Long Sands SAC;
- Stodmarsh SPA;
- Stodmarsh SAC;
- Stodmarsh Ramsar; and
- Blean Complex SAC.

Evidence for likely significant effects on their qualifying features is detailed within the footnotes to the screening matrices below.

Matrix Key:

✓ = Likely significant effect **cannot** be excluded at Stage 1

✗ = Likely significant effect **can** be excluded at Stage 1

C = construction

O = operation

D = decommissioning

Where effects are not applicable to a particular feature they are denoted with n/a.

Stage 1, Matrix A: Thanet Coast and Sandwich Bay SPA

Name of European site: Thanet Coast and Sandwich Bay SPA

Distance to Order Limits: 0m

European site features	Likely effects of the Proposed Development																							
	Effect 1 (outfall)			Effect 2 (aircraft)			Effect 3 (AQ)			Effect 4 (bird scaring)			Effect 5 (barrier)			Effect 6 (dust)			Effect 7 (con. dist.)			Effect 8 (in-comb.)		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
A069 Turnstone (non-breeding)	✓b	✓b	✓b	n/a	✓b	n/a	Xa	Xa	Xa	n/a	Xa	n/a	n/a	Xa	n/a	Xa	n/a	Xa	Xa	n/a	Xa	✓b	✓b	✓b
A140 Golden plover (non-breeding)	✓b	✓b	✓b	n/a	✓b	n/a	Xa	Xa	Xa	n/a	✓b	n/a	n/a	✓b	n/a	Xa	n/a	Xa	✓b	n/a	✓b	✓b	✓b	✓b
A195 Little tern (breeding)	n/a	n/a	n/a	n/a	✓b	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**Xa**	n/a	**Xa**	n/a	n/a	n/a	n/a	n/a	n/a

Note: updates indicated by emboldened text

Evidence supporting conclusions

a. Table 3.2 Screening Assessment (**Annex A** of this note)
b. Section 4 Assessment of Adverse Effects in the RIAA [REP7a-014]

wood.

Stage 1, Matrix B: Thanet Coast and Sandwich Bay Ramsar

Name of European site: Thanet Coast and Sandwich Bay Ramsar Site

Distance to Order Limits: 0m

European site features	Likely effects of the Proposed Development																							
	Effect 1 (outfall)			Effect 2 (aircraft)			Effect 3 (AQ)			Effect 4 (bird scaring)			Effect 5 (barrier)			Effect 6 (dust)			Effect 7 (con. dist.)			Effect 8 (in-comb.)		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Turnstone (non-breeding)	✓b	✓b	✓b	n/a	✓b	n/a	Xa	Xa	Xa	n/a	Xa	n/a	n/a	Xa	n/a	Xa	n/a	Xa	Xa	n/a	Xa	✓b	✓b	✓b
Red Data Book invertebrates	Xa	Xa	Xa	n/a	n/a	n/a	✓b	✓b	✓b	n/a	n/a	n/a	n/a	n/a	n/a	**Xa**	n/a	**Xa**	n/a	n/a	n/a	✓b	✓b	✓b

Note: updates indicated by emboldened text

Evidence supporting conclusions

a. Table 3.2 Screening Assessment (**Annex A** of this note)
b. Section 4 Assessment of Adverse Effects in the RIAA [REP7a-014]

Stage 1, Matrix C: Thanet Coast SAC

Name of European site: Thanet Coast SAC

Distance to Order Limits: 300m

European site features	Likely effects of the Proposed Development																							
	Effect 1 (outfall)			Effect 2 (aircraft)			Effect 3 (AQ)			Effect 4 (bird scaring)			Effect 5 (barrier)			Effect 6 (dust)			Effect 7 (con. dist.)			Effect 8 (in-comb.)		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
H1170 Reefs	n/a	n/a	n/a	n/a	n/a	n/a	Xa	Xa	Xa	n/a	n/a	n/a	n/a	n/a	n/a	**Xa**	n/a	**Xa**	n/a	n/a	n/a	Xa	Xa	Xa
H8330 Submerged or partially submerged sea caves	n/a	n/a	n/a	n/a	n/a	n/a	Xa	Xa	Xa	n/a	n/a	n/a	n/a	n/a	n/a	**Xa**	n/a	**Xa**	n/a	n/a	n/a	Xa	Xa	Xa

Note: updates indicated by emboldened text

Evidence supporting conclusions

a. Table 3.2 Screening Assessment (**Annex A** of this note)

Stage 1, Matrix D: Sandwich Bay SAC

Name of European site: Sandwich Bay SAC

Distance to Order Limits: 0m

European site features	Likely effects of the Proposed Development																							
	Effect 1 (outfall)			Effect 2 (aircraft)			Effect 3 (AQ)			Effect 4 (bird scaring)			Effect 5 (barrier)			Effect 6 (dust)			Effect 7 (con. dist.)			Effect 8 (in-comb.)		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
H2110 Embryonic shifting dunes	Xa	Xa	Xa	n/a	n/a	n/a	✓b	✓b	✓b	n/a	n/a	n/a	n/a	n/a	n/a	Xa	n/a	Xa	n/a	n/a	n/a	✓b	✓b	✓b
H2120 Shifting dunes along the shoreline	Xa	Xa	Xa	n/a	n/a	n/a	✓b	✓b	✓b	n/a	n/a	n/a	n/a	n/a	n/a	Xa	n/a	Xa	n/a	n/a	n/a	✓b	✓b	✓b
H2130 Fixed coastal dunes with herbaceous vegetation	Xa	Xa	Xa	n/a	n/a	n/a	✓b	✓b	✓b	n/a	n/a	n/a	n/a	n/a	n/a	Xa	n/a	Xa	n/a	n/a	n/a	✓b	✓b	✓b
H2170 Dunes with Salix repens ssp. argentea	Xa	Xa	Xa	n/a	n/a	n/a	✓b	✓b	✓b	n/a	n/a	n/a	n/a	n/a	n/a	Xa	n/a	Xa	n/a	n/a	n/a	✓b	✓b	✓b
H2190 Humid dune slacks	Xa	Xa	Xa	n/a	n/a	n/a	✓b	✓b	✓b	n/a	n/a	n/a	n/a	n/a	n/a	Xa	n/a	Xa	n/a	n/a	n/a	✓b	✓b	✓b

Note: updates indicated by emboldened text

Evidence supporting conclusions

a.	Table 3.2	Screening Assessment (**Annex A** of this note)
b.	Section 4	Assessment of Adverse Effects in the RIAA [REP7a-014]

Manston Airport DCO:
North Pegwell Bay: Noise and Turnstone

1. Background

This Technical Note provides an update on the issue of the potential for aircraft noise to affect turnstone, a qualification feature of the Thanet Coast and Sandwich Bay Special Protection Area (SPA) and Ramsar site.

At Issue Specific Hearing 6 (ISH6) dealing with HRA matters (5 June 2019) Natural England stated they had a residual uncertainty in respect of the potential for aircraft noise to affect turnstone in Pegwell Bay. The Report to Inform the Appropriate Assessment issued at Deadline 7a (RIAA [REP7a-014]) had concluded that the species would not be affected and that there would be no adverse effect on site integrity. It was also acknowledged that NE and the Applicant are close to agreement however mitigation, probably in the form of a financial contribution towards an appropriate mitigation programme, would be required in the event that residual concerns cannot be resolved.

In terms of the substantive issue under discussion, during the winter turnstone regularly forage on the northern coastline of Pegwell Bay, part of the SPA/Ramsar, where noise levels of 70-75dB LAmax are modelled to occur. These levels result only from flights departing east (so may only occur on 30% of the days in a given year) and will only be generated by the noisiest aircraft predicted to be operated in future (Boeing 747-400) and also planes classed as in the mid-range of noise generation (e.g. Boeing 737-800). Natural England's view was that due to exposure to these noise levels it could not be ruled out with certainty that turnstone would not react in a significant way to noise events generated by these departures. This could therefore undermine the conservation objectives of the SPA, specifically in the context of restoration of the turnstone population. That view is based solely on potential disturbance from noise and not from the visual stimulus of aircraft, as all planes will be sufficiently distant (i.e. above 500m in altitude and/or beyond 1km in lateral distance) to either have no or a negligible effect.

Given Natural England's residual uncertainty, mitigation was indicated as being required. As noted above, at ISH6 Natural England suggested that mitigation could be provided through a financial contribution by the Applicant to implementation of an appropriate project of the Thanet District Council's (TDC) Strategic Access Management and Monitoring Plan (SAMM) in respect of the Thanet section of the Thanet Coast and Sandwich Bay SPA[1]. As neither TDC or the Applicant were aware of this suggestion prior to the Hearing, discussion amongst the parties has occurred subsequently. As a result of these discussions it has been determined that an appropriate project does not currently exist within the TDC SAMM to which a financial contribution could be made. Nonetheless the Applicant has offered to help fund a suitable project or projects, and if necessary to work with TDC and NE to ensure implementation on an appropriate timeline.

During the recent constructive post-Hearing discussions, once information submitted by the Applicant at Deadline 7a had been fully reviewed, Natural England brought to the attention of the Applicant valuable information about the previous operation of the airport, which was that aircraft flight paths departing/arriving to/from the east, were located around 1km to the north of Pegwell Bay, and that planes using these paths previously had not been reported to cause significant disturbance to the SPA birds. Natural England indicated that if the Applicant could show that the proposed flight paths were sufficiently similar to those used previously, and provide a narrative on the relative noisiness of the previous fleet mix

[1] Main Report. v1. April 2016. Prepared for Thanet District Council by Bayne, S (Blackwood Bayne Ltd) and Hyland, V. (V. Hyland Associates Ltd). https://www.thanet.gov.uk/wp-content/uploads/2018/03/Thanet-DC-SAMM-MAIN-REPORT-Final-21st-April-2016.pdf

compared with that proposed, then this would be an acceptable approach to removing Natural England's uncertainty regarding noise and turnstone and allow them to concur with the conclusions of the RIAA [REP7a-014]. Their view was supported by the Pegwell Bay Bird Disturbance Study[2], undertaken over a two year period between January 2010 and December 2011 when the airport was previously operational, which did not report that flights from the airport were a cause of disturbance to the birds in Pegwell Bay.

This Technical Note provides the following information:

- Confirmation that the proposed flight paths when planes leave to the east over Ramsgate and arrive from the east over Ramsgate, will be sufficiently similar to those used when the airport was previously operational;
- Information showing that the fleet now proposed will comprise no planes louder than previously operated, with the majority quieter than previously used
- Confirmation that the loudest planes that previously operated from Manston Airport will now be banned via the Noise Mitigation Plan and Chapter 3 of Part II, Volume 1 of Annex 16 to the Convention on International Civil Aviation which prohibits certain aircraft from operating within European airspace.
- Confirmation that the assessment provided in the RIAA [REP07a-014] is still considered valid; and
- Support to projects and studies on disturbance in Pegwell Bay.

2. Information on flightpath and fleet mix

2.1 Former and proposed flightpaths

The proposed flight path swathes are shown in Figure 1, informed by Figure 4.4 of the RIAA. Although the precise flight paths are subject to approval under the Civil Aviation Authority airspace change process, the flight path indicated for planes leaving to the east over Ramsgate and arriving from the east over Ramsgate is unlikely to deviate significantly from that indicated on Figure 1. At this distance from the airport there is little scope for variation.

The flight path used to the east of the airport during the period when the airport was previously operational is superimposed onto the proposed flight paths figure included in the Application (see Figure 1). The flight path shown is very similar to the flight path previously used which, based on the feedback from Natural England, would not result in disturbance of turnstone in Pegwell Bay.

2.2 Fleet mix and flight numbers

In the last five-ten years of operation, there were approximately 1,000 freight and 1,000-1,500 passenger Air Traffic Movements annually to/from Manston (Tom Wilson, Viscount Aviation, pers. comm.).

The freight fleet operated from Manston in its last years of operation comprised almost entirely of Douglas DC8-62, Boeing 747-200 and Boeing 747-400 aircraft (Tom Wilson, Viscount Aviation, pers. comm.). Based on noise certification data for these aircraft types, the DC8-62 and Boeing 747-200, which comprised the

[2] Swandale, T and Waite, A. 2012. Pegwell Bay, Kent: Bird Disturbance Study 2010-2011. Kent Wildlife Trust, Maidstone.

majority of air transport movements, are noisier aircraft than any of the fleet proposed[3] when the airport re-opens. The Boeing 747-400 was the quietest of the three.

The risk of the noisiest aircraft being operated in future is minimised by the Quota Count approach detailed in the Noise Mitigation Plan [REP8-004], and some models are now banned by EU Legislation. Neither the Boeing 747-200 nor the DC8-62 are Chapter 3 compliant unless fitted with 'hush kits' and as such they could not use Manton Airport unless they are significantly quieter than those that flew under the previous operation.

Despite the previous fleet mix comprising planes that are as, or more, noisy as the noisiest proposed for future use, at the time of the two year Pegwell Bay bird disturbance study, disturbance as a result of airport operations in the northern part of Pegwell Bay was not recorded.

The numbers of flights forecast were presented in Appendix 3.3 [APP-044] of Environmental Statement Chapter 3 [APP–033]. The number of flights in Year 2 would be approximately double the number of commercial flights previously operated, and numbers would increase to Year 20 as per the forecast. However, although more frequent, the fleet will comprise no planes louder than the quietest of the freight planes operated previously, and as indicated above, disturbance as result of airport operations in the northern part of Pegwell Bay was not recorded.

3. Assessment

The proposed take-off flight path to the east is sufficiently similar to that used when the airport was previously operational that, based on the feedback from Natural England, it can be concluded that adoption of this path would not result in adverse effects on turnstone. The fleet mix proposed comprises no planes louder than the quietest freight aircraft previously operated, with the majority quieter than previously used, which accords with the general trend of more modern planes being less noisy than older aircraft types. Therefore, as the previous operation of the airport was not reported to disturb birds, despite a forecast increase in the number of flights, it can also be concluded that future operation with a predominantly less noisy fleet will also not result in disturbance of the birds using Pegwell Bay.

This supports the previous assessment and conclusion presented in the RIAA [REP7a-014] as detailed below.

- During the noise monitoring undertaken by the Applicant at Pegwell Bay in February-May 2019[4], peak noise levels exceeded 70 dB_{LAmax} on average 10 times per hour from the northern Vantage (monitoring) Point, and exceeded 60 dB_{LAmax}, 121 times per hour. Overall therefore, operation of the airport will result in a small number of additional noise events of a similar magnitude to those already occurring in the Bay;
- The Applicant's Bird Disturbance Study[5] identified no occurrences where noise alone (i.e. arising from a disturbing source further than 500m from birds present) elicited a response in the birds present. Similar findings supporting this have been found from disturbance studies for other developments for example work undertaken by Jacobs[6] for the recent Wylfa DCO examination.
- Although the noise modelling indicates that the area (at the base of West Cliff) frequented by turnstone will experience levels up to 75dB, the cliffs are likely to dampen the noise;

[3] Appendix 3.3 [APP-044] of Environmental Statement Chapter 3 [APP–033] details the proposed fleet mix.
[4] Appendix G of the RIAA [REP7a-014].
[5] Appendix G of the RIAA [REP7a-014].
[6] Jacobs (2018). Wylfa Newydd Project. *Addendum to Seabird Baseline Report: Disturbance Monitoring at Cemlyn Lagoon*. PINS Ref. EN01007, December 2018.

- The visual stimuli provided by aircraft can be further discounted due to distance and the presence of the cliffs;
- Research suggests that birds react to the presence of aircraft in flight if they are perceived to represent a threat (for example, their appearance and flight profile of the aircraft appears to be similar to that of an avian predator such as a peregrine). This may explain why low-flying helicopters, light aircraft and military jets often elicit a much more severe response in birds than higher flying commercial jets;
- Aircraft noise results in gradual increase and decrease in noise over a longer period than a sudden loud noise to which birds are far more sensitive;
- Flights will be infrequent with the predictability of flight paths again reducing the potential for disturbance, and the loudest planes make up a relatively small proportion of the forecast fleet and that only certain flight directions will occur on any one day;
- Results from the Pegwell Bay Waterbird Disturbance Survey in 2018/19 provide no evidence to indicate that the birds using Pegwell Bay, or the north Thanet coast, respond to the overflights of commercial jets, with only low flying helicopters and micro-lights eliciting a response from the combined visual and noise stimulus. It is however, acknowledged that the flight paths and altitudes of the commercial jets currently flying over or close to Pegwell Bay are different and higher respectively to those for the Proposed Development;
- There is no publicly available evidence suggesting that the conservation objectives of the SPA were impacted by aircraft noise whilst Manston Airport was operational. There is no historical evidence to suggest that turnstone were displaced from areas of Pegwell Bay close to the flight paths during the period when Manston airport was operational, and conversely, numbers of turnstone have declined since operation ceased (Hodgson, 2016[7]).

The proposed operation of Manston Airport will therefore not result in an adverse effect on the integrity of the Thanet Coast and Sandwich Bay SPA and Ramsar.

4. Support to projects and studies on disturbance in Pegwell Bay

Despite the conclusion of no adverse effect presented above, the Applicant recognises that disturbance in Pegwell Bay is a key pressure on the SPA species present, and that this is the subject of on-going initiatives including:

- Implementation of the Strategic Access Management and Monitoring Plan (SAMM) by Thanet District Council. This plan seeks to reduce the pressure exerted on turnstone in the SPA by an increase in recreational pressure resulting from new residential development;
- Monitoring of levels of disturbance in Pegwell Bay by Kent Wildlife Trust.

The Applicant has concluded that no adverse effects would occur that would affect achievement of the conservation objectives of the SPA. Recent discussions have centred around an understanding that bird populations were not affected by disturbance when the airport was previously operating and the fact that quieter aircraft will use the airport under the current proposals. Nonetheless, following discussion with Natural England it is acknowledged that unforeseen circumstances (such as changes in the aircraft fleet mix)

[7] Hodgson, I. (2016). *Thanet Coast Turnstone (Arenaria interpres) monitoring, January – February 2016*. Report to Natural England. Sandwich Bay Bird Observatory Trust, Sandwich.

could result in minor impacts on the conservation objectives of the SPA. In all likelihood the aircraft fleet mix will continue to become quieter however, as this is outside of the control of the Applicant, the following precautionary mitigation is proposed:

1. The noise mitigation plan secures a ban on certain noisier aircraft as well as placing an overall noise envelope and QC based limit on aircraft movement. Both of these factors will motivate the airport to accept quieter aircraft as both the QC measure as well as the noise envelope would be exceeded more rapidly if noisier aircraft use the airport.

2. The Applicant will, through a Section 106 agreement with Thanet District Council, provide a sum of £100,000 to be used to mitigate any impacts on bird populations in Pegwell Bay.

3. The first £20,000 of this sum will be used to support the current bird disturbance monitoring study being undertaken by Kent Wildlife Trust.

4. If it is found that the operation of the airport is affecting bird populations, the remining sum will be made available to Kent Wildlife Trust (KWT), Thanet District Council (TDC) and Natural England (NE) (mechanism to be confirmed) to develop and support projects directly relevant to species affected by disturbance. This element will have two phases:

    a. KWT, TDC and NE to develop mitigation plan (with support from the Applicant/Operator as appropriate)

    b. Use of the remaining funds (£80,000) for implementation of mitigation schemes to assist with restoration measures for affected bird population. It is likely that this would involve measures such as access control to minimise human disturbance such as water sports and dog walking which already occur at locations such as West Cliffe.

5. KWT will also have access to the Community Trust Fund established through the noise mitigation plan. This fund makes available £50,000 per annum for community groups. It is administered by the Airport Consultative Committee which will allocate funding according to need on the basis of applications made by community groups or projects affected by noise.

5. Conclusion

Following review of the information provided in this Note, Natural England has confirmed that it concurs with the assessment presented in Section 3, that the proposed operation of Manston Airport will therefore not result in an adverse effect on the integrity of the Thanet Coast and Sandwich Bay SPA and Ramsar, and that the funding/support proposed in Section 4 is appropriate.

Issued by

....
Mark Linsley

Approved by

....
Andy Brooks

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Third party disclaimer

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wood.

Technical note:
Manston Airport: Appendix to Ec.4.8

This technical note provides updated entries to Tables from the RIAA [REP7a-014] to reflect the screening process undertaken, but accidentally omitted from the RIAA, for the effects of outfall repair works (during the construction phase) and maintenance work (during the operational phase) of the Proposed Development. Updated entries are provided as detailed below:

- Table 3.2 Screening Table (see **Annex A to this Note**);
- Table 4.1 Qualifying features of European Sites to be taken forward for detailed assessment (see **Annex B to this note**); and
- Updated HRA Screening matrices, showing only the effects on qualifying features of European Sites due to the outfall repair and maintenance works **Effect 9** (see **Annex C to this Note**).

Annex A Table 3.2 Screening Assessment

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
Thanet Coast and Sandwich Bay Ramsar site† (0m)	Turnstone (non-breeding) (Criterion 6)	Maintain and restore the extent, distribution, structure and function of habitats turnstone reply upon, and their supporting processes. Maintain and restore the population and distribution of turnstone‡.	**Construction and operation phases (outfall repair and maintenance works):** Disturbance due to the visual presence and noise from operatives and their machinery and damage to habitats used by turnstone (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of turnstone from their foraging/roosting areas.	Results from the desk study and field survey indicate that turnstone regularly use the northern shores of Pegwell Bay within the Ramsar/SPA (within the 750m ZoI) for roosting and foraging.	There is the potential for adverse effects on turnstone due to visual and noise disturbance from operatives during repair and maintenance works to the outfall during the construction and operation phases. In view of this, further assessment has been provided in order to determine any adverse effects on the integrity of the Ramsar site.	**Screened in**
	15 British Red Data Book invertebrate species (Criterion 2)	Maintain and restore the extent, distribution, structure and function of habitats the qualifying feature invertebrate	**Construction and operation phases (outfall repair and maintenance works):** Disturbance and damage (including any dust generated) to habitats that invertebrates	None of the habitats (primarily mudflats) within the Ramsar site and within the ZoI (100m) are likely to support the qualifying invertebrate species.	None of the 15 British Red Data Book invertebrate species are known to be associated with the mudflat habitats that could be potentially adversely affected by the outfall works. All the habitats likely to support the invertebrate species (sand dunes, grassland and other freshwater wetland habitats) are located well beyond the 100m ZoI of the outfall, beyond which,	Screened out

* Full designation information is provided in Appendix B of the updated RIAA (REP7a-014).
† Conservation objectives for all sites are listed in Appendix D of the updated RIAA (REP7a-014).
‡ The conservation objectives for turnstone for the Ramsar site have been taken as being the same as for the SPA of the same name, with which it shares a common boundary over much of its area.

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
		species reply upon, and their supporting processes. Maintain and restore the populations and distributions of the qualifying feature invertebrate species.	depend upon due to operatives and their machinery during outfall repair and maintenance works.		no LSE is predicted. In view of this, no adverse impacts on the invertebrate species are predicted. No LSE is predicted.	
Thanet Coast and Sandwich Bay SPA (0m)	Golden plover (non-breeding)	Maintain and restore the extent, distribution, structure and function of habitats golden plover reply upon. Maintain and restore the population and distribution of golden plover.	**Construction and operation phases (outfall repair and maintenance works):** Disturbance due to the visual presence and noise from operatives and their machinery, and damage to habitats used by golden plover (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of golden plover from their foraging/roosting areas.	Results from the desk study and field survey indicate that golden plover use the mudflats within 750m of the outfall (within the SPA) for roosting.	There is the potential for adverse effects on golden plover due to visual and noise disturbance from operatives during repair and maintenance works to the outfall during the construction and operation phases. In view of this, further assessment has been provided in order to determine any adverse effects on the integrity of the SPA.	**Screened in**
	Little tern (breeding)	Maintain and restore the extent, distribution, structure and function of habitats little tern reply upon.	**Construction and operation phases (outfall repair and maintenance works):** Disturbance due to the visual presence and noise from operatives and their machinery and damage to habitats used	The nearest potential nest site for recolonization of little tern is at Shell Ness, 1.2km south of the outfall route.	Suitable habitat for nesting little tern does not occur within the 750m ZoI (for noise/visual disturbance) and 100m ZoI (for habitat damage) and therefore no adverse effects on the conservation status of the SPA population of little tern are predicted No LSE is predicted.	Screened out

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
		Maintain and restore the population and distribution of little tern.	by little tern (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of little tern from their nest site.			
	Turnstone (non-breeding)	Maintain and restore the extent, distribution, structure and function of habitats turnstone reply upon and their supporting processes. Maintain and restore the population and distribution of turnstone.	**Construction and operation phases (outfall repair and maintenance works):** Disturbance due to the visual presence and noise from operatives and their machinery and damage to habitats used by turnstone (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of turnstone from their foraging/roosting areas.	Results from the desk study and field survey indicate that turnstone regularly use the northern shores of Pegwell Bay within the SPA (within the 750m ZoI) for roosting and foraging.	There is the potential for adverse effects on turnstone due to visual and noise disturbance from operatives during repair and maintenance works to the outfall during the construction and operation phases. In view of this, further assessment has been provided in order to determine any adverse effects on the integrity of the SPA.	**Screened in**
Thanet Coast SAC (300m SE)	Annex 1 habitats	Maintain and restore the extent, distribution, structure and function of the qualifying habitats (and the typical species they support), and the	**Construction and operation phases (outfall repair and maintenance works):** Disturbance and damage to qualifying SAC habitats (including any dust generated) due to operatives and their	The Annex I habitats (reefs and submerged or partially submerged sea caves) are located, at their closest, 300m from the outfall route.	The qualifying habitats do not occur within the ZoI (100m) within which the effects of potential damage to habitats would occur, such as sediments disturbed by outfall works. In view of this, no adverse effects are predicted on the distribution, structure and function of the habitats due to outfall works during construction and operation of the Proposed Development.	Screened out

Site Name (distance from Order Limits)	Designated Features*	Conservation objectives of qualifying feature	Potential Effects	Current Baseline	Screening rationale	Conclusion
		supporting processed they rely upon.	machinery during outfall repair and maintenance works.		No LSE is predicted.	
Sandwich Bay SAC (0m)	Annex I habitats	Maintain and restore the extent, distribution, structure and function of the qualifying habitats (and their typical flora), and the supporting processes they rely upon.	**Construction and operation phases (outfall repair and maintenance works):** Disturbance and damage to qualifying SAC habitats (including any dust generated) due to operatives and their machinery during outfall repair and maintenance works.	Annex I (sand dune) habitats occur at their closest, 1.2km south of the outfall route.	Qualifying sand dune habitats do not occur within the ZoI (100m) within which the effects of potential damage to habitats would occur, such as sediments disturbed by outfall works. In view of this, no adverse effects are predicted on the distribution, structure and function of the habitats due to outfall works during construction and operation of the Proposed Development. No LSE is predicted.	Screened out

Annex B Table 4.1 Qualifying features of European Sites to be taken forward for detailed assessment

Site Name (distance from Order Limits)	Designated Features[§]	Conservation objectives of qualifying feature	Potential effects and pathway
Thanet Coast and Sandwich Bay Ramsar (0m)	Turnstone (non-breeding)	Maintain and restore the population and distribution of turnstone. Maintain and restore the extent, distribution, structure and function of habitats turnstone reply upon. Maintain or restore the supporting processes on which the habitats of turnstone rely.	**Construction and Operational Phases (outfall repair and maintenance):** Disturbance due to the visual presence and noise from operatives and their machinery, and damage to habitats used by turnstone (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of turnstone from their foraging/roosting areas.
Thanet Coast and Sandwich Bay SPA (0m)	Turnstone (non-breeding)	Maintain and restore the extent, distribution, structure and function of habitats turnstone reply upon. Maintain and restore the population and distribution of turnstone.	**Construction and Operational Phases (outfall repair and maintenance):** Disturbance due to the visual presence and noise from operatives and their machinery, and damage to habitats used by turnstone (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of turnstone from their foraging/roosting areas.
	Golden plover (non-breeding)	Maintain and restore the extent, distribution, structure and function of habitats golden plover reply upon. Maintain and restore the population and distribution of golden plover.	**Construction and Operational Phases (outfall repair and maintenance):** Disturbance due to the visual presence and noise from operatives and their machinery, and damage to habitats used by golden plover (including any dust generated) during repair and maintenance works to the outfall, resulting in displacement of golden plover from their foraging/roosting areas.

[§] Full designation information is provided in **Appendix B.**

Annex C HRA Stage 1 Screening Matrices

The Screening Matrices for the following European Sites required update:

- Thanet Coast and Sandwich Bay SPA;
- Thanet Coast and Sandwich Bay Ramsar;
- Thanet Coast SAC;
- Sandwich Bay SAC;

The Screening Matrices for the European Sites listed below are unchanged from the RIAA [REP7a-014], as these sites lie well beyond the ZoI (750m) within which adverse effects could occur due to the outfall repair and maintenance works. The matrices for these European Sites have therefore not been provided in this note.

- Outer Thames Estuary SPA;
- Margate & Long Sands SAC;
- Stodmarsh SPA;
- Stodmarsh SAC;
- Stodmarsh Ramsar; and
- Blean Complex SAC.

Evidence for likely significant effects on their qualifying features is detailed within the footnotes to the screening matrices below.

Matrix Key:

✓ = Likely significant effect **cannot** be excluded at Stage 1

✕ = Likely significant effect **can** be excluded at Stage 1

Where effects are not applicable to a particular feature they are denoted with n/a.

Stage 1, Matrix A: Thanet Coast and Sandwich Bay SPA

European site name: Thanet Coast and Sandwich Bay SPA

Distance from Order limits = 0m

Qualifying feature	Effect 9 (Outfall repair and maintenance works)		
	Construction	Operation	Decommission
A069 Turnstone (non-breeding)	✓b	✓b	✓b
A140 Golden plover (non-breeding)	✓b	✓b	✓b
A195 Little tern (breeding)	Xa	Xa	Xa

Evidence supporting conclusions

a.	Table 3.2	Screening Assessment (**Annex A** of this note)
b.	Section 4	Assessment of Adverse Effects in the RIAA [REP7a-014]

Stage 1, Matrix B: Thanet Coast and Sandwich Bay Ramsar

European site name: Thanet Coast and Sandwich Bay Ramsar Site

Distance from Order limits = 0m

Qualifying feature	**Effect 9 (Outfall repair and maintenance works)**		
	Construction	Operation	Decommission
Turnstone (non-breeding)	✓b	✓b	✓b
Red Data Book invertebrates	Xa	Xa	Xa

Evidence supporting conclusions

a. Table 3.2 Screening Assessment (**Annex A** of this note)
b. Section 4 Assessment of Adverse Effects in the RIAA [REP7a-014]

Stage 1, Matrix C: Thanet Coast SAC

European site name: Thanet Coast SAC

Distance from Order limits = 300m

Qualifying feature	Effect 9 (Outfall repair and maintenance works)		
	Construction	Operation	Decommission
H1170 Reefs	Xa	Xa	Xa
H8330 Submerged or partially submerged sea caves	Xa	Xa	Xa

Evidence supporting conclusions

a. Table 3.2 Screening Assessment (**Annex A** of this note)

Stage 1, Matrix D: Sandwich Bay SAC

European site name: Sandwich Bay SAC

Distance from Order limits = 300m

	Effect 9 (Outfall repair and maintenance works)		
	Construction	Operation	Decommission
H2110 Embryonic shifting dunes	Xa	Xa	Xa
H2120 Shifting dunes along the shoreline	Xa	Xa	Xa
H2130 Fixed coastal dunes with herbaceous vegetation	Xa	Xa	Xa
H2170 Dunes with Salix repens ssp. argentea	Xa	Xa	Xa
H2190 Humid dune slacks	Xa	Xa	Xa

Evidence supporting conclusions

a. Table 3.2 Screening Assessment (**Annex A** of this note)

Appendix CA.4.10

The Conservation of Habitats and Species Regulations 2017

Licence Application Form

Mitigation Licensing - Bats

Wildlife Licensing
Natural England
Horizon House
Deanery Road
Bristol
BS1 5AH
T. 020 802 61089
EPS.Mitigation@naturalengland.org.uk

Please Note - Applications can be completed online. For more information please visit our website.

- Please complete this application form using **dark ink** and BLOCK CAPITALS.
- Return the completed form to the address shown.
- All questions should be answered as appropriate. Questions marked with `*' are mandatory and failing to complete these may result in delays to your application.
- If there is insufficient space for completing answers on this form, please attach a separate sheet.
- Natural England will aim to determine the outcome of a completed licence application within its published service standards.

- If you experience any problems completing this application or using the online Case Work Management (CWM) system - please see our website for guidance or contact Wildlife Licensing.
- Additional guidance is provided in Using CWM - Applicant Guidance Document. This can be downloaded from our website or you can ask Wildlife Licensing to send you a copy.

For Office Use Only
CWM Ref No:

Charter Deadline

1. Applicant Details

Please enter the details of the person or company who will become the licensee.
(For guidance please see attached annex)
•If the applicant __is__ already registered as a customer please complete Registered Applicant Details (a)
•If the applicant __is not__ already registered as a customer please complete the New Applicant Registration (b)

(a) Registered Applicant Details

*Customer Number	*Surname	*Forename	*Postcode

(b) New Applicant Registration

Please note: If you are the agent / named ecologist registering on behalf of the applicant you will need to provide their full authorisation with this application.

*Title (please tick as appropriate) Mr ☐ Mrs ☐ Ms ☐ Other ☐ (Please Specify) ______

*Forename	Middle Name	*Surname

*Email Address ______

Professional Membership (eg, CIEEM, IEMA, etc.) ______

House Name / No.

*Address Line 1

*Address Line 2

Address Line 3

Town

*County

*Postcode

Country

Either `Telephone No.' or `Mobile No.' must be completed.

Telephone

Mobile

Fax

*Customer Type *(eg, Farmer, Householder, Ecologist, etc.)*

*Are you VAT registered? ☐ Yes ☐ No If Yes, VAT Number:

*Are you registered with the Rural Payments Agency? ☐ Yes ☐ No If Yes, RPS SBI number

(c) If you are registering on behalf of an organisation please complete this section.

*Position

*Organisation Name

What is the size of your organisation?

- ☐ Micro (1 to 10 employees)
- ☐ Small (11 to 49 employees)
- ☐ Medium (50 to 249 employees)
- ☐ Large (250 employees or more)

What is the legal status of your organisation?
(eg. private limited company, registered charity,voluntary organisation, Government agency, Local Authority)

Companies House Registration or Registered Charity Number:

(d) Alternative Applicant Contact Details

In the event that the applicant is unavailable to discuss the application, it would be helpful if alternative contact details could be provided. By completing this section you are confirming that this contact is authorised to act on behalf of the applicant.

Name:

Telephone number:

Email Address:

2. Named Ecologist Details

Please enter the details of the named ecologist. Please note a named ecologist is required for all development and mitigation applications *(For guidance please see attached annex)*

- *If the ecologist* ***is*** *already registered as a customer please complete Registered Named Ecologist Details (a)*
- *If the ecologist is not already registered as a customer please complete the New Named Ecologist Registration (b)*
- *If there will not be an ecologist used in conjunction with this application please go to the next section*

(a) Registered Named Ecologist Details

*Customer Number	*Surname	*Forename	*Postcode
C136320	Bradford	Tim	[redacted]

(b) New Named Ecologist Details

Please note: If you are the applicant registering on behalf of the agent/named ecologist you will need to provide their full authorisation with this application.

*Email Address: Tim.bradford@woodplc.com

*Title (please tick as appropriate): Mr ☐ Mrs ☐ Ms ☐ Other ☐ (Please Specify)

*Forename | Middle Name | *Surname

Professional Membership (eg, CIEEM, IEMA, etc)

House Name / No.

*Address Line 1

*Address Line 2

Address Line 3

Town | *County

*Postcode | Country

Either `Telephone No.' or `Mobile No.' must be completed.

Telephone | Mobile

Fax

*Customer Type *(eg, Farmer, Householder, Ecologist, etc.)*

*Are you VAT registered? ☐ Yes ☐ No If Yes, VAT Number:

*Are you registered with the Rural Payments Agency? ☐ Yes ☐ No If Yes, RPS SBI number:

(c) If you are registering on behalf of an organisation please complete this section.

*Position: Principal Ecologist | *Organisation Name: Wood Plc

What is the size of your organisation?

- [ ] Micro (1 to 10 employees)
- [ ] Small (11 to 49 employees)
- [ ] Medium (50 to 249 employees)
- [x] Large (250 employees or more)

What is the legal status of your organisation?
(eg, private limited company, registered charity, voluntary organisation, Government agency, Local Authority

Private Limited Company

Companies House Registration or Registered Charity Number:

(d) Alternative Named Ecologist Contact Details

In the event that the named ecologist is unavailable to discuss the application, it would be helpful if alternative contact details could be provided. By completing this section you are confirming that this contact is authorised to act on behalf of the named ecologist and has a detailed knowledge of the application.

Name: Mark Linsley

Telephone Number: [redacted]

Email Address: mark.linsley@woodplc.com

3. Communication Preferences

Please indicate who should be contacted if we need to discuss this application:
(Please note more than one option can be selected for each question):

Applicant [ ] Named Ecologist [x]

Please indicate to whom the outcome documentation for this application should be sent:

Applicant [x] Named Ecologist [x]

Applicant Preferences: Email [x] Post [ ] Telephone [ ]

If `Yes' for telephone, please provide a contact no.

Named Ecologist preferences: Email [x] Post [ ] Telephone [ ]

If `Yes' for telephone, please provide a contact no.

4. Previous Applications

(a) * To your knowledge, have there been any previous applications or licence decisions concerning this site? [ ] Yes [x] No

If `No' please move to question 4(g). If `Yes' to (a), please complete the following.

(b) * Date of most recent application:

(c) * Which species was the subject of the previous application?

(d) * What was the application or licence reference number?

(e) * What was the outcome of the previous application? (Please select one of the following)

Granted ☐ Not Granted ☐ Advice Only ☐ Deferred ☐ Not yet known ☐

(f) To your knowledge, does this application relate to any previously licensed `mitigation' work for any species on the site being applied for? ☐ Yes ☐ No

If `Yes' to (f): Please provide application/ licence reference numbers, species details and outcome details.

(g) To your knowledge, is the site being applied for subject to any recent, concurrent, pending or future applications for licences for the same or other European protected species or other protected species? ☐ Yes ☑ No

If `Yes' to (g): Please provide application/ licence reference numbers and/or species information.

For applications which are part of the Pre-Submission Screening Service:

More information on Natural England's Pre-Submission Screening Service can be found here.

Is this a first draft application? ☑ Yes ☐ No Is this a subsequent draft? ☐ Yes ☐ No

Are you aware if your case has been seen or reviewed by Natural England? ☑ Yes ☐ No ☐ Not sure

If yes, who provided the advice and when? Clare Storey, Letter dated 17th December 2018

Any further information you would like to provide:

Is this a formal application? ☑ Yes ☐ No

Please provide any earlier reference numbers: DAS/2392/194378

For applications which are part of Nationally Significant Infrastructure Projects:

Is this a first draft application? ☑ Yes ☐ No

Is this a subsequent draft? ☐ Yes ☐ No

Is this a formal application? ☑ Yes ☐ No

Please provide any earlier reference numbers: DAS/2392/194378

5. Purpose

(a) * Brief Description of Proposal
eg, Construction of a new road, maintenance of a bridge, construction of five flats with access road and car parking area.

Redevelopment of a disused airport to bring it back into use and construction of associated infrastructure including commercial units.

(b) * Please tell us why you need a licence.
eg. A day roost will be damaged, a night roost will be destroyed, a maternity roost will be modified and a day roost will be destroyed.

Hibernation, day roosts and night feeding roosts will be lost during the development

(c) * Please confirm the purpose of the application:

☑ Imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment under section 55(2)(e)

☐ Preserving public health or public safety, under section 55(2)(e)

☐ Preventing the spread of disease, under section 55(2)(f)

☐ Preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber, fisheries or inland waters, or any other form of property under section 55(2)(g)

☐ A purpose not specified in Regulation 55(2) that is consistent with Article 16(1)(e) of the Habitats Directive, under section 55(4)

(d) * Please confirm the category most appropriate to your proposed work
(Please select one of the following): :

- ☐ Agriculture / Fishing / Forestry
- ☐ Archaeological investigation/Site investigation
- ☐ Bat exclusion from domestic dwelling
- ☐ Barn Conversion
- ☐ Commercial
- ☐ Communications
- ☐ Energy generation
- ☐ Energy supply
- ☐ Flood and coastal defences
- ☐ Health & Safety
- ☐ Heritage
- ☐ Housing
- ☐ Industrial / Manufacturing
- ☐ Mineral extraction
- ☐ Nationally Significant Infrastructure Projects
- ☐ Places of worship
- ☐ Public community projects (eg, schools, universities, hospitals, care facilities and other public buildings)
- ☐ Small scale repair and maintenance works
- ☑ Transport
- ☐ Waste management
- ☐ Water management
- ☐ Other

If other, please provide details here:

(e) * Is the proposed work part of a phased or a multi-plot development? ☐ Yes ☑ No

If `Yes' to (e): You must submit a species specific master plan and Habitat Management and Maintenance Plan with this application, as a separate document. Guidance on what should be included in a master plan can be found at - http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/Images/WML- G11_tcm6-9930.pdf

6. Site Details

*Is the address for the site to be licensed different to the applicant's address? ☑ Yes ☐ No

If `Yes': For the Site/Location to be licensed, please complete **all** of the following details:
If `No': Please complete Site/Location Name and OS Grid Reference boxes only.
(For linear projects, please add the start and end points separately)

Site Details

*Site / Location Name:	Manston Airport
House Number:	
Address Line 1:	
Address Line 2:	
Address Line 3:	
Town:	
*County:	Kent
Postcode:	
*OS Grid Reference: *(In format XX123456)*	

7. Conservation Considerations

(a) *Will any part of the proposed activity fall in and/or adjacent to a Designated Site? ☐ Yes ☑ No ☐ N/A

If `Yes' to (a) please complete the table below. If `No', please go to the next section.

Please indicate whether the activity will fall on and/or adjacent to a designated site:	Designated Site Name	Type of Designated Site *Eg National Nature Reserve (NNR), Site of Special Scientific Interest (SSSI), Special Protection Area (SPA), Special Area of Conservation (SAC), Ramsar Site, Ancient Monument, Marine Nature Reserve (MNR), Area of Outstanding Natural Beauty (AONB)*
On ☐ Adjacent to ☐		
On ☐ Adjacent to ☐		
On ☐ Adjacent to ☐		
On ☐ Adjacent to ☐		

Please indicate whether the activity will fall on and/or adjacent to a designated site:	Designated Site Name	Type of Designated Site *Eg National Nature Reserve (NNR), Site of Special Scientific Interest (SSSI), Special Protection Area (SPA), Special Area of Conservation (SAC), Ramsar Site, Ancient Monument, Marine Nature Reserve (MNR), Area of Outstanding Natural Beauty (AONB)*
On ☐ Adjacent to ☐		
On ☐ Adjacent to ☐		

(b) Have you consulted with Natural England for advice on the implications of the application on the designated site? ☐ Yes ☐ No ☐ Not known

(c) Please give either the outcome of your consultations or the reason why you have not consulted us. Please provide any relevant correspondence and the name of the local Natural England adviser or reserve manager consulted.

8. Authorisation

(a) *Is the applicant the owner/occupier of the land? ☐ Yes ☐ No ☐ N/A

If `Yes' to (a) please go to the next section. If `No' to (a) please answer (b).

(b) Have you received the owner occupier's permission to apply? ☐ Yes ☐ No

Please note that it is your responsibility as the applicant to obtain the owner or occupier's permissions to act under licence on their property.

You may be asked to provide documentation which confirms that you have owner or occupier's permissions and we will contact you if this is necessary

9. Application Details

(a) Please add details for all licensable actions you wish to perform. Please complete one column per species. You may enter more than one Activity and/or Method or Field Technique per species. **All the data entered here MUST be accurately reflected in your accompanying method statement**.

- *Please see annex for guidance on bat roost definitions.*
- *If you require additional rows, please attach extra sheets to your application, presenting the information in the same table format.*

Application Subject	Bats	Bats	Bats	Bats	Bats
*Species	Brown Long eared	Natterer's	Whiskered	Common pipistrelle	Soprano pipistrelle
*Activity	Capture Take ☑	Capture Take ☑	Capture Take ☑	Capture Take ☑	Capture Take ☑
	Disturb ☑	Disturb ☑	Disturb ☑	Disturb ☑	Disturb ☑
	Transport ☐	Transport ☐	Transport ☐	Transport ☐	Transport ☐
	Damage Breeding Site ☐	Damage Breeding Site ☐	Damage Breeding Site ☐	Damage Breeding Site ☐	Damage Breeding Site ☐
	Destroy Breeding Site ☐	Destroy Breeding Site ☐	Destroy Breeding Site ☐	Destroy Breeding Site ☐	Destroy Breeding Site ☐
	Damage Resting Place ☐	Damage Resting Place ☐	Damage Resting Place ☐	Damage Resting Place ☐	Damage Resting Place ☐
	Destroy Resting Place ☑	Destroy Resting Place ☑	Destroy Resting Place ☑	Destroy Resting Place ☑	Destroy Resting Place ☑
*Method or Field Technique	By hand ☑	By hand ☑	By hand ☑	By hand ☑	By hand ☑
	By static hand-held net ☑	By static hand-held net ☑	By static hand-held net ☑	By static hand-held net ☑	By static hand-held net ☑
	Temporary exclusion ☐	Temporary exclusion ☐	Temporary exclusion ☐	Temporary exclusion ☐	Temporary exclusion ☐
	Permanent exclusion ☐	Permanent exclusion ☐	Permanent exclusion ☐	Permanent exclusion ☐	Permanent exclusion ☐
	Destructive search by soft demolition ☑	Destructive search by soft demolition ☑	Destructive search by soft demolition ☑	Destructive search by soft demolition ☑	Destructive search by soft demolition ☑
	Mechanical demolition ☑	Mechanical demolition ☑	Mechanical demolition ☑	Mechanical demolition ☑	Mechanical demolition ☑
	Disturbance by illumination (intentional by torch) ☐	Disturbance by illumination (intentional by torch) ☐	Disturbance by illumination (intentional by torch) ☐	Disturbance by illumination (intentional by torch) ☐	Disturbance by illumination (intentional by torch) ☐
	Disturbance by noise or vibration ☐	Disturbance by noise or vibration ☐	Disturbance by noise or vibration ☐	Disturbance by noise or vibration ☐	Disturbance by noise or vibration ☐
	Temporary obstruction of roost access ☐	Temporary obstruction of roost access ☐	Temporary obstruction of roost access ☐	Temporary obstruction of roost access ☐	Temporary obstruction of roost access ☐
	Endoscopes ☐	Endoscopes ☐	Endoscopes ☐	Endoscopes ☐	Endoscopes ☐
* Maximum number of bats to be licensed at the time that works are proposed	5	3	3	5	5
* Number of breeding sites to be impacted	0	0	0	0	0
* Number of resting sites to be impacted	4	1	1	5	4

Expected roost type affected					
	Hibernation confirmed ☑	Hibernation confirmed ☑	Hibernation confirmed ☑	Hibernation confirmed ☐	Hibernation confirmed ☐
	Day ☑	Day ☐	Day ☐	Day ☑	Day ☑
	Transitional/ Occasional ☐	Transitional/ Occasional ☐	Transitional/ Occasional ☐	Transitional/ Occasional ☑	Transitional/ Occasional ☑
	Feeding perch ☑	Feeding perch ☐	Feeding perch ☐	Feeding perch ☐	Feeding perch ☐
	Night ☑	Night ☐	Night ☐	Night ☐	Night ☐
	Satellite ☐	Satellite ☐	Satellite ☐	Satellite ☐	Satellite ☐
	Swarming or mating ☐	Swarming or mating ☐	Swarming or mating ☐	Swarming or mating ☐	Swarming or mating ☐
	Maternity ☐	Maternity ☐	Maternity ☐	Maternity ☐	Maternity ☐
	Underground - mines, caves, cellars, tunnels or bridges (number & type) ☐	Underground - mines, caves, cellars, tunnels or bridges (number & type) ☐	Underground - mines, caves, cellars, tunnels or bridges (number & type) ☐	Underground - mines, caves, cellars, tunnels or bridges (number & type) ☐	Underground - mines, caves, cellars, tunnels or bridges (number & type) ☐

Please enter the proposed start date of action below. *Please note this refers to the date of the first licensable action, not necessarily when the development commences.*

*Proposed Date From:	01/03/2020	01/03/2020	01/03/2020	01/03/2020	01/03/2020
*Proposed Date To:	31/10/2021	31/10/2021	31/10/2021	31/10/2021	31/10/2021

(b) * Have you sent your records to the Local Records Centre? ☐ Yes ☑ No

Please note: You must send survey data and habitat assessment data to your Local Records Centre (LRC). It is a condition of survey licences that records are sent to LRCs annually or to other organisations as specified on a particular survey licence (e.g. People's Trust for Endangered Species).

(c) * Have surveys been conducted within the current or most recent optimal season and undertaken in accordance with the most up to date edition of the Bat Conservation Trust (BCT) *Bat Surveys for Professional Ecologists - Good Practice Guidelines* and the *Bat Mitigation Guidelines*? ☐ Yes ☑ No

If `No', please confirm that full justification has been provided in section C5a in the Method Statement template. **Please note that inadequate or insufficient survey information is likely to cause a delay to your licence application and possibly result in a Further Information Request.** ☑ Yes, I confirm

10. Experience

Please note: For guidance in completing this section please refer to the Experience in Bat Mitigation document at http:// webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/Images/bat-mitigation-guidance_tcm6-10534.pdf

(a) * Has the named ecologist associated with this application held or been named on a bat mitigation licence in the past three years for the same species and in relation to a project of similar scale, methodology and mitigation?

☐ Yes ☑ No

If `Yes' to (a): (b) * Please provide the name of the issuing authority, the licence reference number, date of issue and the species and roost types of licences held

If `No' to (a) please complete the following section. If "Yes" to (a) go to the next section.

(c) * Does the named ecologist currently hold a valid personal survey licence or are they registered to use a minimum of Level 2 Bat class survey licence?

☑ Yes ☐ No

If `Yes' complete **all** of the following.

If `No' go to (f)

(d) * What is/are the survey licence reference number(s)?

2015-12885-CLS-CLS

(e) * Number of years the survey licence(s) have been held (minimum of 2 years):

7

(f) * Please give brief details of the named ecologist's current science, education or conservation licence or any other licences issued to the ecologist in the last three years relevant to the species relating to this application:

Have been named ecologist on licenses for destruction of common and soprano pipistrelle and brown long-eared roosts (e.g. 2018-34200-EPS-MIT and 2017-30985-EPS-MIT)

(g) * Please give brief details of the named ecologist's experience on mitigation projects (a minimum of 3 projects) relevant to the species relating to this application, including in what capacity they acted. State the site names and reference numbers of licences and the type of mitigation involved:

Tim has prepared license applications for updates to chart school and aldershot road, worplesdon (Natterer's bat) as well as east sutton park (EPSM2010-2561, Whiskered bat), and acted as accredited agent for Chipping sodbury (Whiskered bat)

(h) * Please provide details of the named ecologist's Qualifications, including any Continual Professional Development (CPD) training relevant to the species relating to this application:

Chartered Environmentalist and MCIEEEM, BSc. (Hons) Zoology and MSc. Biodiversity and Conservation

Please note: If you have not held a mitigation licence in the last three years you will need to provide written references from two people who are familiar with the named ecologist's work. Please attach these references with your application. References provided in support of your licence application should:

- *Vouch for the named ecologist's suitability and competence to prepare and deliver mitigation projects;*
- *State how long referees have known the named ecologist and in what capacity;*
- *Provide details of the named ecologist's mitigation experience with the relevant species or a related species; and*
- *Provide details of the referees' own mitigation experience and mitigation licence held (if appropriate): at least one referee must have held a mitigation licence within the last 3 years.*

(i) * Are you providing references? ☑ Yes ☐ No

If `Yes' to (i): Please provide details of the referees. We may need to contact these referees to verify their statements.

1st Referee:

Claire Wilmer, Director of Ecology, WYG, 11th Floor, 1 Angel Court, London, EC2R 5HJ

2nd Referee:

Katheryn Leggat, Associate Director, Wood, 23rd Floor, 25 Canada Square, Canary Wharf, E14 5LQ

11. Consent Status

(a) * Is any consent required for your proposed project and the subject of this licence application?

- ☑ 1. Planning-related consent required (e.g. Planning permission, listed building consent, etc)
- ☐ 2. Demolition consent (under Building Act 1984) including prior notice to demolish.
- ☐ 3. Other type of consent required (e.g. Minerals consents, Highway Act consents, Secretary of State Decision Letter, Compulsory Purchase Order, Environment Agency Consent, etc.)
- ☐ 4. Permitted Development (under Town and Country Planning Act 1990) - no specific consent required.
- ☐ 5. No consent required (e.g. Public Health and safety issues)

If `3' is selected (b) * Please provide details of these consents

If `5' is selected (c) * Please explain why no consent is required

If `1', `2' or `3' is selected

(d) Have you obtained the necessary consent(s) to allow the proposed activity to be commenced? ☐ Yes ☑ No

- *If `No' to (d), please complete `Consent Not Obtained'*
- *If `Yes' to (d), please complete `Consent Obtained'*

* Please confirm that you will submit copies of any consent(s) or extracts that are relevant to the proposed activity and this licence application if applicable: ☑ Yes, I confirm

Consent not obtained

Please note: If you have not held a mitigation licence in the last three years you will need to provide written references from two people who are familiar with the named ecologist's work. Please attach these references with your application. References provided in support of your licence application should:

(e) * Please provide details of the outstanding consents to be obtained and the likely time scales for their determination/issue.

Pre-submission Screening Service:

We will provide advice on draft applications, prior to consents being in place and prior to a formal licence application being submitted through this chargeable service. We **strongly** advise customers to use this service rather than trying to pursue a licence under Exceptional Circumstances, particularly where there are concerns about financial implications resulting from delays in obtaining a licence once planning consents are in place. Please see our website for further advice about this.

Consent obtained

(f) * Please confirm details of all the consents that have been granted relevant to the proposed activity and this licence application.

Full Planning Permission	☐	Outline Planning Permission	☐
Demolition consent (under Building Act 1984) including prior notice to demolish	☐	Conservation Area Consent	☐
Listed Building Consent	☐	Tree Preservation Order	☐
Highways Act Consent	☐	Utilities Consent	☐
Mineral Consent	☐	Mineral Consent with Review of Mineral Planning Permission	☐
Mineral Consent (Review of Mineral Planning Permission submitted to Mineral Planning)	☐	Other consent type	☐

If Other, please provide details here:

(g) * Please provide consent reference number(s)

Please submit copies of the consents (or extracts) that are relevant to the proposed activity and this licence application, if applicable

(h) For all consents that have been granted, have all conditions or Reserved Matters relating to wildlife species and habitat issues (which are intended to be and are capable of being discharged before development begins) been discharged?

☐ Yes ☐ No

If `No' to (i), please answer **all** of the following. If `Yes', please skip to (j).

Please note: If it is not possible or not intended for the conditions to be discharged before development commences then please complete the questions below.

(i) Please give details of those conditions that are still to be discharged and explain why they have not been discharged.

(j) Is the site subject to any commitment that affects the protected species named in this application?

For example a Section 106 Agreement (Town and Country Planning act 1990) or other commitments made at a Public Inquiry or in an Environmental Statement.

☐ Yes ☐ No

If `Yes' to (j) Has the commitment been met? Please also explain what has been done.

If `Yes' to (j) What work is outstanding and when will it be completed?

(k) Is the site subject to any such commitment that affects other European Protected Species or other protected species? *Eg, a Section 106 Agreement (Town and Country Planning Act 1990) or other commitments made at a Public Inquiry or in an Environmental Statement.*

☐ Yes ☐ No

If `Yes' to (k) Has this been met?

If `Yes' to (k) When will this be complete?

Reasoned Statement & Supporting Documents

A Reasoned Statement and supporting documents may be required in support of this application

Copies of the latest version of the Reasoned Statement template which sets out when a Reasoned Statement is required and further guidance to help are available on our website.

Please confirm that you have read and understood the Reasoned Statement template and advice note/guidance

☑ Yes, I confirm

(I) *Does your application require a Reasoned Statement? ☑ Yes ☐ No

If `No' to (I) *Please confirm the exception that applies

☐ Applications for home improvements and small scale housing developments:

- Repairs and maintenance
- Roof replacements, loft conversions and extensions
- Renovations of existing domestic dwellings and associated structures, such as garages
- Housing developments of less than 1 hectare, including:
  - existing buildings and associated structures that may need to be demolished before redevelopment takes place (whether domestic dwellings or other types of buildings)
  - barn conversions for domestic dwellings (this doesn't include conversions for commercial use, such as holiday lets)

☐ Applications to conserve and protect listed buildings, scheduled monuments or places of worship:

- listed buildings
- scheduled monuments
- registered places of worship or a place of worship belonging to the Church of England for:
  - repairs and maintenance (including roof replacement)
  - restoration
  - essential works to:
    - prevent serious damage to buildings and structures (including contents
    - preserve public health and safety
    - enable continued appropriate use of the building or structure

☐ Applications to maintain, repair, improve public buildings or develop public land

Public buildings and public land includes buildings and land owned or leased by the government, their departments, agencies and arm's length bodies, such as:

- schools (state funded and academies only)
- hospitals
- prisons
- courts
- airfields

You don't need to include a reasoned statement where bats and their roosts will be affected by:

- repairs and maintenance
- restoration
- renovation

- redevelopment of an existing building(s), which may include demolition before redevelopment, as long as it remains in use as a public building
- extending or adding new buildings within the grounds of the existing developed site
- essential works to:
  - prevent serious damage to buildings (including contents)
  - preserve public health and safety
  - allow the building to be continued to be used as it was intended

Extending public buildings beyond existing boundaries, changing them to private use, or developing land for private use will need a reasoned statement with your application.

If you have selected one of the above exceptions, please provide details of how the proposed works meet the exception criteria:

(m) Does your application affect a regionally or nationally important population of a European Protected Species? ☐ Yes ☑ No

If `Yes' to (m) ***and*** *a Reasoned Statement is* ***not required ...*** (n) You must consult Natural England for advice before making an application. Please give either the outcome of your consultation (with details of who you consulted) or the reason why you have not consulted us

12. Consenting Authority

Please provide the Local Planning Authority/Authorities that have granted consent for the proposed project and the subject of this licence application. Please then provide contact details for the responsible officer.
If consent is granted by another body (e.g. Secretary of State, Natural England, Environment Agency, Utilities Consent, Highways Consent, etc) then please provide details for it as appropriate.
If no consent is required (e.g. Public health and safety issues) then please leave the remaining fields blank.

*Consenting Authority Name:

*Title	*Forename	*Surname	*Position

Email Address:

Telephone Number

Address

13. Method Statement

A Method Statement must be provided to support this application, along with other supporting documents, which may include some or all of the following:

- Maps
- Figures
- Habitat management and maintenance plans
- Master plan
- Appended survey results
- A work schedule

Please note: The Method Statement should be prepared by a consultant ecologist or another suitably qualified person because compiling the content requires specific species and site-related knowledge.

Further Advice: Copies of the latest versions of templates for all species and further guidance to help you complete them are available on our website.

14. Supplementary Information

Please provide any additional information you may have to support your application.

15. Data Protection

The data controller is the Natural England, Foss House, Kings Pool, 1-2 Peasholme Green, York, Y01 7PX. You can contact the Natural England Data Protection Manager at: Natural England, County Hall, Spetchley Road, Worcester, WR5 2NP; foi@naturalengland.org.uk.

Any questions about how we are using your personal data and your associated rights should be sent to the above contact. The Data Protection Officer responsible for monitoring that Natural England is meeting the requirements of the legislation is: Defra group Data Protection Officer, Department for Environment, Food and Rural Affairs, SW Quarter, 2nd floor, Seacole Block, 2 Marsham Street, London SW1P 4DF.
DefraGroupDataProtectionOfficer@defra.gsi.gov.uk

The information on the licence application form and any supporting material will be used by Natural England to undertake our licensing functions. This will include, but is not limited assessing your application, issuing a licence if applicable, monitoring compliance with licence conditions and collating licence returns and reports. The personal information we will process will include, but is not limited to your name and contact details, customer type and reasons for wanting a licence.Processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the data controller. That task is to conduct the licensing functions as delegated by Defra to Natural England under Part 8 Agreement under section 78 of the Natural Environment and Rural Communities Act 2006.

The processing by us of personal data relating to wildlife-related or animal welfare offences or related security measures is carried out only under official authority. This information is used in assessing an application as it is a material fact.Natural England will for particular licence applications and at specific stages of the licencing process discuss your application with third parties. The details of this sharing are set out here https://www.gov.uk/government/publications/wildlife-licensing-privacy-notice.

Your personal data will be kept by us for 7 years after the expiry of your licence or longer if stated in the licence conditions.

Failure to provide this information will mean that we will be unable to assess your application for a wildlife licence.The information you provide is not connected with individual decision making (making a decision solely by automated means without any human involvement) or profiling (automated processing of personal data to evaluate certain things about an individual).

The data you provide will not be transferred outside the European Economic Area.

A list of your rights under the General Data Protection Regulation, the Data Protection Act 2018, is accessible at: https://ico.org.uk/for-organisations/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/.

You have the right to lodge a complaint with the ICO (supervisory authority) at any time. Should you wish to exercise that right full details are available at: https://ico.org.uk/for-organisations/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/.

Details of our Personal Information Charter can be found at: https://www.gov.uk/government/organisations/natural-england/about/personal-information-charter.

Important Advice:

- If your application is made under the Wildlife and Countryside Act 1981 (as amended) or the Conservation of Habitats and Species Regulations 2017, any person who in order to obtain a licence knowingly or recklessly makes a statement or representation, or furnishes a document or information which is false in a material particular, shall be guilty of an offence and may be liable to criminal prosecution. Any person found guilty of such an offence is liable, on summary conviction, to imprisonment for a term not exceeding six months or to a fine not exceeding level 5 on the standard scale, or to both. Regarding other wildlife legislation, we will look to provisions in the Fraud Act 2006 (as amended) in respect of applicants making any false representations.

- Natural England or the Secretary of State can modify or revoke at any time any licence that is issued, but this will not be done unless there is good reason for doing so. Any licence that is issued is likely to be revoked immediately if it discovered that false information has been provided that resulted in the issue of a licence.

16. Declaration

*Have you or any person listed in the application been convicted of any wildlife-related or animal welfare offence? ☐ Yes ☐ No

If `Yes' to (j)	Please provide details of the convictions: *(including dates)*	

The offences we are referring to relate to persons convicted on or after 1 January 2010 of an offence under the Wildlife and Countryside Act 1981, the Conservation (Natural Habitats &c.) Regulations 1994, the Conservation of Habitats and Species Regulations 2017, the Protection of Badgers Act 1992, the Deer Act 1991, the Hunting Act 2004, the Wild Mammals (Protection) Act 1996, the Animal Welfare Act 2006 and the Protection of Animals Act 1911 (all as amended). You do not have to declare conviction if the person concerned is: (1) a rehabilitated person for the purposes of the Rehabilitation of Offenders Act 1974 and their conviction is treated as spent; or (2) in respect of such an offence, a court has made an order discharging them absolutely.

16b. Applicant Declaration

☐ I have read and understood the privacy notice above.

- Where required, I undertake to obtain permission from landowners / occupiers of land to exercise any licence resulting from this application, and to allow any employee or representative of Natural England to monitor or inspect the work described in this application.
- I have read and understood the guidance provided in the application form and on the Wildlife Licensing Internet guidance pages.
- I declare the particulars given are correct to the best of my knowledge and belief, and I apply for a licence in accordance with the information I have provided.
- I confirm that there is no satisfactory alternative to meet the need/resolve the problem detailed in this application.

☐ I agree to the declaration above.

Signature of applicant:

For electronic applications, please insert an electronic signature above or tick this box to confirm with the declaration. ☐

Name: *(In BLOCK letters)* Date:

16c. Ecologist Declaration

☑ I have read and understood the privacy notice above.

- I confirm that I have visited the site(s).

- I confirm that I have visited the site(s).
- I have designed and inputted into the licence proposal.
- I confirm that there is no satisfactory alternative to meet the need/resolve the problem detailed in this application
- I am satisfied that the proposal will result in no adverse impact on the species concerned
- I declare the particulars given are correct to the best of my knowledge and belief, and the applicant may apply for a licence in accordance with information I have provided
- I have documentary evidence that I am authorised to act on behalf of the applicant that I will supply to Natural England on request.

☑ I agree to the declaration above.

Signature of ecologist:

For electronic applications, please insert an electronic signature above or tick this box to confirm with the declaration. ☑

Name: *(In BLOCK letters)*	Date:
TIM BRADFORD	28 June 2019

17. Annex - Application Notes

Applicant

The applicant is the person submitting the application (usually the landowner or occupier) who, if the licence was granted, would become the licensee. The applicant may appoint agents to produce the application pack and act on their behalf. A person with specific skills and knowledge of the species concerned, such as a consultant ecologist, must be appointed to assist in the preparation and the delivery of the proposals that ensure the species protection requirements can be met.

Licensee

The "Licensee" named on the licence is responsible for ensuring that all activities carried out on site in relation to the licence comply with the terms and conditions of the licence. However, all persons authorised to act under the licence must comply with the licence and its conditions (see Regulation 60(1) of the 2017 Regulations (as amended)). This means that all authorised persons have a responsibility for ensuring that the licence terms and conditions, including any annex special conditions, are understood and complied with. Failure to do so could lead to prosecution.

Consultant/Named Ecologist

The "Named Ecologist" is a professional ecological consultant who has satisfied Natural England that they have the relevant skills, knowledge and experience of the species concerned and is responsible for undertaking and/or over-seeing the work undertaken in respect of the licensed species. The `Named Ecologist' has a responsibility for ensuring that the licence is complied with. They are responsible for advising the licensee on the suitability and competence of any Accredited Agents or Assistants employed on site to undertake the required duties and may include the direct supervision of Assistants where appropriate. More information about the experience required to become a named ecologist can be found at: http://webarchive.nationalarchives.gov.uk/20140605090108/http:/ www.naturalengland.org.uk/Images/bat- mitigation-guidance_tcm6-10534.pdf

Accredited Agent

An "Accredited Agent" is a suitably trained and experienced person who is able to carry out work under a licence without the personal supervision of the Named Ecologist. Any Accredited Agent must be appointed by the Licensee and be in possession of a letter signed by the Licensee confirming their appointment. Agents shall carry a copy of the said letter when acting under the licence and shall produce it to any police or Natural England officer on request.

Assistants

An "Assistant" is a person assisting a Named Ecologist or Accredited Agent. Assistants are only authorised to act under this licence whilst they are under the direct supervision of either the Named Ecologist or an Accredited Agent.

Bat Roost Definitions

Day roost: a place where individual bats, or small groups of males, rest or shelter in the day but are rarely found by night in the summer.

Night roost: a place where bats rest or shelter in the night but are rarely found in the day. May be used by a single individual on occasion or it could be used regularly by the whole colony.

Feeding roost: a place where individual bats or a few individuals rest or feed during the night but are rarely present by day.

Transitional / occasional roost: used by a few individuals or occasionally small groups for generally short periods of time on waking from hibernation or in the period prior to hibernation.

Swarming site: where large numbers of males and females gather during late summer to autumn. Appear to be important mating sites.

Mating sites: where mating takes place from later summer and can continue through winter.

Maternity roost: where female bats give birth and raise their young to independence.

Hibernation roost: where bats may be found individually or together during winter. They have a constant cool temperature and high humidity.

Satellite roost: an alternative roost found in close proximity to the main nursery colony used by a few individual breeding females to small groups of breeding females throughout the breeding season.

Other - if applicable this will be specified in special condition 7.

For the purpose of this licence the following licensed methods are defined as:
Destructive search by soft demolition: the taking apart of a bat structure in a controlled and careful manner by hand, or in some instances with the assistance of hand-held tools and machinery, under direct ecological supervision. Only the Named Ecologist, Accredited Agent or a directly supervised Assistant may take any bats found.

Mechanical demolition: destruction of a structure that previously supported a bat roost using mechanical means after the structure has been declared free of bats by the Named Ecologist or Accredited Agent. Mechanical demolition usually is preceded by a soft demolition exercise or completion of an exclusion process.

The Conservation of Habitats and Species Regulations 2017

NATURAL ENGLAND

Bats – Method Statement template to support a licence application

The Method Statement will be used to determine the impact of the proposal on the favourable conservation status (FCS) of the species concerned (Regulation 55(9)(b)).
You are strongly advised to refer to the Bat Mitigation Guidelines.
Please use recent photographs to support your application.

Wildlife Licensing
Natural England
Horizon House
Deanery Road
Bristol
BS1 5AH.
T. 020802 61089

Important advice:
The format below must be used. Please enter text below each heading keeping information as concise as possible.

All maps/figures that will become part of any annexed licence granted must be submitted as separate documents (with the site name and date included on the map/figure. See section I for list – all others may be included within the Method Statement document (e.g. survey maps/figures) if preferred).
A separate work schedule must also be submitted on form WML-A13a-E5a&b to accompany the Method Statement.

A Executive summary

Provide an overview (no more than 1 side of A4) of what works are proposed and how the impacts identified will be addressed in order to ensure no detriment to the maintenance of the population at a favourable conservation status.

RiverOak Strategic Partners (“RiverOak”) is proposing to re-open Manston Airport (the ‘Proposed Development’). The Proposed Development will secure the future of the Site as a valuable regional and national aviation asset by re-developing the existing Manston Airport infrastructure. The proposal is to re-develop Manston Airport as a freight airport with the capacity to handle a minimum of 10,000 air traffic movements annually. It is envisaged that this will provide additional air freight capacity to the UK and also serve to relieve pressure from other heavily congested airports in the south-east.

There has been an operational airport at the site of the Proposed Development since 1916. From 1998 it was operated as a private commercial airport, known as Kent International Airport. Although the airport was closed in May 2014, much of the airport infrastructure, including the runway, taxiways, aprons, cargo facilities and passenger terminal remain.

The Proposed Development shall consist of the following principal components:

- Runways and taxiways suitable for the take-off and landing of a broad range of cargo aircraft;
- An area for cargo freight operations able to handle at least 10,000 movements per year and associated infrastructure.

Works to accommodate the new infrastructure will result in the demolition or modification of all the buildings present at Manston Airport. Between August and October 2017 and in January 2019, all the buildings within the airport were surveyed by Wood to assess their potential and usage as bat roosts. The internal assessment and activity survey work did not identify any evidence of the buildings being used as maternity roosts (but see Section c5a for limitations). The buildings have been assessed as having the potential to support bats overwinter and for short periods in the summer months.

Demolition will take place between 15th March 1st May and 1st October and 30th November (i.e. avoiding the main maternity and hibernation periods) or be sufficiently advanced by the 1st May/30th November to prevent bats using them. In order to ensure no bats are harmed during demolition works carried out during the summer months, all buildings will be inspected as far as possible by the licensed

ecologist to ensure that no bats remain, immediately prior to demolition. Any bats found will be moved by a licenced ecologist or accredited agent to a previously installed bat box. Where practicable and safe to do so, a soft strip approach to demolition will be adopted under the presence of the named ecologist (or their agent). All contractors working on site will be given a "toolbox talk" before they begin work.
Mitigation and compensation measures for roosts lost during the demolition works are as follows:

- Summer roosts - A purpose built bat barn will be provided to replace the roost space for three potential maternity roosts consisting of low-moderate numbers of bats targeting common pipistrelle, soprano pipistrelle and brown long-eared bat species and five transitional roosts (individual roosting or small number of bat species). The barn will be located in the proposed Biodiversity Area approximately 1 km away from the southern boundary of the Site, near an existing hedgerow boundary (Figure E3.1). The roost would be placed in the southern section of the land parcel to minimise the effects of lighting, noise and risk of bat collision from the aircraft and vehicle traffic.
- Winter roosts - A purpose-built bunker is proposed to be installed in the southern section of the Biodiversity Area to compensate for five (potential) hibernation roosts comprising a low number of bat species; brown long-eared, Myotis sp., common pipistrelle or soprano pipistrelle species. Within the bunker there will be features providing crevices for bats to hibernate.
- Tree roosts - Bat boxes will be placed along hedgerows on suitable trees or artificial surfaces such as poles along tree lines on-Site, along the northern boundary (approximately five boxes) and off-Site, and also along the existing tree line along the west of the Biodiversity Area (approximately five boxes). They will be positioned so that bats have a clear flight to the box entrance, with space below where they can land. Boxes will be placed approximately 5m high using headless or domed nails, not fully hammered in, to allow the tree to push the box off as it grows without splitting. No trees with bat roosting features will be removed until replacement bat boxes have been installed.

The Biodiversity Area in which the bat barn and bunker will be placed will extend to some 36 hectares and, in addition to roost provision, a range of habitats are to be created to favour foraging bats e.g. flower-rich grassland, hedgerows, ephemeral wetland and woodland. The creation of the Biodiversity Area and the new roost structures, will provide long-term alternative roosting opportunities for long-eared bat, whiskered and Natterer's bats as well as common and soprano pipistrelle bats, and other crevice dwelling species of bat.

Temporary artificial lighting may be required during construction works to extend the length of the working day. Spill of construction related lighting onto roosts will be avoided using directional lighting during the construction phase, unless it is existing lighting. Where security lighting is required during construction, this will be operated on motion sensors using directional LED lighting and aimed only where necessary, with no light spill onto known or potential roost sites or key flight-lines. Nocturnal light spill onto hibernation sites will also be avoided between November and March inclusive. This will avoid effects of lighting on bat roosts during the construction phase.

There will be an increase in permanent lighting levels across the DCO Site. This increase in lighting, particularly around the runway, aviation car park and passenger terminal would likely deter and cause barrier/severance effects on a low number of foraging and commuting bats in this immediate area. Based on the current low levels of usage and limited value of habitat present for foraging bats within this area there would be a slight adverse effect on foraging and commuting bat species because of an increase in lighting at the Site. However, this would not be considered to result in a significant effect on the conservation status of bat populations present.

With the implementation of the measures described in this method statement it is assessed that there will be no residual negative effects on the bat populations in the medium to long-term and that the favourable conservation status of bats around the Site will be maintained. Post-development monitoring in order to assess the success of the mitigation strategy is proposed for a ten-year period.

B Introduction

B1 Background to activity/development:

Include a brief summary of:

- Why the activity and a licence are necessary (*e.g. bridge structure repairs are required and will affect a known maternity roost of Daubenton's bats, which will be temporarily lost whilst works are being undertaken; renovation works to an office building will result in the permanent loss of three day roosts of common pipistrelle bats; demolition of an existing hospital to be replaced with flats will result in the loss of a brown-long eared bat maternity roost*).

The development will consist of a new freight airport to include new infrastructure such as an air traffic control tower and fire station as well as warehouses for storage and facilities for airport related businesses. This will require the demolition or modification of the built structures on the site resulting in the permanent loss of:

- Two long-eared bat hibernacula;
- One long-eared bat day/transitional roost;
- One long-eared bat night/feeding roost;
- A whiskered bat hibernacula;
- A Natterer's bat hibernacula;
- Five common pipistrelle day/transitional roosts;
- Four soprano pipistrelle day/transitional roosts;
- A Nathusius day/transitional roost;
- A noctule day/transitional roost;
- A Leisler's bat day/transitional roost;
- A serotine day/transitional roost;
- A Daubenton's bat hibernacula; and
- A Brandt's bat hibernacula.

- Include current status of planning permission (if applicable) *e.g. full planning permission with all relevant wildlife conditions discharged; permitted development; demolition with prior notification of demolition issues resolved*. If the proposal is for demolition only of a structure supporting a bat roost/s, please confirm whether there are plans to develop the site in the future and if so when.

The planned development is a Nationally Significant Infrastructure Project, and is currently in the examination phase of the Development Consent Order process.

B2 Relationship with other nearby development and cumulative impacts

B2.1 Is the current application part of a larger development project? For example, is it part of a phased or multi-plot housing development that will require more than one bat licence? Enter Yes, No or N/A in the text box below. If yes, note a separate ***master plan*** document will be required.

No

Important Advice: If yes to the above, please note that sections in this Method Statement on impact assessment and mitigation measures must explicitly relate *only* to impacts from the works currently proposed.

A project-wide master plan must detail the overall impact assessment and mitigation and explain where, and why, each of the bat licences will be required. The master plan must be included as a separate document to this application: see http://www.naturalengland.org.uk/Images/WML-G11_tcm6-9930.pdf for details that are to be included in this separate document. The separate master plan is expected to take due regard of the overall project to ensure that in-combination effects are considered, and mitigation and compensation measures are both sufficient and coherent.

If the current development is part of a larger development project, summarise very briefly here how the current application relates to the larger project and how the in-combination effects are considered and mitigation/compensation is sufficient.

N/A

Important Advice: to accompany this Method Statement also include Figure. B2.1 for a Master plan overview - and see section I "Map checklist" at the end of this document.

B2.2 Apart from any mention in B2.1, please inform us of any past or future development or other projects (in the last 5 years or next 5 years) in the vicinity which may have significantly impacted or are likely to significantly impact on the same population/s of bats as this application (e.g. loss of maternity or hibernation roosts). You must make reasonable efforts to establish this, including discussions with your client and the Local Planning Authority – stating below what you undertook. A brief summary of the project/s should be provided including the site name and location, dates and if known the licence reference number(s).

Please note we are not expecting details of every licence/planning permission issued within the vicinity of the site – we are only concerned with projects that have the potential to significantly impact or have impacted on same population of bats (maternity and hibernation roosts). Note: Natural England is aiming to make available licensing records from the last 5 years publically available.

No developments were identified in the local area (within 5 km of the Site) which may impact the same populations of bats. There are residential developments proposed nearby in particular Manston Green (OL/TH/14/0050), Land off New Haines Road (OL/TH/11/0910) and Land adjacent to Salmestone Grange (OL/TH/16/1765) (all Thanet DC planning applications), and Thanet Parkway Station (KCC/TH/0105/2018) which could affect bat's ability to forage or commute (e.g. through loss or lighting of commuting routes). However all of these developments incorporate appropriate mitigation for these impacts, therefore they are unlikely to significantly impact on the same population of bats.

Important Advice: locations of other bat mitigation sites that may have significantly impacted or are likely to significantly impact on the same population/s of bats as this application must be shown on Figure B2.2.

C Survey and site assessment (also see section 5 of the Bat Mitigation Guidelines)

C1 Pre-existing information on the bat species at the survey site:
Please undertake a historical data search within a 2km search radius and provide a summary of the results of this search. For example, records from local environmental records centres, local bat groups and previous survey work undertaken at the site is all relevant. Please briefly comment on the results in relation to your project/site

- Should no historical records be found from your search please state this – and specify what searches you undertook.
- Note that you must not include records from National Biodiversity Network (NBN) without first obtaining written permission from the relevant Data Provider.

Historical records of bats within a 5km radius of the Site were obtained from the Kent Bat Group (KBG) via Kent and Medway Biological Records Centre (KMBRC). The data supplied included numerous records of bat activity from 10 different species or species groups, namely common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *P. pygmaeus*, Nathusius' pipistrelle *P. nathusii*, brown long-eared bat *Plecotus auritus*, serotine *Eptesicus serotinus*, noctule *Nyctalus noctula*, Nyctalus sp. (species unidentified), Daubenton's bat *Myotis daubentonii*, Natterer's bat *M. nattereri*, and Myotis sp. (species unidentified). Records of other bat roosts (either maternity or type unidentified) were also supplied in the data. Most of these records related to common pipistrelle, soprano pipistrelle and brown long-eared roosts. Although not all species which have been targeted for mitigation have been found they have been included as a worst case scenario in line with previous discussions with and reports to Natural England see section C5a.

C2 Status of the bat species: Detail conservation status at the local, county and regional levels. Please complete the following table, justifying your assessment, and add additional lines where necessary. If the status is unknown then please enter 'unknown'.

Species	Conservation status assessment		
	Local	**County**	**Regional**
Common pipistrelle	Common	common	Common and widespread
Soprano pipistrelle	Common	common	Common and widespread
Brown long-eared bat	Common	common	Common and widespread
Natterer's bat	Scarce	Scarce	Generally scarce
Whiskered bat	Scarce and elusive	Scarce and elusive	Locally distributed

Daubenton's bat	Scarce	Common near water	Widespread, increasing in parts of range
Brandt's bat	Not present	Rare and elusive	Locally distributed
Nathusius' pipistrelle	Scarce	Scarce, often migrant	Locally distributed
Noctule	Scarce	Generally uncommon, declining	Widespread
Leisler's bat	Not present	Scarce, may be under-recorded	Widespread but rare
Serotine	Scarce	Widespread but declining	Widespread but limited to southern counties and East Anglia

* ***Please note** that you can add more rows to the table: right click in any cell choose Insert > Insert rows below.*

C3 Objectives of the survey to inform this proposal: Please complete the following table, entering 'Yes', 'No' or N/A' to indicate the objective of your survey and provide comments/explanation where necessary:

Survey objective	Yes / No / N-A	Comments
Determine presence / absence of bats	Yes	Visual inspections and emergence/re-entry surveys were carried out
Determine bat usage of site (e.g. maternity, hibernation, night roosts in various structures (specify)).	Yes	Emergence and re-entry surveys are to be carried out to identify the type of bat roosts present, identify access points and estimate number of bats.
Identify foraging, commuting or swarming sites (explain)	Yes	Activity transects and passive monitoring surveys are to be carried out in order to identify foraging, commuting, or swarming sites
Other (explain)	Yes	Due to lack of recent survey (see C5a) as discussed with Natural England the mitigation outlined is based on a worst case scenario as outlined in the ecology chapter of the environmental statement.

C4 Site/habitat description: Please provide:

- Brief descriptions of the site, including total size of the development site (ha) (most often within the red line planning boundary) and areas of the site with potential value to bats (ha).

Manston Airport covers an area of approximately 325ha and comprises a range of hardstanding, buildings (including cargo facilities and passenger terminal), and large expanses of semi-improved grassland. The northern part of the Site is bisected by the B2050 (Manston Road), and the Site is bounded by the A299 dual carriageway to the south and the B2190 (Spitfire Way) to the west. Habitats adjacent to the Airport are predominantly large arable fields with small pockets of trees and hedgerow. Some of the buildings on Site provide roosting potential for bats whilst the small areas of neighbouring trees and hedgerows may provide commuting opportunities.

The different habitat types within the site are shown on Figure C5a and comprise:

- Hardstanding (runway, buildings) ~107ha;
- Semi-improved grassland ~70.15ha;
- Poor semi-improved grassland ~118.59ha;
- Dense scrub ~0.47ha;
- Dense scrub/tall ruderal mosaic ~0.3ha;
- Scattered scrub ~0.11ha;
- Buildings ~2.5ha; and
- Arable ~16.57ha.

- Brief descriptions of the structures on site, differentiating between **those surveyed** and **not surveyed**, with an explanation why. Ensure structures are referenced and consistently indicated on relevant figures and tables.

There are 71 buildings within the Manston Airport Site. Between August and October 2017 all of these buildings were assessed on behalf of the Applicant for their potential to support bat roosts in accordance with BCT guidelines (BCT, 2016). This initial assessment, which included an external and, where necessary and access was possible. The internal visual inspection by a licensed ecologist, was used to identify existing evidence of roosting bats and to determine the need for further survey work. Further internal inspections were carried out in January 2019.

The 2017 inspections determined the suitability of the buildings to support bats as follows:

- Confirmed Roost: B8, B16, B17, B33, B41, B54;
- High: B1, B43;
- Moderate: B5, B18, B28, B29, B39, B53;
- Low: B2, B3, B7, B11, B14, B15, B22, B25, B27, B34, B40, B44, B45, B46, B47, B50, B52, B56, B61, B62, B63, B64, B66; and
- Negligible: B4, B9, B10, B12, B13, B19, B20, B21, B23, B24, B26, B30, B31, B32, B35, B38, B42, B48, B49, B51, B55, B57, B58, B59, B60, B65, B67, B68, B70, B71.

Full building descriptions can be found in Annex H1.a.

The following buildings did not have internal inspections carried out (note that wherever this lead to any uncertainty in the suitability for bats, it is assumed there is suitability and further nocturnal surveys are required):

- B1 – H&S issues;
- B2 – H&S issues;
- B3 – H&S issues;
- B5 – Access restrictions;
- B6 – Not required;
- B7 – Not required;
- B9 – Access restrictions;
- B10 – Not required;
- B13 – Not required;
- B14 – Access restrictions;
- B15 – Access restrictions;
- B17 – Unable to access extension in northern elevation;
- B21 – Access restrictions;
- B22 – Access restrictions;
- B23 – Access restrictions;
- B26 – Not required;
- B28 – Not required;
- B30 – Not required;
- B32 – Access restrictions;
- B33 – H&S issues;
- B34 – H&S issues;
- B36 – Not required;
- B37 – Access restrictions;
- B38 – Access restrictions;
- B42 – Not required;
- B43 – Access restrictions;
- B44 – Unable to access roof void;
- B46 – Access restrictions;
- B47 – Access restrictions
- B48 – Not required;
- B49 – Not required;

- B50 – Not required;
- B51 – Not required;
- B53 – No access to roof void;
- B56 – H&S issues;
- B57 – Not required; and
- B61 – Unable to access roof void.

A table showing full limitations and reasons buildings were not inspected is shown in Annex H1.b

- A description of adjacent areas/offsite habitats, specifying any relevance to bats, including descriptions of habitat/s relevant to bat commuting/foraging behaviour.

Manston Airport is bordered on all aspects by large expanses of agricultural land. There is a large solar farm to the north-east and a smaller one to the south of the Site. A small residential area is located to the north-west with an adjacent private runway with associated aviation buildings. Manston golf course is located to the east with Preston Park Holiday Park and Manston Court Holiday Park in the north. Small pockets of trees are located on all aspects as are hedgerows which may provide commuting routes for bats. Small areas/belts of broad-leaved trees occur adjacent the Biodiversity Area and solar farm to the south of the Airport, and also around residential development either side of Manston Road to the north-west of the Airport.

- Please also include annotated (cross reference the structures) and dated photographs (showing both internal and external survey areas) as these are very useful as an assessment aid. These can be inserted below or submitted as a separate (referenced) document.

See Annex H1.a

C5 Field survey(s):

Surveys must be up to date and have been conducted within the current or most recent optimal season. Surveys must be undertaken in accordance with the most up to date edition of the Bat Conservation Trust (BCT) *Bat Surveys for Professional Ecologists – Good Practice Guidelines* and the *Bat Mitigation Guidelines*.

C5a Justification for surveys that deviate from the best practice guidelines: Please provide full justification below if your surveys deviate from the aforementioned best practice guidelines, confirming how you have obtained a full appreciation of the bat species roosting at the site, and of the type and status of roosts they use on site and in the context of the immediate surrounding area. **Please note that inadequate survey information is likely to cause delays to your licence application and may result in a Further Information Request.**

Despite effort to gain entry to the DCO Site via section 53 requests (Rights of Entry, Planning Act 2008) insufficient access was gained to carry out adequate up-to-date baseline surveys. As a consequence a worse-case assessment was used to determine the impact on the bats, upon which the mitigation presented here is based. The approach to rely on Licensing Policy 4 (reduced survey effort) was agreed with Natural England (see letter from Lead Advisor, Claire Storey, dated 17/12/2018; reference DAS2392/194378).

Full surveys will be undertaken prior to the final licence application taking place; this licence is to inform Natural England of our proposed mitigation with the aim of receiving a Letter of no Impediment (LONI). Therefore the lack of current survey cannot adversely affect bats.

Previous surveys undertaken at the Site for a different planning application submission are given for context below.

C5b Please complete the following tables and add additional lines where necessary (*right click in any cell <u>outside the grey box</u> area. Choose Insert > Insert rows below)*. Please enter 'N/A' if the table is not applicable to your survey. Please ensure the information is consistent with Figure **C5b** (showing all buildings, structures and habitats that are within the survey area and distinguishing those that were surveyer and those that were not; indicate where surveyors were located):

Visual inspection

Date of each survey visit **(e.g. format 01/06/13)**	**Structure reference / location**	**Equipment used (e.g binoculars, endoscope)**	**Weather –** ***(Include temps, precipitation, Beaufort wind scale etc)***
External: 10/10/2017	B1	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B2	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A survey visual and not affected by the weather
Comments: 2 licensed surveyors			
External: 10/10/2017	B3	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017 Internal: 10/10/2017	B4	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B5	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017	B6	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017	B7	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope..	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017 Internal : 05/10/2017	B8	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017	B9	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017	B10	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017 Internal: 04/10/2017	B11	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017 Internal: 04/10/2017	B12	Close-focusing binoculars, powerful focused-beam	N/A

		light, ladders and endoscope.	
Comments: 2 licensed surveyors			
External: 04/10/2017	B13	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017	B14	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017	B15	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 04/10/2017 Internal: 05/10/2017	B16	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017 Internal: 05/10/2017	B17	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017 Internal: 05/10/2017	B18	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017 Internal: 05/10/2017	B19	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017 Internal: 05/10/2017	B20	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017	B21	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017	B22	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B23	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/10/2017 Internal: 09/10/2017	B24	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017	B25	Close-focusing binoculars,	N/A

Internal: 05/10/2017		powerful focused-beam light, ladders and endoscope.	
Comments: 2 licensed surveyors			
External: 10/10/2017	B26	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 05/10/2017 Internal: 05/10/2017	B27	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/10/2017	B28	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/09/2017 Internal: 09/09/2017	B29	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/09/2017	B30	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/09/2017 Internal: 09/09/2017	B31	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/09/2017	B32	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/09/2017 Internal: 09/09/2017	B33	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B34	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017 Internal: 10/10/2017	B35	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B36	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B37	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			

External: 10/10/2017	B38	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017 Internal: 10/10/2017	B39	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017 Internal: 10/10/2017	B40	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/10/2017 Internal: 09/10/2017	B41	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B42	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B43	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope..	N/A
Comments: 2 licensed surveyors			
External: 14/09/2017	B44	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 14/09/2017 Internal: 14/09/2017	B45	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/10/2017	B46	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 09/10/2017	B47	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 14/09/2017	B48	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 21/08/2017	B49	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 21/08/2017	B50	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A

Comments: 2 licensed surveyors			
External: 21/08/2017	B51	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 21/08/2017	B52	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 21/08/2017	B53	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 14/09/2017 Internal: 14/09/2017	B54	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 14/09/2017 Internal: 09/10/2017	B55	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B56	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B57	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 10/10/2017	B58	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B59	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B60	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017	B61	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B62	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B63	Close-focusing binoculars, powerful focused-beam light, ladders and	N/A

		endoscope..	
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B64	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B65	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B66	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017	B67	Close-focusing binoculars, powerful focused-beam light.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017	B68	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B69	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B70	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
External: 17/10/2017 Internal: 17/10/2017	B71	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors			
17/01/2019	B8	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments (to include # of surveyors used for each visit): 2 licensed surveyors plus 1 unlicensed surveyor			
17/01/2019	B16	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors plus 1 unlicensed surveyor			
17/01/2019	B17	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors plus 1 unlicensed surveyor			
18/01/2019	B33	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors plus 1 unlicensed surveyor			

18/01/2019	B39	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors plus 1 unlicensed surveyor			
18/01/2019	B41	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors plus 1 unlicensed surveyor			
17/01/2019	B54	Close-focusing binoculars, powerful focused-beam light, ladders and endoscope.	N/A
Comments: 2 licensed surveyors plus 1 unlicensed surveyor			

Please provide surveyors names *(including Class Licence registration number if applicable)* and ensure the above table states the number of surveyors used for each survey visit undertaken.

2017 surveys were led and designed by Jon Bannon BSc MSc MCIEEM, working on behalf of Wood. Natural England class 2 licence (Registration no: 2015-11543-CLS-CLS) and Tim Buckland BSc MSc MCIEEM, Natural England class 2 licence (Registration no: 2015-11006-CLS-CLS). They were assisted by Jeff Turton BSc (Hons) GradCIEEM.
January 2019 surveys were carried out by Tim Bradford BSc (Hons), MSc, MCIEEM working for Wood plc under Natural England Bat Survey Class 2 Licence (Registration No. 2015-12885-CLS-CLS), Jon D'Arcy BSc (Hons), MSc, Natural England Bat Survey Class 2 Licence (Registration No: 2018-37285-CLS-CLS), and assisted by Laura Villar BSc (Hons), MSc, GradCIEEM.

Dusk survey

Date of each survey visit **(e.g. format 01/06/13)**	**Start and end times and time of sunset**	**Structure reference / location**	**Equipment used (include make of bat detectors and logging equipment)**	**Weather –** ***(Include start and end temps, precipitation, Beaufort wind scale etc)***
11/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B1	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 15°C Cloud cover: 4-6 (Oktas) Wind:3 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
12/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B14	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 1 surveyor				
02/08/2016	Sunset: 20:39 Start: 20:24 End: 22:09	B14	Either EM3+ or Elekon Batlogger M detector	Start temp: 19°C End temp: 18°C Cloud cover: 8 (Oktas) Wind: 4 Precipitation: None
Comments: 2 surveyors				
12/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B14a	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light

Comments: 1 surveyor				
12/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B16	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 1 surveyor				
28/06/2016	Sunset: 21:14 Start: 20:59 End: 22:44	B23	Either EM3+ or Elekon Batlogger M detector	Start temp: 13°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 4 Precipitation: None
Comments: 2 surveyors				
11/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B23	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 15°C Cloud cover: 4-6 (Oktas) Wind:3 Precipitation: None
Comments: 2 surveyors				
04/07/2016	Sunset: 21:12 Start: 20:57 End: 22:42	B31	Either EM3+ or Elekon Batlogger M detector	Start temp: 17.3°C End temp: 16.5°C Cloud cover: 8 (Oktas) Wind: 3-4 Precipitation: None
Comments: 2 surveyors				
13/07/2016	Sunset: 21:06 Start: 20:51 End: 22:36	B31	Either EM3+ or Elekon Batlogger M detector	Start temp: 11°C End temp: 10°C Cloud cover: 1 (Oktas) Wind: 1-2 Precipitation: None
Comments: 2 surveyors				
21/06/2016	Sunset: 21:14 Start: 20:59 End: 22:44	B32	Either EM3+ or Elekon Batlogger M detector	Start temp: 18°C End temp: 15°C Cloud cover: 4/8 (Oktas) Wind: 2/3 Precipitation: None
Comments: 2 surveyors				
13/07/2016	Sunset: 21:06 Start: 20:51 End: 22:36	B36	Either EM3+ or Elekon Batlogger M detector	Start temp: 11°C End temp: 10°C Cloud cover: 1 (Oktas) Wind: 1-2 Precipitation: None
Comments: 2 surveyors				
03/08/2016	Sunset: 20:37 Start: 20:22 End: 22:07	B36	Either EM3+ or Elekon Batlogger M detector	Start temp: 18°C End temp: 18°C Cloud cover: 8 (Oktas) Wind: 5 Precipitation: None
Comments: 2 surveyors				
12/07/2016	Sunset: 21:07	B41	Either EM3+ or	Start temp: 15°C

	Start: 20:52 End: 22:37		Elekon Batlogger M detector	End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 2 surveyors				
23/06/2016	Sunset: 21:15 Start: 21:00 End: 22:46	B43	Either EM3+ or Elekon Batlogger M detector	Start temp: 18.2°C End temp: 17.4°C Cloud cover: 3-5 (Oktas) Wind: 1 Precipitation: None
Comments: 2 surveyors				
12/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B43	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 2 surveyors				
11/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B45	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 15°C Cloud cover: 4-6 (Oktas) Wind:3 Precipitation: None
Comments: 1 surveyor				
21/06/2016	Sunset: 21:14 Start: 20:59 End: 22:46	B46	Either EM3+ or Elekon Batlogger M detector	Start temp: 18°C End temp: 15°C Cloud cover: 4/8 (Oktas) Wind: 2/3 Precipitation: None
Comments: 1 surveyor				
03/08/2016	Sunset: 20:37 Start: 20:22 End: 22:07	B46	Either EM3+ or Elekon Batlogger M detector	Start temp: 18°C End temp: 18°C Cloud cover: 8 (Oktas) Wind: 5 Precipitation: None
Comments: 2 surveyors				
21/06/2016	Sunset: 21:14 Start: 20:59 End: 22:46	B47	Either EM3+ or Elekon Batlogger M detector	Start temp: 18°C End temp: 15°C Cloud cover: 4/8 (Oktas) Wind: 2/3 Precipitation: None
Comments: 1 surveyor				
11/07/2017	Sunset: 21:07 Start: 20:52 End: 22:37	B56a	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 15°C Cloud cover: 4-6 (Oktas) Wind:3 Precipitation: None
11/07/2016	Sunset: 21:07 Start: 20:52 End: 22:37	B56b	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 15°C Cloud cover: 4-6 (Oktas)

				Wind:3 Precipitation: None
Comments: 1 surveyor				
20/07/2016	Sunset: 20:58 Start: 20:43 End: 22:28	B63	Either EM3+ or Elekon Batlogger M detector	Start temp: 22°C End temp: 20°C Cloud cover: 0-1 (Oktas) Wind: 4-2 Precipitation: None
Comments: 1 surveyor				
20/07/2016	Sunset: 20:58 Start: 20:43 End: 22:28	B65	Either EM3+ or Elekon Batlogger M detector	Start temp: 22°C End temp: 20°C Cloud cover: 0-1 (Oktas) Wind: 4-2 Precipitation: None
Comments: 1 surveyor				
11/07/2016	Sunset: Start: End:	B1	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 15°C Cloud cover: 4-6 (Oktas) Wind:3 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
12/07/2016	Sunset: Start: End:	B14	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 1 surveyor				
02/08/2016	Sunset: Start: End:	B14	Either EM3+ or Elekon Batlogger M detector	Start temp: 19°C End temp: 18°C Cloud cover: 8 (Oktas) Wind: 4 Precipitation: None
Comments: 2 surveyors				
12/07/2016	Sunset: Start: End:	B14a	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 1 surveyor				
12/07/2016	Sunset: Start: End:	B16	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 2 Precipitation: Very light
Comments: 1 surveyor				
28/06/2016	Sunset: Start: End:	B23	Either EM3+ or Elekon Batlogger M detector	Start temp: 13°C End temp: 14°C Cloud cover: 8 (Oktas) Wind: 4 Precipitation: None
Comments: 2 surveyors				

Please provide surveyors names *(including Class Licence registration number if applicable)* and ensure the above table states the number of surveyors used for each survey visit undertaken.

Surveys were designed and led by Anna Muckle MCIEEM working for WSP. Natural England Bat Survey Class 2 Licence (Registration No. 2015-11522-CLS-CLS)) and assisted by Tim Buckland MCIEEM, Natural England Bat Survey Class 2 Licence (Registration No: 2015-11006-CLS-CLS), Kevin Hume (NE licence number 2015-13066-CLS-CLS), Jessica Tait, Anna McDermott, Abbi Kent, Rebecca Blamey and Jeff Turton,

Dawn survey

Date of each survey visit (e.g. format 01/06/13).	**Start and end time and time of sunrise**	**Structure reference / location**	**Equipment used (include make of bat detectors and logging equipment)**	**Weather – *(Include start and end temps, precipitation, Beaufort wind scale etc)***
25/05/2016	Sunrise: 04:49 Start: 03:19 End: 04:49	B36	Either EM3+ or Elekon Batlogger M detector	Start temp: 10°C End temp: 9°C Cloud cover: 8 (Oktas) Wind: 3 Precipitation: light rain
Comments (to include # of surveyors used for each visit): 2 Surveyors				
14/07/2016	Sunrise: 04:55 Start: 03:25 End: 04:55	B36	Either EM3+ or Elekon Batlogger M detector	Start temp: 11°C End temp: 10°C Cloud cover: 1 (Oktas) Wind: 1 Precipitation: None
Comments: 2 Surveyors				
24/06/2016	Sunrise: 04:39 Start: 03:09 End: 04:39	B43	Either EM3+ or Elekon Batlogger M detector	Start temp: 17.1°C End temp: 15.4°C Cloud cover: 8 (Oktas) Wind: 1 Precipitation: None
Comments: 2 Surveyors				
04/08/2016	Sunrise: 05:25 Start: 03:55 End: 05:25	B43	Either EM3+ or Elekon Batlogger M detector	Start temp: 15°C End temp: 15°C Cloud cover: 1 (Oktas) Wind: 3 Precipitation: None
Comments:2 Surveyors				
25/05/2016	Sunrise: 04:49 Start: 03:19 End: 04:49	B46	Either EM3+ or Elekon Batlogger M detector	Start temp: 10°C End temp: 9°C Cloud cover: 8 (Oktas) Wind: 3 Precipitation: light rain
Comments:2 Surveyors				
22/06/2016	Sunrise: 04:38 Start: 03:08 End: 04:38	B46	Either EM3+ or Elekon Batlogger M detector	Start temp: 13°C End temp: 12°C Cloud cover: 2 (Oktas) Wind: 2-3 Precipitation: None
Comments:2 Surveyors				
12/07/2016	Sunrise: 04:53 Start: 03:23 End: 04:53	B47	Either EM3+ or Elekon Batlogger M detector	Start temp: 14°C End temp: 15°C Cloud cover: 6 (Oktas) Wind: 1 Precipitation: None
Comments:1 Surveyor				
22/06/2016	Sunrise: 04:38 Start: 03:08 End: 04:38	B49	Either EM3+ or Elekon Batlogger M detector	Start temp: 13°C End temp: 12°C Cloud cover: 2 (Oktas) Wind: 2-3 Precipitation: None
Comments:2 Surveyors				
12/07/2016	Sunrise: 04:53 Start: 03:23 End: 04:53	B61	Either EM3+ or Elekon Batlogger M detector	Start temp: 14°C End temp: 15°C Cloud cover: 6 (Oktas) Wind: 1

				Precipitation: None
Comments:2 Surveyors				
21/07/2016	Sunrise: 05:04 Start: 03:34 End: 05:04	B69	Either EM3+ or Elekon Batlogger M detector	Start temp: 17°C End temp: 16°C Cloud cover: 0 (Oktas) Wind: 3 Precipitation: None
Comments:2 Surveyors				

Please provide surveyors names *(including Class Licence registration number if applicable)* and ensure the <u>above</u> table states the number of surveyors used for each survey visit undertaken.

Surveys were designed and led by Anna Muckle MCIEEM working for WSP Natural England Bat Survey Class 2 Licence (Registration No. 2015-11522-CLS-CLS)) and assisted by Tim Buckland MCIEEM, Natural England Bat Survey Class 2 Licence (Registration No: 2015-11006-CLS-CLS), Kevin Hume (NE licence number 2015-13066-CLS-CLS), Jessica Tait, Anna McDermott, Abbi Kent, Rebecca Blamey, Jeff Turton and Louise Morrison.

'Other' survey (please specify e.g. trapping, remote, etc)

Date of each survey visit **(e.g. format 01/06/13).**	**Start and end times**	**Structure reference / location**	**Equipment used (include make of bat detectors and logging equipment)**	**Weather – *(Include start and end temps, precipitation, Beaufort wind scale etc)***
22/08/2017	Sunset: 20:01 Start: 20:01 End: 23:01	Bat activity transect 1	Elekon Batlogger M detector	Start temp: 16.5°C End temp: 18.2°C Cloud cover: 8 (Oktas) Wind: 2-3 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
14/09/2017	Sunset: 19:10 Start: 19:10 End: 22:10	Bat activity transect 1	Elekon Batlogger M detector	Start temp: 9.6°C End temp: 12.8°C Cloud cover: 3 (Oktas) Wind: 3 Precipitation: Shower
Comments (to include # of surveyors used for each visit): 1 surveyor				
17/10/17	Sunset: 17:56 Start: 17:56 End:	Bat activity transect 1	Elekon Batlogger M detector	Start temp: 7.1°C End temp: 12.5°C Cloud cover: 6 (Oktas) Wind: 1 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
22/08/2017	Sunset: 18:51 Start: 18:51 End: 21:51	Bat activity transect 2	Elekon Batlogger M detector	Start temp: 16.5°C End temp: 18.2°C Cloud cover: 8 (Oktas) Wind: 2-3 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
14/09/2017	Sunset: 19:10 Start: 19:10 End: 22:10	Bat activity transect 2	Elekon Batlogger M detector	Start temp: 9.6°C End temp: 12.8°C Cloud cover: 3 (Oktas) Wind: 3 Precipitation: Shower
Comments (to include # of surveyors used for each visit): 1 surveyor				
17/10/17	Sunset: 17:56 Start: 17:56 End: 20:56	Bat activity transect 2	Elekon Batlogger M detector	Min temp: 7.1°C Max temp: 12.5°C Cloud cover: 6 (Oktas) Wind: 1 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
21/08/2017	Sunset: 18:53 Start: 18:53 End: 21:53	Bat activity transect 3	Elekon Batlogger M detector	Start temp: 16.6°C End temp: 18.2°C Cloud cover: 8 (Oktas) Wind: 1 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
13/09/2017	Sunset: 19:12 Start: 19:12	Bat activity transect 3	Elekon Batlogger M detector	Start temp: 9.6°C End temp: 12.1°C

	End: 22:12			Cloud cover: 3 (Oktas) Wind: 3 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
18/10/17	Sunset: 17:54 Start: 17:54 End: 20:54	Bat activity transect 3	Elekon Batlogger M detector	Start temp: 14.3°C End temp: 15.3°C Cloud cover: 6 (Oktas) Wind: 1 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
21/08/2017	Sunset: 20:03 Start: 20:03 End: 23:03	Bat activity transect 4	Elekon Batlogger M detector	Start temp: 16.6°C End temp: 18.2°C Cloud cover: 8 (Oktas) Wind: 1 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
13/09/2017	Sunset: 19:12 Start: 19:12 End: 22:12	Bat activity transect 4	Elekon Batlogger M detector	Start temp: 9.6°C End temp: 12.1°C Cloud cover: 3 (Oktas) Wind: 3 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				
18/10/17	Sunset: 17:54 Start: 17:54 End: 22:54	Bat activity transect 4	Elekon Batlogger M detector	Start temp: 14.3°C End temp: 15.3°C Cloud cover: 6 (Oktas) Wind: 1 Precipitation: None
Comments (to include # of surveyors used for each visit): 1 surveyor				

Please provide surveyors names *(including Class Licence registration number if applicable)* and ensure the above table states the number of surveyors used for each survey visit undertaken.

Surveys in 2017 were undertaken for Wood by Jon Bannon BSc MSc MCIEEM, Natural England class 2 licence (Registration no: 2015-11543-CLS-CLS) and Tim Buckland BSc MSc MCIEEM, Natural England class 2 licence (Registration no: 2015-11006-CLS-CLS). They were assisted by Jeff Turton BSc (Hons) Grad CIEEM.

Please explain any constraints on the survey/s undertaken (time of year, cold weather, refused access, safety issues preventing access etc – justify as necessary and include evidence where required). If access was refused please provide evidence (letter/email) to demonstrate this.

Access to 19 buildings was limited due to health and safety issues and access refusal. No internal access was gained to the following buildings:

B1, B2, B3, B5, B6, B7, B9, B10, B13, B14, B15, B17, B21, B22, B23, B26, B28, B30, B32, B33, B34, B36, B37, B38, B42, B43, B44, B46, B47, B48, B49, B50, B51, B53, B56, B57, B61.

A table showing limitations to building inspections can be found in Annex H1.b and locations shown in Figure C5a.1

Also complete the following:

- If DNA analysis of droppings has been undertaken, please indicate below (Yes, No, N/A) and ensure that **Figure C5b** (if applicable – see below) details the locations where the samples were taken. Where long-eared bats are detected but cannot be identified to species level visually, DNA analysis of any droppings will be needed where grey long-eared bats may be present.

No

- Please confirm that a walk over survey/check has been carried out within 3 months *prior* to application submission by a suitably experienced ecologist to ensure that conditions have not changed since the most recent survey was undertaken. Provide details of any changes to conditions and habitats and/or structures on site since the surveys were undertaken.

Date of walkover survey/check	31/01/2019
Details of any changes to conditions and habitats and/or structures, if there are no changes please insert 'None'	None. Subsequent to this date the Department for Transport's 'Operation Stack' occurred at the DCO Site. No information is available to the applicant on whether this resulted in any relevant impacts at the Site.

C6 Survey results: Summarise your findings in the tables below and cross reference to **Figure C6** (which must also include flight lines, access points, dimensions of existing roosts etc). If you did not undertake a specific survey type please add N/A to the relevant table/s. Raw data is to be appended to the Method Statement (including sonograms, DNA analysis results etc).

Roost t*ypes to be referenced as:* *Day, Night, Feeding Perch, Transitional, Satellite, Maternity, Hibernation confirmed, Foraging Area, Commuting Route, Swarming Site, Other*. See end of document for "Definitions" of these roosts.

When completing "**Notes/observations" include** reference *to direct observations, extent and age of droppings, presence of field signs, emergence or re-entry, echolocation analysis. Also include DNA results if applicable and include nil results)*

Visual inspection results

Date (e.g. format 01/06/13)	**Species and numbers**	**Roost type** *(to be consistent with the above listed types)*	**Structure reference** *(consistent with relevant figures and other text)*	**Roost location**	**Access points (include # of them)**	**Dimensions of existing roosts or explanation of where the roost is (as appropriate)**
External: 04/10/2017 Internal: 05/10/2017	Brown long-eared bat, Natterer's bat, Daubenton's bat, Brandt's and whiskered bat	Hibernation roost	B8	N/A	There are vents on the eastern and western elevations which may provide access into the wall cavity. A small gap above the door provides access to the interior of the building.	Internal area 13m x 4m x 3m (l x w x h) unclear where bats hibernate. As bats not found, no clear piles of droppings, and no obvious features where bats would hibernate.
Notes/observations: Droppings were found adjacent to the northern internal wall						
External: 04/10/2017 Internal: 05/10/2017	Brown long-eared bat	Day/transitional roost	B16	Roof void	Several gaps beneath the ridge tiles providing access to loft space and cavity walls.	Roost within roof void
Notes/observations: Three droppings recorded scattered within the roof void						
05/10/2017	Brown long-eared bat	Night and./or feeding roost	B17	N/A	Gaps around main entrance provides access to interior of the building. Gap under fascia provides access to	Building approximately 28 m x 16 m x 6 m. Not clear where feeding point was.

					interior of the extension on the northern elevation	
Notes/observations: Approx 40 mixed aged droppings scattered alongside the eastern and western wall. Absence of feeding remains and restricted roosting features suggests most likely use of the building is as a night roost.						
June - October 2015 (WSP survey)	Brown long-eared bat	Hibernation, day/transitional roost	B33	N/A	Bats can access the underground structure via a missing manhole cover on the roof of the tower and via an open stairway.	Hibernating behind damaged plasterboard in northeast side of building.
Notes/observations: Single brown long-eared hibernating and 20 brown long-eared droppings and one pipistrelle sp. droppings.						
09/10/2017	Brown long-eared bat and common and soprano pipistrelle	Day/transitional roost	B41	N/A	Several gaps beneath the ridge tiles provide access to the ridge as well as the cavity walls. Bats could potentially go on to access the roof void via gaps in the bitumen felt lining. Gaps under roof tiles and in the fascia boards on the eastern and western elevations.	Roosting in kitchen in north-east of building and in loft space.
Notes/observations: 30 pipistrelle sp. droppings						
June – October 2015 (WSP survey)	Common and soprano pipistrelle	Day/transitional roost.	B54	N/A	Gaps under roof tiles. There are large gaps in the fascia boards on the gable walls which provide access to the roof void. There are several gaps under the lead flashing on the hexagonal extension.	Likely roosting under roof tiles
Notes/observations: 30 pipistrelle sp. droppings						

Provide further (brief) comments/explanation if required:

Dusk survey results

Date (e.g. format 01/06/13)	Start and end times	Species and numbers	***Roost type*** *(to be consistent with the above listed types)*	**Structure reference** *(consistent with relevant figures and other text)*	**Roost location**	**Access points (include # of them)**	**Dimensions of existing roosts or explanation of where the roost is (as appropriate)**
12/07/16		Common Pipistrelle: 4	Day/ transitional roost	B28	Eastern aspect	3	Under cladding and lifted tiles
Notes/observations:							
Notes/observations:							
Notes/observations:							
Notes/observations:							

Provide further (brief) comments/explanation if required:

Dawn Survey results

Date (e.g. format 01/06/13)	Start and end times	Species and numbers	**Roost type** *(to be consistent with the above listed types)*	**Structure reference** *(consistent with relevant figures and other text)*	**Roost location**	**Access points (include # of them)**	**Dimensions of existing roosts or explanation of where the roost is (as appropriate)**
Notes/observations:							
Notes/observations:							
Notes/observations:							
Notes/observations:							

Provide further (brief) comments/explanation if required:

'Other' results – please specify.

Date (e.g. format 01/06/13)	Species and numbers	**Roost type** *(to be consistent with the above listed types)*	**Structure reference** *(consistent with relevant figures and other text)*	**Roost location**	**Access points (include # of them)**	**Dimensions of existing roosts or explanation of where the roost is (as appropriate)**
Notes/observations:						
Notes/observations:						
Notes/observations:						
Notes/observations:						

Provide further (brief) comments/explanation if required:

C7 Interpretation/evaluation of survey results (also see the Bat Mitigation Guidelines section 5.8 and Figure 4 for conservation significance of roost type): Please complete the following table:

Structure reference *(ensure consistency with other text and Figures)*	**Species**	**Count / estimate of number of individuals**	**Roost location**	**Site status assessment (e.g. maternity, feeding roost, swarming site, hibernation confirmed etc)**	**Conservation significance of roost**
B8	Brown long-eared bat		N/A	Confirmed hibernation roost	Moderate
B8	Natterer's bat, Duabenton's bat, Brandt's bat and whiskered bat		N/A	Confirmed hibernation roost	Moderate
B16	Brown long-eared bat	1-3 (estimate)	N/A	Confirmed day/transitional roost.	Moderate
B16	Common and soprano pipistrelle		N/A	Confirmed day/transitional roost.	Moderate
B17	Brown long-eared bat		N/A	Confirmed night/feeding roost.	Low
B33	Brown long-eared bat	1 (Count)	N/A	Confirmed hibernation, day/transitional roost	Moderate
B33	Common and soprano pipistrelle	1-3 (estimate)	N/A	Summer/transitional roost	Moderate
B41	Common and soprano pipistrelle		N/A	Confirmed day/transitional roost.	Low
B54	Common and soprano pipistrelle	1-3 (estimate)	N/A	Confirmed day/transitional roost.	Low

Provide further (brief) comments / explanation if required:

Important Advice:

Survey maps that must be included in this section of the Method Statement, or as separate documents if preferred, are listed in *section I "Map checklist" at the end of this document.*

Insert survey figures, photographs etc below here if not submitting them as separate documents

D Impact assessment <u>in absence of mitigation or compensation for each species / roost type</u>

(also see section 6 of the Bat Mitigation Guidelines). Where appropriate you must take into consideration cumulative impacts of your proposals on the bat species and populations identified in your survey in each section.

Guidance on quantifying roosts for the purpose of licensing: *To be considered the same roost, the locations need to have the same **functional** and **qualitative** (e.g. physical) characteristics, be used by the **same species** for the **same purpose** (e.g. day roosting) and be within the **same building / structure**. If the physical characteristics are different (e.g. one roost is in external crevices in the wall and the other is in the roof void against internal timbers) then they should be considered different roosts - because they offer bats different roosting opportunities. If the physical characteristics are similar and provide the same functional characteristics, used by the same species for the same purpose (e.g. transitional roost) but with different individual roosting locations within the overall building / structure, that could be considered one transitional roost. If two species are using an area which provides the same characteristics, for the same function, it is still two roosts - as there are two species.*

D1 Initial impacts: The impact/s of activities undertaken on site pre-development and during works must be considered and explained. **Consider disturbance** (such as human presence, noise, vibration, dust, lighting, access obstruction due to scaffolding and plastic sheeting etc), **temporary damage and temporary loss of roosts and injuring/killing.**
E.g. Unsupervised contractor removing roof tiles has the potential to crush 3 common pipistrelle bats using the roof tiles as day roosts. Major negative impact at a site level; Demolition of an extension to a building will take place adjacent to a maternity roost of common pipistrelle bats situated under the soffit board of the retained building. Potential for significant disturbance if demolition works are undertaken during the maternity period through vibration, noise and dust. Medium negative impact on a local level.

In the absence of mitigation, unsupervised demolition of buildings B8, B16, B17, B33, B41, and B54, and repair of B28 has the potential to injure or kill bats using these roosts. This would result in a medium negative impact at the county level.

Confirm number of roosts to be damaged: 7 buildings

D2 Long-term impacts: Consider and explain the impacts of the proposed works on the different species populations at a site, local, regional, and national level**.**

D2.1. Roost modification: e.g. changes to roosts/access points, new entrances (including human access e.g. for servicing/maintenance etc), change in size of roost space, changes in air flow, temperature and humidity, light etc. Please detail the access points into each roost and the type/s of roosts which will be modified.
E.g. Non-mitigated changes to the roof structure, which requires replacing, will lead to the modification of 3 access points into a common pipistrelle maternity roost which will result in bats being unable to enter or exit the roost. Moderate negative impact on a local level.

All roosts are to be destroyed, no roosts to modify.

Confirm number of roosts to be modified: 0

D2.2. Roost loss: Loss or deterioration of roosting sites, access points, habitat, etc must be considered. Please detail the access points into each roost and types of roost/s which will be lost.
E.g. Demolition of building reference X in June will lead to the loss of a night roost in the porch used by 1 lesser horseshoe bat and the loss of a maternity brown-long eared bat roost in the loft space. This will lead to the death and/or injury of bats including dependent young and permanent destruction (loss) of both roosts. Moderate negative impact at a site level for lesser horseshoe bats and moderate negative impact at a local level for brown-long eared bats.

The demolition of buildings B8, B16, B17, B33, B41, and B54, and repair of B28 would be of medium conservation significance in the context of the county, with the rarest of these species being scarce at a county level.
The demolition will result in up to five hibernation roosts being lost (two confirmed and three potential, within buildings, potentially supporting long-eared, Natterer's bat, whiskered bat and common pipistrelle and soprano pipistrelle species. The hibernacula are likely to support very low numbers of common species and their loss would not be expected to have a significant effect on bat populations of these species.

The loss of three buildings which may contain small-moderate male/noon breeding female roosts for common pipistrelle, soprano pipistrelle and/or long-eared bats would be of medium conservation significance in the context of this Site, these species are common and widespread in the UK, and the loss of these roosts would not be expected to have a significant effect on the national or local bat populations of these species.

In the absence of mitigation, the demolition of buildings B8, B16, B17, B33, B41, and B54, and repair of B28 would impact populations of long-eared, whiskered, and Natterer's bats at a county level and common and soprano pipistrelle at a site level.

Confirm number of roosts to be destroyed: 7 buildings

D2.3. Fragmentation and isolation: Will the proposed works results in these impacts? E.g. loss of linear features such as hedges, tree lines, increased lighting, severance of flight lines by roads/rail lines, separation of breeding/hibernation sites from feeding grounds, etc.
E.g. In addition to the removal of common pipistrelle day roosts in trees along the proposed road, removal of hedgerows, shown on Figure D, and the construction of the new road will fragment a significant commuting and foraging route for a lesser horseshoe maternity roost. This may cause a reduction in the long term success of the breeding colony of lesser horseshoes by restricting existing foraging range or killing bats on the road. Potentially major negative impact at a site and local level.

No significant impact. The Site is already an airport and there are no plans to remove significant commuting or foraging areas. Loss of grassland foraging habitat will be outweighed by installation of attenuation ponds.

D3 Post-development interference impacts: e.g. extra street lighting or other external lighting, use of loft space as storage, increased noise. Please also consider other direct or indirect post development impacts which may include disturbance/ injuring/killing.
E.g. Security lighting being installed will shine on the brown-long eared bat maternity roost access points which may affect emergence patterns and lead to a reduction in foraging times. This may cause a reduction in the long term success of the breeding colony or cause the roost to be abandoned. Moderate to high negative impact at a site and local level.

There will be an increase in permanent lighting levels across the Site. This increase in lighting, particularly around the runway, aviation car park and passenger terminal would likely deter and cause barrier/severance effects on a low number of foraging and commuting bats in this immediate area. Based on the current low levels of usage and limited value of habitat present for foraging bats within this area there would be a slight adverse effect on foraging and commuting bat species as a result of an increase in lighting at the Site. However, this would not be considered to result in a significant effect on the conservation status of bat populations presents.

D4 Predicted scale of impact of this development/activity on species status (also see section 6.5 of the Bat Mitigation Guidelines and the BCT's Bat Survey Good Practice Guidelines): Please complete the following table to explain what this is likely to be at the site, local/county and regional levels for each roost type and species. Add additional lines when necessary

Roost types to be referenced as: Day, Night, Feeding Perch, Transitional, Satellite, Maternity, Hibernation confirmed, Foraging Area, Commuting Route, Swarming Site, Other.

Species and Numbers (which will be affected at the time works will be undertaken)	**Roost type**	**Predicted scale of impact *(place X in relevant column)***			**Notes** (include impact on roost – damage / destruction /modification etc)
		Site	**County**	**Regional**	
Common pipistrelle	Day/transitional roost	X			Destruction of roost.
Common pipistrelle	Maternity roost	X			Destruction of roost.
Soprano pipistrelle	Day/transitional roost.	X			Destruction of roost.
Soprano pipistrelle	Maternity roost.	X			Destruction of roost.
Brown long-eared bat	Hibernation		X		Destruction of roost.
Brown long-eared bat	Maternity		X		Destruction of roost.
Brown long-	Day/transitional	X			Destruction of roost.

eared bat	roost				
Brown long-eared bat	Night/feeding roost	X			Destruction of roost.
Natterer's bat	Hibernation		X		Destruction of roost.
Whiskered bat	Hibernation		X		Destruction of roost.
Brandt's bat	Hibernation		X		Destruction of roost.
Daubenton's bat	Hibernation		X		Destruction of roost.
Nathusius' pipistrelle	Day/transitional roost.		X		Destruction of roost.
Serotine	Day/transitional roost.	X			Destruction of roost.
Serotine	Maternity roost.		X		Destruction of roost.
Noctule	Day/transitional roost.	X			Destruction of roost.
Leisler's bat	Day/transitional roost.	X			Destruction of roost.

* ****Please note*** *that you can add more rows to the table: right click in any cell outside the grey box area. Choose Insert > Insert rows below.*

Provide further comments/explanation as required (this helps understand how the impacts will be mitigated or compensated for when assessing section E):

Important Advice:
Please ensure that a separate 'Impact map' is provided (Figure D) which must show all structures or habitats (clearly referenced) that will be disturbed, damaged or destroyed, detailing where the roosts and access points are etc. Also *see section I "Map checklist" at the end of this document*.

E Mitigation and Compensation (please also see section 7 and 8 of the Bat Mitigation Guidelines)

E1 Please explain why this design was chosen over other potential solutions - set out what other designs were considered and why they were not feasible (*e.g. if the proposal is to construct a new stand-alone roost, explain why it is not possible to retain the roost in the existing structure etc).* The mitigation solution being proposed in the method statement should be the one that delivers the 'need' with the least impact on the bat population.

The increase in demand for air transport seen over the preceding years is forecast to continue in the period up to 2035. The Airports Commission report shows that all London airports will be at capacity by 2030. The south-east is particularly hard hit by the lack of airport capacity.

The Proposed Development aims to address a number of issues, including:
- The lack of available slots at existing south-east airports;
- 'Bumping' of freight from passenger aircraft;
- Security issues particularly with outsized cargo; and
- Speed of turnaround and bottlenecks for air freight.

In addition to helping meet air freight capacity requirements, the Proposed Development would bring significant economic benefit to the area. Since the closure of the Pfizer plant near Sandwich in 2012 and Manston Airport in 2014, east Kent has not been host to a significant high-tech employer. Re-opening Manston is predicted to bring 3,417 direct jobs and a total of 23,235 direct, indirect, induced and catalytic jobs to the local, regional and UK economy by the 20th year of operation. To ensure the demand for skilled workers can be met locally, RiverOak is also working with local educational institutions to establish complementary education and training programmes.

To accommodate the new infrastructure required as part of the Manston Airport development, it is necessary to remove or significantly alter all existing buildings. Two buildings have high potential to support bat roosts and therefore impacts to bats are unavoidable. However, given the low numbers of

bats foraging and commuting across the site this is not predicted to result in a significant effect on the conservation status of bat populations.

E2.2 Capture and release (if applicable):

Please confirm that you agree to undertake the following procedures for the capture and exclusion of bats, where these are applicable:

a. The use of endoscopes, artificial light from torches, destructive search by soft demolition (see Definitions), temporary obstruction of roost access, temporary or permanent exclusion methods (including installation) and use of static hand held nets must only be undertaken or directly supervised by the Named Ecologist, or an Accredited Agent.

b. Where capture and/or handling of bats are necessary, only the Named Ecologist, Accredited Agent, or an Assistant directly supervised by the Named Ecologist may do so. Capture/handling/exclusion of bats must only be undertaken in conditions suitable for bats to be active.

c. Where bats are discovered and taken (excluding unexpected discoveries during adverse weather conditions) they must either be relocated to an alternative roost (see Definitions) suitable for the species, or where bats are held this must be done safely and bats released on site at dusk in, or adjacent to, suitable foraging/ commuting habitat in safe areas within or directly adjacent to the pre-works habitat.

d. Endoscopes and hand held nets are only to be used to assist with the locating and capture of bats.

e. Temporary and permanent exclusion must be carried out using techniques specified in the most up to date edition of the '*Bat Workers Manual*'. If one-way exclusion devices are to be used, each device must remain in position for a period of at least 5 consecutive days/ nights throughout a spell of suitable weather conditions, or remain longer until these conditions prevail.

f. Prior to destructive works, an inspection using torches and/or an endoscope must be performed internally to search for the presence of bats. If any licensed vesper bat species is found and is accessible, each will be captured by gloved hand or hand-held net, given a health check and then each placed carefully inside a draw-string, calico cloth holding bag or similar for transport. If any licensed horseshoe bat species is found, the capture methods outlined in (h) will only be used after it has been shown that overnight dispersal or exclusion are no longer practicable methods.

g. Following inspection and exclusion operations, the removal of any feature with bat roost potential, will be only performed by hand in suitable weather conditions and under direct ecological supervision. Where applicable, materials will be removed carefully away and not rolled or sprung to avoid potential harm to bats. The undersides of materials will be checked by the Named Ecologist or Accredited Agent for bats that may be clung to them before removal.

h. For sites where the presence of horseshoe species has been confirmed, the following exclusion method will be used: prior to work commencing, the Named Ecologist or Accredited Agent will conduct a thorough internal inspection for the presence of horseshoe bats. Only after the void is shown to be unoccupied will the destructive search commence, or all apertures into that void be closed and sealed (windows, doors, etc) by use of boarding, sealed tarpaulin or similar.

   If a horseshoe bat is encountered, it will be left undisturbed during daylight. After all bats have dispersed overnight, the void will be sealed as described above. If all bats have not emerged, the Named Ecologist will either use torchlight and non-tactile human presence to disturb the bat to encourage it to emerge and disperse, during night only, or through use of a hand held net. Only after all bats have emerged from the building or void will it be sealed.

Yes, I agree / No, I don't agree
Yes

If NO, please provide justification below. Please use this text box to describe any additional information on protocols to be employed if bats are found during works. Non-standard capture and exclusion apparatus must be shown on **Figure E2**.

Should your proposals include capture (taking) please specify numbers of each species that will be affected at the time the works are to be undertaken:

Species	Expected number of bats to be captured at the time works will be undertaken. *Note: this may be different to the number of bats using the roost at its optimum time as timings for works will be at a time when bats are least likely to be present*.
Common pipistrelle	As a precautionary approach, it is anticipated that a maximum of five common pipistrelle bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Soprano pipistrelle	As a precautionary approach, it is anticipated that a maximum of five soprano pipistrelle bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Brown long-eared bat	As a precautionary approach, it is anticipated that a maximum of five brown long-eared bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Natterer's bat	As a precautionary approach, it is anticipated that a maximum of three Natterer's bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Whiskered bat	As a precautionary approach, it is anticipated that a maximum of three whiskered bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Brandt's bat	As a precautionary approach, it is anticipated that a maximum of three Brandt's bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Daubenton's bat	As a precautionary approach, it is anticipated that a maximum of three Daubenton's bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Nathusius pipistrelle	As a precautionary approach, it is anticipated that a maximum of two Nathusius' pipistrelles will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Serotine	As a precautionary approach, it is anticipated that a maximum of three serotines will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Noctule	As a precautionary approach, it is anticipated that a maximum of three noctules will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.
Leisler's bat	As a precautionary approach, it is anticipated that a maximum of three Leisler's bats will be captured during the works. The actual number is likely to be lower than this given the timing of the proposed works.

** * Please note that you can add more rows to the table: right click in any cell outside the grey box area. Choose Insert > Insert rows below.*

E3 Bat roost and access point retention, modification and creation: Please detail how all impacts to each species (as identified in sections C and D) will be mitigated. If not applicable to your proposals please state 'N/A' in the relevant text boxes.

Please note that breathable roofing membranes must not be installed into a roof used by bats. If the use of roof membranes is necessary, only Bitumen type 1F felt with a hessian matrix will be permitted under licence:

Yes, I agree

E3.1 Retention of existing roost(s) – *Works may include, for example, maintenance works that result in no material changes to the roost but may cause disturbance or temporary damage e.g.* temporary *exclusion of a roost to allow investigative and repair works to a bridge*. Provide details of all works including:

- Number and description of roosts to be retained, with an explanation of how they will be retained. Confirm dimensions to be retained.

N/A

- Number of access/entrance points to be retained and how this will be achieved. If enhancements to the roosts will be provided, such as through crevice provision, please detail.

N/A

- Mitigation for any other impacts e.g. new lighting at the site.

N/A

E3.2 Modification of existing roost(s) - *Works may include, for example, reduction in roof void height, change of tiles and roof lining (stating the type of membrane that will be used), alteration of access point through replacement of soffits etc.* Please provide the following:

- Dimension details of modified roosts: clearly state what the original roost dimensions were and what the dimensions of the modified roost will be.

N/A

- Dimension details of modified access points: clearly state how the access points are being modified.

N/A

- Details of any other modifications to be made to roosts.

N/A

- Mitigation for any impacts of lighting on the modified roost/s if appropriate.

N/A

E3.3 New roost creation (including bat houses, cotes and bat boxes etc).

Note – creation of compensation for high impact cases (e.g. loss of a maternity roost) must be protected in the long term. Any bat boxes or roost structures that are part of a licence proposal which do not show signs of bats must be retained for a minimum of 5 years from date of completion of the development/works. Typically this will be around 5 years for low conservation status roost compensation (e.g. bat boxes) and longer for other significant roosts (e.g. bat houses, lofts etc). The exact time period will be specified in any licence issued. For high conservation status roost loss, the compensation roost/s must still be protected in the long term by another means (such as a s106 agreement), which is particularly important if the structure is likely to change ownership.

E3.3a Please complete the table below for the species and roost types listed. For all other species and roost types please provide information under **E3.3b**.

Species & Roost type for which new roost creation will be provided Select 'yes' for those species impacted or 'N/A' if not applicable	**New roost creation**
	Compensation should be in line with the *Bat Mitigation Guidelines*. Where compensation is being provided, there should be at least **one compensation feature, suitable for the species concerned, per roost and per species to be impacted**, OR If a proposal impacts more than one bat species and / or roost type then cumulative impacts must be considered when designing the compensation; this should always be in line with the species and / or roost type which will be subject to the greatest impact and

to this application	ensure that the requirements of all species impacted are met.		
	Compensation Feature	**Quantity**	**Location of Compensation Feature** (as shown on Figure E3)
Common pipistrelle ☒ Yes ☐ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☒ Bat box ☐ Integrated bat box/ bat brick/ bat tube ☒ Bat tile (including ridge tile) ☐ Other (specify): ☐ None	48	☐ In same building ☐ In other existing building on site ☒ In new building ☒ Other (specify): Forteen bat boxes to be installed in northern part of the application site, eight in the bat barn and twenty-six around the Biodiversity Area.
Soprano pipistrelle ☐ Yes ☐ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☐ Bat box ☐ Integrated bat box/ bat brick/ bat tube ☒ Bat tile (including ridge tile) ☐ Other (specify): ☐ None	48	☐ In same building ☐ In other existing building on site ☒ In new building ☒ Other (specify): Forteen bat boxes to be installed in northern end of site, Eight in the bat barn and twenty-six around the bBodiversity Area
Whiskered ☒ Yes ☐ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☒ Bat box ☐ Integrated bat box/ bat brick/ bat tube ☐ Bat tile (including ridge tile) ☐ Other (specify): ☐ None	48	☐ In same building ☐ In other existing building on site ☒ In new building ☒ Other (specify): Forteen bat boxes to be installed in northern end of site, Eight in the bat barn and twenty-six around the Biodiversity Area
Brandt's ☐ Yes ☒ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☐ Bat box ☐ Integrated bat box/ bat brick/ bat tube ☐ Bat tile (including ridge tile) ☐ Other (specify): ☐ None		☐ In same building ☐ In other existing building on site ☐ In new building ☐ Other (specify):
Daubenton's ☐ Yes ☒ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☐ Bat box ☐ Integrated bat box/ bat brick/ bat tube ☐ Bat tile (including ridge tile) ☐ Other (specify): ☐ None		☐ In same building ☐ In other existing building on site ☐ In new building ☐ Other (specify):
Natterer's ☒ Yes ☐ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☒ Bat box ☐ Integrated bat box/ bat brick/ bat tube ☐ Bat tile (including ridge tile) ☐ Other (specify): ☐ None	48	☐ In same building ☐ In other existing building on site ☒ In new building ☒ Other (specify): Forteen bat boxes to be installed in northern end of site, Eight in the bat barn and twenty-six around the Biodiversity Area
Brown long-eared ☒ Yes ☐ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	Note: boxes for this species will only be acceptable in certain circumstances, where this is justified on an ecological basis ☐ Bat box, justification ☒ Other (specify): Designed bat barn and bunker ☐ None		☐ In same building ☐ In other existing building on site ☒ In new building ☐ Other (specify):

Serotine ☐ Yes ☒ N/A *Day roost* *Night roost* *Feeding* *Transitional/Occasional*	Note: bat boxes are not suitable for this species. Compensation should replicate, as closely as possible, the existing roost: ☐ Bat tile ☐ Bat brick ☐ Other (specify):		☐ In same building ☐ In other existing building on site ☐ In new building ☐ Other (specify):
Lesser Horseshoe ☐ Yes ☒ N/A *Day roost* *Transitional/Occasional*	A proportionate number of bat features suitable for the species. The provision of one feature, suitable for the species concerned (eg void) per roost to be impacted will be considered appropriate: Specify:		☐ In same building ☐ In other existing building on site ☐ In new building ☐ Other (specify):

E3.3b For all species and roost types not covered in the above table please provide the following:

- New roost dimension details or features (to include bat tiles/boxes as applicable).

<u>Bat Barn</u>

New bat barn designed for myotis sp. and long eared bats. The new barn will have minimum internal volume of 250m^3 with minimum roof height 2.5m.

Shape and orientation:
An L-shaped floor plan will be used as this offers a number of aspects, creating a range of microclimates inside the building. The short arm of the 'L' will be south-facing.
The short arm of the 'L' will have potential to be used for maternity roosting and so the roof void should not be over shaded by trees. The barn will be connected to near-by broadleaved woodland via the adjacent low hedgerow.

Wall construction
Walls will be constructed from stone or brick. A double skin will be used, with cavity wall insulation, leaving a 10-15cm gap at the top of the walls as bat roosting crevices. Small gaps in the pointing will be left open near to the eaves to allow crevice roosting species additional access to the wall cavity. Fibrous or sticky insulation materials which could entrap and entangle bats will not be used.

Gable ends
A permanently open aperture "letterbox sized" would be placed on one of the gable ends ideally away from the maternity roost end to prevent drafts. This would be provided for species such as brown long-eared and Natterer's.

Roof construction
The roof will be steep (optimum angle 42°) and double-pitched, with gables overhanging the walls by at least 10cm all round. In addition, the roof will be covered with black slates or tiles (for maximum heat absorption) e.g. charcoal grey plain concrete roof tiles. The type of timber frame used should aim to minimise the number of support trusses which clutter the flying space within the roof void. A traditional cut and pitch construction with joists and rafters, including a deep central ridge board, is ideal, providing angles within which bats will roost.

Ridge tiles will contain sections unfilled with mortar to provide roosting crevices, with occasional ventilated ridges tiles to allow access into these and into the roof void. Occasional tiles in roof to allow bat access e.g. raised tiles at edges with mastics.
A wooden soffit box will be fitted around the whole edge of the roof (side walls and gables), with occasional gaps (e.g. 1.5cm deep x 10cm wide) between the wall and lower edge of soffit to permit bat access to the wall cavity and roof void.

The roof will be lined internally with loose-fitting traditional bitumastic felt which allows bats to hang from, in addition allowing space for bats to roost between tiles and felt, and tears created in the felt for bat access. Breathable membrane will not be used. Within the roof void, 1m lengths of rafter will be added alongside the roof timbers spaced 20-25mm away with a further piece used to bridge the two, creating a long-enclosed cavity. Additional rough sawn timbers fixed longitudinally within the roof void at various heights on the rafters will provide opportunities for grooming and social interaction.

Internal partitioning
A double wooden floor will be installed, with insulation between the two layers, dividing the house into a ground floor and an upper floor open to the roof ridge.

The ground floor will be further subdivided into smaller rooms, including a room within the north-facing area: the wall insulation material in this area will be continued to the tops of the walls, to create a very well insulated cool room. Within the cool room there will be a 2m minimum height of the artificial hibernaculum buried at least 1m deep underground with a 1m foundation.

Flooring
It is important that a high humidity is maintained in the lower floor, and especially the cool room, during winter, when bats are hibernating. Bare earth floors should be adequate for this, depending on local conditions; otherwise measures may be needed to introduce water into the ground floor, for example by having rainwater drainpipes routed into the building. Any areas of open water should be covered with mesh to prevent bats from drowning.

External access and security
A high-security access doorway to the ground floor will be built as the main human entrance to the bat barn. The upper part of the door will comprise an opening at least 500mm x 500mm (or an equivalent area, not less than 300mm high). The opening will be covered by a grille with horizontal bars spaced 130mm apart. Vertical supports will be spaced further apart than the horizontals bars, though not enough to allow the horizontal bars to be bent easily: a spacing of 750mm would be adequate. The door will be as close as possible to trees or hedges nearby without these actually obstructing the entrance. The ground floor access doorway will lead to a room in the centre of the ground floor. The doorway will not lead directly into the cool room.

A second, smaller (e.g. 500mm wide x 300mm deep) grilled entrance to the roost will be provided on a different aspect to the main entrance in order to provide bats with a choice of entry points and will include a mammal prevention panel below. This would need to be fitted with a similar baffle system, opening into one of the ground floor rooms (other than the cold room).

Wide, steeply sloping metal sills will be fitted to the bottom of both grilled bat entrances, to deter entry by predators such as cats.

Bat Bunker

A purpose-built bat bunker will be constructed within the BA to compensate for the loss of five (potential) hibernation roosts on site comprising a low number of bat species; brown long-eared, Myotis sp., common pipistrelle or soprano pipistrelle species. The bunker will provide crevices for bats to hibernate.

The bunker will be constructed of materials similar to that of the bunkers to be lost on site. Wall construction will ensure a cavity is present and insulation should be continued to the tops of the walls throughout, to create a very well insulated bunker. In addition, the concrete block roof should be fully insulated. The bunker will be a 2m minimum height with the bunker dug into the ground to at least 1m or alternatively back filling around the wall to over 1m in height. There porch area will be over 1m x 2m which will have a divide leading into two subsequent chambers each being over 3m x 3 m in size which will provide roosting opportunities throughout and will create a stable internal microclimate, primarily suitable for hibernation purposes although may be used by small numbers of bats on an occasional basis for transitional or day roosting purposes.

It is important that a high humidity is maintained during winter, when bats are hibernating. Bare earth floors would be provided for this and if required water introduced into the ground floor (with any areas of open water being covered with mesh to prevent bats from drowning).

Full schematics can be found in Appendix E3.3.

- Access points and size of access points.

Barn

- Ventilated ridge tile – 20mm high;
- Raised tiles with 20mm high gap;
- X8 bat boxes (5x Kent boxes and 3x Schwegler 1FW) with 20mm high gap created by raising tile;
- A permanently open aperture “letterbox sized” would be placed on one of the gable ends ideally away from the maternity roost end to prevent drafts. This would be provided for species such as brown long-eared and Natterer’s.

- Location details (including an 8-figure grid reference for bat houses or bat lofts relating to the structure. 8-figure grid references are not required for positions of individual boxes, tiles etc).

TR 3356 6485

- Aspect. Explain how the internal conditions of the roost will be created.

See above. Multiple aspects and internal microclimates created by L-shape design and pitched roof, alongside internal partitions. Floor will be left unsurfaced to provide an access route for moisture to create suitable humidity.

- Details of the materials to be used e.g. timber, sarking, felt etc.

Plywood, timber, galvanised access grill, loose fitting bitumastic felt, roof tile.

- Justification for any variation from the original roost and/or deviations from recommendations in the Bat Mitigation Guidelines. (*Diagrams of widely available standard bat box designs are not required; just refer to bat box name and reference number, e.g. Schwegler 1FF*).

- Mitigation for any impacts of lighting if appropriate.

The on-site lighting strategy will be designed to ensure low light levels in the immediate vicinity of the bat box locations (see Figure 3.2). The northern section of the Site will be designed to be a bat corridor and as such the following key principles to reduce the lighting will need to be considered:

- The minimum amount of light needed for safety should be used, following published standards for lighting tasked to minimise upward reflected light. Wherever possible, artificial lighting should be avoided completely;
- The use of bare bulbs and upward-pointing light should be avoided, to keep the spread of light near to or below the horizontal;
- Light sources with a narrow spectrum of wavelengths should be used, to reduce the range of species (both bats and other nocturnal fauna) affected by lighting;
- Light-spill should be minimised with the use of hoods, cowls, louvers and shields to direct the light where possible;
- For pedestrian lighting, low level lighting that is as directional as possible should be used, to achieve light levels below 3 lux at ground level; and
- The times that lights are on should be restricted, for example through the use of motion-activated lighting, to provide some dark periods for bats and other wildlife.

There will be no artificial lighting in the Biodiversity Area

- Structures for access for monitoring / maintenance purposes (if applicable)

N/A

E3.4 Other habitat re-instatement or creation (e.g. retention of existing flight lines, retention or creation of appropriate vegetation around roost entrances where applicable) – please include details of:

- Habitat replacement (following works resulting in temporary impacts) or creation not covered by sections E2 to E3 such as hedgerow/woodland planting or enhancement. State the length of hedgerow planting and areas (ha) of other planting to be provided such as woodland and anticipated establishment period etc.

In addition to the bat barn, bat bunker and bat boxes the Biodiversity Area is to include the following habitats: 31.1 ha semi-improved neutral grassland;0.5 ha broad-leaved woodland; 0.2 ha scattered scrub; 0.2 ha ephemeral wetland/inundation vegetation; 3ha ephemeral/short perennial vegetation; 0.65 ha bare ground and 2.4 km of species-rich hedgerow.

- Creation of flight lines/routes of connectivity.

Within the Biodiversity Area hedgerows will be created or enhanced (by filling in gaps). This will form a species-rich hedgerow which will grow to provide commuting routes for bats along with foraging opportunities. Feathered whips (at least 150cm in height) should be planted to ensure commuting routes are in place immediately and reduce the need for newly planted hedgerows to grow in.
The broadleaved woodland to the west of the Biodiversity Area will be enhanced and increased in area. Connections will be made from the bat barn and bunker to this woodland. Reptile and invertebrate habitat will extend ~5m from the hedgerow boundary surrounding the Site which will provide additional invertebrates for foraging and commuting bats. Fruit bearing trees will be planted around the bat barn, these attract insects important for foraging bats but also will not shade out important southern faces aspects of the bat barn.
Two ditches will extend along the southern part of the western boundary to increase invertebrates adjacent to the bat barn, bat bunker and bat boxes.
Much of the BA will include species-rich grassland which increases invertebrate abundance and will in turn provide an additional foraging resource for bats

- Foraging area enhancements, etc

N/A

- Mitigation for any impacts of lighting if appropriate.

N/A

E3.5 Wider biodiversity gains:
Please indicate if enhancements, over and above what is necessary to mitigate the impact of the activity of the licence proposal, are being provided. Please indicate if enhancements are included to satisfy the requirement of a planning permission, and if so state the relevant planning condition, or other consents in your response below. Please also state if an applicant wishes to provide more than is typically required to mitigate for the impacts. Enter N/A if this is not applicable to your application.
Note: *Any licence granted will only cover mitigation and compensation required to fulfill licensing requirements, but will acknowledge additional biodiversity enhancements*.

In line with the requirements of Policy 4 for EPS and discussions with Natural England the mitigation strategy provides more compensation than is necessary to balance the data deficiency of this application. The greatest benefits are within the Biodiversity Area south of the Proposed Development area. In this there will be hedgerow creation and enhancement as well as creation of new water bodies.

Mitigation and compensation provided under the worst case assessment (i.e. the bat boxes, bat barn and bunker) provides considerably greater benefits to bats than those currently present within the development area (as indicated by the applicant’s survey data and those of the Stone Hill Park Ltd 2018 application (OL/TH/18/0660). The additional mitigation is not a condition of planning consent.

Important Advice:
Scaled maps/plans of mitigation/compensation must be provided as separate maps/figures (also ***see section I "Map checklist" at the end of this document)***:

- **Figure E2** if non-standard capture and exclusion apparatus is proposed please include diagrams/photographs.
- **Figure E3** to show specifications for mitigation / compensation to be provided and annotate where it will be provided. Should the scheme be large or complicated it may be necessary to submit more than one figure.

NOTE: It must be possible to compare these with the survey results plan (**Figure C6**) and 'Impacts' Figure (**D)**.

E4 Post-development site safeguard: Further guidance and explanation on post-development monitoring requirements are included within our 'How to get a licence' document http://www.naturalengland.org.uk/Images/wml-g12_tcm6-4116.pdf. Also see Section 8.7 of the Bat Mitigation Guidelines.

E4.1 Habitat/site management and maintenance: Is any specific post-development habitat management and site maintenance planned? If 'No; state 'N/A'. If 'Yes' include the following:

- The period (years and months) for which habitat management and maintenance will take place. Ensure that this is consistent with the post development works detailed in section **E5b** of the **Work Schedule document, WML-A13-a-E5a&b**.

In line with the additional effort required to satisfy Natural England's Policy 4 for EPS licences the condition of the barn will be checked once a year by the client's licensed ecologist for 10 years.

- Details of what will be undertaken in terms of site maintenance required to ensure long-term security of the affected population (e.g. maintain, repair or reinstate access points; maintain and repair heaters and /or data loggers; maintain, repair or restore bat feature / bat loft in good condition; repair or replace inspection hatches; management and maintenance of lighting regime, or bat boxes etc).

During to check barn will be repaired as necessary under supervision of licensed ecologist

- Details of what will be undertaken in terms of habitat management (e.g. planting cover around roost structure, hedgerow management regime, checking establishment of habitat creation; reduction of shade around roosts, woodland management to maintain species and structural diversity etc). Ensure this relates to the relevant map.

N/A

Note – for phased or multi-plot developments a separate habitat management and maintenance plan is required, which must be submitted with the master plan: see guidance on phased developments.

Important Advice:
Please include **Figure E4** as a separate figure to show which structures and habitats will be managed, maintained and monitored post development as part of your proposal – also *see section I "Map checklist" at the end of this document)*.

E4.2 Population monitoring, roost usage etc: This should be in line with the monitoring requirements detailed in the Bat Mitigation Guidelines section 8.7 and Figure 4.

E4.2a Please complete the table below for the species and roost types listed. For all other species and roost types please provide information under E4.2b.

Species	Roost type	Post-development monitoring requirement
Common pipistrelle **Soprano pipistrelle** **Whiskered** **Brandts** **Daubenton's** **Natterer's** **Brown long-eared**	*Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☐ None. There is no post-development requirement for proposals affecting bat roosts supporting up to any 3 species indicated, of the roost types listed, where they are used by low numbers of each species. ☐ A single presence / absence survey at an appropriate time of year is to be undertaken. This should not take place in the first year following completion of development. Timing (year): ☒ Other (specify): See below

Serotine	*Day roost* *Night roost* *Feeding* *Transitional/Occasional*	☐ A single presence / absence survey at an appropriate time of year is to be undertaken. This should not take place in the first year following completion of development. Timing (year): ☐ Other (specify):
Lesser Horseshoe	*Day roost* *Transitional/Occasional*	☐ A single presence or absence survey at an appropriate time of year to be undertaken in year 2 post development plus a check of the condition and suitability of the roost. ☐ Other (specify):

E4.2b For all species and roost types not covered in the above table please include details of:

- Timing – state the years and months post development monitoring or other will be undertaken. Ensure that is consistent with the post development works detailed in section **E5b** of the **Work Schedule document WML-A13-a-E5a&b**.

Every other year for 10 years

- The type of monitoring which will be undertaken – include survey methods and equipment to be used. If it is expected any bats are to be taken or disturbed during this period please state anticipated numbers per species against each licensable activity.

Hibernation survey using endoscopes and binoculars. Emergence and re-entry surveys will be carried out using Elekon Batlogger M detectors.

- Specify which compensation/mitigation measures will be subject to monitoring (as referenced on Figure E4).

Bat barn and bat bunker. Visual inspection of bat boxes.

Please note that it will be a requirement of the licence to undertake remedial action should monitoring identify that further management/maintenance is required of any compensation/mitigation provided, to ensure that mitigation/compensation measures are working effectively and are fit for purpose.

Important advice: Please always consider whether any *post development* monitoring effort should be staggered over alternate years in cases where use of the compensation measures may not occur in the same year of provision.

E4.3 Mechanism for ensuring safeguard of mitigation/compensation and post-development management, maintenance and monitoring works:

Please explain what mechanism is in place to ensure safeguard of mitigation/compensation provisions (e.g. Restrictive Covenant, clause to relinquish future development rights in S106 agreement, NERC Act agreement, explicit recognition of site in local planning documents, designation as County Wildlife Site or similar.) The need for this, and the type of mechanism, will vary with the scheme and impact. For substantial impact schemes (e.g. destruction of a significant maternity roost, or important hibernation site), some mechanism is always required. If you offer no specific mechanism, explain how you believe the population will be free of threats as far as can be reasonably determined (**the expectation of the granting of a licence should not be used for this purpose**).

Kate/Nick to advise Development subject to Development Consent Order (DCO), therefore it will be enshrined in law.

Explain how all post-development works (management, maintenance (including remedial action) and monitoring, as appropriate) will be ensured? Include a commitment that the monitoring, habitat management and maintenance work will be undertaken. Mechanism/s for ensuring delivery must be in place before applying for a licence (also see Section F).

Contract for works agreed with client.

E5 Timetable of works: Please complete the **work schedule document WML-A13-a-E5a&b found on the 'bat' application form web page and append to your application pack.**

Important Advice: *Please note that from end of March 2014 a separate work schedule is a mandatory requirement to support a new bat licence application when using this template.*

F Declarations

If the mitigation/compensation area/s is/are not owned by the applicant, you must have consent from the relevant land owner(s). You must have also secured details of how any measures to maintain the population in the long term will be achieved (e.g. a legal agreement).

F1 Declaration Statement(s) – **You must include the following declarations within your Method Statement and include the appropriate answer (Yes/No/Not applicable):**

F1.1 **Re: section E1 -** I confirm that relevant landowner consent/s has/have been granted to accept bats into roosts or access into roosts on land outside the applicant's ownership:

Select

F2.2 **Re: section E2 -** I confirm that landownership consent/s has/have been granted to allow the creation of the proposed compensation on land outside the applicant's ownership

Select

F2.3 **Re: section E3** - I confirm that consent/s has/have been granted by the relevant landowner/s for monitoring, management and maintenance purposes on land outside the applicant's ownership

Select

Comments if applicable:

Important Advice:

Unsecured consents statement:

If you have been unable to secure consents for any of the three declarations please explain why and detail any plans you have in place to obtain the consent(s) or provide details of any right(s) or agreement(s) that will enable the lawful implementation of the proposed mitigation, compensation and monitoring. Failure to provide the appropriate landowner consents means that the Method Statement is unlikely to meet the requirements for the FCS test to be met. It is therefore in your interest to ensure that the appropriate consents have been secured *before* applying for a licence.

G References: List any references cited, and include credits for source information.

H Annexes (supporting documents please append to your application pack)

H1 Pre-existing survey reports;

H2 Raw survey data.

I Check list of figures to be submitted with each Bat Method Statement

With your Method Statement and supporting documents please submit the following maps/figures – see table below. Note that some can be included within the Method Statement itself (if preferred) and others must be submitted individually (i.e. separate documents). Maps/Figures must include the title, site name as referenced on your application form, date and figure reference. If a grid reference is more applicable (e.g. a bat house is being provided please included this). Include a scale bar (appropriate to the situation e.g. 100m on site maps, 1km on location maps) and direction of North etc.

Additional maps, photographs or diagrams should be included where necessary to adequately explain the scheme.

Figure reference	Mandatory as will be included in the annexed licence, if applicable	Mandatory for assessment purpose only, but will not be included in the annexed licence	What it must show (also see details above on site reference, dating and naming).
Figure B2.1	-	Yes, if the application is part of a phased or multi-plot development	**Master plan overview-** note – this is not the same as a master plan document, for which you should follow the guidance as stated in section B2.1.
Figure B2.2	-	Yes, if applicable	**Locations of other nearby bat licensed sites, or sites which will be impacted on by future development.**
Figure C5a	-	Yes	**Location map** at an appropriate scale for the application (often 1:50,000 or 1:25,000)
Figure C5b	-	Yes	**Survey area** showing all buildings, structures and habitats that are within the survey area and distinguishing those that were surveyed and those that were not. Indicate where surveyors were located. Aerial photographs should be provided where possible (ensure you have permission to use copy righted maps). If automated detectors were used or transect routes, ensure that these are indicated as appropriate.
Figure C6	-	Yes	**Survey results -** provide clear, annotated and cross-referenced maps/plans/photographs to show the survey results (access points, location of roosts, flight lines, results of activity surveys where DNA samples were taken etc).Ensure Figure is at a suitable scale to show the results.
Figure D	**Yes**	**-**	**Impacts plan –** map/figure which must show all structures or habitats (clearly referenced) that will be disturbed, damaged or destroyed, detailing where the roosts and access points are.
Figure E2	**Yes** – but only if applicable to the application	**-**	**Non-standard capture and exclusion apparatus.** If these are proposed please include diagrams/photographs.
Figure E3	**Yes**	**-**	**Specifications for mitigation / compensation** (including all dimensions for bat lofts/houses/stand-alone structures and materials to be used etc and 8-figure grid reference). Mitigation / compensation (must show all habitat creation, restoration, boxes). It may be necessary to submit more than 1 figure if the proposal is large or complicated.
Figure E4	**Yes** – when monitoring and maintenance will be included in the licence	**-**	**Monitoring, management and maintenance map.** Please indicate the specific structures and habitat that are to be managed, maintained and monitored as part of this licence proposal. Ensure that they are correctly referenced and are consistent with other parts of the Method Statement and figures.

Definitions of roost types to be included in the application (further detail can also be found in the Bat Mitigation Guidelines and the BCT's "Bat Surveys Good Practice Guidelines"):

a. **Day roost**: a place where individual bats, or small groups of males, rest or shelter in the day but are rarely found by night in the summer.

b. **Night roost**: a place where bats rest or shelter in the night but are rarely found in the day. May be used by a single individual on occasion or it could be used regularly by the whole colony.

c. **Feeding roost**: a place where individual bats or a few individuals rest or feed during the night but are rarely present by day.

d. **Transitional / occasional roost**: used by a few individuals or occasionally small groups for generally short periods of time on waking from hibernation or in the period prior to hibernation.

e. **Swarming site**: where large numbers of males and females gather during late summer to autumn. Appear to be important mating sites

f. **Mating sites**: sites where mating takes place from later summer and can continue through winter.

g. **Maternity roost**: where female bats give birth and raise their young to independence.

h. **Hibernation roost**: where bats may be found individually or together during winter. They have a constant cool temperature and high humidity. Sites where hibernating bats have been confirmed by appropriate survey effort should be classed as '**hibernation confirmed**'.

i. **Satellite roost**: an alternative roost found in close proximity to the main nursery colony used by a few individual breeding females to small groups of breeding females throughout the breeding season.

j. **Other** – please explain what the roost type is if not one of the above (we recognise that roost types are interchangable and not always easy to classify according to the nuances of certain species).

k. An **'alternative roost'** shall include: a purposely installed bat box; an existing roost which will not be impacted by the works; or other new/enhanced roosting opportunities. Any alternative roost must be suitable for the species, within or close to the existing roost and free from additional disturbance or development pressure.

WML-A13a-E5a&b – WORK SCHEDULE FOR BAT

ANNEXED LICENCE

NATURAL ENGLAND

Site name and address (as stated on the application form or licence granted):

Please ensure that the work schedules are S.M.A.R.T and appropriate timescales are provided for each activity, to fit with order of events.
Complete these schedules to show timings for all categories of work (mitigation and compensation measures), and to show the main construction period. The most common activities are listed here, and you can add up to 6 more if needed. Leave blank if not applicable. Enter timing by stating **start and end dates, to nearest month and year** (see first lines for examples). Enter comments if you need to clarify timings. For very complex schemes (e.g. high impact or phased development schemes) if additional lines are needed please do add in. This work schedule will form part of any annexed licence.

E5a

PLEASE INCLUDE DATE OF SUBMISSION (e.g. 01 July 2016). This will be referenced in the annex →

Activity	Timing	Comments
Pre- development activity		
Example: Bat house creation (in advance of licence)	***Sept-14 to Nov-14***	***Also put up 3 bat boxes before end of December 2015, in advance of works commencing***
Creation of standalone bat feature/s (state completed and fit for purpose if created before licensable works due to commence)	1/3/2020-1/6/2020	Creation of bat barn and hibernacula before winter 2020
Installation of bat boxes pre-development works (state completed and fit for purpose if created before licensable works due to commence)	1/3/2020-1/6/2020	Total of 48 bat boxes in biodiversity area and on site
Permanent exclusion measures (e.g. use of one-way excluders prior to permanent blocking of access points or destruction of roost)		
Mid-development activity		

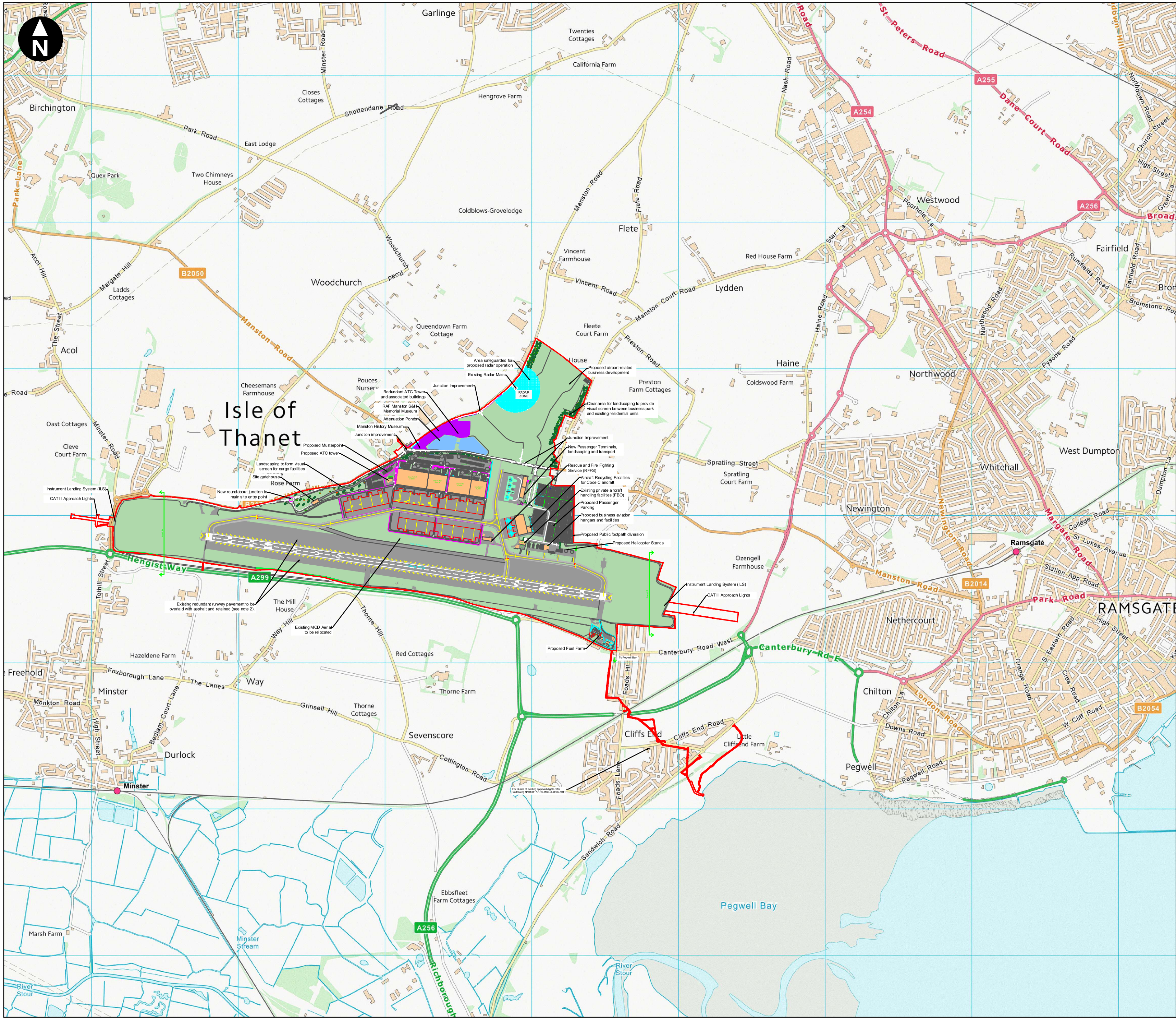
Example: Capture exercise (e.g. by hand /hand-held nets, etc)	***Sept-2016***	***By hand***
Pre-works inspection by Named Ecologist or Accredited Agent	1/3/2020-31/10/2020	
Installation of protective measures (e.g. separation membranes whilst working in lofts)		
Disturbance by noise, illumination or vibration (please specify)		
Temporary exclusion measures (e.g. use of one-way excluders with access re-instated following works)		
Permanent exclusion measures (e.g. use of one-way excluders prior to permanent blocking of access points or destruction of roost)		
Capture exercise (e.g. by hand / hand-held nets, etc – please state)	1/3/2020-31/10/2020	By hand/static net
Destructive search by soft demolition	1/3/2020-31/10/2020	To have at least demolished buildings to a state where they are unsuitable for bats by end date
During development		
Example: Mechanical demolition	***Oct-2016***	***Buildings X and Y will be knocked down after sign off from Named Ecologist***
Mechanical demolition of all or part of structures (once declared free of bats by Named Ecologist or Accredited Agent) – please state	15/3/2020-31/12/2020	
Construction period start and end dates	1/4/2020-1/1/2025	Bat mitigation in place seperately from construction - see pre-development activity
Site checks and maintenance during construction		To be checked during annually by client
Post construction mitigation/compensation on 'development' site or other (provide details below)		
Example: Installation of access points and bat boxes	***Feb-2017***	***Access points will be installed after completion of new roof structure; remaining 3 x bat boxes installed by end of this month.***
Creation of mitigation/compensation post development (e.g. installation of bat tubes, bricks, boxes, access points, etc – specify in comments section)		
Habitat reinstatement or restoration (following temporary impacts)		
Hedgerow or woodland planting (please specify)	1/3/2020-31/12/2020	Hedgerow planting and infilling in Biodiversity

		Area

E5b) Post-development works - type a "Y" where each activity will occur for a given year and leave blank for no activity.

Year:	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Monitoring						Y		Y		Y		Y
Habitat management												
Site maintenance												

Year:	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Monitoring		Y										
Habitat management												
Site maintenance												



Key

- Order Linits
- Buildings / Structures
- Grassed Area
- Landscaped Area
- Drainage Pond
- Museum Area
- Pavement & Aircraft Pavement

Notes
Masterplan reproduced from Drawing
NK018417 RPS-MSE-XX-DR-C-2000 P15

0 km 1.5 km
Scale 1:25,000 @ A3

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure B2.1
Masterplan overview

May 2019

wood.

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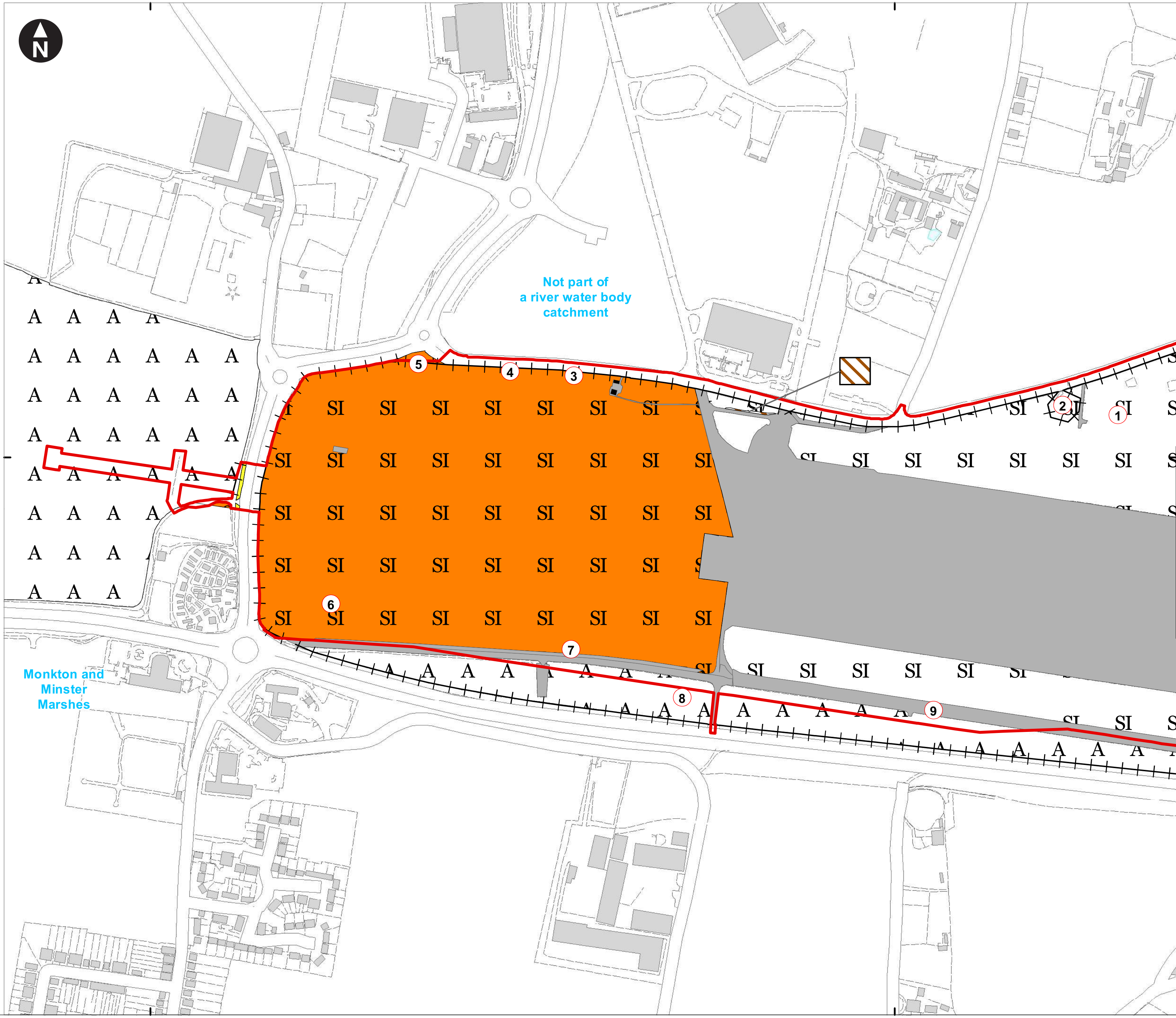
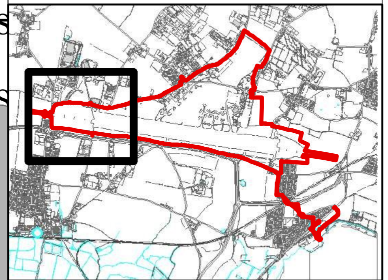


Key

	Order Limits
SI SI	Neutral grassland - semi-improved
I SI SI	Poor semi-improved grassland
	Tall ruderal
A A	Arable
A A A	Amenity grassland
	Buildings
	Hardstanding
	Fence
3	Target note



0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5a
Phase 1 habitat map of the site

Page 1 of 5

April 2019

wood.

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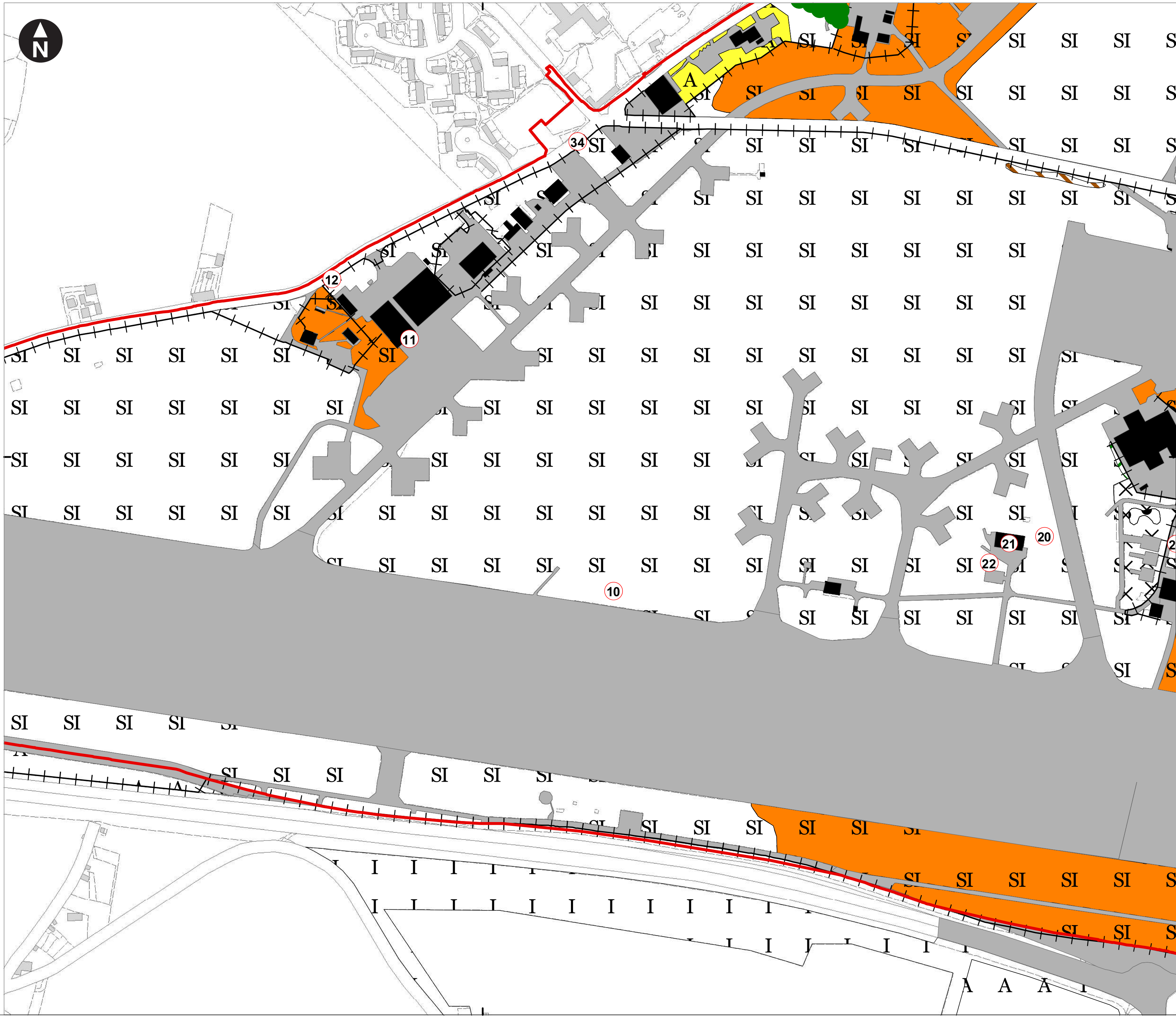

Key

- Order Limits
- Scrub- dense/continous
- Neutral grassland - semi-improved
- Poor semi-improved grassland
- Tall ruderal
- Arable
- Amenity grassland
- Ephemeral/short perennial
- Buildings
- Bare ground
- Hardstanding
- Fence
- Parkland and scattered trees- broad-leaved
- Target note

0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5a
Phase 1 habitat map of the site

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April 2019

wood.

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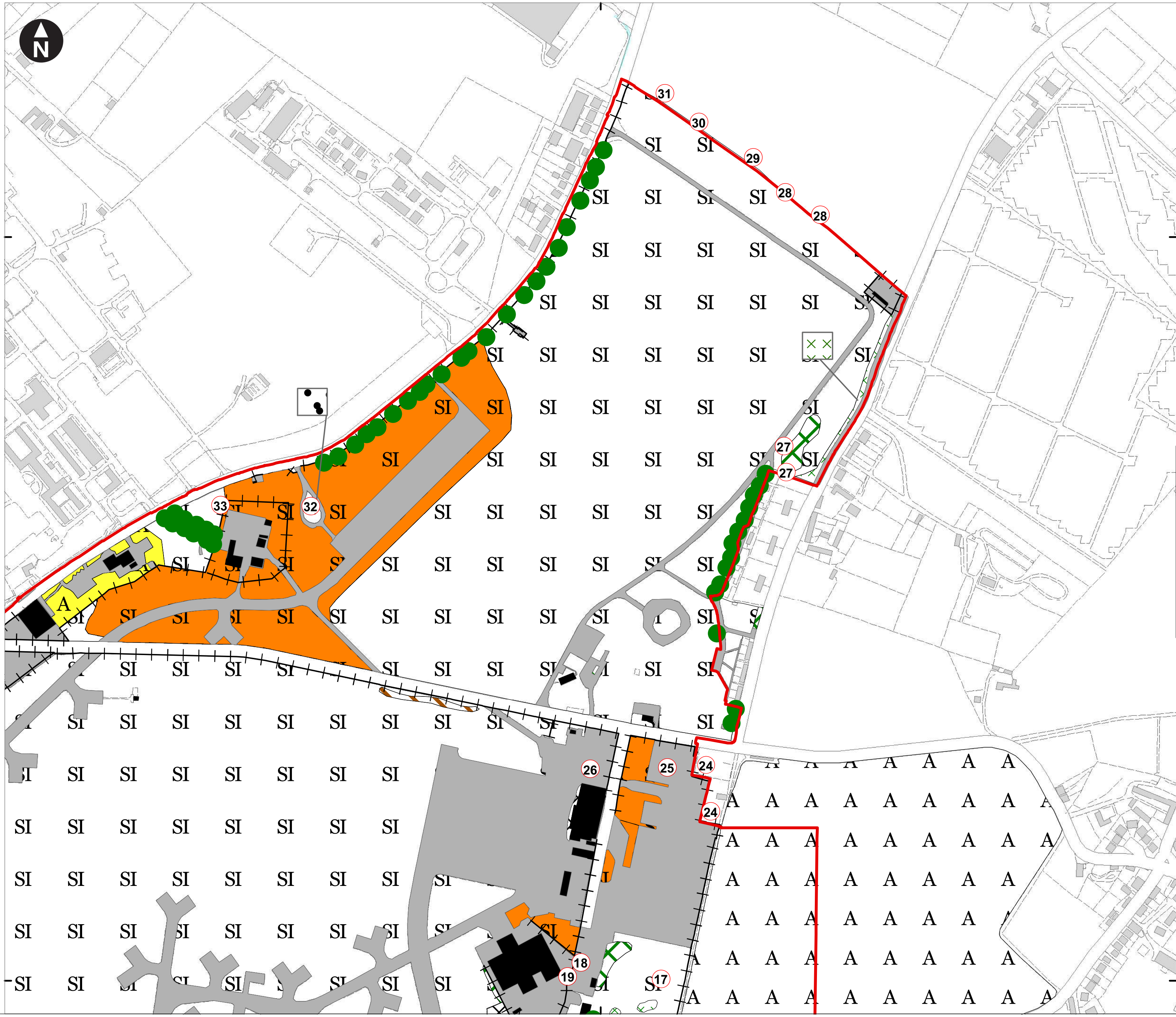
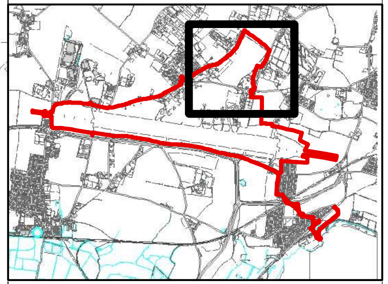


Key

- Order Limits
- Scrub- dense/continous
- Scrub- scattered
- Neutral grassland - semi-improved
- Poor semi-improved grassland
- Tall ruderal
- Arable
- Amenity grassland
- Ephemeral/short perennial
- Buildings
- Bare ground
- Hardstanding
- Fence
- Parkland and scattered trees- broad-leaved
- 3 Target note



0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5a
Phase 1 habitat map of the site

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April 2019

wood.

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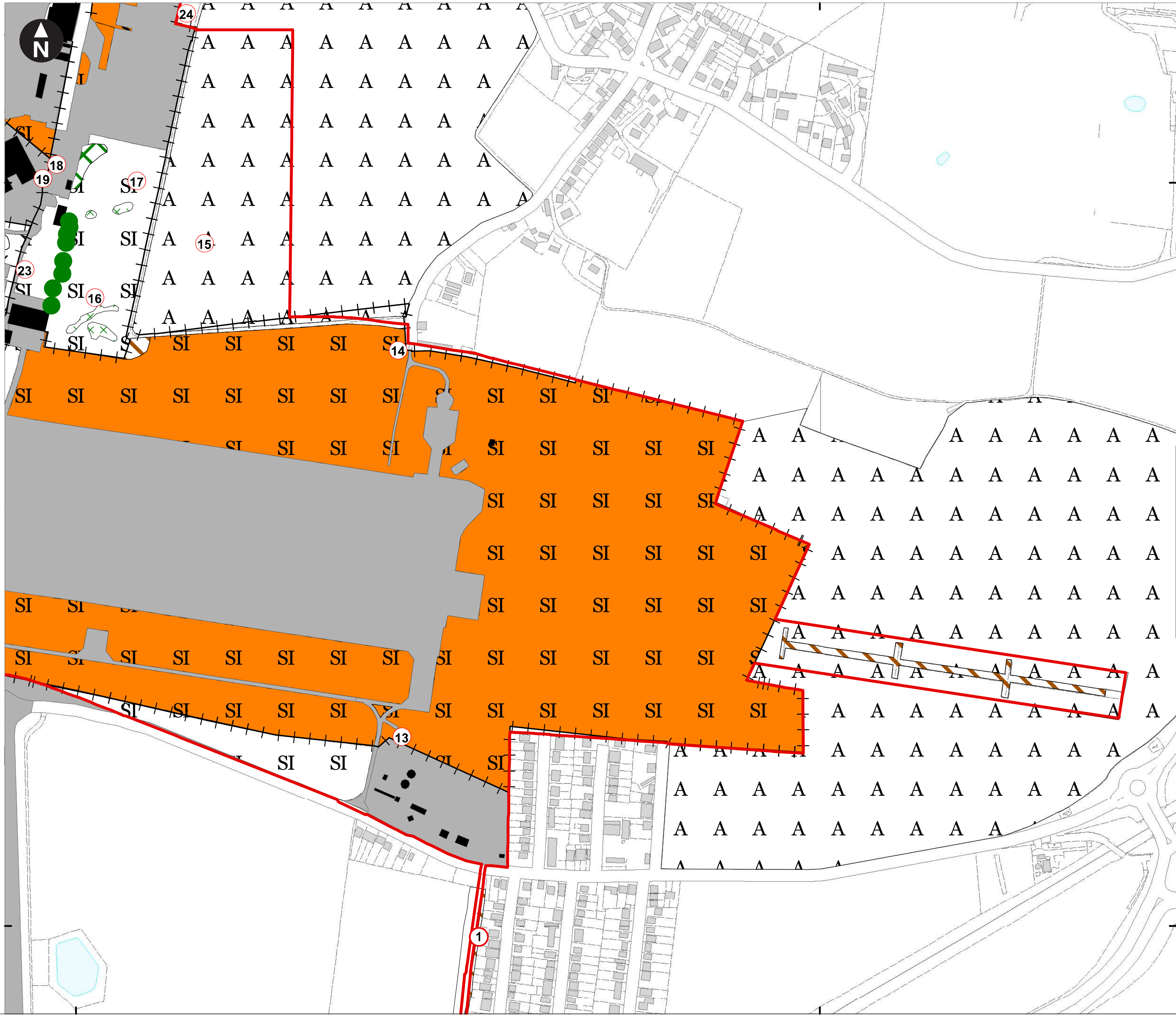
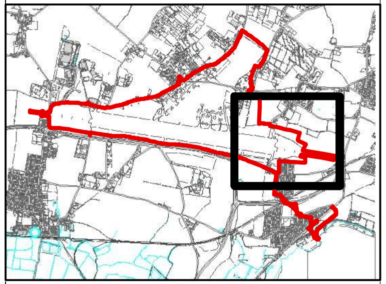


Key

- Order Limits
- Scrub- dense/continous
- Scrub- scattered
- Neutral grassland - semi-improved
- Poor semi-improved grassland
- Tall ruderal
- Arable
- Ephemeral/short perennial
- Buildings
- Bare ground
- Hardstanding
- Fence
- Parkland and scattered trees- broad-leaved
- Target note



0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5a
Phase 1 habitat map of the site

Page 4 of 5

April 2019

wood.

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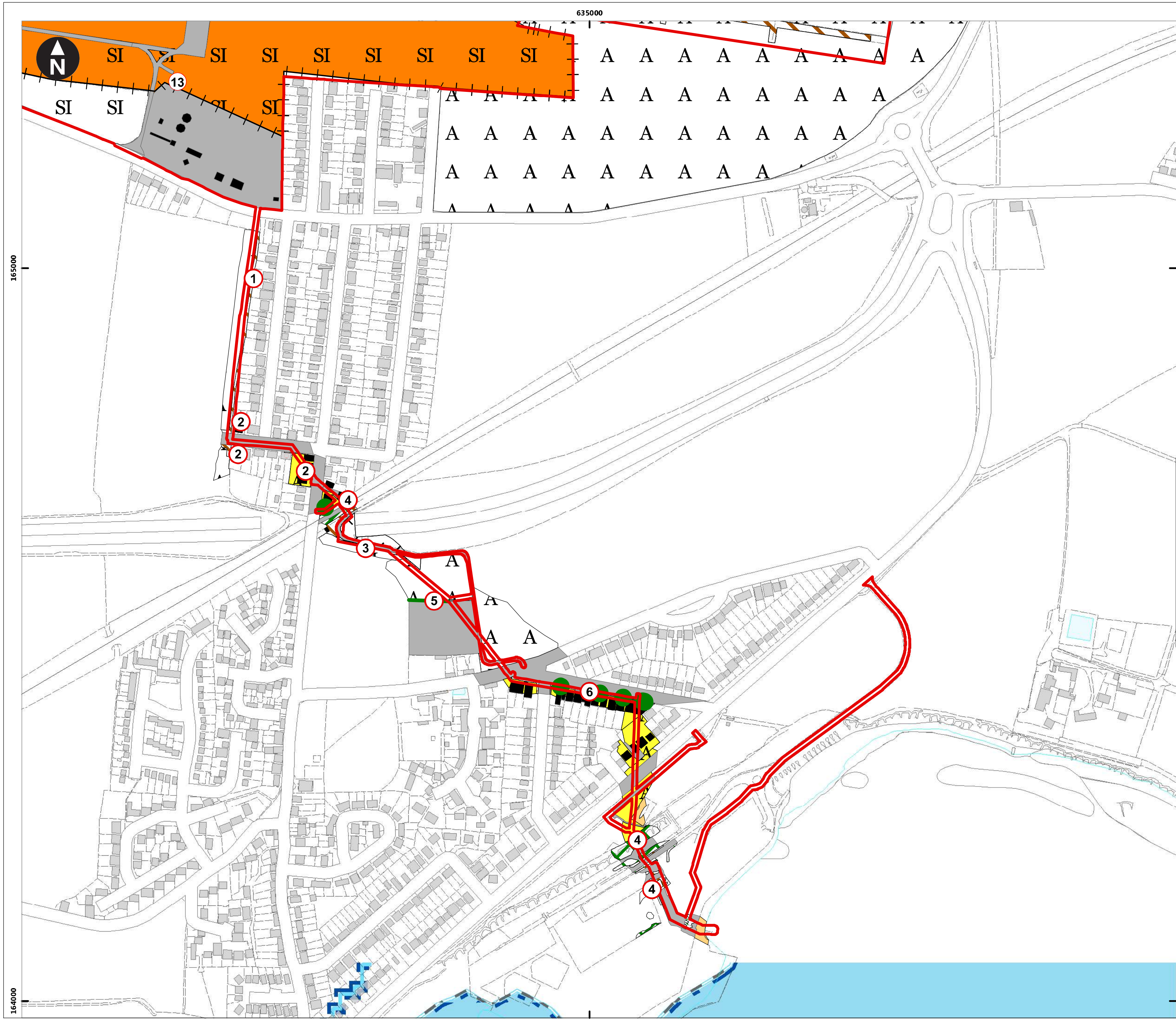

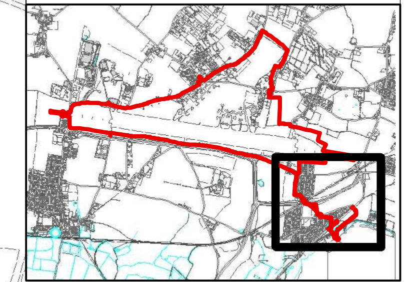

Key

	Order Limits
SI SI	Neutral grassland - semi-improved
SI SI	Poor semi-improved grassland
	Tall ruderal
A A	Arable
	Buildings
	Hardstanding
	Fence
3	Target note

0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5a
Phase 1 habitat map of the site

Page 5 of 5

April 2019

wood.

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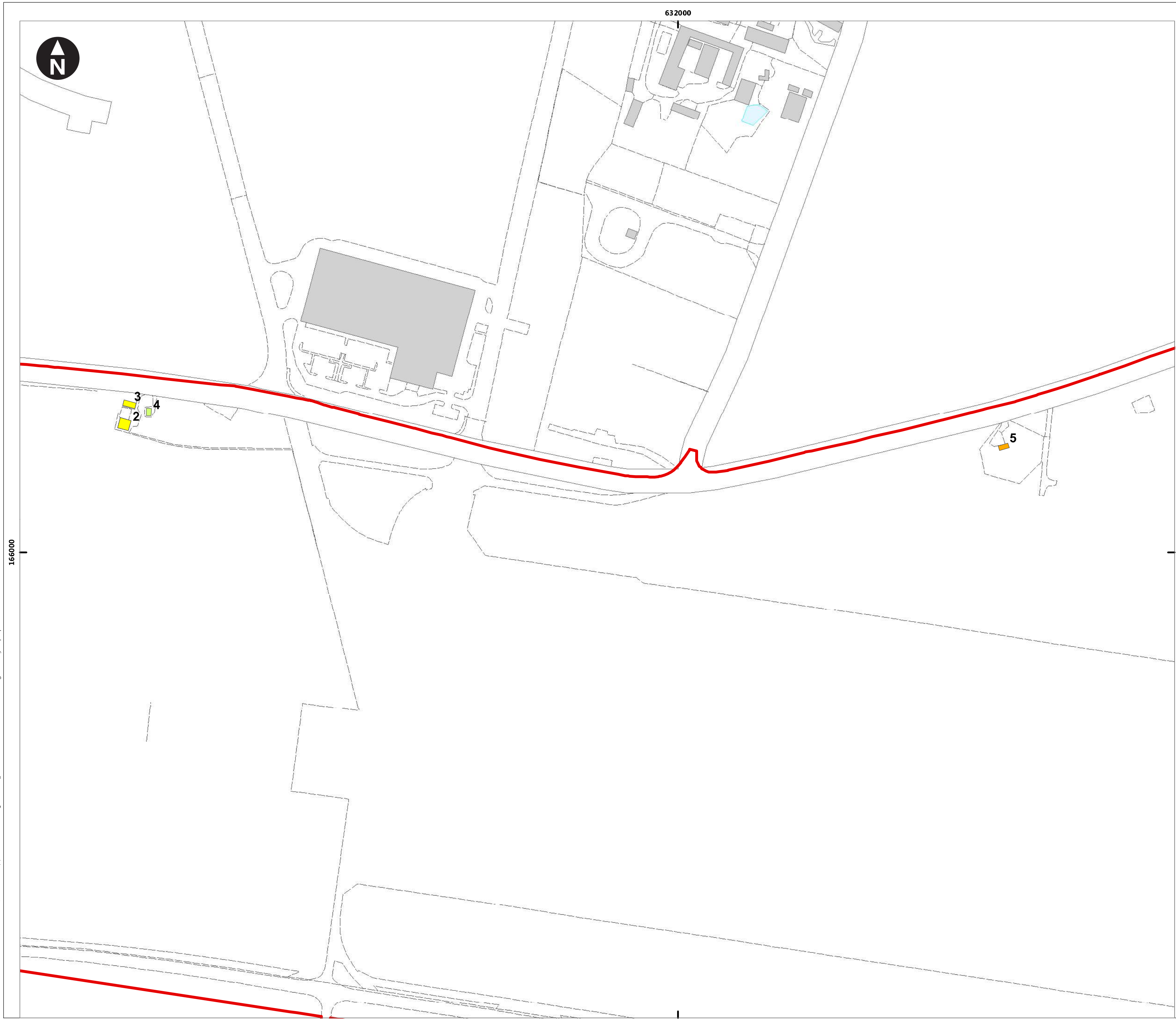


Key

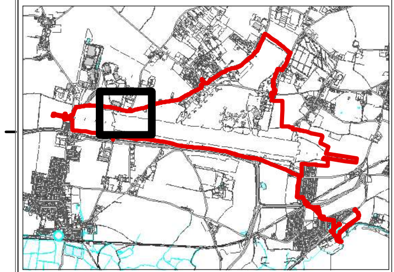
Order Limits

Confirmed Roosts and Potential Roosts 2017

Moderate

Low

Negligible



0 50 100 150 m

Scale at A3: 1:2,500

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5b.1
Locations of buildings with roosts and bat potential

Page 1 of 5

April 2019

wood.

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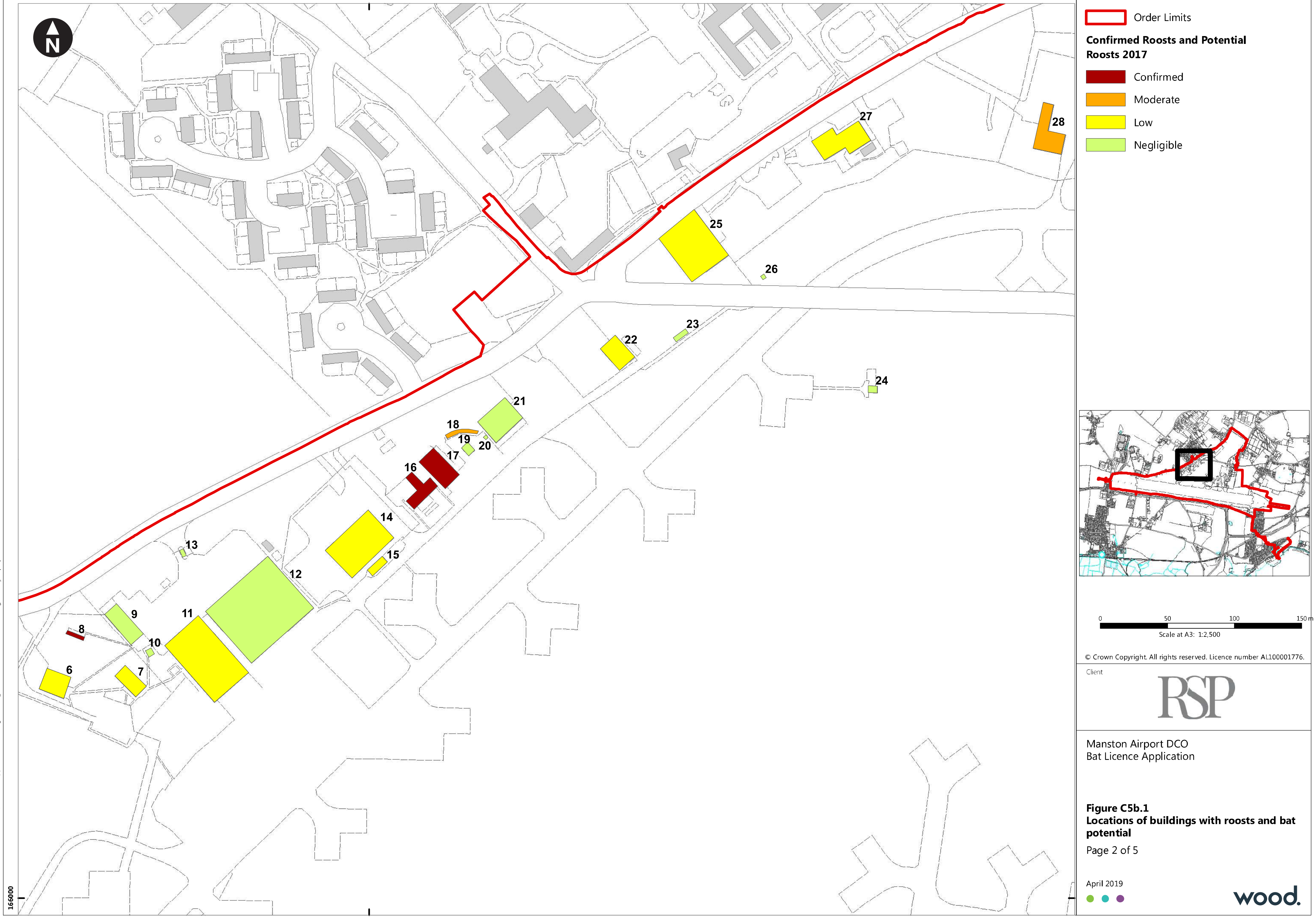

Key

Order Limits

Confirmed Roosts and Potential Roosts 2017

- Confirmed
- Moderate
- Low
- Negligible

0 50 100 150 m

Scale at A3: 1:2,500

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5b.1
Locations of buildings with roosts and bat potential

April 2019

wood.

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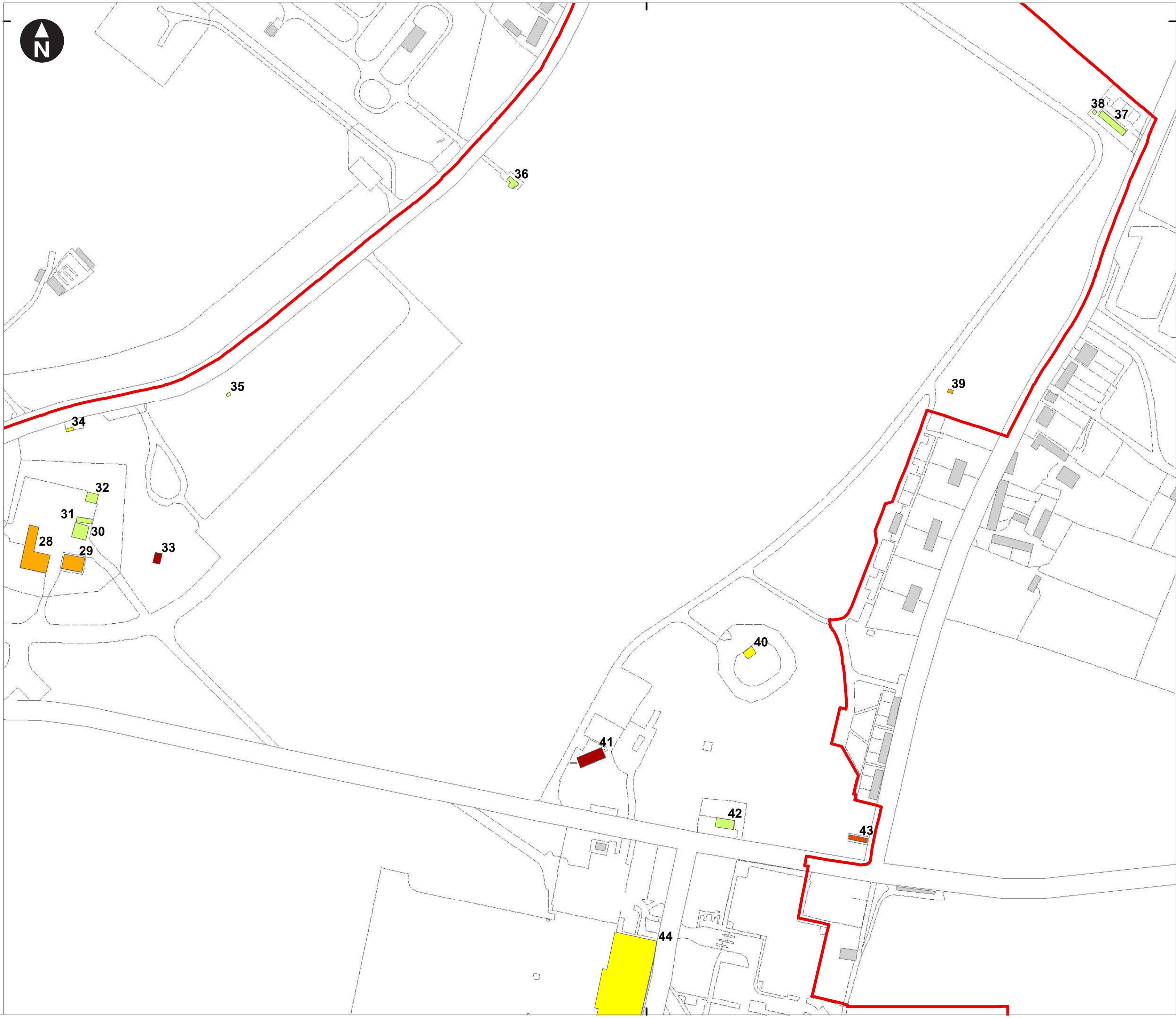
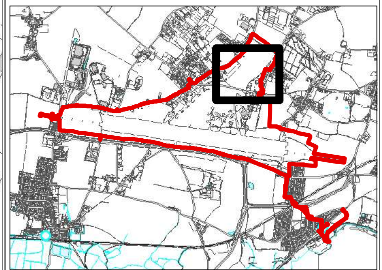




Key

Order Limits

Confirmed Roosts and Potential Roosts 2017

Confirmed

High

Moderate

Low

Negligible

0 50 100 150 m

Scale at A3: 1:3,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5b.1
Locations of buildings with roosts and bat potential

Page 3 of 5

April 2019

wood.

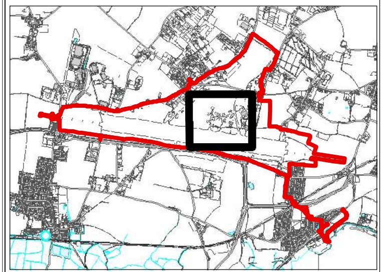
H:\Projects\40820 LON Manston Airport Post Application\Drawings\GIS\Figures\40820-Lon119.mxd Originator: jacqui.parkin

Key

(red outline)	Order Limits

Confirmed Roosts and Potential Roosts 2017

- Confirmed
- Moderate
- Low
- Negligible



0 50 100 150 m

Scale at A3: 1:3,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5b.1
Locations of buildings with roosts and bat potential

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April 2019

wood.

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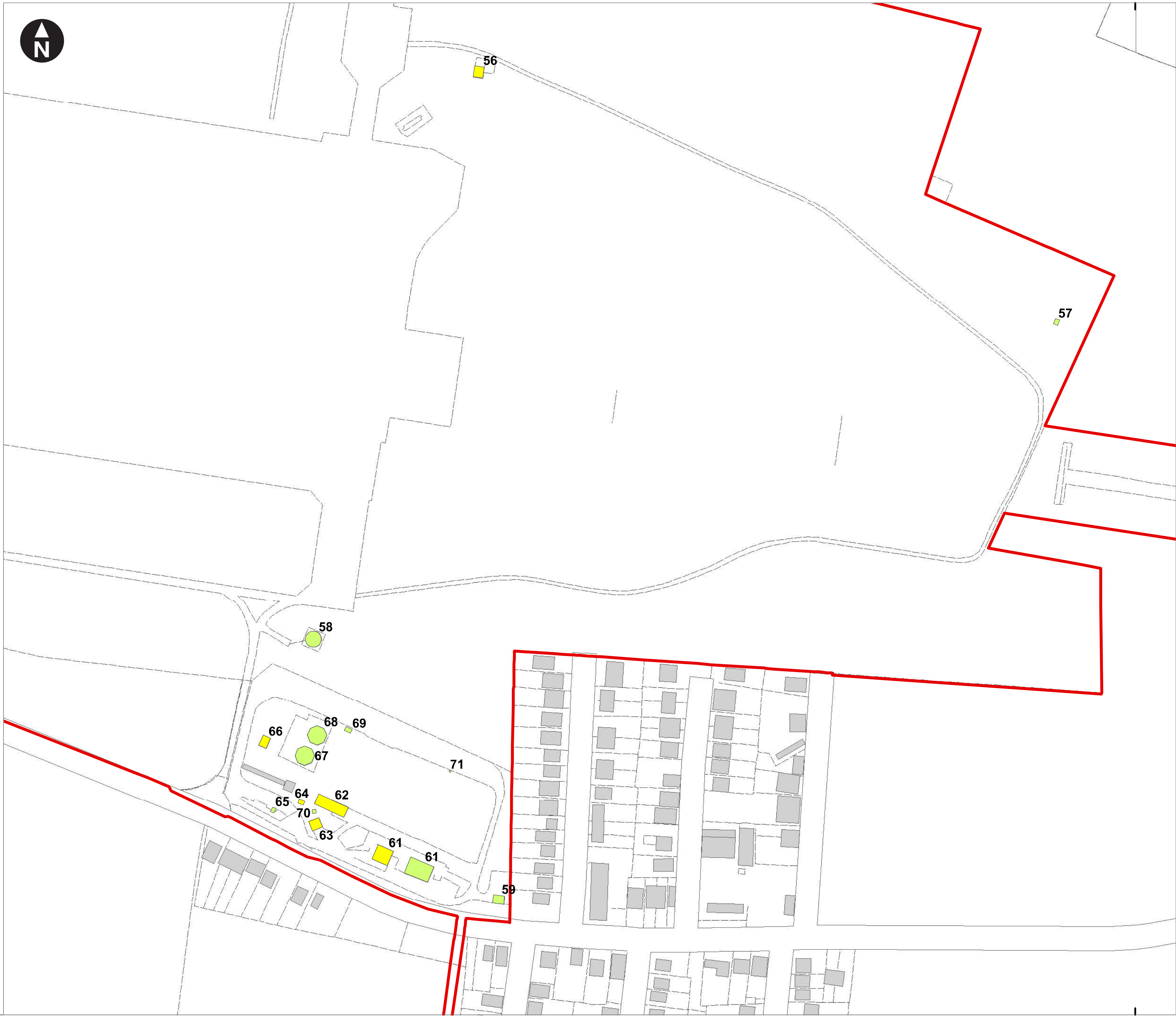
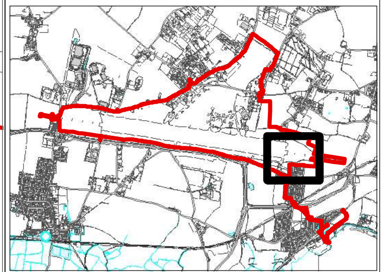




Key

Order Limits

Confirmed Roosts and Potential Roosts 2017

Low

Negligible

0 50 100 150 m

Scale at A3: 1:2,500

Client

RSP

Manston Airport DCO
Bat Licence Application

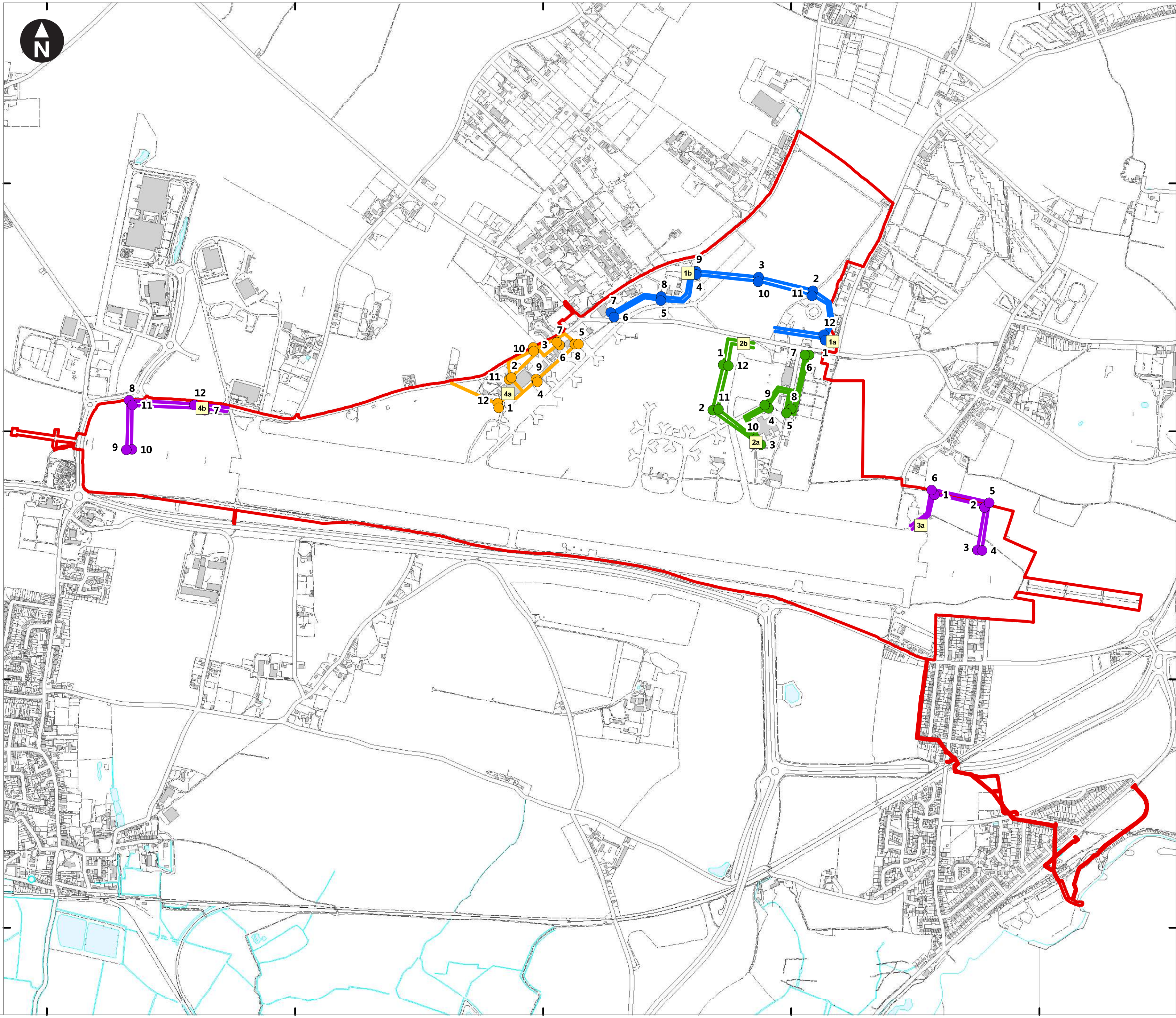
Figure C5b.1
Locations of buildings with roosts and bat potential

Page 5 of 5

April 2019

wood.

H:\Projects\40820 LON Manston Airport Post Application\Drawings\GIS\Figures\40820-Lon119.mxd Originator: jacqui.parkin



Key

- Order Limits
- Static detector location

Stopping Points

- Transect 1
- Transect 2
- Transect 3
- Transect 4

Transect Legs

- Transect 1
- Transect 2
- Transect 3
- Transect 4

0 200 400 600 800 m

Scale at A3: 1:15,000

Client

RSP

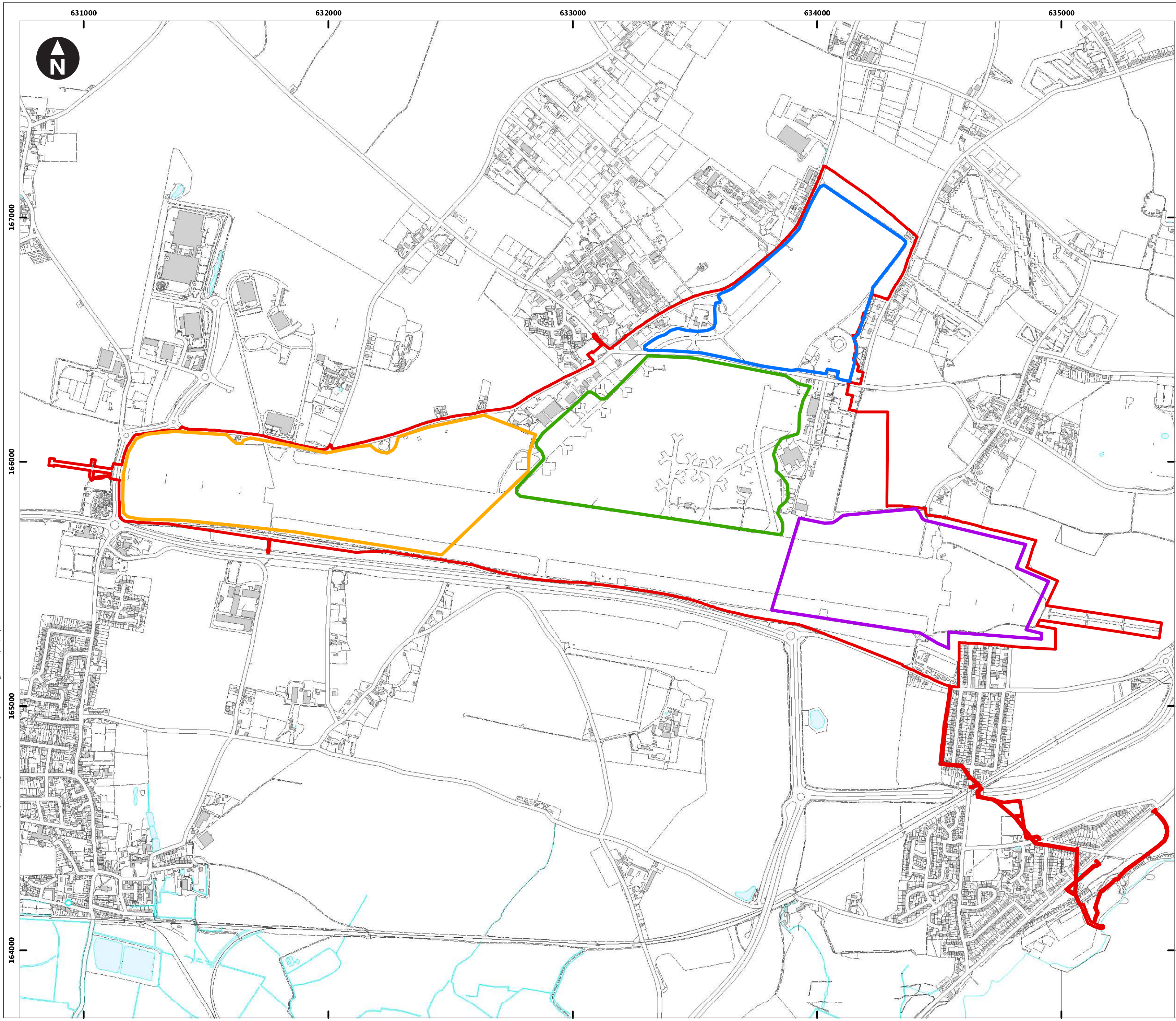
Manston Airport DCO
Bat Licence Application

Figure C5b.2.1
WSP transect routes

April 2019

wood.

H:\Projects\40820 LON Manston Airport Post Application\Drawings\GIS\Figures\40820-Lon120.mxd Originator: jacqui.parkin



Key

Order Limits

Location of activity transects

Transect 1

Transect 2

Transect 3

Transect 4

0 200 400 600 800 m

Scale at A3: 1:15,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5b.2.2
Babtec transect routes

April 2019

wood.

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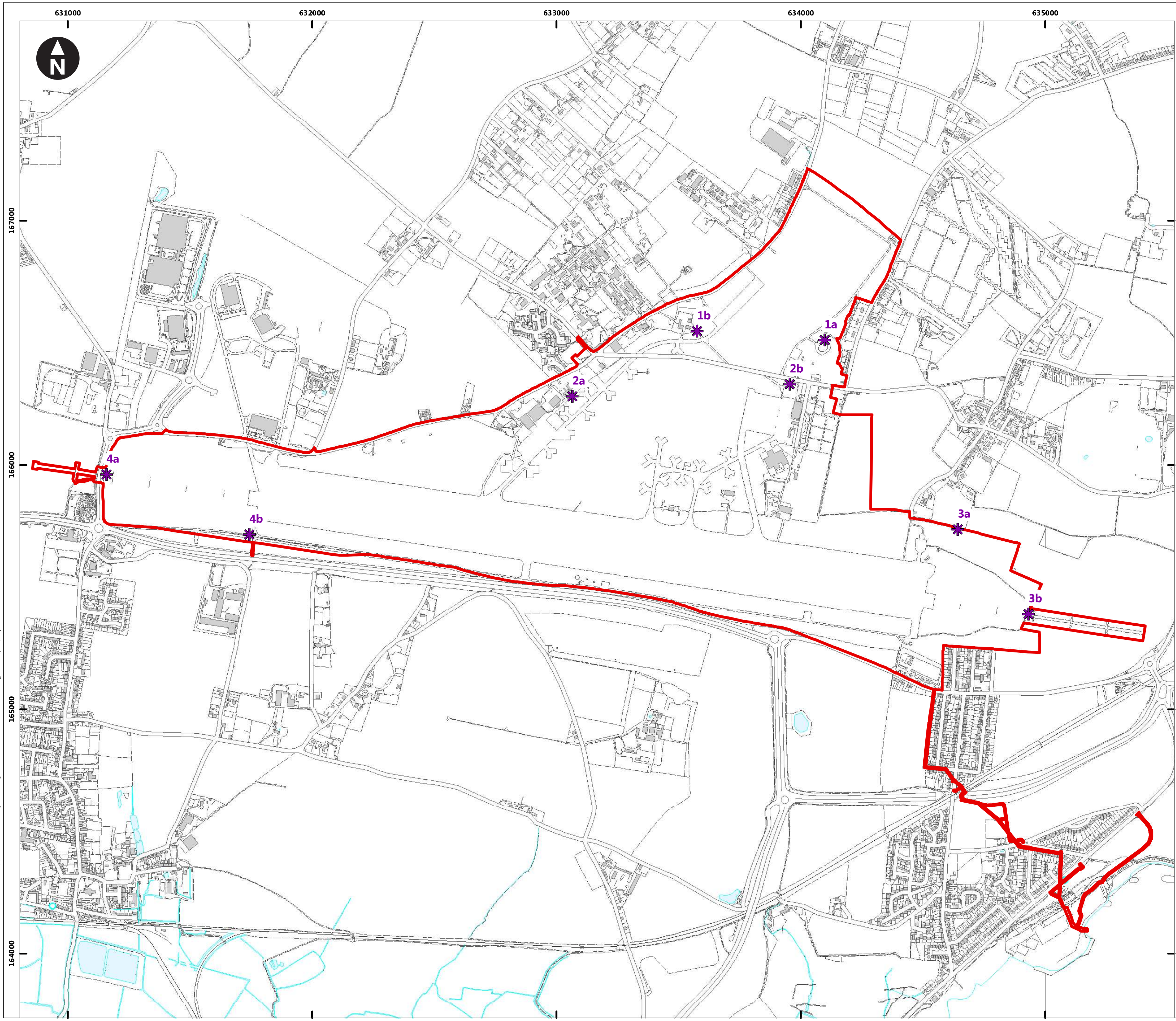

Key

Order Limits

Passive detector location

0 200 400 600 800 m

Scale at A3: 1:15,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure C5b.3
Passive detector locations

April 2019

wood.

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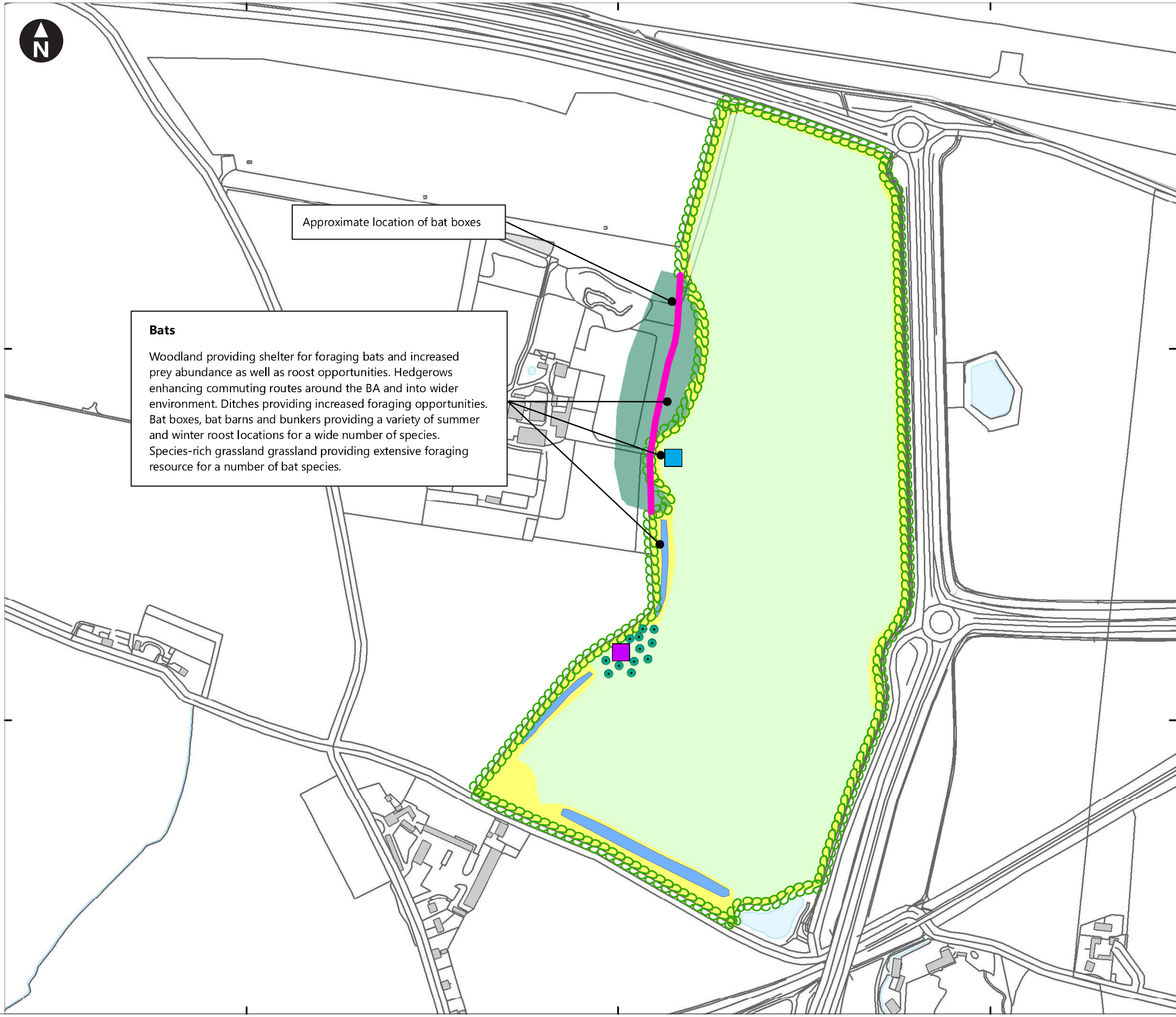

Key

- Broadleaved woodland
- New, low hedgerow planting
- Species-rich grassland
- Reptile and invertebrate habitat
- Low growing fruit trees
- Ditch
- Bat boxes
- Bat barn
- Bat bunker

Approximate locations subject to site conditions.

0 100 200 300 m

Scale at A3: 1:5,000

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure E3.1
Habitat Creation in the Biodiversity Area (BA)

April 2019

wood.

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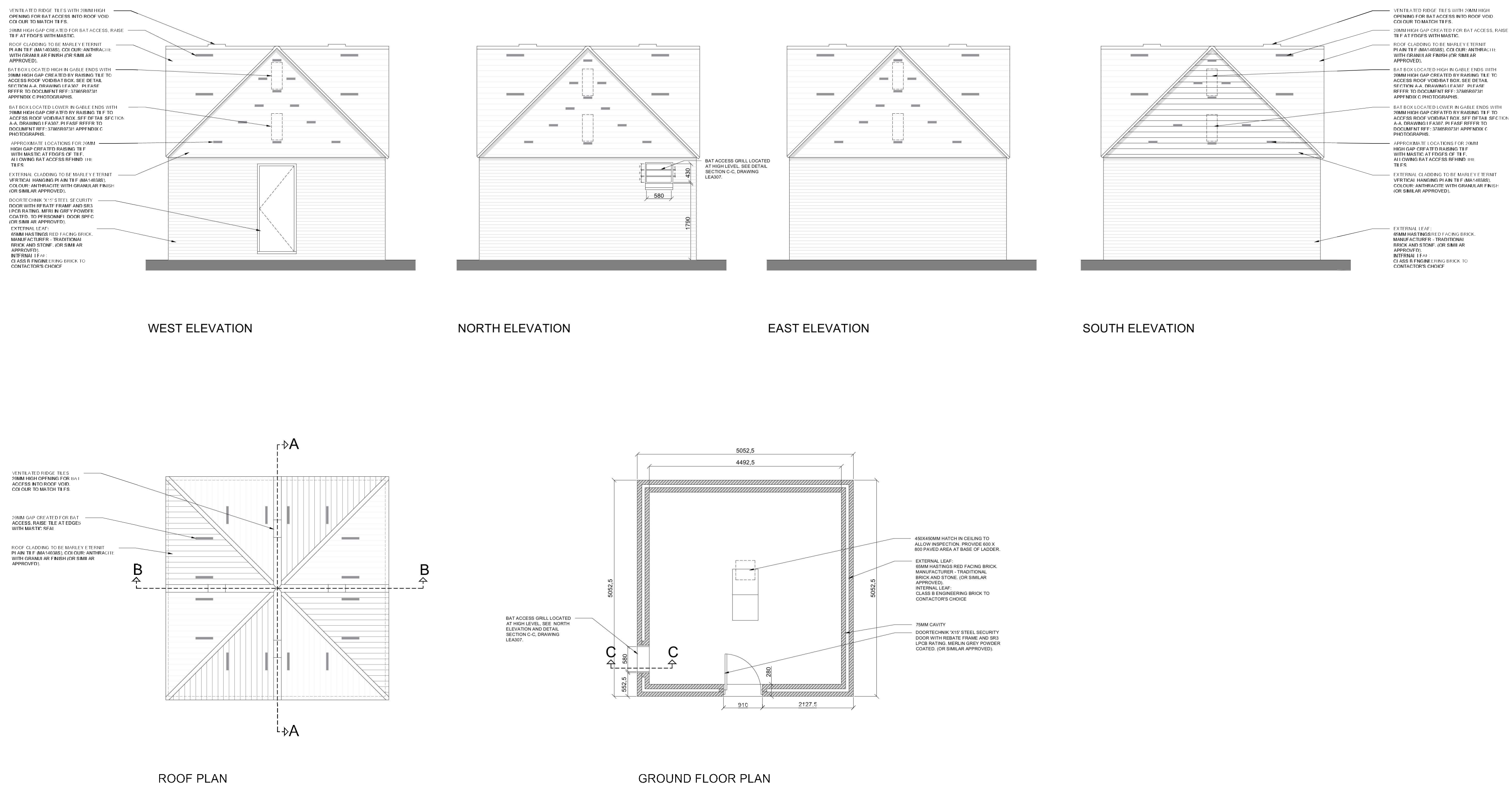


Notes

1. All plywood to be resistant to moisture, humidity and warping.
2. All rough cut timber to be tanalised to bs en 335-1 class 3.2.

Scale 1:50 @ A1

Client

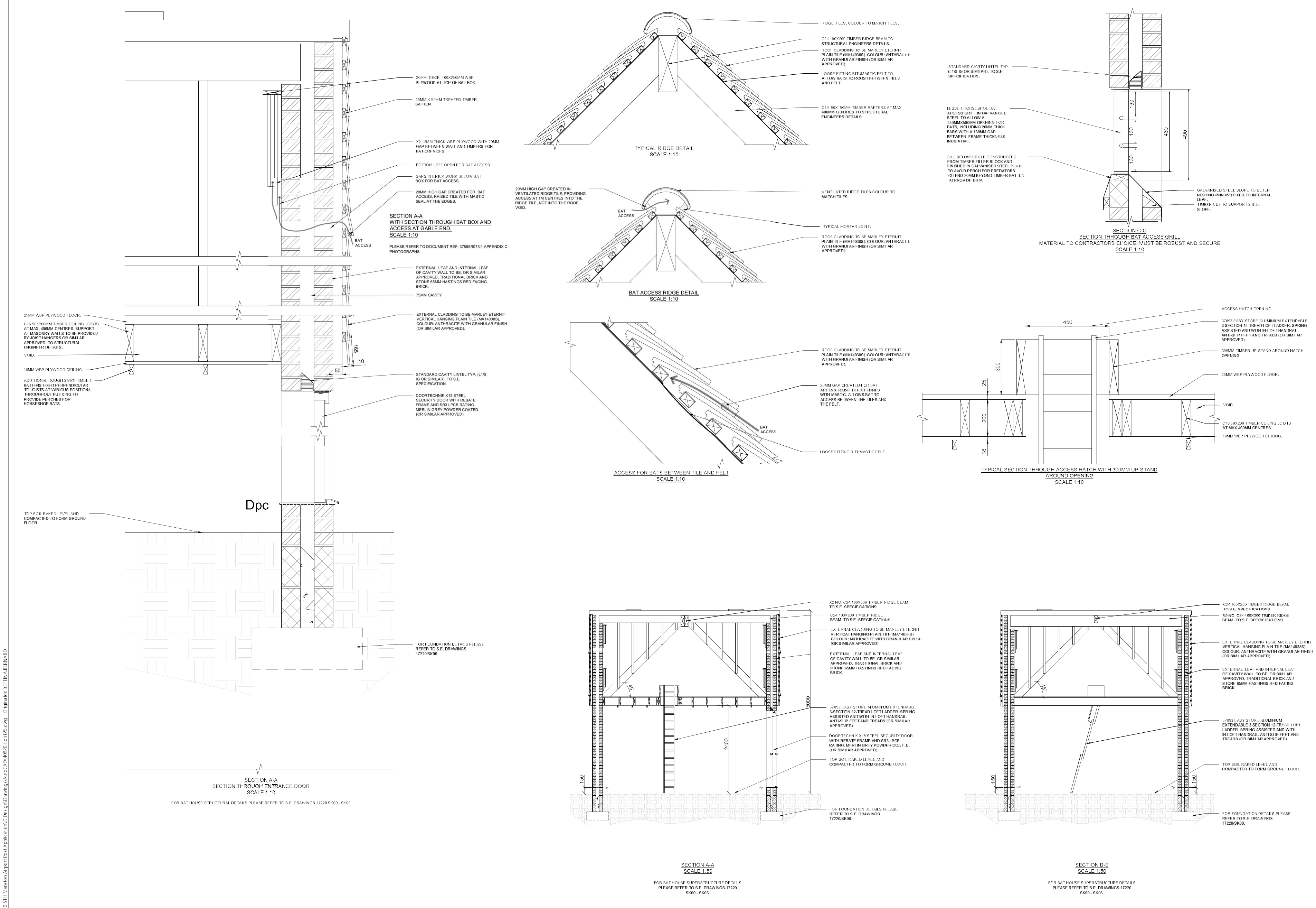
RSP

Manston Airport DCO
Bat Licence Application

Figure E3.2
Bat barn Plans and elevations

April 2019

wood.



Notes

1. All plywood to be resistant to moisture, humidity and warping.
2. All rough cut timber to be tanalised to bs en 335-1 class 3.2.

Scale 1:50 @ A1

Client

RSP

Manston Airport DCO
Bat Licence Application

Figure E3.2.1
Bat barn Full sections

April 2018

wood.

CA.4.15 - Schedule of correspondence

Cogent Land Ltd	**1 February 2019 –** Email from Angus Walker of the Applicant's solicitors to representatives of Cogent Land, Iceni Projects, regarding a statement of common ground **5 February 2019** – Email from Cogent Land's management, Stratland Management Limited, to Angus Walker confirming receipt of Angus Walker's email on 1 February **5 February 2019** – Email from Angus Walker to Stratland Management Limited confirming fees and that a draft statement of common ground will be sent **8 February 2019 –** Email from Andrew Lister of the Applicant's solicitors to Stratland Management attaching a first draft of the statement of common ground **12 February 2019 –** Email from Stratland Management Limited to Angus Walker confirming the statement of common ground is being reviewed **12 February 2019 –** Email from Angus Walker to Stratland Management regarding the statement of common ground and Cogent Land's involvement in the project to date **13 February 2019** – Email from Stratland Management to Angus Walker requesting copies of correspondence between Cogent Land and the Applicant to date **13 February 2019 –** Email from Angus Walker to Stratland Management confirming a colleague at the Applicant's solicitors will provide copies of correspondence requested **13 February 2019 –** Email from Angus Walker to Stratland Management attaching a letter sent to Cogent Land in August 2018 inviting a representation to be made **14 February 2019** – Email from Stratland Management to Angus Walker confirming they are aiming to revert back on the statement of common ground by 19 February and confirming fees

	14 February 2019 – Email from Angus Walker to Stratland Management regarding fees and agreeing a statement of common ground **14 February 2019 –** Email from Stratland Management to Angus Walker regarding the statement of common ground **14 February 2019** – Email from Angus Walker to Stratland Management acknowledging their email **15 February 2019** – Email from Cogent Land's solicitors to Angus Walker attaching an initial draft statement of common ground with amendments **15 February 2019 –** Email from Angus Walker to Cogent Land's solicitors confirming the parties will aim to conclude the statement of common ground by 8 March **21 February 2019 –** Email from Angus Walker to Cogent Land's solicitors attaching an amended statement of common ground **21 February 2019 –** Email from Cogent Land's solicitors to Angus Walker confirming that they are continuing some work on the proposals and will revert back once completed **19 March 2019 –** Email from Cogent Land's solicitors to Angus Walker confirming a revised statement of common ground will be sent shortly **20 March 2019 –** Email from Cogent Land's solicitors to Angus Walker attaching the draft statement of common ground and confirming a summary of concerns on the noise assessments will be sent to the Applicant's solicitors **28 March 2019 –** Email from Cogent Land's solicitors to Angus Walker attaching a letter sent to the inspectorate summarising Cogent Land's position and requesting further details from the Applicant **5 April 2019 –** Email from Cogent Land's solicitors to Andrew Lister proposing a call on 23 or 24 April **10 April 2019** – Email from Andrew Lister to Cogent Land's solicitors proposing 23 April for a call **10 April 2019 –** Email from Cogent Land's solicitors to Andrew Lister confirming the phone call

	11 April 2019 – Email from Iceni Projects to Andrew Lister regarding the phone call **11 April 2019 –** Email from Andrew Lister to Iceni Projects regarding the phone call **11 April 2019 –** Email from Iceni Projects to Andrew Lister acknowledging his email **23 April 2019 –** Call between Iceni Projects and the Applicant **23 April 2019 –** Email from Angus Walker to Iceni Projects with a link to the noise mitigation plan **25 April 2019 –** Email from Angus Walker to Iceni Projects regarding the noise mitigation plan **25 April 2019** – Email from Iceni Projects to Angus Walker acknowledging the email regarding the noise mitigation plan **3 May 2019 –** Email from Cogent Land's solicitors to Angus Walker of the Applicant's solicitors attaching drawings for the development areas for the approved MG scheme and the access road **28 May 2019** – Email from Cogent Land's solicitors to Angus Walker requesting updates on the noise contours, the possible CPO red line and access road conflict **29 May 2019** – Email from Angus Walker to Cogent Land's solicitors regarding the order limited and noise contours **29 May 2019** – Email from Cogent Land's solicitors to Angus Walker requesting further information on the noise contours **29 May 2019** – Email from Angus Walker to Cogent Land's solicitors confirming the Applicant's solicitors are taking instructions regarding the noise contours **12 June 2019** – Email from Cogent Land's solicitors to Angus Walker (Iceni Projects cc'd in) requesting information under Action 26 arising from the June 2019 hearings (detailed noise assessments for the Manston Green Development and a location map of HRDF alternative sites) and a scaled plan showing the CPO take for the landing lights

	12 June 2019 – Email from Angus Walker to Cogent Land's solicitors (Iceni Projects cc'd in) confirming that Wood (the environmental consultants) would provide the information in relation to Action 26 and that a scaled plan will be asked for **18 June 2019** – Email from Cogent Land's solicitors to Angus Walker requesting updates on the information requested **21 June 2019** – Email from Wood to Cogent Land's solicitors with attached noise assessment. **26 June 2019** – Email from Cogent Land's solicitors to Angus Walker asking for the provision of the scale plan for the landing lights and the alternative locations being considered for the HRDF.

Schedule 2 Part 2

1.— Applications made under requirements

(1) Where an application has been made to a relevant planning authority for any consent, agreement or approval required by a Requirement (including consent, agreement or approval in respect of part of a Requirement) included in this Order the relevant planning authority must give notice to the undertaker of its decision on the application within a period of 8 weeks beginning with—

(a) where no further information is requested under paragraph 1(2), the day immediately following that on which the application is received by the authority;

(b) where further information is requested under paragraph 1(2), the day immediately following that on which further information has been supplied by the undertaker; or

(c) such longer period as may be agreed in writing by the undertaker and the relevant authority.

(2) Any application made to the relevant planning authority pursuant to sub-paragraph (1) must include a statement to confirm whether it is likely that the subject matter of the application will give rise to any materially new or materially different environmental effects compared to those in the environmental statement and if it will then it must be accompanied by information setting out what those effects are.

(2) Where an application has been made under paragraph 1(1) the relevant planning authority may request such reasonable further information from the undertaker as it considers is necessary to enable it to consider the application.

(3) If the relevant planning authority or a requirement consultee considers further information is the relevant planning authority must, within 21 business days of receipt of the application, notify the undertaker in writing specifying the further information required.

(5) If the relevant planning authority does not give the notification mentioned in sub-paragraph (3) or (4) it is deemed to have sufficient information to consider the application and is not thereafter entitled to request further information without the prior agreement of the undertaker.

2.— Fees

(1) Where an application is made to a relevant planning authority for any consent, agreement or approval required by a Requirement, the fee for the discharge of conditions attached to a planning permission contained in regulation 16(1)(b) of the Town and Country Planning (Fees for Applications, Deemed Applications, Requests and Site Visits) (England) Regulations 2012(a) (as may be amended or replaced from time to time) is to apply and must be paid to the relevant planning authority for each application.

(2) Any fee paid under this Schedule must be refunded to the undertaker within 35 days of—

(a) the application being rejected as invalidly made; or

(b) the relevant planning authority failing to determine the application within 8 weeks from the date on which it is received, unless within that period the undertaker agrees in writing that the fee may be retained by the relevant planning authority and credited in respect of a future application; or

(c) a longer period where a longer time for determining the application has been agreed pursuant to paragraph 1(1)(c)

3.— Appeals

(1) The undertaker may appeal if—

(a) the relevant planning authority refuses an application for any consent, agreement or approval required by—

(i) a Requirement and any document referred to in any Requirement; or

(ii) any other consent, agreement or approval required under this Order, or grants it subject to conditions to which the undertaker objects;

(b) the relevant authority does not give notice of its decision to the undertaker within the period specified in paragraph 1(1);

(c) having received a request for further information under paragraph 1(3) the undertaker considers that either the whole or part of the specified information requested by the relevant planning authority is not necessary for consideration of the application; or

(d) having received any further information requested, the relevant authority notifies the undertaker that the information provided is inadequate and requests additional information which the undertaker considers is not necessary for consideration of the application.

(2) The procedure for appeals is as follows—

(a) any appeal by the undertaker must be made within 42 days of the date of the notice of the decision or determination, or (where no determination has been made) expiry of the decision period as determined under paragraph 1;

(b) the undertaker must submit to the Secretary of State a copy of the application submitted to the relevant planning authority and any supporting documents which the undertaker may wish to provide ("the appeal documents");

(b) the undertaker must on the same day provide copies of the appeal documents to the relevant planning authority and the requirement consultee (if applicable);

(c) as soon as is practicable after receiving the appeals documents the Secretary of State must appoint a person to determine the appeal ("the appointed person") and notify the appeal parties of the identity of the appointed person and the address to which all correspondence for the appointed person must be sent;

(d) the relevant authority and the requirement consultee (if applicable) may submit any written representations in respect of the appeal to the appointed person within 10 business days beginning with the first day immediately following the date on which the appeal parties are notified of the appointment of the appointed person and must ensure that copies of their written representations are sent to each other and to the undertaker on the day on which they are submitted to the appointed person;

(e) the appeal parties may make any counter-submissions to the appointed person within 10 business days beginning with the first day immediately following the date of receipt of written representations pursuant to paragraph (d) above; and

(f) the appointed person must make a decision and notify it to the appeal parties, with reasons, as soon as reasonably practicable.

(3) If the appointed person considers that further information is necessary to consider the appeal, the appointed person must as soon as practicable notify the appeal parties in writing specifying the further information required, the appeal party from whom the information is sought, and the date by which the information must be submitted.

(4) Any further information required pursuant to sub-paragraph (3) must be provided by the party from whom the information is sought to the appointed person and to other appeal parties by the date specified by the appointed person.

(5) The appeal parties may submit written representations to the appointed person concerning matters contained in the further information.

(6) Any such representations must be submitted to the appointed person and made available to all appeal parties within 10 business days of the date mentioned in sub-paragraph (3).

4.— Outcome of appeals

(1) On an appeal under paragraph 3, the appointed person may—

(a) allow or dismiss the appeal; or

(b) reverse or vary any part of the decision of the relevant planning authority (whether the appeal relates to that part of it or not), and may deal with the application as if it had been made to the appointed person in the first instance.

(2) The appointed person may proceed to a decision on an appeal taking into account only such written representations as have been sent within the time limits prescribed or set by the appointed person under this paragraph.

(3) The appointed person may proceed to a decision even though no written representations have been made within those time limits if it appears to the appointed person that there is sufficient material to enable a decision to be made on the merits of the case.

(4) The decision of the appointed person on an appeal is final and binding on the parties, and a court may entertain proceedings for questioning the decision only if the proceedings are brought by a claim for judicial review.

(5) Any consent, agreement or approval given by the appointed person pursuant to this paragraph is deemed to be an approval for the purpose of part one of this Schedule as if it had been given by the relevant planning authority.

(6) The relevant planning authority may confirm any determination given by the appointed person in identical form in writing but a failure to give such confirmation (or a failure to give it in identical form) does not affect or invalidate the effect of the appointed person's determination.

(7) Except where a direction is given pursuant to sub-paragraph (8) requiring the costs of the appointed person to be paid by the relevant authority, the reasonable costs of the appointed person must be met by the undertaker.

(8) On application by the relevant authority or the undertaker, the appointed person may give directions as to the costs of the appeal parties and as to the parties by whom the costs of the appeal are to be paid.

(9) In considering whether to make any such direction as to the costs of the appeal parties and the terms on which it is made, the appointed person must have regard to the Planning Practice Guidance or any guidance which may from time to time replace it.

5.— Interpretation of Schedule 4

(1) In this Schedule—

"the appeal parties" means the relevant planning authority, the requirement consultee and the undertaker;
"business day" means a day other than a Saturday or Sunday which is not Christmas Day, Good Friday or a bank holiday under section 1 of the Banking and Financial Dealings Act 1971; and
"requirement consultee" means any body named in a Requirement which is the subject of an appeal as a body to be consulted by the relevant authority in discharging that Requirement.

Appendix F.4.6

China Silver Asset Management Ltd (Cayman)
Cricket Square, Hutchins Drive, P.O. Box 2681
Grand Cayman, KY1-1111, Cayman Islands
T: +852 3468 8208 F: +852 3106 8133

June 17, 2019

Niall Lawlor
Director
RiverOak Strategic Partners Limited
Audley House
9 North Audley Street
London W1K 6WF

Dear Niall,

Re: Manston Airport

We are writing this letter to confirm our interest in Manston Airport. Our analytical and investment team have been following the DCO process at Manston very closely and you have our authority to disclose this letter to the Planning Inspectorate for release into the public domain.

CS Asia Opportunities Master Fund (CSAOMF), a registered fund in the Cayman Islands and an FSS registered fund in South Korea, China Silver its funds and affiliates, manages in excess of US$1.75 billion in assets under management (AUM).

The principals and analyst team of China Silver, have been involved with RiverOak Strategic Partners, (RSP) and Manston Airport, as a focus project, for over two years.

Our research, and investment thesis, as a principal investor, has been on the financial structuring, business development plans, and coordination with Asian and mainland China air freight, export finance and manufacturing companies. We have also had held extensive discussions about developing strategic links with Swire Pacific Limited (Group of Companies) owners of Cathay Air Cargo, and the largest air freight facility in the world, currently located at Hong Kong airport. This company currently has 17.6 million available cargo and mail tonne kilometres (AFTK) and handles 2.15million tonnes of cargo and mail annually..

The lack of efficient airport capacity in the UK, particularly to serve the southeast conurbation of London, makes for a very inefficient process for dedicated freighter aircraft. Our research, which we have developed in our engagement with RSP, has focused on the export driven market out of Asia, and the driving of cost efficiencies through increased specialized airport facilities, customs and excise simplification to one location and quick turnaround to see product logistically moved to the "last mile" of delivery.

With this in mind, through our Global Macro Fund investment strategy, subject to final due diligence regarding the Development Consent Order currently underway, and RSP, by voluntary

China Silver Asset Management Ltd (Cayman)
Cricket Square, Hutchins Drive, P.O. Box 2681
Grand Cayman, KY1-1111, Cayman Islands
T: +852 3468 8208 F: +852 3106 8133

or compulsory acquisition in securing the freehold of the airport site, we are willing to commit upwards of US$150m to the infrastructure development requirements proposed under the RSP scheme of works.

CSAML sees the UK, especially post Brexit, as still the major consumer market in Europe for goods manufactured in Asia, the efficient connectivity of that market to Asian product is a strategic investment that CSAOMF are very interested in allocating capital towards, and Manston Airports redevelopment meets this strategy goal of our for the next ten years of our investment cycle.

Please feel free to contact us for any further information.

Yours Sincerely,

[redacted]

Patrick Maloney

Director

CHINA SILVER ASSET MANAGEMENT LIMITED

[redacted]

ACUNIS
AIR CARGO INTRALOGISTICS

AMOVA GmbH • Postfach 1451 • D-57238 Netphen

RiverOak Strategic Partners

16 Charles II Street
London SW1Y 4NW
UK

Jörg Ohrendorf
Project Director Sales
SDA

Phone: +49 2738 21-1212
[redacted]
joerg.ohrendorf@acunis.de

18th June 2019

DE00.000096 RSP - Manston
Material Handling System for the Reopening and Development of Manston Airport
Letter of Support

Dear Sirs

At first we thank you for giving us the opportunity to participate in the project of:
"The Reopening and Development of Manston Airport, in east Kent, in the UK"

We herewith officially confirm our intention to participate in the above mentioned project.

Before we give some explanations to our application documents, we would like to provide some background information regarding the cooperation between AMOVA GmbH and Unitechnik Systems GmbH and our set-up for this project.

Unitechnik Systems GmbH ("Unitechnik") has its headquarter in Wiehl, Germany. Unitechnik is well known as supplier for air cargo systems for more than 20 years and holds extensive experience in engineering, supply and installation of air cargo systems. Unitechnik has realized plenty of reference systems, such as those in Frankfurt, Sweden, Dubai, Taiwan, Ethiopia, South Africa and the USA.

AMOVA GmbH is registered in Netphen, Germany. AMOVA is a world marked leader for logistics systems in the steel and aluminium industry and has accumulated a vast experience in handling and storage of loads from 30 kg to 40 tons as well as in Warehouse Management Systems within the last 60 years. Consequently AMOVA can refer to numerous references of sophisticated logistic solutions worldwide - also in the sector of airport logistics.

Unitechnik and AMOVA have been realizing lots of projects worldwide jointly and have meanwhile established a close cooperation in the field of the air cargo business. Whereas AMOVA is responsible for the mechanical portion in this cooperation, Unitechnik brings in its extensive experience in automation and its warehouse management systems UniWare with its specific air cargo modules. Unitechnik has been serving the international air cargo market since 1992 and also shares the knowledge and experience of ICM Airport Technics, which has been part of the Unitechnik Group since 2004.

ACUNIS
AIR CARGO INTRALOGISTICS

AMOVA and Unitechnik are now concentrating their expertise under the brand name ACUNIS with the aim to realize our vision of becoming one of the leading players in the air cargo logistics sector and thus to establish a long-term, reliable partnership with your esteemed company.

The brand name ACUNIS unites two market-leading companies with the pronounced expertise in plant engineering and automation and stands for reliable partners for air cargo companies to realize turnkey solutions for air cargo terminals.

AMOVA will act for ACUNIS as a proficient and reliable general contractor and can, due to its corporate affiliation, revert back to the capabilities and financial strength of SMS group. SMS group has been realizing an annual turnover of 3,5 billion Euro and has approximately 13,800 employees. SMS group has been doing business in UK successfully for decades.

Furthermore we like to point out that due to its membership of SMS group AMOVA is also in the position to develop tailor-made project financing for major air cargo projects.

After having provided these general information, we would now like to briefly introduce our application.

As a turnkey supplier ACUNIS is commenced to working with RSP to supply and install the most sophicated air freight handling equipment at Manston.

Our products and services range from the complete engineering for a cargo terminal, through high –bay storage systems, elevating transfer vehicles (ETVs), conveying equipment, work stations, shipment buffers and cooling technology including automation, warehouse management systems and video monitoring (CCTV) to assembly, installation and commissioning up to a customized after sales service.

For futher references please have a look at the attached reference list showing other airports where our equipment is deployed. In addition we provide two detailed reference sheets of our last installations.

Therefore we are looking forward if our application would find your appreciation also for Manston Airport.

For any questions left our Project Director Jörg Ohrendorf (Phone: +49 2738 21-1212;
Mobil: +49 170 9077 284 or mail: joerg.ohrendorf@acunis.de) is available for you at any time.

Best regards

AMOVA GmbH

[redacted]

ppa. Mr. Dr. Horst Thorn
Executive Vice President
Business Development

[redacted]

i.A. Mr. Jörg Ohrendorf
Project Director Air Cargo

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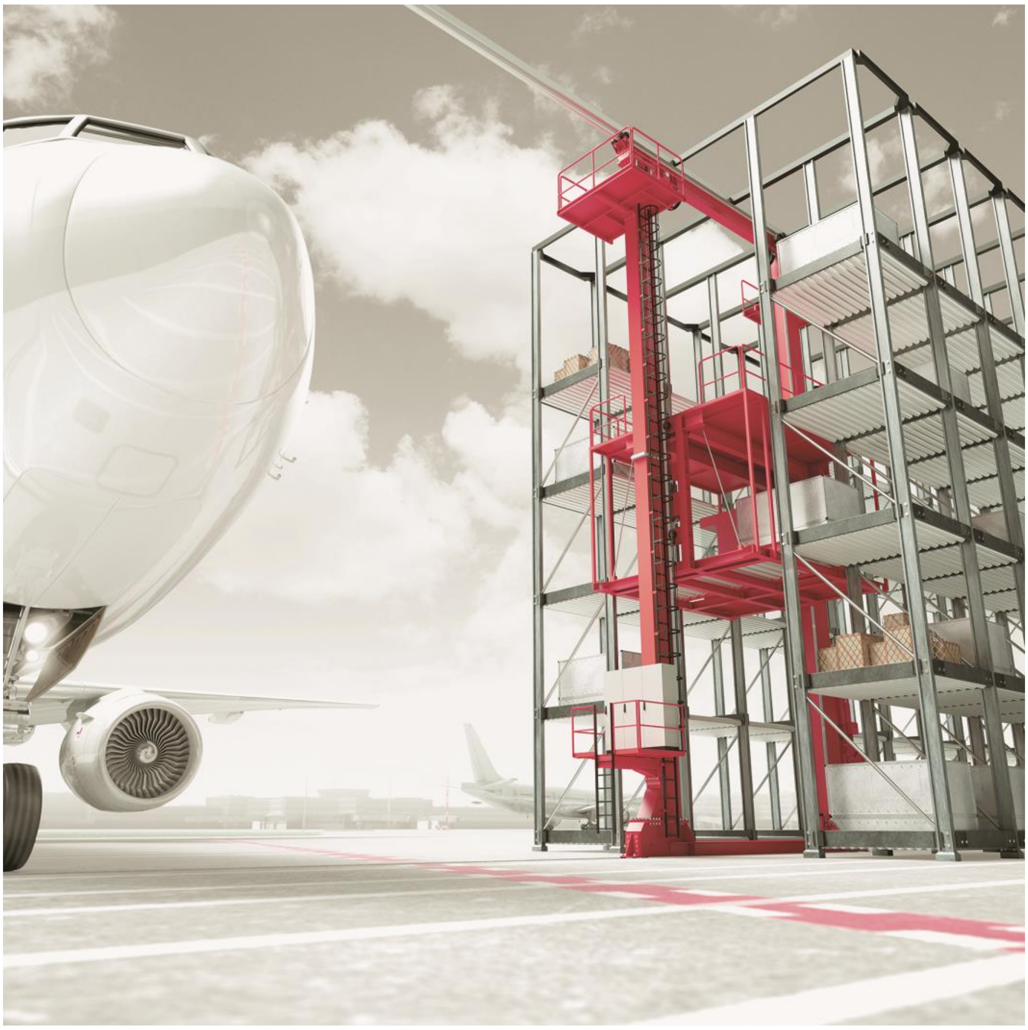

Appendix 1

List of references of ACUNIS

AMOVA GmbH
Obere Industriestraße 8
57250 Netphen
Germany

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Fax: +49 2738 21 – 1299
E-Mail: joerg.ohrendorf@acunis.de

Clients Name	Project Name	Scope of Work (among other items)	Completion Date
Mitchell Cotts New Cargo Terminal Nairobi, KE	MHS System	- 2 ETV - 106Storage Positions 20ft - 4 Dolly Dock - 1 Truck Dock - 4 Workstation - 1 Pallet Mover - Roller Decks - 4 Ball Mat Area - Steel Structure - Pallet racking - PLC Control System - High Level Control System	2019
Ethiopian Airlines	Cargo Terminal 2 (Design Contract for construction work and material handling)	- 491 Storage Positions - 2 Truck Dock - 8 Dolly Dock - 31 workstation - Roller Decks - Ball Mat Area - Steel Structure CCTV-System Cold room equipment Access control system PLC Control System - High Level Control System	2017
Emirates Sky Cargo at DWC, Dubai	Perishable Terminal	- 96 Storage Positions - 2 X-Mover - 3 Roller Decks	2014
HCH, at London Heathrow	MHS System	- 14 Storage Positions - 2 TV - 2 Truck Dock - 3 Workstation	2013
Servisair, at London Heathrow	MHS System	- 108 Storage Positions - 1 ETV - 2 TV - 2 Truck Dock - 7 Workstation - 2 RA Deck - 5 Dolly Bridge	2012
Spirit Air Cargo at Copehagen/DK	Modernization of MHS System	- 288 Storage Positions - 2 ETV - 6 Truck Dock - 32 workstation - 3 TV	2011
Dube Tradeport Durban/South Africa	MHS System	- 202 Storage Positions - 2 ETV - 2 Truck Dock - 9 workstations - Roller Decks	2010

Celebi Cargo GmbH at Frankfurt Airport	MHS System	- 132 Storage Positions - 1 ETV - 1 Cargo Hoist - 4 Truck Dock - 8 workstations - Roller Decks	2010
Spirit Air Cargo Stockholm Sweden	MHS System	- 131 Storage Positions - 1 X-Mover - 2 TV - 2 Truck Dock - 9 Dolly Dock - 11 workstation - 2 Turn Table - Roller Decks	2010

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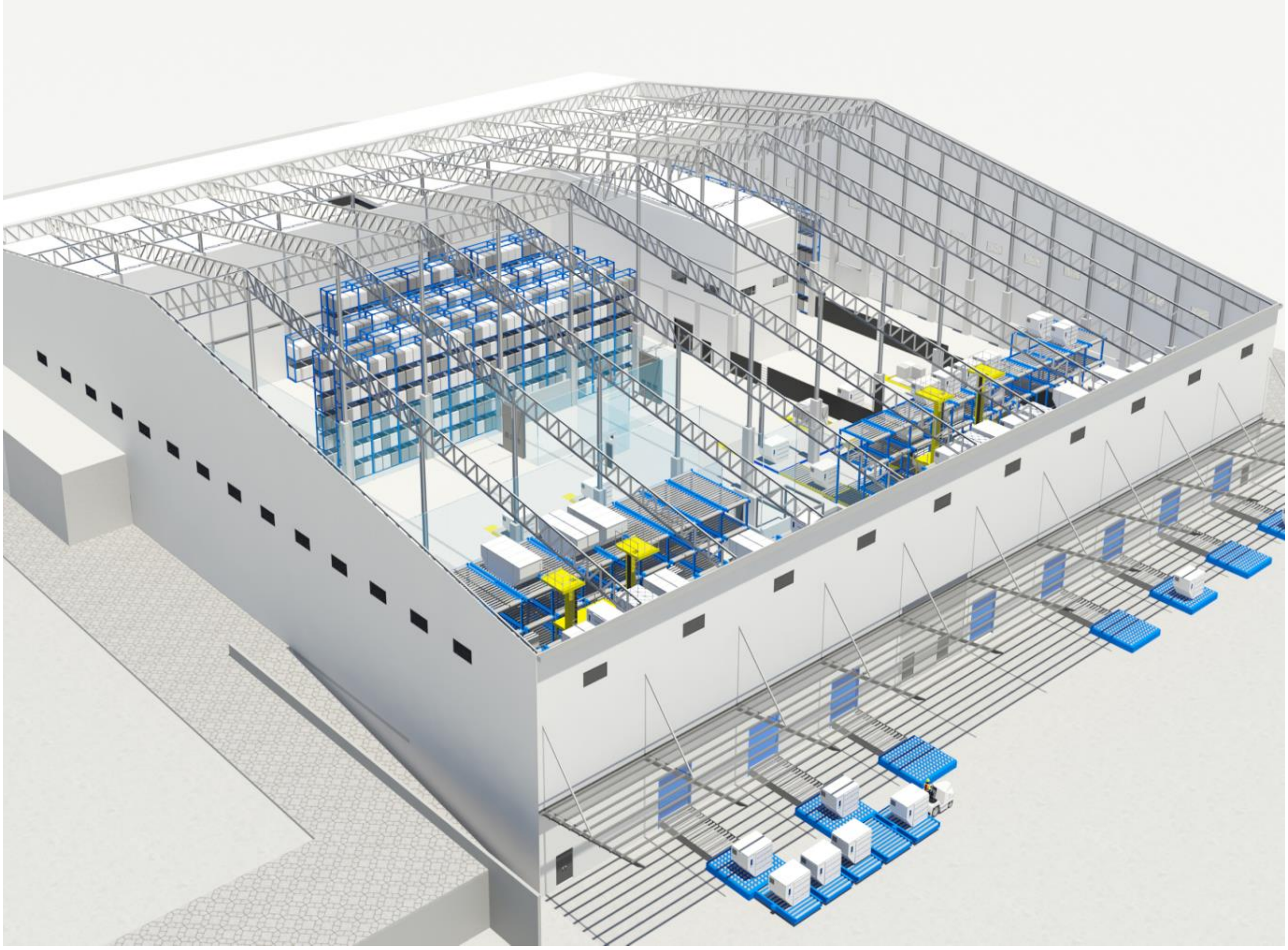

REFERENCE

Mitchell Cotts Cargo Terminal

Jomo Kenyatta International Airport, Nairobi | Kenya

New terminal for perishables and dry cargo
Throughput capacity of 80,000 tons per year
Opening scheduled for October 2018

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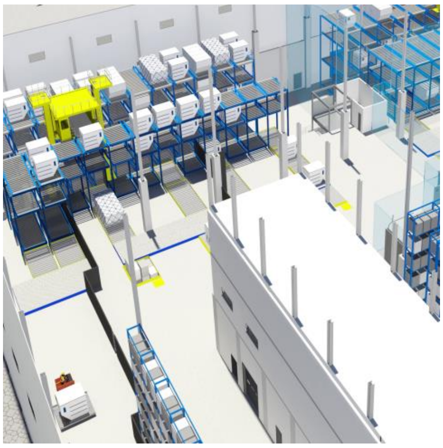
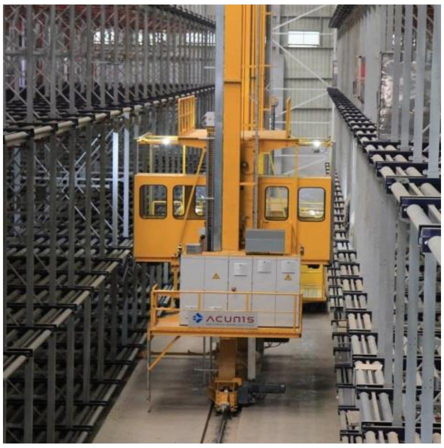
AIR CARGO INTRALOGISTICS





KEY DATA

Customer
Mitchell Cotts Freight Kenya, Nairobi

Location
Jomo Kenyatta Int'l Airport, Nairobi
Mitchell Cotts Cargo Terminal

Capacity
80,000 tons/year

Year of completion
2018

Future expansion planned
150,000 tons/year

OPTIMIZED CARGO HANDLING

A major challenge that faced the construction design of the new terminal was integrating all of the required areas such as warehouse space and break rooms/communal areas as well as customs clearance in the relatively dense overall available space.

The resulting solution has been to foresee dividing the facility into two separate storage areas with virtually identical layout; one for dry goods and another for perishables. The latter is installed in a cold storage warehouse that is capable of regulating temperatures down to 2 °C.

SCOPE OF SUPPLY

- ULD store:
  2 ETVs, steel structure,
  120 friction-driven roller decks
  20ft, 240 storage locations 10ft
- Automatic and manual conveyor lines, ball mat areas
- 4 dolly docks
- 2 truck docks
- 5 workstations
- Inventory control system and visualization UniWare
- Slave pallet mover with charging system
- Slave pallets
- Pallet racking
- House ULD for bulk cargo
- 5 dock levelers

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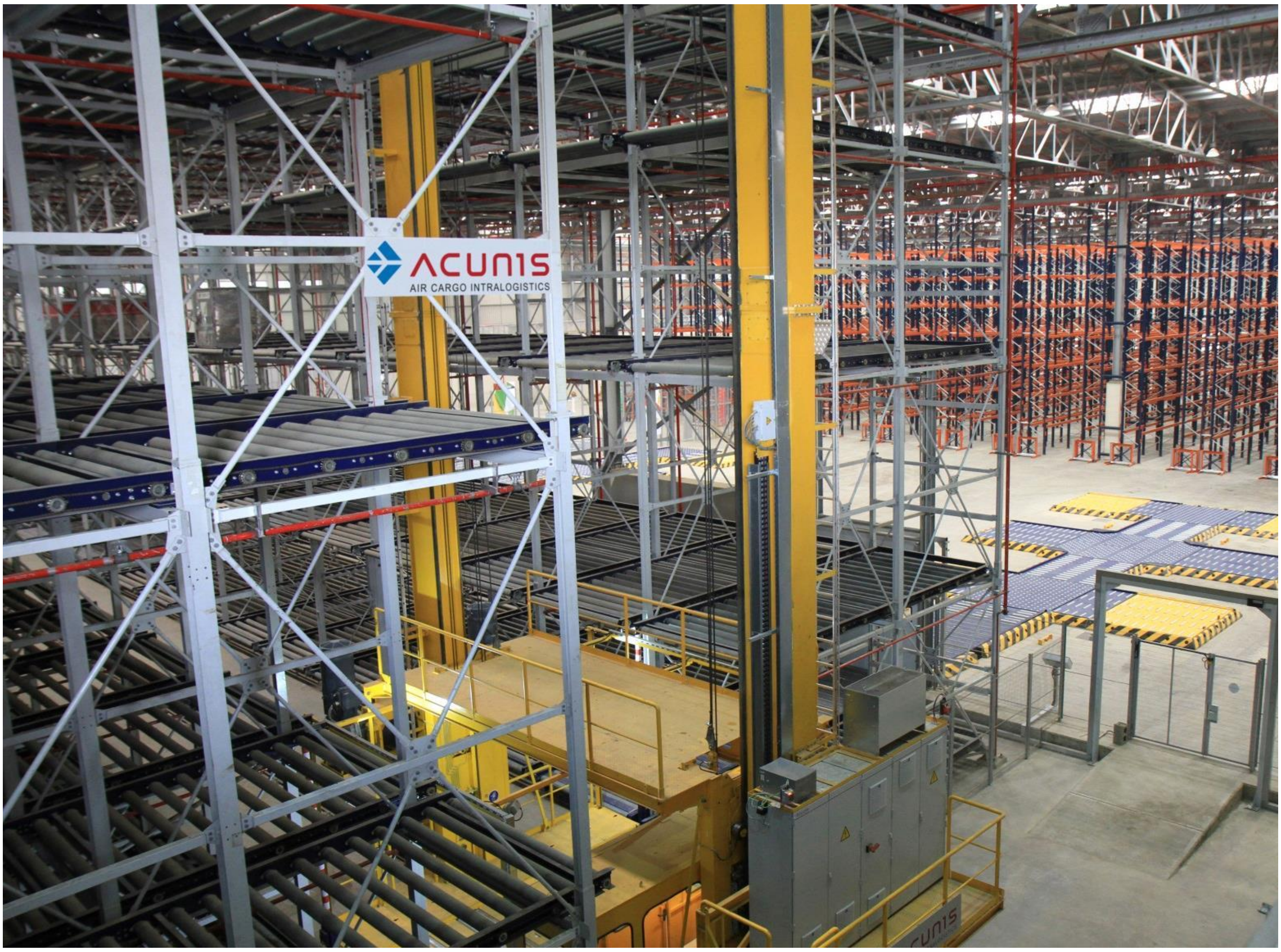

REFERENCE

Ethiopian Airlines Cargo Terminal 2

Bole International Airport, Addis Ababa | Ethiopia

Africa’s largest & most state-of-the-art cargo terminal
Throughput capacity of 600,000 tons per year
Opening in June 2017

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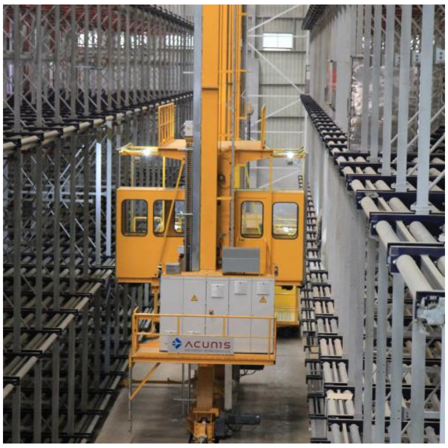

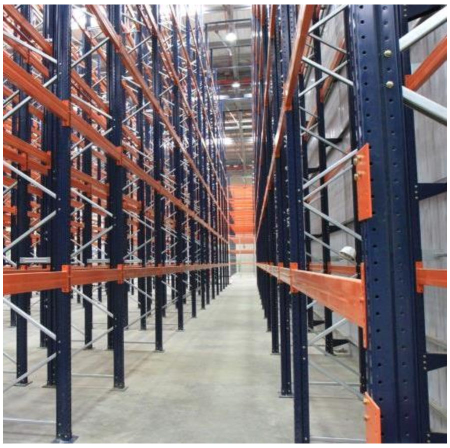

KEY DATA

Customer
Ethiopian Airlines, Ethiopia

Location
Bole Int'l Airport, Addis Ababa
Ethiopian Airlines Cargo Terminal

Capacity
600,000 tons/year

Year of completion
2017

Future expansion planned
1,200,000 tons/year

CARGO HUB FOR AFRICA

As general design-build contractor, ACUNIS was responsible for planning and implementing the entire terminal including engineering, delivery, installation and commissioning of the mechanical equipment and automation systems.

The heart of the air-cargo terminal are two automatic warehouses for ULDs (unit load devices) with space for 1,000 10-ft units with a total of 4 elevating transfer vehicles (ETVs).

Half of the 38,000 m² hall complex is devoted to the handling of fresh goods and chilled to a temperature of 2 to 10 °C.

SCOPE OF SUPPLY

- ULD store:
  4 ETVs, steel structure,
  500 friction-driven roller decks 20ft, 1,000 storage locations 10ft
- Automatic and manual conveyor lines, ball mat areas
- 16 dolly docks and 2 truck docks
- 31 workstations
- Meat hanger system
- X-ray machines
- Inventory control system and visualization UniWare
- Fork lifts, VNA truck system and charging rooms
- Slave pallet mover and slave pallets
- Pallet racking
- Cold room equipment
- CCTV system
- Access control system

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REFERENCE

Spirit Air Cargo Handling

Copenhagen Airport, Kastrup | Denmark

Modernization of air-cargo terminal

New control technology and Inventory Control

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AIR CARGO INTRALOGISTICS

KEY DATA

Customer
Spirit Air Cargo Handling, Denmark

Location
Copenhagen Airport, Kastrup / Denmark

Year of modernization
2011

SCOPE OF SUPPLY

Modernization of complete material handling system

ULD warehouse:

- 288 storage positions 10 ft
- 2 coolers 20 ft, 2 freezers 20 ft
- 7 empty-pallet stores
- 2 elevating transfer vehicles (ETV)

ULD truck docks:

- 6 truck docks
- 1 intermediate storage with own ETV
- 1 conveyor link to the ULD warehouse

Import / export area:

- 32 workstations 10 ft / 20 ft with integrated scales
- 3 transfer vehicles (TV) | automatic storage and retrieval system for Europallets, 4 aisles, 936 positions, pre-storage zone

Control-technology and Inventory Control (completely renewed)

- 12 x Simatic S7 300 with CPU 317F
- PROFINET / PROFIBUS
- New travel measuring systems and sensors
- Inventory control software UniWare 4.0 (hosted in Stockholm)
- Operation by Handhelds and Tablet-PCs
- Integration of 34 scales

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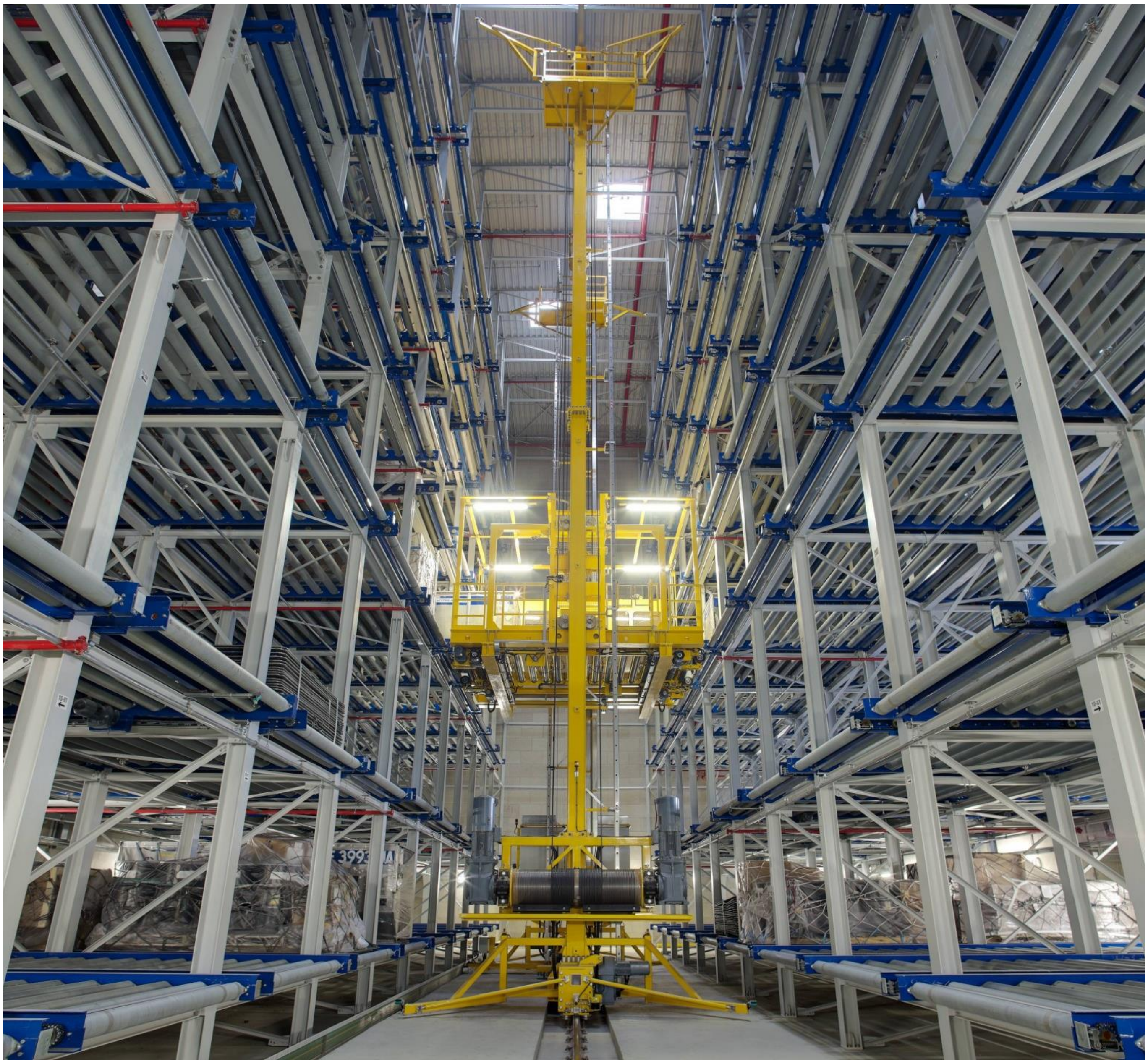

REFERENCE

Celebi Cargo

Frankfurt Airport | Germany

New air-cargo terminal

Complete ULD handling system, operation on two levels

KEY DATA

Customer
Çelebi Cargo GmbH, Frankfurt

Location
Cargo City Süd, Airport Frankfurt / Germany

Year of completion
2010

SCOPE OF SUPPLY

Cargo Handling System

- Elevating transfer vehicle 15 ft
- Cargo hoist 15 ft
- 4 truck docks 20 ft with scales
- 8 workstations with scales
- 34 powered roller decks
- 132 storage decks 20 ft
- Inventory Control System

Steel structure provided as rack-supported building

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REFERENCE

Dube Cargo Terminal

King Shaka Int'l Airport, Durban, South Africa

New air-cargo terminal with tradezone link

Automated ULD and pallet storage system

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KEY DATA

Customer
Dube Tradeport Company, Durban / South Africa

Location
King Shaka International Airport, Durban / South Africa

Year of completion
2010

SCOPE OF SUPPLY

Pallet high-bay store with 1,584 locations

ULD handling system:
- 2 elevating transfer vehicles (ETV)
- 6 elevating workstations 10 ft
- Cold room with workstation
- 2 turntables
- 46 cold-storage locations
- 202 storage conveyer decks
- Elevating truck docks
- Ball mat areas

Express and courier facility
X-ray units
Inventory Control System UniWare

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ACUNIS
AIR CARGO INTRALOGISTICS

長榮空運倉儲
EGAC

REFERENCE

Evergreen Air Cargo Terminal

Taiwan Taoyuan International Airport, Taipei / Taiwan

600,000 tons air-cargo terminal
Fully automatic ULD material handling system

KEY DATA

Customer
EGAC - Evergreen Air Cargo Services Corporation

Location
Taiwan Taoyuan International Airport,
Taipei, Taiwan

Year of completion
2003

SCOPE OF SUPPLY

Fully automatic material handling system

- 2 15‘ forktype elevating transfer vehicle (ETVs)
- 608 ULD storage positions
- 8 15’ TVs
- 6 vertical conveyor ULDs (up to 15’)
- 3 10’ elevating truck docks
- 20 10’ elevating workstations

Automatic storage and retrieval system

- 4 double-fork stacker cranes
- 1,880 storage positions in rack structure

Empty-container handling system

- 2 empty-container cranes
- 2 storage areas, each for 108 empty ULDs

Inventory Control System UniWare

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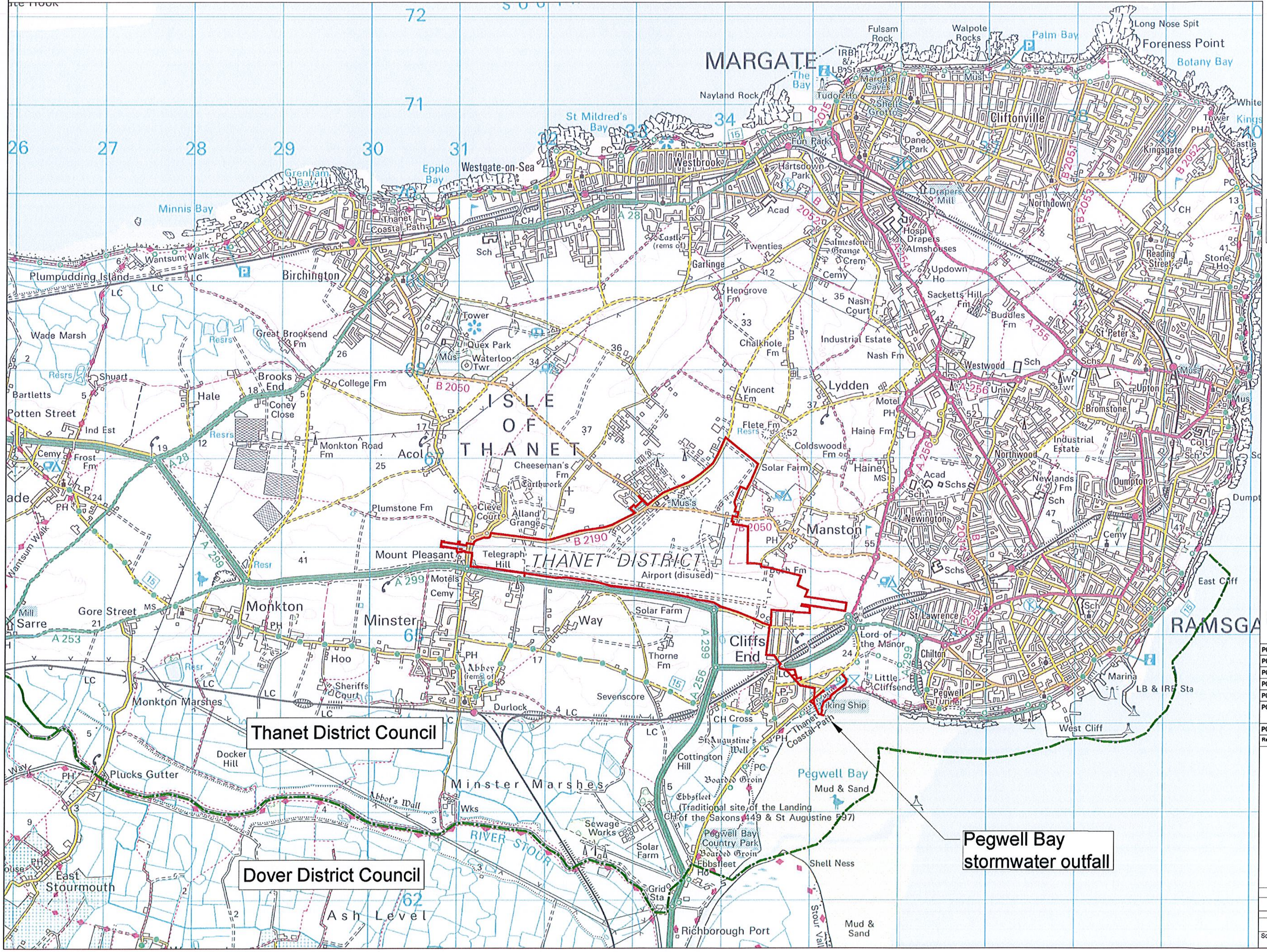
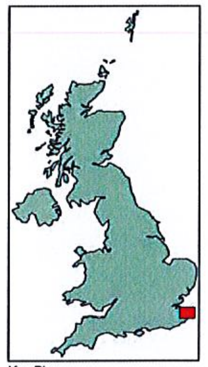
Appendix F.4.13

MANSTON AIRPORT DEVELOPMENT CONSENT ORDER
LOCATION PLAN
REGULATION 5(2)(j)
THANET DISTRICT COUNCIL





Key Plan
Scale: NTS

KEY

Order Limits

Local Authority Boundary

NOTES

1. OS data obtained from emapsite™ May 2017: © Crown copyright and database rights 2017. Ordnance Survey 0100031673

100m SCALE 1:20,000

Rev	Description	By	Ckd	Apr	Date
P07	Key amended	SO	CJ	GDD	27.03.18
P06	Application number added	SO	CJ	GDD	23.03.18
P05	Updated DCO Boundary	AAG	CJ	CJ	15.03.18
P04	Upadted labels	GS	CJ	CJ	02.03.18
P03	Boundary line updated and notes added	TC	CJ	GD	16.02.18
P02	Order limits amended following project team review. Access routes to manholes on private land included. For details of order limits refer to Land Plans.	TAW	CJ	CJ	11.10.17
P01	First Issue	TAW	CJ	GD	03/10/17

Project MANSTON AIRPORT DEVELOPMENT CONSENT ORDER

Title LOCATION PLAN
REGULATION 5(2)(j)
THANET DISTRICT COUNCIL

Document Number: NK018417-RPS-MSE-XX-DR-C-2200
Revision: P07
Project Number | Originator - Zone - Level - Type - Role - Drawing Number

Application Number - TR020002

Scale	Sheet Size	Sheet No	Status
1:20,000	A1	1 of 1	S. 56

Appendix F.4.17

Tilbury2 – DCO granted 20/02/2019

Obligation	Location in s.106 agreement	Secured in DCO?
Not to allow the First Operation of the Development until payment to Council of Tilbury Fort Heritage Contribution in full	Schedule 2	No
Not to allow the First Operation of the Development until payment to Council of the Tilbury Ferry Contribution in full	Schedule 3	No
Not to allow the First Operation of the Development until payment to Council of the Gravesend Heritage Contribution in full	Schedule 4	No
Owner to implement, promote and ensure (so far as is reasonably practicable) the Skills and Employment Strategy	Schedule 5	No

Silvertown Tunnel – DCO granted 10/05/18

Obligation	Location in s.106 agreement	Secured in DCO?
On Commencement TfL and the Owner to pay the Council the Sustainable Transport Contribution	Second Schedule, Part 1, 1.1	No
On Commencement TfL and the Owner to pay the Council the DLR Victoria Road Bridge Contribution	Second Schedule, Part 1, 1.2	No
On Commencement TfL and the Owner to pay the Council the North Woolwich Road Off-Cycle Carriageway Contribution	Second Schedule, Part 1, 1.3	No
On Commencement TfL and the Owner to pay the Council the Tidal Basin Road Contribution	Second Schedule, Part 1, 1.4	No
On Commencement TfL and the Owner to pay the Council the Silvertown Way Underpass Contribution	Second Schedule, Part 1, 1.5	No

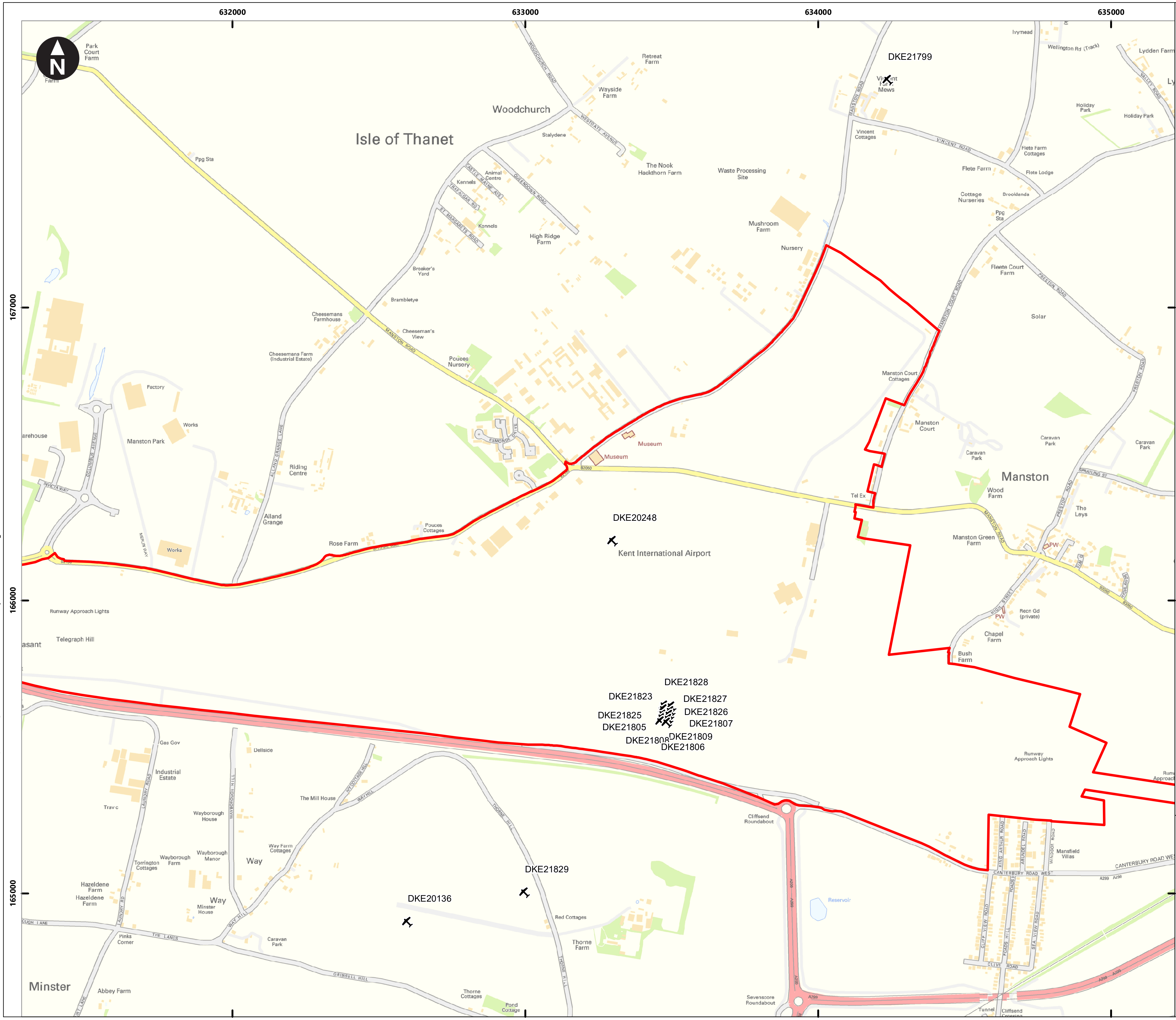
On Commencement TfL and the Owner to pay the Council the Business Transitional Support Contribution	Second Schedule, Part 1, 1.6	Yes – Schedule 2, Part 1, 21
TfL to comply with the Local Labour and Goods and Services Provisions	Second Schedule, Part 2, 1	No
TfL and the Owner to not Commence or permit Commencement of the DCO until the Neighbourhood Enhancement Areas Strategy is approved in writing by the Council to the satisfaction of the Council	Second Schedule, Part 3, 1	No

Thames Tunnel Tideway– DCO granted 17/03/15

Obligation	Location in s.106 agreement	Secured in DCO?
The Undertaker shall require its Contractor and their sub-contractors to use reasonable endeavours to achieve a cumulative target of 25% of employees who are living within the Development Boroughs across Development Sites	Schedule 1, Part 1 Employment and Skills	No
On or before the Construction Phase Completion Date relating to the works and landscaping at the Development Sites of Carnwath Road Riverside the Undertaker shall serve a notice to the Council identifying the area of the Land to be made available for public use in accordance with the provisions of this (the "Permissive Public Realm").	Schedule 1, Part 2 Permissive Public Realm	No
The undertaker shall pay to the Council: the Highways Contribution; the Bus Improvements Contribution; the Thames Path Contribution; the Cycle and Pedestrian Route Improvements Contribution; and the Controlled Parking Zone Review Contribution.	Schedule 1, Part 3 Transport Mitigation	No

The Undertaker covenants with the Council that prior to Implementation the Undertaker shall pay to the Council the Landscape and Amenity Improvements Contribution.	Schedule 1, Part 4 Landscaping and Local Amenity	No
The Undertaker covenants with the Council that prior to Implementation the Undertaker shall pay to the Council the Community and Education Impact Contribution.	Schedule 1, Part 5 Community and Education Impact	No
The Undertaker covenants with the Council that prior to Implementation it will pay the Council Monitoring Contribution.	Schedule 1, Part 6 Council Monitoring	No

Appendix HE.4.3



Note :
The KCC GIS Data contained in this material was obtained on 03/11/2016.

Manston Airport DCO
Historic Environment Post Hearing Note

Figure HE.4.3 ii
Indicative location of recorded military crash sites (via KCC HER)

July 2019

wood.

R:\Projects\38199 Manston Airport DCO EIA\3 General\Archaeology & Heritage\Working GIS\MXDs\40820 - 4WQ military remains.mxd Originator: John.Mabbitt

Technical note:
Manston Airport Noise Assessment: Examination Authority clarification item 27 and Fourth Written Question Ns.4.3

1. Introduction

1.1.1 This Technical Note has been prepared to respond to a request raised by the Examination Authority following Issue Specific Hearing 5. This relates to item 27 which states:

1.1.2 *'Provide an evidenced response to:*

a) Five10Twelve noise contour modelling undertaken by the Civil Aviation Authority (CAA); and

b) No Night Flight noise contour modelling undertaken by CAA.'

1.1.3 Five10Twelve Ltd commissioned a study which suggests slightly different noise levels than those reported in the Environmental Statement (ES) [APP-034]. This Technical Note has been prepared to provide clarity regarding this situation.

1.1.4 Five10Twelve have employed CAA's Environmental Research and Consultancy Department (ERCD) section to produce noise contours for Manston Airport. These contours result in a difference area exposed to the Significant Observed Adverse Effect Level (SOAEL) and hence have a different conclusion with respect to the population exposed above the SOAEL presented in the ES.

1.1.5 This note has been updated for Deadline 9 to also reflect the input assumptions for NNF submission 14th June 2019 [AS-156], in response to Fourth Written Question Ns.4.3.

1.1.6 It should be noted that the operation of Manston Airport will be limited to the noise effects reported in the ES via a noise contour cap imposed via the Noise Mitigation Plan (NMP) [REP8-004]. In this regard any variations in factors like flight paths and fleet mix reported below would not affect the overall outcome of the assessment carried out on behalf of the Applicant.

2. Comparison

2.1.1 The ES sets out the parameters which influence aircraft noise prediction outcomes and the assumptions on which the assessment has been based. Where work specific to Manston has been carried out to derive these assumptions, explanations are provided. An example of this is Appendix 12.3 Aircraft Noise Modelling (APP-057).

2.1.2 To assist with interpretation of the information, Table 1 has been produced comparing the assessments carried out by Five10Twelve, NFF and the Applicant.

Table 1 Comparison of the assessments conducted by the Applicant, Five10Twelve and NFF

Item	Applicant	Five10Twelve	NFF	Comment
Prediction model	INM	ANCON	As Five10Twelve	ANCON and INM both implement the standard method within the profession for producing noise contours around airports, provided in ECAC Doc 29 and SAE AIR1845A documents. Methodology is therefore unlikely to result in a difference in results. Inputs for the method are aircraft noise (and performance) data. INM is commercially available, whereas ANCON is only available to the CAA.
Aircraft noise data	Aircraft Noise and Performance (ANP) database	NPD data (and flight profiles) deriving from Noise and Track Keeping (NTK) systems	As Five10Twelve	ANP is publicly available data[1] whereas ANCON uses NPD data, derived from NTK data which may be refined for extant airports (i.e. where track keeping data is available). The CAA use it to produce airport specific curves for extant airports for which the data is refined individually. This is not possible for Manston as it is not currently operating.
Takeoff and approach flight profiles	Default takeoff/approach procedures within INM	Proxy average flight profiles of height, speed and thrust from ANCON Stansted database (departures and arrivals). Aircraft types not present in the Stansted database were substituted by Heathrow profiles where possible, and if not present in the Heathrow database, by Gatwick profiles. The flight profiles assume average weights. Standard instrumental departures and arrivals used.	As Five10Twelve	Actual take-off/approach procedures have not been set out in the Five10Twelve submission and instead referenced those at other airports. The use of ANCON-derived thrust and speed values may contribute to a marginal difference in outcomes because: • Standard instrumental departures are used, as in INM; • Average weights are assumed. Similarly, INM uses average weights for groups of aircraft. It is reasonable to assume that in average terms, weight differences are relatively small, compared to differences at single event level.

[1] https://www.aircraftnoisemodel.org/

Item	Applicant	Five10Twelve	NFF	Comment
Flight path	Swathe Centreline[2] with examination of likely possible variants (Appendix 12.3 Methodology *'Aircraft noise modelling'* [APP-057]). Area navigation (RNAV) is assumed. Track dispersion as described in Table A12.3.40 in the ES [APP-057] is used, which is INM binomial dispersion pattern with 4 sub-tracks either side of a centre track). The distribution has been set as described in Table A12.3.41 of the ES [APP-057], with 2 options to west departures, where 50/50 has been assumed (see Table 12.3.40 of ES, [APP-057].	Historical Manston airport flight tracks digitised from the 'Wiggins' route map (Figure 5). RNAV lateral spread was modelled on all the departure tracks. All arrivals were modelled as 'straight-in' tracks along the extended runway centreline. There are two options available for west departures, where an almost 50/50 has been assumed (departure route 1 and departure route 2 are used 49 and 23 times respectively).	The "Wiggins routes". Unconfirmed whether this includes the Five10Twelve assumptions (outlined in the adjacent-left cell in this Table).	As noted in previous submissions, it is highly unlikely that the CAA would adopt the same flight paths as previously used by the airport specifically because of the likely worsening of the noise impacts. **This factor is considered to be the most likely cause of difference between outcomes**.
Modal splits	Various were examined, the ES main text data reporting was based on scenario of 70% west and 30% east. The following scenarios were also assessed during examination (3rd Written Questions: [REP7a-002]: • 100% west; and • 100% east.	4 scenarios were assessed: • 100% west; • 100% east; • 70% west and 30% east; and • 30% west and 70% east.	As Five10Twelve	When comparing like with like, this should influence the difference.
Fleet Mix	See Table 2 below. Figures used were 26,469 commercial air traffic managements (ATMs) and 36,135 general aviation (GA) movements.	See Figure 1 below. Used same commercial fleet mix as the Applicant. Figures used were 26,469 commercial ATMs and 38,000 GA movements.	See Figure 2 and Figure 3 below. NNF used an alternative commercial fleet mix, different than the one used by the Applicant and Five10Twelve.	Five10Twelve believed that GA movements were not included in the Applicant's model, however they were. The difference is these numbers is not expected to make a significant difference in outcomes.
MET conditions	From INM standard setting: Temperature: 14.7℃ Pressure: 759.97 mmHg Average headwind: 14.8 km/hour Humidity: 70%	Not reported	Not reported	Comment not possible. However, it can be assumed that the MET conditions employed in ANCON modelling are within the reference conditions range suggested by ECAC doc 29 (if they are not the same as the INM default) and therefore should not induce differences in the outcomes.

[2] Osprey Consulting Services Ltd 18 December 2017 Review of potential aircraft noise abatement operational procedures; Report 70992-001 Version 2.1 for RiverOak Strategic Partners

Item	Applicant	Five10Twelve	NFF	Comment
Topography	Digital terrain mapping from the project Emap site	Meridian 2 Gridded Heights terrain data (OS)	As Five10Twelve	Unlikely to result in significant difference for aircraft in the air.
Households/ populations	2017 CACI census data	2018 CACI census data	As Five10Twelve	No influence
Assessment year	Year 20	Year 20	Year 20	No influence

Table 2 Applicant Fleet Mix for Year 20

Aircraft Type Description	INM Modelled Type	Yearly Movements (Year 20)
Boeing 747-800	7478	788
Boeing 737-300	737300	2309
Boeing 737-800	737800	8281
Boeing 747-400	747400	1232
Boeing 757-300	757300	154
Boeing 767-300	767300	0
Boeing 767-400	767400	0
Boeing 777-200	777200	3700
Boeing 757-200	757RR	2001
Airbus A320	A320-211	193
Airbus A330-200	A330-343	2001
ATR 72	ATR72	4310
Lockheed L-100 Hercules	C-130E	22
Boeing C-17 Globemaster III	C17	22
Fokker 70	FK50	1456
Total		26469

Table 1 Manston 'Five10Twelve' fleet mix average day 100% W traffic

Type	Code	Departure route 1	Departure route 2	RWY 28 arrivals
Airbus A320	A320	1	0	1
Airbus 330-200	A332	1	1	3
Boeing 747-400	B744	1	0	2
Boeing 747-800	B748	1	0	1
Boeing 757-200	B752	1	1	3
Boeing 757-300	B753	1	0	1
Boeing 737-800	B738	6	6	11
Boeing 737-300	B733	2	2	3
Boeing 777-200	B772	3	3	5
ATR72	AT72	3	3	6
Boeing C17 Globemaster III	C17	1	0	1
Fokker 70	F70	1	1	2
Lockheed L-100 Hercules	C130	1	0	1
Single Propeller	SP	15	15	30
Small Twin Piston	STP	4	4	8
Small Twin Turboprop	STT	4	4	8
Executive Jet	EXE3	3	3	6
	Total	**49**	**43**	**92**

Table 2 Manston 'Five10Twelve' fleet mix average day 100% E traffic

Type	Code	Departure route 3	RWY 10 arrivals
Airbus A320	A320	1	1
Airbus 330-200	A332	3	3
Boeing 747-400	B744	2	2
Boeing 747-800	B748	1	1
Boeing 757-200	B752	3	3
Boeing 757-300	B753	1	1
Boeing 737-800	B738	11	11
Boeing 737-300	B733	3	3
Boeing 777-200	B772	5	5
ATR72	AT72	6	6
Boeing C17 Globemaster III	C17	1	1
Fokker 70	F70	2	2
Lockheed L-100 Hercules	C130	1	1
Single Propeller	SP	30	30
Small Twin Piston	STP	8	8
Small Twin Turboprop	STT	8	8
Executive Jet	EXE3	6	6
	Total	**92**	**92**

Figure 1 Five10Twelve Fleet Mix

Table 1 Manston 'NNF' fleet mix average day 100% W traffic

Type	Code	Departure route 1	Departure route 2	RWY 28 arrivals
Airbus A320	A320	0.1	0.1	0.3
Airbus 330-200	A332	1.4	1.4	2.7
Boeing 747-400	B744	0.8	0.8	1.7
Boeing 747-800	B748	0.5	0.5	1.1
Boeing 757-200	B752	1.4	1.4	2.7
Boeing 757-300	B753	0.1	0.1	0.2
Boeing 737-800	B738	5.7	5.7	11.3
Boeing 737-300	B733	1.6	1.6	3.2
Boeing 777-200	B772	2.5	2.5	5.1
Boeing C17 Globemaster III	C17	< 0.1	< 0.1	< 0.1
Fokker 70	F70	1.0	1.0	2.0
Lockheed L-100 Hercules	C130	< 0.1	< 0.1	< 0.1
Boeing 737-800	B738	0.7	0.7	1.5
Boeing 767-300	B763	2.2	2.2	4.4
General Aviation	SP/STP/STT/EXE3	26.0	26.0	52.1
	Total	**44.2**	**44.2**	**88.3**

Table 2 Manston 'NNF' fleet mix average day 100% E traffic

Type	Code	Departure route 3	RWY 10 arrivals
Airbus A320	A320	0.3	0.3
Airbus 330-200	A332	2.7	2.7
Boeing 747-400	B744	1.7	1.7
Boeing 747-800	B748	1.1	1.1
Boeing 757-200	B752	2.7	2.7
Boeing 757-300	B753	0.2	0.2
Boeing 737-800	B738	11.3	11.3
Boeing 737-300	B733	3.2	3.2
Boeing 777-200	B772	5.1	5.1
Boeing C17 Globemaster III	C17	< 0.1	< 0.1
Fokker 70	F70	2.0	2.0
Lockheed L-100 Hercules	C130	< 0.1	< 0.1
Boeing 737-800	B738	1.5	1.5
Boeing 767-300	B763	4.4	4.4
General Aviation	SP/STP/STT/EXE3	52.1	52.1
	Total	**88.3**	**88.3**

Figure 2 NNF day Fleet Mix

Table 3 Manston 'NNF' fleet mix average night 100% W traffic

Type	Code	Departure route 1	Departure route 2	RWY 28 arrivals
Boeing 737-800	B738	1	1	0
Airbus A320	A320	0.5	0.5	0
Boeing 747-400	B744	0	0	3
	Total	**1.5**	**1.5**	**3**

Table 4 Manston 'NNF' fleet mix average night 100% E traffic

Type	Code	Departure route 3	RWY 10 arrivals
Boeing 737-800	B738	2	0
Airbus A320	A320	1	0
Boeing 747-400	B744	0	3
	Total	**3**	**3**

Figure 3 NNF night Fleet Mix

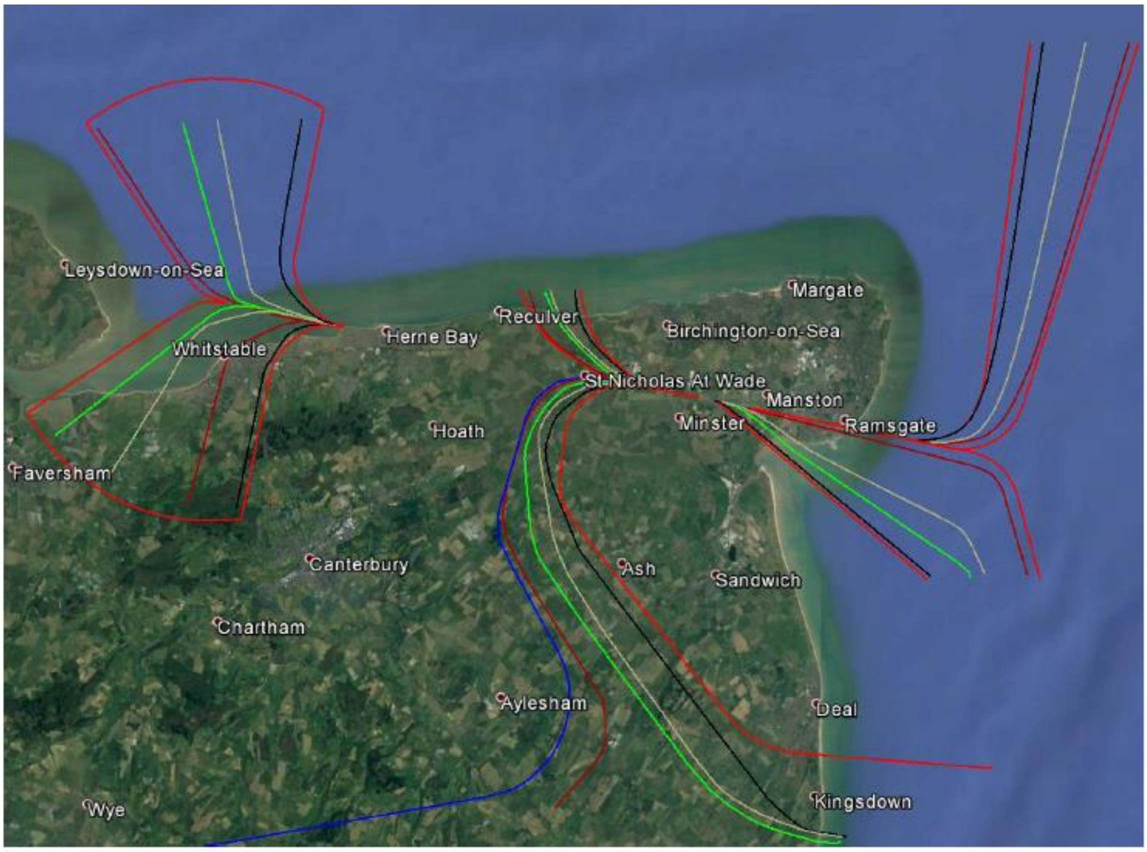


Figure 4 Applicant's potential flight paths

Note: Applicant's swathe centreline is grey lines

Table 3 Indicative Airspace Option Design Principles (A12.3.39 [APP-057])

Design principle	ARR 10	ARR 28	DEP 10 N	DEP 10 S	DEP 28 N	DEP 28 S
Avoiding urban concentration	Green	Straight in	Grey (No green route available)	Green	Green	Green
Swathe Centreline	Grey	Straight in	Grey	Grey	Grey	Grey
Tight Turns	Black	Straight in	Black	Black	Black	Black
Over or Near Urban Concentration	Dark Red	Straight in	Dark Red	Dark Red	Dark Red	Dark Red
Swathe Line (closest to airport)	Red – Swathe (earliest turn)	Straight in	Red – Swathe (earliest turn)	Red – Swathe (earliest turn)	Red – Swathe (earliest turn)	Red – Swathe (earliest turn)
Swathe Line (furthest from airport)	Red – Swathe (latest turn)	Straight in	Red – Swathe (latest turn)	Red – Swathe (latest turn)	Red – Swathe (latest turn)	Red – Swathe (latest turn)

Figure 5 Five10Twelve and NNF Flight Paths

3. Commentary for Ns.4.3 NNF

3.1 Input assumptions for contours with comparable metrics and modes

3.1.1 NNF have used the previous Manston Airport operations flight paths and would therefore be expected to produce a different zone of land but the same area within a given contour, even if all other inputs were the same. The Applicant has presented a significant amount of information with respect to potential flight paths and their potential outcomes in respect to the populations exposed and the potential costs (in terms of annoyance and sleep disturbance) in ES Appendix 12.3, specifically the Options Appraisal Approach section [APP-057].

3.1.2 NNF have considered an alternative fleet mix, so some difference might be seen in the contours, depending on their choice of aircraft.

3.2 Other NNF contours presented

Single mode contours

3.2.1 NNF have provided a 100% easterly and 100% westerly single mode L_{Aeq} contours. The Applicant has also provided these at LOAEL (50dB$L_{Aeq(16hr)}$ contour) in Figures 12.29 and 12.30 respectively, in Appendix Ns3.2, Appendices to Answers to Third Written Questions, TR020002/D7a/TWQ/Appendices [REP7a-003], in answer to Ns.3.2. However, as set out above, other input assumptions are different.

3.2.2 NNF have also presented 100% east and 100% west L_{Amax} contours for a single aircraft type, using their flight path.

NNF's contours

3.2.3 NNF have presented contours which they state will more closely relate to the nuisance they believe will result from the airport, which the Applicant does not believe are required to enable consideration of the application with respect to policy. The NNF contours provide an alternative way of presenting information, which is not directly comparable with that presented by the Applicant.

3.2.4 The following five paragraphs address why the Applicant has used 16 hour and 8 hour contours, average day and modal splits, rather than taking NNF's approach.

3.2.5 The noise information that should be presented with an application for a new airport is not mandated in England. In determining what information to provide for the ES the Applicant has aimed to identify areas/populations exposed above LOAEL and SOAEL in line with the Noise Policy Statement for England and related planning guidance for noise and aviation (see below). The assessment has also used L_{AMax} levels to assess the question of awakenings during the night, as awakenings are directly related to this metric. These methods were chosen in order to carry out an impact assessment to identify likely significant effects associated with the scheme, in line with guidance, to enable assessment outcomes to be considered in light of policy. NNF's contours have been provided to highlight their concerns regarding 'nuisance' and to indicate that they do not consider a worst-case approach has been taken when using a Rochdale Envelope approach. The Applicant wishes to clarify that they are not relying on a Rochdale Envelope for the application, but instead proposing a noise contour area cap [REP8-004].

3.2.6 Aviation Policy Framework 2013[3] refers to the production of L_{Aeq} 16hr and 8hr contours (for designated airports), and states '*The Airports Commission has also recognized that there is no firm consensus on the way to measure the noise impacts of aviation and has stated that this is an issue on which it will carry out further detailed work and public engagement.[95] We will keep our policy under review in the light of any new emerging evidence*.' The Applicant did not consider it appropriate to pre-judge the outcome of any potential policy change in preparing its assessment and has therefore used L_{Aeq} contours.

3.2.7 Commentary regarding the reason for the Applicant's choice of modal split is given in ES Appendix 12.3 Aircraft Noise Modelling [APP-057]. S5.53 of the Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England, June 2018[4] states that '*In assessing the likely significant impacts of aircraft noise, the applicant should have regard to the noise assessment principles, including noise metrics, set out in the national policy on airspace*'. The ES has done this through the presentation of LOAEL and SOAEL contours.

3.2.8 As explained in the ES [APP-034], the production of the contours has followed normal industry practice through use of a representative average day. As set out in the ES (para 12.7.44) [APP-034] the Applicant has adopted a 'typical busy day' in the winter as this is expected to generate more traffic than a typical summer's day.

3.2.9 The Applicant's contour production has used an anticipated modal split (as set out in Appendix 12.3 Aircraft Nosie Modelling section of the ES [APP-057]) which is the norm for presentation of aviation noise contours. This is evidenced by reference to noise contours produced by ERCD for Heathrow airport. This assumes average modal splits (ERCD REPORT 1601, Noise Exposure Contours for Heathrow Airport 2015[5], section 2.7) from (a) actual splits recorded for the airport (possible because the airport is operating, unlike Manston) and (b) long-term modal split calculated from the 20-year rolling average. The Heathrow report, for 2015 states: '*Use of the standard modal split enables year-on-year comparisons without the runway usage significantly affecting the contour shape*'.

4. Conclusion

4.1.1 Noise resulting from the operation of the airport will be limited by the noise contour cap (and other measures) contained within the NMP [REP8-004]. As such the adverse effects of the proposed development are limited to those reported in the ES, and variations such as those reported in the Five10Twelve and NNF commissioned reports thus have limited relevance. It should also be noted that the measures described in the NMP [REP8-004] will be reported on an annual basis using flight forecasts for the period when the airport is in operation. In this regard any variance in flight path, fleet mix etc. is embedded within the ongoing monitoring and assessment process.

[3] Secretary of State for Transport 2013 Aviation Policy Framework [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf [Accessed June 2019]
[4] Department for Transport June 2018 Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714106/airports-nps-new-runway-capacity-and-infrastructure-at-airports-in-the-south-east-of-england-web-version.pdf [Accessed June 2019]
[5] Environmental Research and Consultancy Department Civil Aviation Authority January 2017 ERCD REPORT 1601 Noise Exposure Contours for Heathrow Airport 2015 [online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/582641/heathrowairport-noise-2015.pdf [Accessed June 2019]

4.1.2 In terms of direct comparison, it is considered that the most likely source of difference between the contours/population affected is the different flight paths adopted, with a possible minor contributor being the flight profiles, and for NNF, fleet mix. It is not possible to comment on any difference associated with the aeroplane noise level input data as this has not been provided for ANCON.

4.1.3 The ES has provided six indicative route options based on the options work carried out by Osprey Consulting Limited. In the ES Appendix 12.3 p.5 is it stated:

'The assessment of aircraft air noise for ES has therefore considered six indicative airspace route options within a design swathe as provided by the airspace consultant Osprey Consulting Limited. The design swathe has taken into account the 'knowns' of the local airspace, including airways and navigational aids.'

4.1.4 Table 12.1 'Limitations' in the ES sets out the next stage of the process:

'*In addition to the DCO application for the airport, the exact airspace options, operating principles and aircraft flight paths will be formalised through an Airspace Change Proposal (ACP), which is a separate consenting regime that will happen after the airport receives its powers under the DCO.*'

…

'This means that <u>the assessment of aircraft noise presented in this ES is based on indicative prototype routes</u> which will be subject to authorisation and/or modification via the ACP, hence the impact of aircraft noise will be subject to change during that process.' (emphasis added).

4.1.5 The ACP process is introduced on the CAA's website and defined in CAP1616[6]. The environmental requirements for the process are given in CAP 1616a[7]. The Applicant's options appraisal approach within Appendix 12.3 followed the (then) draft Airspace Change proposal guidance linked above.

4.1.6 The final routes will therefore not be determined by the current DCO application, but by the CAA via the Airspace Change process. The Manston application can be followed on the CAA website under ID ACP-2018-75.

[6] Civil Aviation Authority November 2018 Airspace Design: guidance on the regulatory process for changing airspace design including community engagement requirements (CAP1616) [online]. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8127 [Accessed June 2019]

7 Civil Aviation Authority December 2017 Airspace Design: environmental requirements technical annex (CAP 1616a) [online]. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8128 [Accessed June 2019]

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Appendix SE.4.2

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3. Local Economy: Literature Review

Airports Commission

Final report

November 2014

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This document has been prepared for the Airports Commission in accordance with the terms of the Provision of Consultancy for Commercial, Financial and Economic Option Appraisal and Analysis (DfT) framework and the Contract Reference RM 2750 (650) dated 12th February 2014 and solely for the purpose and on the terms agreed with the Airports Commission within the Project Inception Document reference 3.1 dated 1st April 2014. We accept no liability (including for negligence) to anyone else in connection with this document.

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Contents

1 Executive summary

1.1 Background

PricewaterhouseCoopers (PwC) was commissioned by the Airports Commission to undertake research designed to provide the Commission with a better understanding of the impacts of airports and airport expansions on local economies. Our research is intended to inform the Commissioners' final decision on the preferred long-term expansion option by feeding into further work to set the baseline and assess the economic impacts of the proposed schemes (including additional surface access infrastructure) on the local area.

1.2 Aim of project

The purpose of our project is to provide the Commission with a 'road map' which links the available evidence in relation to the local economic impacts of airport development to its Appraisal Framework[1]. Specifically, we aim to:

- Identify the local economic impacts of increases in airport capacity/use in general, not just the shortlisted schemes, focusing primarily on the supply chain effects of airports, but also considering their impacts as catalysts of wider economic impacts for airport users; and
- Undertake a series of six case studies which examine these issues in specific local contexts:
  - Four of the case studies examine the historic evolution of the local economic impacts of Heathrow, Gatwick, Manchester airports and the New York system as a whole;
  - Two more focused studies look at the impacts of airport expansion/use in the context of the origin-destination market at Paris Charles de Gaulle and surface access links at Frankfurt.

The study seeks to understand the local economic impact of an airport's operation across four areas outlined in the Airports Commission's Appraisal Framework:

- **Business & services:** what type of businesses may be attracted to locate at or in the locality of an airport?
- **Labour demand:** what are the implications of an airport's operation for local labour demand, and is there sufficient supply to meet this demand?
- **Housing & social infrastructure demand:** how is an individual's decision on where to live impacted by the presence of an airport, and what impact does this have on local housing and infrastructure?
- **Land required:** what type of land is required for new commercial, residential and other development and how easily can this land be identified and developed following airport expansion?

A key issue for our research has been to understand and assess how the 'local' area has been defined in previous studies.

1.3 Approach

Our work has involved collating and exploring existing research (both theoretical and empirical) and case studies (in the UK and internationally). Its scope is limited so that it builds on existing research and does not duplicate that being undertaken as part of other modules. This means that:

- It excludes impacts such as those covered in the national economy impacts module[2], quality of life, sense of place, landscape and environmental impacts;

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[1] Airports Commission, Appraisal Framework, April 2014 (see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf)

[2] We recognise that there will be some overlap with the national economic impact, to the degree that local impacts contribute to the national picture

- It does not involve modelling or secondary data analysis (beyond the literature review); and
- It builds on the literature review by SDG on aviation and the economy[3].

1.4 Key findings

The two tables below summarise our findings from a review of the literature available on the local economic impact of airports. The focus of the review has been on the operation of airports rather than their construction and/or expansion.

Our findings are structured in a way which is aligned with the Airports Commission's proposed approach to assessing the local impacts of an aiport option, as set out in its Appraisal Framework[4]. We start by considering the impact on local businesses and services attracted to the local area and then consider the implications for labour demand and how labour supply adjusts to meet this demand (see Table 1). We distinguigh between those generated:

- Through airport operation (the direct impacts);
- Through supply chain spending and the spending of direct and supply chain employees (the indirect and induced impacts); and
- By the attraction, retention or expansion of economic activity resulting from the increased connectivity facilitated by the airport (the catalytic impacts).

We then consider the impacts on demand for housing and social infrastructure arising directly and indirectly from airport operation, and the land required for commercial, residential and infrastructure development (see Table 2).

Table 1: Key findings from literature review in relation to business & services and labour demand & supply

	Business & services attracted	Labour demand & supply
Questions to analyse	• How has the nature of the local business environment been affected by local airport development? • What businesses have been attracted to/ deterred from the local area?	• What employment has been generated: direct on- and off-site, indirect, induced and catalytic? • Could the jobs be met by the local and wider area? What was the remaining 'net additional labour demand'?
Direct impacts	• The majority of the direct business activity generated at airports is seen through passenger or freight airlines, although the sectoral breakdown of impacts is more commonly expressed in employment terms than business activity, and the definition of relevant industry groups varies between studies. • In addition, in the case of both London Heathrow and Manchester, nearly 90% of the total was direct activity on the airport site • The scale of additional business activity generated by expansion of airport capacity (measured in terms of additional passengers handled) depends on several factors including: - The share of air traffic movements which are long-haul flights (rather than low cost carriers) - How developed non-aviation activity is on the	• Our review of airport economic impact studies suggests that just over half of direct jobs created at airports are in airlines or other aviation industry firms: other major employment groups include government & security (9-18%) and ground transportation (6-15%) • The average number of direct jobs generated for each million passengers handled ranges from under 500 to over 1,500 • In the UK and USA, transport industry jobs are more skilled and more productive than the national average whereas jobs in the storage, trade and retail sectors tend on average to be relatively lower skilled • The commuting patterns of direct employees (airport workers) are relatively consistent across those airports where information is

[3] Steer Davies Gleave, 'Aviation and the economy – Framework and Evidence', 2014 (see https://www.gov.uk/government/publications/airports-commission-interim-report)

[4] Airports Commission (2014); Appraisal Framework; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf

	Business & services attracted	Labour demand & supply
	airport site - How much freight is handled • Also, the scope of airport impact studies often differs significantly which means comparisons require careful interpretation	available: over 75% live within a 30-minute drive of the airport, and the majority travels by car • This pattern of commuting provides some indication of the geographic scale of the local labour market • It is also relevant for considering the effectiveness and efficiency with which labour supply adjusts to changes in labour demand as a result of airport development
Indirect & induced impacts	• The economic impact studies reviewed use a broad range of multipliers to estimate the local indirect and induced impacts on value added of airport operation: a multiplier of 1.45 was used for Edinburgh Airport and one of 2.9 at Copenhagen Airport • The size of the multiplier is partly influenced by how broadly or narrowly the local area is defined: multipliers tend to be larger when the impact is being assessed at a regional level (e.g. North West England in the context of Manchester Airport and the Ile de France in the case of the Paris airports) because the areas are more self-contained • The attractiveness of the locality of an airport as a location for firms also affects the level of indirect and, to a lesser extent, the induced business activity	• The evidence on the share of national indirect and induced employment impacts which are felt locally and regionally is less than that for the direct impacts • A key factor influencing the employment multipliers is the size of the local area being considered: all other things being equal, multipliers will be larger in larger areas because leakages from the 'local' economy will tend to be smaller • Evidence from Sydney Airport suggests that the nature of the local labour market will need to adjust to accommodate the increase in supply • Similar evidence is seen from the Joseph Rowntree Foundation who highlight that new unskilled workers have moved into local communities, while the existing workers have taken on higher skilled jobs • These adjustment mechanisms determine how labour costs and pressure on social infrastructure will change with labour demand changes • They can only be fully assessed through general equilibrium modelling.
Catalytic impacts	• The catalytic impacts are rarely quantified, and often not discussed, within the literature around the economic impact of individual airports	
Investment and productivity	• The existing literature highlights the positive influence of (good) transport infrastructure on firms' investment location decisions • For example, a survey of UK companies shows that access to the air transport network is rated as vital or very important by more than 40% of companies, ahead of the cost of labour and business taxes • Similarly, the series of European Cities Monitors prepared by Cushman & Wakefield indicate that the most important factor influencing firms' choice of location is 'Easy access to markets, customers or clients' • The limited evidence available suggests that, in addition to companies which directly support aviation activity, occupiers of commercial space at or close to airports are typically in the technology and telecommunications (T&T) and manufacturing sectors • Businesses in the financial services, tourism, distribution and high-tech/ knowledge intensive manufacturing sectors are often cited as amongst those most influenced by connectivity: the list,	• The impact on the labour market of airport expansion depends on the nature of industries which locate in the locality • The evidence is mixed: for example, Dallas/ Fort Worth International Airport has attracted high-productivity industries, such as computing, finance and insurance whereas evidence from Memphis International and Amsterdam Schiphol airports suggests concentrations of low productivity distribution and storage firms • These differences indicate how the local economic geography and history affect the labour market demand through changing required skill mixes

	Business & services attracted	Labour demand & supply
	however, varies significantly depending on the local context • This means that findings from airports outside the London system do not readily transfer to London because the local economic context is quite different	
Tourism	• The impact of tourism on local business and services will predominantly be determined by the definition of the 'locality' which is assumed. While there may be limited benefit of close proximity to the airport, beyond the direct and induced impacts, there may be a more significant impact when the nearest metropolitan area or region is considered[5] • For a given number of passengers visiting the local area, the value added by tourism varies greatly: the shares of international and long-haul flights are key factors which can increase the level of impact[6] • In the UK, tourism value-added is 40% of visitor spending and average visitor spending is more than twice as high for non-European visitors as it is for European visitors (£1,027 vs £451) • In addition, £24.2bn of expenditure was generated through outbound tourism from the UK. This is a further source of value added, facilitated by the airport[7]	• The value added by tourism is associated with additional jobs in tourism intensive sectors, notably accommodation and transport • The proportion of these jobs which is local to the airport depends on the travel patterns of airport users in relation to their final destinations: for example, some are closer to the final visitor destination than others • Further jobs will also be created through outbound tourism: the majority of these (60%) are in the air transport industry (i.e. direct or indirect jobs), with additional employment in areas such as retail (25%) and travel agencies (7%) • Outbound tourism could also reduce value-added by facilitating the substitution of local expenditure for expenditure in other regions or abroad: local economic welfare may be enhanced by changes in the opportunity for travel • How far an increase in airport capacity will lead to increased outbound travel depends on levels of demand and price adjustments in the air transport market: this is being analysed through the DfT's transport modelling, which should be applied in this module
Clustering & agglomeration economies	• The emergence of airport city models reflects a belief that airports can drive the development of (local) industry-specific concentrations of economic activity. These are enabled by improvements in connectivity and access to related services. They, therefore, typically comprise a far broader range of firms than just those directly in the aviation industry • Research shows that firms' motivation to locate with logistics clusters proximate to airports is more strongly motivated by the opportunities to realise agglomeration benefits than a desire simply to be near to the airport • The local context, including governments' economic priorities (and incentives), strongly influence the industries which cluster around airports, with only aviation clusters consistently present at all airports	• There is very little evidence in the existing literature regarding on the impact of industry clustering around airports on the level and nature of labour demand • A wide range of industry clusters (including, transportation, telecommunications, publishing and distribution) have developed around airports, and these have very different implications for productivity, skill mix and employee numbers

[5] See Hakfoort et al (2001)

[6] This can be seen, for example, in comparing Deloitte (2013) and BERL (2008)

[7] For more detail, please refer to the Tourism Satellite Account (ONS, 2013)

Table 2: Key findings in relation to housing, social infrastructure and land

	Housing and social infrastructure demand	Land required
Questions to analyse	• How much of the 'net additional labour demand' will add pressure to the local housing market and associated services? • How much housing demand could there be from other sources, such as people wishing to live close to the airport for connectivity reasons?	• How much land is required for commercial and residential development to meet additional labour and housing demand? • Is the land available and could it plausibly be developed?
Airport impact	• To the extent that airport expansion increases direct and indirect employment in the local area, this will create pressure in the local housing market • The extent of this pressure depends in part on the scale of the local area (geographically and in terms of the economically active population) • Changes in commuting patterns are also an important adjustment mechanism • Evidence from the Joseph Rowntree Foundation in relation to Heathrow suggests that proximity to employment opportunities has affected the location decision of many residents • How airport expansion affects local housing markets is ambiguous: on the one hand, it directly stimulates housing demand as more airport workers are needed, and indirectly, as improved connectivity attract mobile firms and/or enables existing firms to become more competitive (thus boosting their demand for labour). On the other hand, negative externalities associated with airport expansion (e.g. noise, congestion) can make the area less attractive so reducing housing demand • McMillen (2004), for example, finds that the impact of 'severe noise' in reducing demand lowers house prices by 9.2%. The impact of additional airport capacity on noise is considered in Module 5 of the Appraisal Framework • Demand for housing is shown to be increased by Lipscomb (2003) through the improved connectivity brought by an airport	• The evidence demonstrates that the amount of land which is required in the locality of an airport varies greatly according to the local context • For example, Dallas/ Fort Worth airport covers 18,000 acres, or which 6,000 are for non-aviation activity but the majority of other airports are considerably smaller • Baker et al (2012) suggest that the nature of the land used by airports has changed with their recent development, stating that "large international airports in Europe, North America and Asia have varied functions beyond airport traffic and operate as metropolitan hubs with a diverse range of land uses" • Similarly, CBRE research demonstrates how the role of land used by the airport has changed, showing that occupiers of office space at airports are dominated by the technology and telecommunications (T&T) and manufacturing sectors • The result of this has been to increase land rents on airports sites, to the extent that land at Amsterdam Schiphol is now more expensive than in the Amsterdam CBD. This type of adjustment mechanism with regards to an increase in demand will have a significant impact on the nature and level of land use in the vicinity of an airport

Each impact has been considered at the 'local' level. In practice, the way in which the local area is defined varies from study to study (and from location to location). An important aspect of the research, therefore, has been to assess how the local area has been identified and what, if any, lessons can be learned.

Our review suggests that the nature of the 'local' impact varies by type of impact:

- The extent of the direct local impacts is reflected in direct employees' commuting patterns, which are primarily within a 30-minute travel time: this suggests that travel to work areas (or similar labour market measures) define the geographic scope of the main local impacts;
- By definition, the supply chain (indirect) and knock-on employee spending (induced) effects will tend to be more widely distributed spatially, recognising that some suppliers have less need for close physical

proximity to the airport to be competitive: many studies have expanded their geographical scope to consider metropolitan or regional areas, reflecting local economic geography (as well as the availability of data); and

- The extent of the local catalytic impacts, whether they be the influence on business location decisions, the facilitation of growth in wider markets (especially internationally) or the pattern of tourism, is driven by the way in which proximity to the airport makes a location attractive from a business and/or visitor perspective: the evidence suggests that this is broader than the local labour market.

When assessing the potential impacts of runway expansion at either Heathrow or Gatwick Airport, our research suggests that different definitions of the 'local' area will be needed to capture the different types of impact (see Table 3).

Table 3: Basis for defining and assessing local areas

Impact type	Basis for defining local areas
Direct	• Defined by local labour market (e.g. the travel to work area (TTWA)) in which the majority of 'on-airport' (and 'off-airport') employees reside • In the case of Gatwick Airport this is the Crawley TTWA (as defined by ONS) and, in the case of Heathrow Airport, four TTWAs are relevant (London, Reading & Bracknell, Guilford & Aldershot and Wycombe & Slough)
Indirect	• Depends on how widely/narrowly the scope of the airport is drawn • In the case of both Heathrow and Gatwick Airports, the multiplier used in any assessment needs to reflect the airports' footprints across large parts of London and the South East
Induced	• Arguably, less meaningful to define local area • Will be closely linked to the definition of the local area for the purposes of direct and indirect impacts
Catalytic	
Business location	• Influenced by workplace location of airport users • In the case of Heathrow and Gatwick, this is likely to cover a broader region across London and the South East
Tourism	• Influenced by destination of in-bound visitors relative to the airport • Depends on which markets are served by the airport and the extent of competition from other airports (and, to a lesser extent, other modes of transport available)

2 Introduction

2.1 Background

PricewaterhouseCoopers (PwC) was commissioned by the Airports Commission to undertake research designed to provide the Commission with a better understanding of the impacts of airports and airport expansions on local economies. Our research is intended to inform the Commissioners' final decision on the preferred long-term expansion option by feeding into further work to set the baseline and assess the economic impacts of the proposed schemes (including additional surface access infrastructure) on the local area.

2.2 Aim of project

The purpose of our project is to develop the evidence base on the local economic impacts of airport expansion, both immediately at and around airports, and more widely (whilst remaining local to the airport). It provides the Commission with a 'road map' which links the available evidence in relation to the local economic impacts of airport development to its Appraisal Framework[8]. Specifically, the aims are to:

- Identify the local economic impacts of increases in airport capacity/use in general, not just for the shortlisted schemes, focusing primarily on the supply chain effects of airports, but also considering their impacts as catalysts of wider economic impacts for airport users; and
- Undertake a series of six case studies which examine these issues in specific local contexts:
  - Four of the case studies examine the historic evolution of the local economic impacts of Heathrow, Gatwick, Manchester airports and the New York system as a whole;
  - Two more focused studies look at the impacts of airport expansion/use in the context of the origin-destination market at Paris Charles de Gaulle and surface access links at Frankfurt.

Our research and analysis has focused on the evidence relating to the key questions in the Airports Commission's Appraisal Framework:

- What types of business and services are likely to be attracted/deterred from locating at/around an airport and more widely (but still locally)?
- What scale and type of employment does an airport generate directly and indirectly, how productive is it and where is the labour drawn from?
- What factors influence individuals' decisions on where to live in the local and wider area of an airport, and what type and supply of housing is clustered around airports?
- What type of land is required for new commercial, residential and other development, and how easily can this land be identified and developed following airport expansion?
- To what extent are businesses/employment/housing displaced from other areas or additional?
- Following the development of airports, how do local areas mitigate the additional pressures placed on services?

A key issue for our research has been to understand and assess how the 'local' area has been defined in previous studies.

2.3 Approach

Our work has involved collating and examining existing research (both theoretical and empirical) and case studies (in the UK and internationally).

[8] Airports Commission, Appraisal Framework, April 2014 (see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf)

The scope of our research is limited in that it builds on existing research and does not duplicate that being undertaken as part of other modules. This means that:

- It excludes impacts such as those covered in the national economy impacts module[9], quality of life, sense of place, landscape and environmental impacts;
- It does not involve modelling or secondary data analysis (beyond the literature review): we envisage that this will be undertaken as part of the local economic impact assessment; and
- It builds on the literature review by SDG on aviation and the economy[10].

2.4 Report structure

Our report summarises the evidence we have been able to collect in relation to the four themes in the Airports Commission's Appraisal Framework:

- **Section 3** explores the types of business and services attracted to (and deterred from) locating at or around an airport and more widely (but still locally);
- **Section 4** examines the scale and type of employment generated directly and indirectly, how productive this employment is and where the labour supply is drawn from, including the factors that influence individuals' decisions on where to live in relation to the airport;
- **Section 5** considers the available evidence on how airport construction and expansion affects demand for housing and social infrastructure; and
- **Section 6** examines the influence of land availability.

A series of Appendices provide details of each of the six case studies as well as a list of the existing studies which have been reviewed.

[9] We recognise that there will be some overlap with the national economic impact, to the degree that local impacts contribute to the national picture

[10] Steer Davies Gleave, 'Aviation and the economy – Framework and Evidence', 2014 (see https://www.gov.uk/government/publications/airports-commission-interim-report)

3 Business and services

In this section we summarise the impact of an airport, or airport expansion, on those businesses and services which locate at or around an airport. We consider those directly involved in airport operations, those involved in the airport's supply chain, those dependent on the spending of employees at the airport and its supply chain, and those more widely affected by the air transport services provided through the airport. For this latter group of impacts, we focus on three key questions:

- What differences, if any, are there in the types of businesses attracted to locate near different types of airports?
- What value of output do these businesses generate?
- What factors attract/ deter a business to locate near an airport?
- We also consider briefly London's industrial structure, the role of clusters and how it has evolved.

Our key findings are summarised in Box 1.

Box 1: Business and services – key findings

Our analysis of business and services has focused on two questions:

- How has the nature of the local business environment been affected by local airport development?
- What businesses have been attracted to/ deterred from the local area?

Direct impacts

Our key findings in relation to the direct impacts are that:

- The majority of the direct business activity generated at airports is seen through passenger or freight airlines, although the sectoral breakdown of impacts is more commonly expressed in employment terms than business activity, and the definition of relevant industry groups varies between studies
- In addition, in the case of both London Heathrow and Manchester, nearly 90% of the total was direct activities on the airport site
- The scale of additional business activity generated by expansion of airport capacity (measured in terms of additional passengers handled) depends on several factors including the share of air traffic movements which are long-haul flights (rather than low cost carriers), how developed non-aviation activity is on the airport site and how much freight is handled
- Also, the scope of airport impact studies often differs significantly which means comparisons require careful interpretation

Indirect & induced impacts

Our key findings in relation to the indirect and induced impacts are that:

- Most of the impact studies rely on either input-output analysis and/or surveys of airport supply chains to determine the indirect and induced impacts
- The economic impact studies reviewed use a broad range of multipliers to estimate the local indirect and induced impacts on value added of airport operation: a multiplier of 1.45 was used for Edinburgh Airport and one of 2.9 at Copenhagen Airport
- The size of the multiplier is partly influenced by how broadly or narrowly the local area is defined: multipliers tend to be larger when the impact is being assessed at regional level (e.g. North-West England in the context of Manchester Airport and the Ile de France in the case of the Paris airports)
- How attractive the locality of an airport is as a location for firms also affects the level of indirect and, to a lesser extent, of induced business activity
- There is evidence that differences in findings are partly driven by measurement issues: for example, local indirect and induced impacts often depend on estimating regional input-output tables (from national models) but different approaches lead to differences in the multipliers

Catalytic impacts

The catalytic impacts are rarely quantified, and often not discussed, within the literature concerned with the economic impact of individual airports. Our key findings are summarised below:

Investment and productivity

- There is an extensive literature on the role of connectivity and market access on investment and location decisions: this highlights the positive influence of good transport infrastructure on firms' investment location decisions

- For example, a survey of UK companies shows that access to the air transport network is rated as vital or very important by more than 40% of companies, ahead of the cost of labour and business taxes[11]
- Similarly, the series of European Cities Monitors prepared by Cushman & Wakefield indicate that the most important factor influencing firms' choice of location is 'Easy access to markets, customers or clients'
- The limited evidence available suggests that, in addition to companies which directly support aviation activity, occupiers of commercial space at or close to airports are typically in the technology and telecommunications (T&T) and manufacturing sectors
- Businesses in the financial services, tourism, distribution and high-tech/ knowledge intensive manufacturing sectors are often cited as amongst those most influenced by connectivity: the list, however, varies significantly depending on the local context
- This means that findings from airports outside the London system do not readily transfer to London because the local economic context is different

Tourism

- The impact of tourism on local business and services will predominantly be determined by the definition of the 'locality' which is assumed. While there may be limited benefit in close proximity to the airport, beyond the direct and induced impacts, there may be more significant impact when the nearest metropolitan area or region are considered[12]
- For a given number of passengers visiting the local area, the value added by tourism varies greatly: the share of international and long-haul flights are key factors which can affect the level of impact[13]
- In the UK, tourism value-added is 40% of visitor spending and average visitor spending is more than twice as high for non-European visitors as it is for European visitors (£1,027 vs £451)
- In addition, £24.2bn of expenditure was generated through outbound tourism from the UK, which is a further source of value added facilitated by the airport (ONS, 2013)

Clustering & agglomeration economies

- Some studies also refer to the agglomeration benefits which they claim are reflected in the composition of firms which cluster around an airport, but the evidence is typically qualitative
- The emergence of the aerotropolis (Kasarda, 2008) and airport city models reflects a belief that airports can drive the development of (local) industry-specific concentrations of economic activity. These are enabled by improvements in connectivity and access to related services. They, therefore, typically comprise a far broader range of firms than just those directly in the aviation industry
- Research by Warffenmuis (2010) shows that firms' motivation to locate within logistics clusters proximate to airports is more strongly motivated by the opportunities to realise agglomeration benefits than a desire simply to be near to the airport
- Recent analysis has suggested that the clustering benefits may be limited once proximity to transport hubs is controlled for (Overman et al, 2012)
- In addition, the existing literature suggests that the composition of firms which cluster around an airport depends on the local context which limits how far the findings and experiences from one airport can be translated to another

Table 4 highlights some of the key studies we refer to in this section besides those reviewed as part of the case studies: a full list of studies used is provided in Appendix G.

Table 4: Summary of key sources used

No.	Title	Authors	Year	Airport covered
1	Economic and social analysis of potential airport sites	Ernst & Young	2012	Sydney
2	Economic Effects of Airports in Central Europe: A Critical Review of Empirical Studies and Their Methodological Assumptions	Zak & Getzner	2014	Central Europe
3	Minneapolis-St. Paul International Airport	InterVISTAS	2012	Minneapolis-St. Paul

[11] Cited in Oxford Economic Forecasting (2006), The Economic Contribution of the Aviation Industry in the UK, http://www.gacag.org/images/gacag/pdf/The%20Economic%20Contribution%20of%20the%20Aviation%20Industry%20in%20the%20UK.pdf.

[12] See Hakfoort et al (2001)

[13] This can be seen, for example, in comparing Deloitte (2013) and BERL (2008)

No.	Title	Authors	Year	Airport covered
4	The Regional Economic Impact of an Airport: The Case of Amsterdam Schiphol Airport	Hakfoort et al	2001	Amsterdam
5	The Economic Catalytic effects of Air Transport in Europe	Britton, Cooper & Tinsley	2005	EU

3.1 Types of business and services associated with airport operation

Potentially, an airport has a wide range of impacts on the local economy which can be categorised into four groups:

- Direct – those generated through airport operation;
- Indirect – those generated through activity in the upstream airport supply chain;
- Induced – those generated through employee spending (whether employed directly or in the supply chain); and
- Catalytic – spillover demand and supply side effects from airport operation.

A summary of how each of these effects is generated is set out in Figure 1 which is adapted from Britton et al. (2005).

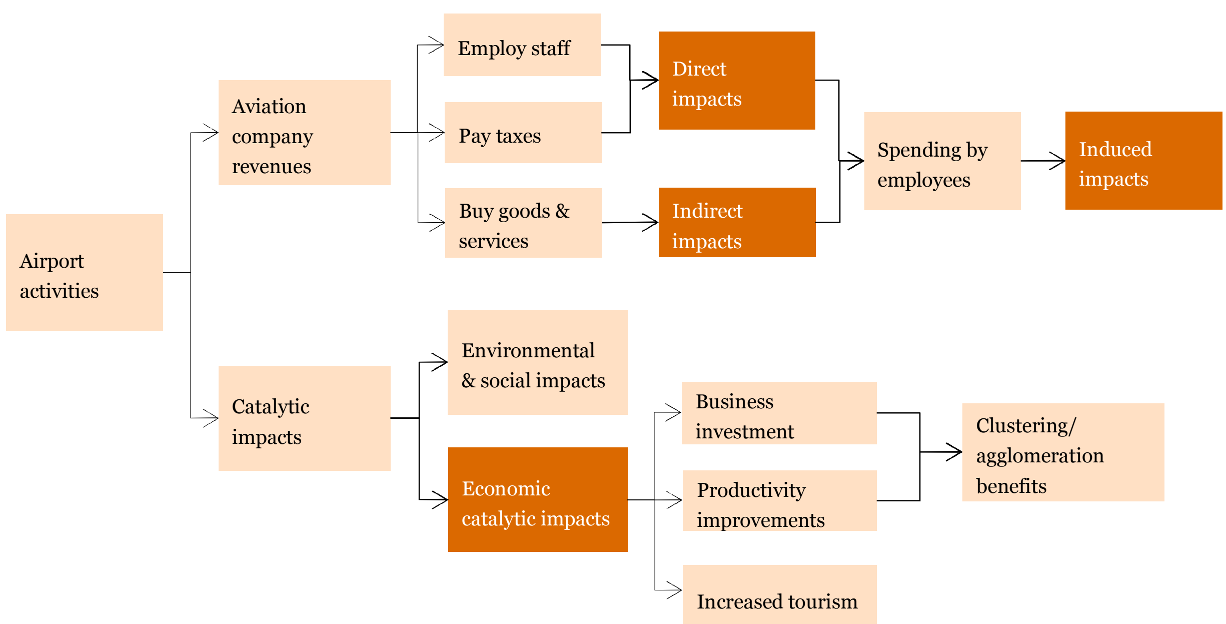


Figure 1: Local direct, indirect, induced & catalytic impacts of airports

Source: Adapted from Britton et al. (2006)

We examine each of the areas highlighted in terms of the business and services associated with each type of impact by reviewing the available evidence on the magnitude and drivers of the impact. We also consider the data required and the different methodologies used so that we can assess the implications of data availability and the choice of methodology for the robustness of the impact estimates.

3.2 Direct economic impacts

The first category of impact we examine is the direct economic impact. This is typically defined as the value added by (or the employment associated with) the activities directly related to the operation of the airport. These activities will typically be undertaken on the airport or in the immediately surrounding area because this is essential to providing the air transport services required by passengers.

Table 5 summarises the findings from a range of previous studies which have been selected because they have a comparable scope and clearly-stated methodology which can be assessed. A key driver of the direct economic impact of an airport is the level of airport activity (as measured by the number of passengers handled). The biggest total impact is at Heathrow and Sydney although there is a large variation in the value generated per passenger, ranging from £22 in Manchester to over £170 at Paris. Figure 2 shows, for a selection of studies, that this variation is in part driven by differing employment densities ranging from low density (300-600 FTEs per million passengers) to very high (1,200+ FTEs per million passengers)[14]. Adjusting for differences in years and currencies, there is a positive correlation between the density of employment and the value generated per head. As wages and salaries make up the majority of GVA, 61% in the UK (Optimal Economics, 2011), hiring additional FTEs will tend to feed through to value added. Some of the difference between airports could also be linked to methodological differences in how employees not directly employed by the airport are counted. Differences in the approach to this could change the estimated workforce without impacting on value-added, thus altering productivity estimates.

Table 5: Summary of direct economic impacts of airports[15]

Airport	Study (date)	Passengers (million)	Direct impact (value added)	FTEs	Value added per passenger	Value added per FTE
Europe						
London Heathrow	Optimal Economics (2011)	70.0	£3.6bn	76,700	£51.40	£46,900
London Gatwick	BHC (2011)	34.2	n/a	24,900	n/a	n/a
Frankfurt am Main	INFRAS (2013)	58.0	£5.52bn	78,000	£95.16	£70,810
JF Kennedy, New York	New York State (2010)	61.5	£3.79bn[16]	69,945	£61.70	£54,185
Paris Charles de Gaulle	BIPE (2012)	62	£11.00bn	115,400	£177.42	£95,321
LaGuardia, New York	New York State (2010)	33.5	£1.36bn	55,100	£40.67	£24,726
Manchester	York Aviation (2008)	21.2	£477m	19,300	£22.50	£24,715
Vienna	WIFO (2007)	19.0	£963m	16,031	£50.70	£60,000
London Stansted	Oxford Economics (2013)	17.4	£556m	10,231	£32.00	£53,900
Cologne/ Bonn	ARC et al. (2008)	9.3	£656m	12,460	£70.50	£52,600
Budapest	Dusek et al. (2010)	8.1	£196m	6,822	£24.10	£28,700
Frankfurt-Hahn	Heuer and Klophaus (2007)	3.1	£91m	2,431	£29.40	£37,400
Other						
Sydney	Deloitte (2013)	36	£2.9bn	28,030	£80.30	£103,200
Minneapolis- St. Paul	InterVISTAS (2013)	33.2	£1.2bn	17,500	£36.10	£68,000
Vancouver	Vancouver Airport	16.8	£1.0bn	21,633	£60.70	£47,200

[14] See York Aviation (2004).

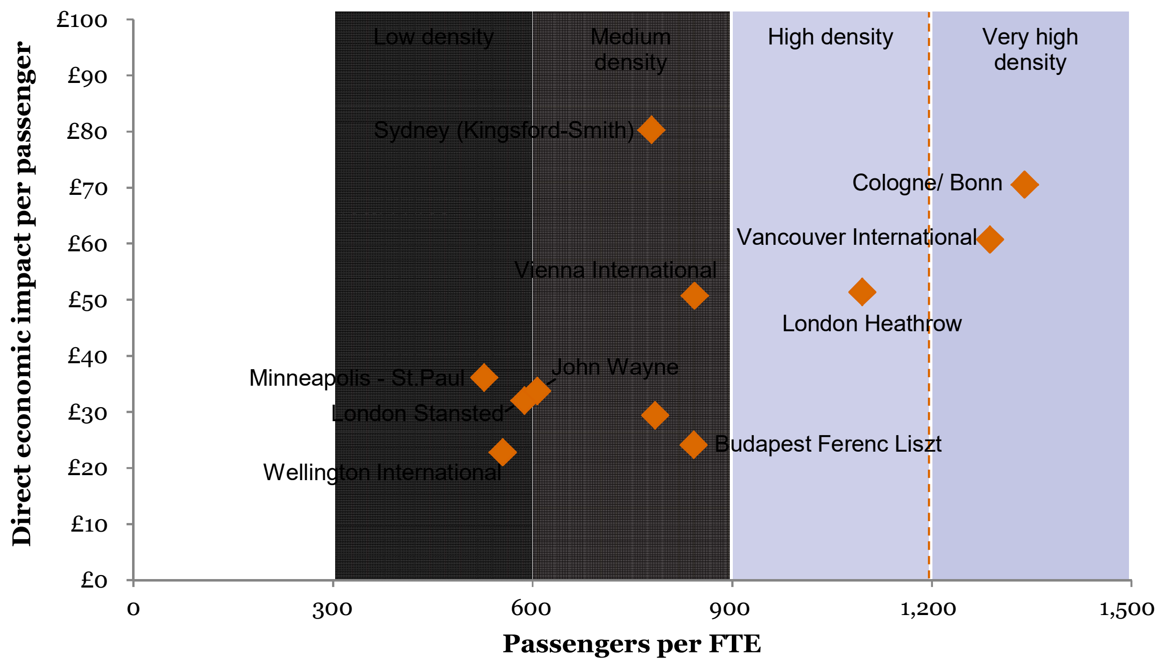
[15] Where relevant, exchange rate adjustments to pound sterling have been made based on the average exchange rate in the year of publication. To ensure consistency with original analysis, figures are not adjusted for inflation.

[16] The direct impact in terms of value added is not available, only wages paid to employees.

Airport	Study (date)	Passengers (million)	Direct impact (value added)	FTEs	Value added per passenger	Value added per FTE
	Authority (2011)					
John Wayne	InterVISTAS (2014)	8.9	£300m	5,400	£33.70	£55,600
Wellington	BERL (2008)	5.0	£115m	2,775	£22.80	£41,300

Source: Compiled by PwC based on previous studies

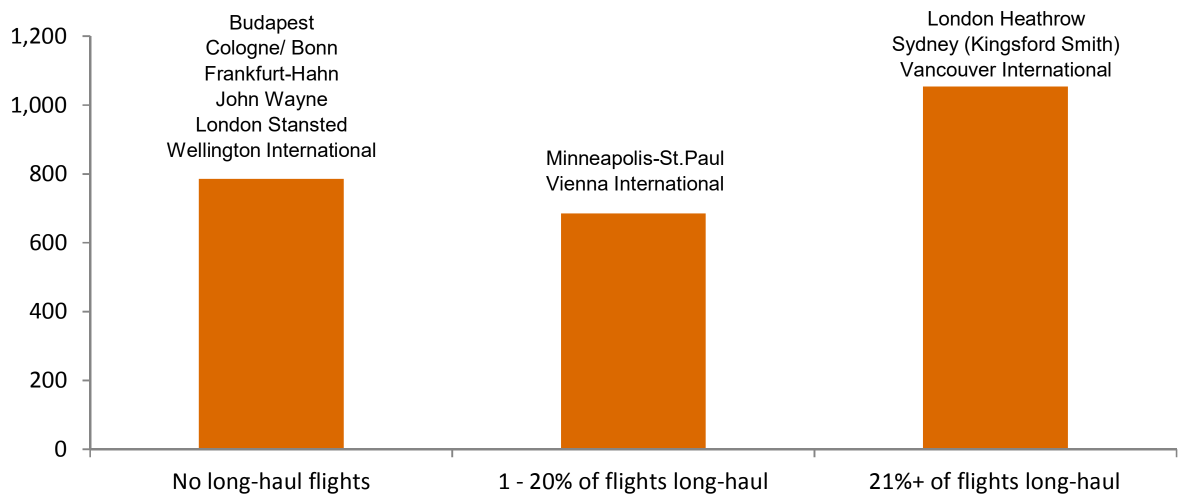
Figure 2: Direct economic impact per passenger by density of employment



Source: Compiled by PwC based on previous studies

A report by York Aviation (2004) suggests that airports which predominantly service short-haul 'no frills' flights typically have lower than average employment densities, due to cost pressures and higher productivity. Our survey of the evidence broadly supports this, with hub airports where more than 20% of passengers are long-haul having the highest employment densities.

Figure 3: Employment density by share of long-haul flights

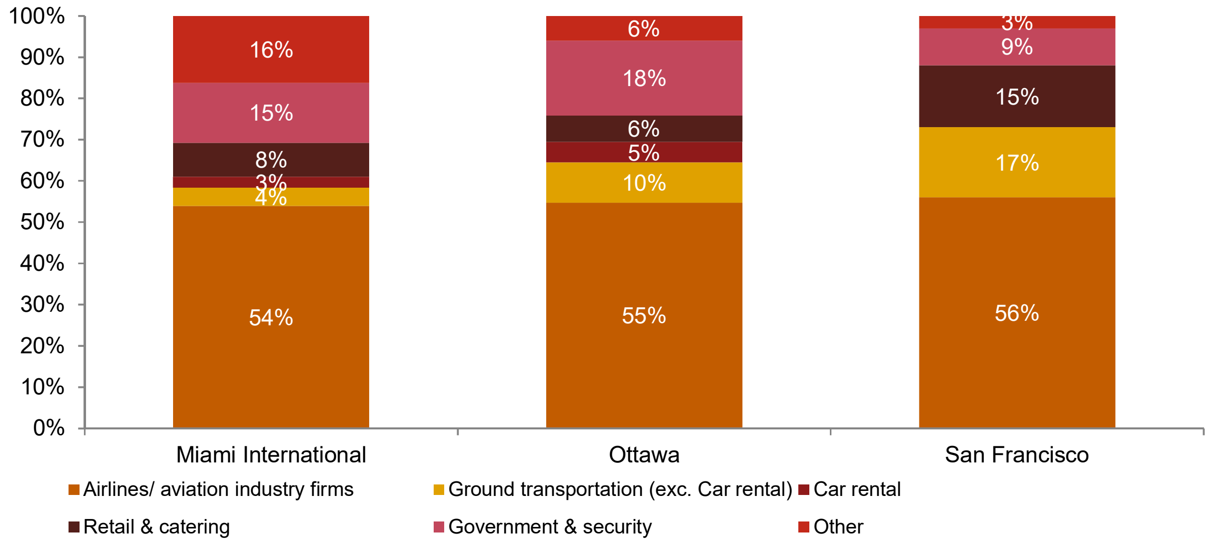


Source: Compiled by PwC based on previous studies, flight data from airport websites

Another factor which impacts total employment, besides employment density, is the volume (and value) of freight handled. For example, Cologne-Bonn Airport has the highest employment density. It handles three times as much freight per passenger as Heathrow and freight transport contributes 39% of its direct on-site employment. At London Heathrow, Amsterdam Schiphol and Miami International, retail and catering are estimated to account for more than 10% of the direct impact. These examples highlight the impact which different airport business models can have on employment and value-added and, therefore, the importance of studies considering the entirety of the business model in their analysis.

Figure 4 summarises the share of employees working in different sectors, at three major airports. In each example the share of jobs relating to airlines, or aviation industry firms (such as aircraft maintenance), is between 54% and 56%. The split between the other sectors is more varied, although this may be partly due to different approaches to counting employees. For example, in San Francisco, only private sector employees are included, with the result that the share of employees relating to government and security is far lower. Similarly, the largest categories in the 'other' category in Miami are cleaning services and consulting & construction. These sectors are not discussed in relation to either of the other two airports. One possible explanation for this is that these services are sub-contracted and, therefore, employees performing such tasks are not direct employees of the airport or its tenants. This would not change the total impact of the airport, but would change the estimated direct employment impact. As well as demonstrating the largest areas of employment likely to be generated within an airport, this example highlights the need to understand airport-specific business models and assumptions when interpreting findings.

Figure 4: % of employment by sector at Miami, Ottawa and San Francisco airports



N.B. The San Francisco data relate only to private sector employees

Source: PwC analysis, Miami-Dade Aviation Department (2009), Leigh Fisher (2011), EDRG (2013)

Box 2: Types of direct business employment – case study evidence

The evidence collected as part of our case studies is broadly consistent with the picture at Miami, Ottawa and San Francisco although some care is needed in interpreting them because the methodologies and definitions may not be consistent:

- At London Heathrow airport, 62% of direct on-site employment was in the airline sector (and 900 out of 7,700 off site jobs were also in the airline sector);
- The study of the New York system used a different structure which makes any comparison problematic; and
- At Frankfurt am Main airport, the airline sector accounted for 61% of direct employment.

Source: PwC case studies

Methodological issues

In addition to the factors discussed above, methodological differences will further broaden the range of estimates. For example, studies apply different definitions of the geographic and sectorial 'scope' of the airport and aviation activity. This is particularly the case with 'airport city' type developments where the limit of activity which is directly linked to the running of the airport is not clear. Similarly, studies apply different approaches to turning headcount numbers into FTEs (e.g. estimating total hours worked, or applying a full of thumb such as a part time worker equates to 0.5 FTEs). These issues mean that the results for one study cannot be directly compared with those from another, as any differences in the results may be driven by methodological differences rather than fundamental differences in the level of airport impact.

3.3 Indirect and induced impacts

The indirect economic impacts of an airport on the local economy are those generated by the activities in the upstream airport supply chain (i.e. those businesses providing goods and services to the airport) and the induced economic impacts are those generated through the spending of those employed either directly by the airport or in its supply chain.

The level of indirect and induced impact is often estimated using (local) multipliers which measure the ratio of direct to indirect and induced impacts (on employment and/or value added). Table 3 summarises a sample of these multipliers from previous studies. There is a reasonably broad variation in the estimated multipliers, from 1.45 in Edinburgh to 2.9 in Copenhagen. It can also be seen that the size or type of the airport has little bearing on the multiplier, with no noticeable correlation between the size of the multiplier and the number of airport passengers. What is more relevant is the variation in how the different studies define their local region of interest. This is likely to have a significant impact on the multiplier.

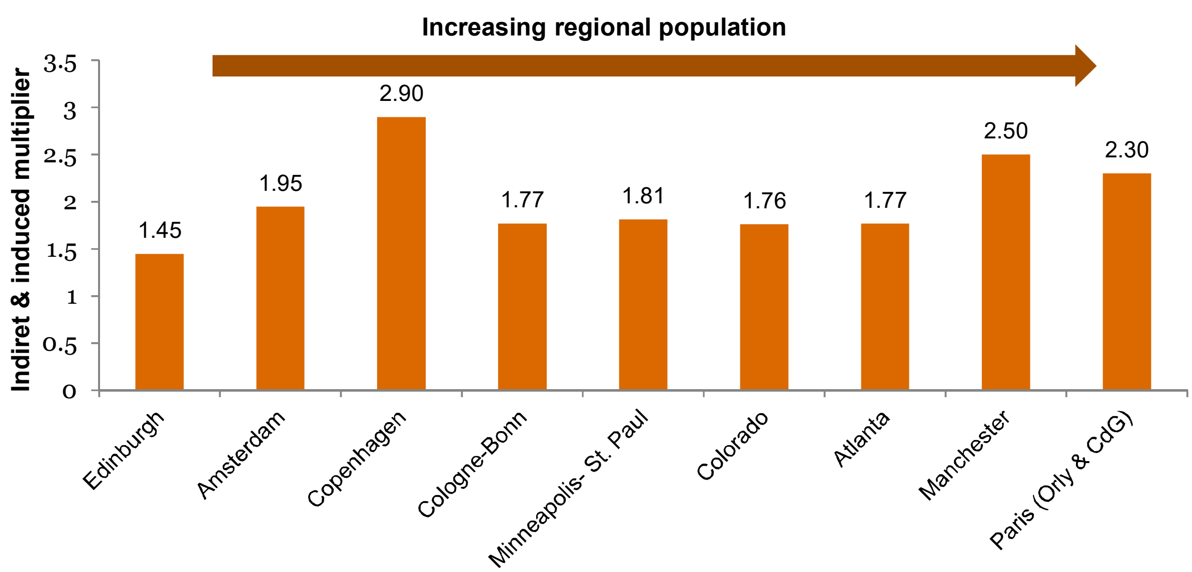
Table 6: Local indirect and induced multiplier estimates

Airport(s)	Year of study	Local area studied	Passengers (2013)	Regional population (m)	Indirect & induced multiplier
Amsterdam Schiphol	2001	Greater Amsterdam	52.6m	1.6	1.95
Atlanta	2009	Atlanta Metropolitan Area	94.4m	5.5	1.77
Cologne-Bonn	2008	Cologne-Bonn Region	9.1m	2.8	1.77
Colorado system	2013	Colorado State	52.6m	5.3	1.76
Copenhagen	1991	Copenhagen Region	24.1m	1.7	2.90
Edinburgh	2009	Edinburgh City Region	9.8m	0.5	1.45
Manchester	2008	North West England	20.7m	7.1	2.50
Minneapolis-St. Paul	2012	Minneapolis-St. Paul Region	33.9m	3.4	1.81
Paris (Orly & Charles de Gaulle)	2013	Ile-de-France	90.6m	12.0	2.30

Source: Compiled by PwC based on previous studies, population data taken from national statistical authorities

The size of the region used to assess the 'local' impact will affect the magnitude of the multiplier as any supply chain spending outside the region studied is a leakage from the system which reduces the multiplier (all other things being equal). This means that studies with a broader definition of 'local' will tend to have larger indirect and induced impacts. Figure 5 shows a weak relationship between the population in the 'local' area studied and the scale of the multiplier.

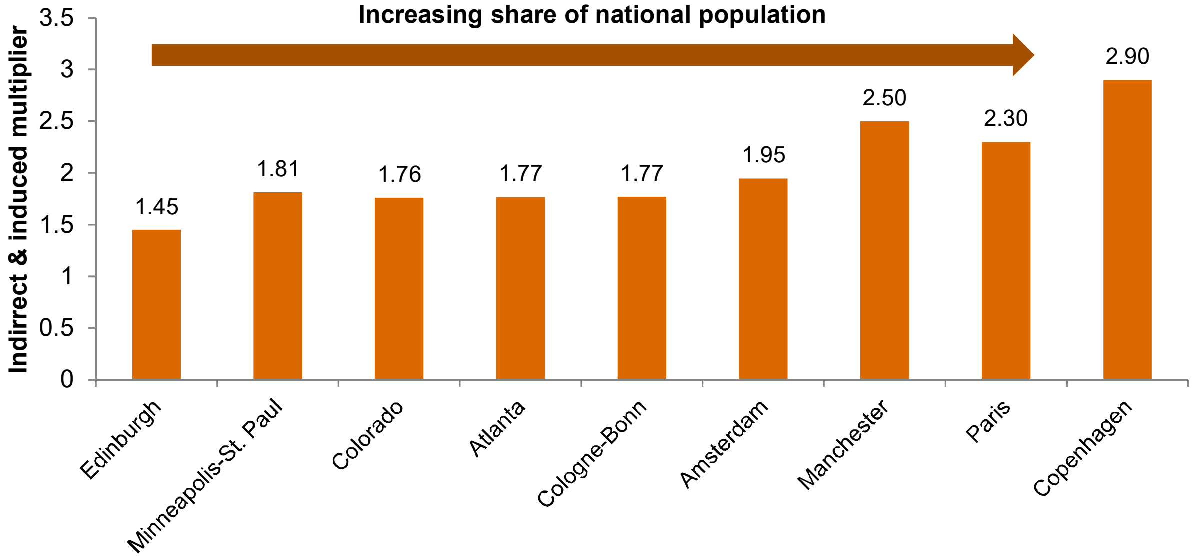
Figure 5: Local induced and indirect output multipliers by population of region studied



Source: Compiled by PwC based on previous studies and population data taken from national statistical authorities

The transaction costs associated with cross-border trade mean that firms are more likely to purchase from domestic suppliers than to import. As a result, more supply chain spending may be expected to leak between regions domestically than internationally. As a result, local areas which make up more of a national economy will tend to experience less domestic leakage and the indirect and induced multipliers will consequently be higher. This relationship is shown in Figure 6. This re-emphasises the importance of the region of study chosen in determining the multiplier estimates.

Figure 6: Local indirect and induced output multipliers



Source: Compiled by PwC based on previous studies, population data taken from national statistical authorities

Methodological issues - multiplier estimates

As described above, the geographic scope of any input-output table has a significant bearing on the multipliers which can be estimated from them. Most tables are at the national level although sub-national tables are sometimes derived or estimated. In these latter cases, while a more detailed table may appear to provide a more reliable estimate of the local impacts, the difficulties accessing accurate information at the local level means that the results need to be interpreted with care. Where this is attempted it is important to understand the source of the information and the assumptions which were made in generating the result.

Local (or regional) input-output tables are typically not produced by national statistics authorities and, therefore, need to be estimated. Rickman and Schwer (1995) tested the IMPLAN, REMI and RIMS II models, three examples from the USA, and found significant differences in the multipliers. These models are commonly used in some of the North American studies which have been analysed. According to the Transportation Research Board (2007), the differences were driven, by the 'techniques used to regionalise national input-output co-efficients'. Similarly, the 2010 study for John Wayne Airport found that using the IMPLAN increased the multiplier estimate for construction spending from $2.01 to $2.20 compared to the RIMS II model.

These examples highlight the importance of understanding the models used to estimate the indirect and induced impacts. They also demonstrate how the findings from one study cannot be compared directly with those of another without an appreciation of the input data and modelling techniques used (and the confidence intervals around the results).

3.4 Catalytic impacts of airports

In this part of the section we examine the catalytic impacts of airports on business and services in the local area. We consider the following impacts:

- The role of the airport in business location decisions;
- The impact of the airport on the productivity of the airports' business users;
- The role of the airport in facilitating tourism; and
- The potential for the airport to lead to the development of local clusters.

Our analysis builds on the work completed by SDG (2013), which looked at the wider impacts of aviation and connectivity on the national economy, but focuses on the specific factors which alter the local dimension of the impact, and the approaches taken to measure those impacts.

Influence of connectivity on business location decisions

Table 7 highlights the importance of transport networks to occupiers of industrial, retail and office space.

Cushman & Wakefield's European Cities Monitor (2011)[17] examines the key factors that businesses consider when assessing new locations. For the third year running, the most important factor influencing the choice of business location was 'Easy access to markets, customers or clients' with 61% of respondents stating that this is absolutely essential. 'Transport links with other cities and internationally' were viewed as absolutely essential by 42% of respondents. Whilst this factor retains its position in fourth place, it slipped back in respondents' perception of importance.

Oxford Economics reinforce this view by stating that although air services are only one component in the assessment that companies make in choosing where to be based or to locate new investment, a wide range of studies confirm that they are one of the most important considerations. Oxford Economics' survey of UK companies[18] highlights that the air transport network is rated as vital or very important by more than 40% of companies, marginally ahead of the cost of labour and business taxes.

Table 7: Key factors influencing business location decisions (2011)

Factor	% of businesses regarding factor as essential for locating a business
Easy access to markets, customers or clients	61
Availability of qualified staff	58
The quality of telecommunications	55
Transport links with other cities and internationally	51
Value for money of office space	36
Cost of staff	33
Availability of office space	31
Languages spoken	27
Ease of travelling around within the city	26
The climate governments create for business through tax policies or financial incentives	27
The quality of life for employees	20
Freedom from pollution	19

Source: Cushman & Wakefield (2011)

Impact on productivity of local firms

A second potentially positive catalytic impact of connectivity offered by an airport is the benefit to firms' productivity. This primarily occurs through two channels:

- Increasing the access of UK firms to international markets; and
- Facilitating the freer movement of workers and capital across borders.

This analysis has typically been undertaken at a national level:

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[17] Cushman & Wakefield (2011), European Cities Monitor. http://www.cushmanwakefield.co.uk/en-gb/research-and-insight/2012/european-cities-monitor-2011/.

[18] Cited in Oxford Economic Forecasting (2006), The Economic Contribution of the Aviation Industry in the UK, http://www.gacag.org/images/gacag/pdf/The%20Economic%20Contribution%20of%20the%20Aviation%20Industry%20in%20the%20UK.pdf.

- Oxford Economics (2006) found that a 10% increase in aviation connectivity (all other things being equal) increased GDP by 0.6%; and
- IATA (2006) found that a 10% increase in connectivity raised long-term productivity by 0.9%.

These findings relate to the national level. It is also important to understand the local impact. The analysis of the local economic impacts of airport capacity on business productivity is severely limited by the absence of robust data on sub-national trade flows within the UK. Overman et al (2009), however, have shown that proximity to an airport had a beneficial impact on firm productivity.

Impact on tourism

Inbound tourism

An additional catalytic impact of airports considered by several studies is their role in generating value added locally by facilitating inbound tourism. The scale of this impact depends on the number of additional inbound visitors to the local area arriving through the airport and how much they spend in the locality. Table 8 shows that spend per head varies greatly by airport and type of passenger. The Canberra and Sydney studies show that international passengers spend considerably more per head than domestic visitors. This is also shown through the increased spend per head at airports such as Miami and Wellington, which service more international flights, relative to airports with a more domestic and regional focus such as Edinburgh, Budapest and Sacramento. There is less consistent evidence on the relative spending of business and leisure visitors: evidence from Sydney suggests a 15-20% premium for leisure passengers, while data from Budapest suggest the opposite. The specific nature and local context of flight patterns, for example the relative shares of charter and scheduled flights, ensures that the direction of this relationship is not consistent across all examples.

Table 8: Spend by visitors arriving at international airports[19]

Airport (year)	Visitor profile	Region	Spend per visitor (£)
Canberra (2011)	Day visitors	Canberra & surrounding region	£99
	Domestic overnight		£266
	International		£954
Sydney (2013)	Domestic business	Western Sydney	£275
	Domestic leisure		£342
	International business		£848
	International leisure		£982
Denver (2013)	Commercial	Colorado	£481
Miami (2009)	All	Miami Metropolitan Area	£1,007
Budapest (2011)	Holiday/ sightseeing	Hungary	£354
	Business trip		£426
Sacramento (2011)	All	Sacramento Area	£397
Wellington (2008)	All	Wellington Region	£640
Edinburgh (2009)	All	Scotland	£351

Source: PwC analysis, based on publically available reports (see bibliography)

In addition to greater spend by international passengers, as demonstrated in Table 8, Figure 7 shows that visitors to the UK who have travelled longer distances from their country of residence also tend to spend more (in part because they tend to stay longer). Of the 18 countries which were the origin of the most visitors to the UK in 2012, the 12 European countries in the list are at the bottom when ranked by spend per head. Average

[19] Where relevant, exchange rate adjustments to pound sterling have been made based on the average exchange rate in the year of publication. Figures are adjusted to be in constant 2013 prices based on relevant national exchange rates.

spend by European visitors from the countries in this list is less than half that of non-European visitors (£1,027 per visitor compared to £451).

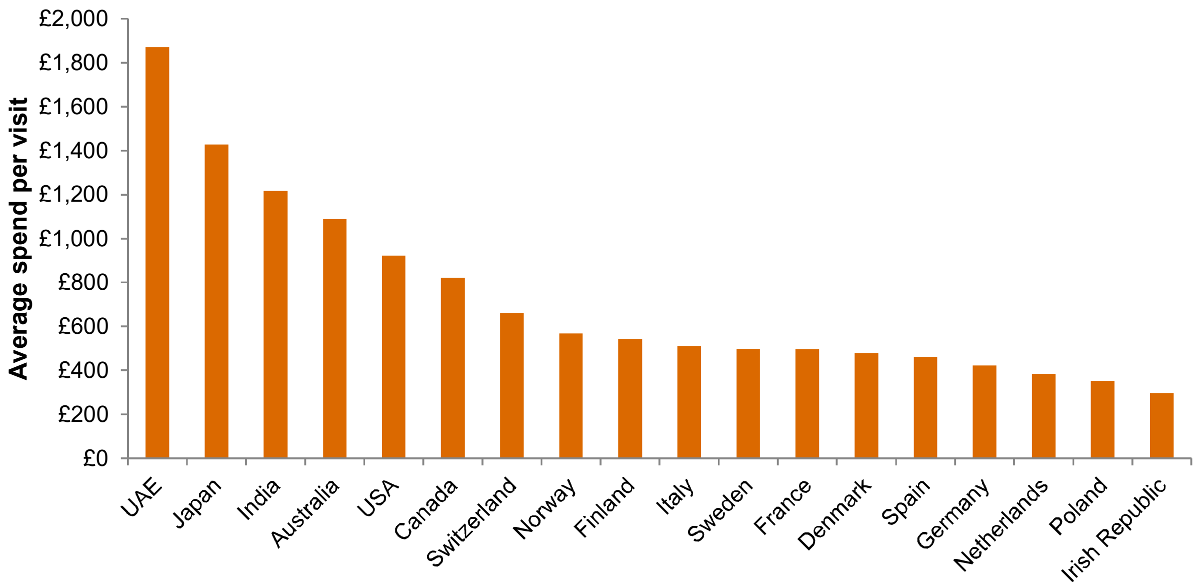
Box 3: The contribution of New York's airports to inbound tourism

Our case study of New York's airport system includes some indication of the economic impacts of those tourists visiting New York and arriving through one its three main airports. It shows that:

- Domestic visitors add more to the local economy than international visitors at all airports;
- LaGuardia contributes more from domestic passengers than JF Kennedy and Newark, despite only providing 15% of the operational impacts; and
- JF Kennedy is significantly ahead when it comes to international tourism.

Overall, tourism at the three airports is estimated to have made an important economic impact creating over 190,000 jobs between 2000 and 2004 and supporting $6.6 billion and $17.6 billion in wages and sales respectively across the same period.

Figure 7: Average spending per visit by visitors arriving by air to the UK by country of residence (2012)



Source: Visit Britain (2014)

In estimating the local economic impact of an airport, it is important to recognise that total visitor spending does not measure either the direct or the indirect and induced effects on value-added which arise from this spending. This is because some of the output generated within the local economy will be spent on purchasing goods and services.

The Office for National Statistics (ONS) satellite tourism accounts show that in 2011 direct GVA generated through tourism in the UK was £53bn (ONS, 2013), which is over 40% of the total internal tourism expenditure of £125bn. Less than £21bn of this expenditure was generated by inbound tourists (rather than UK residents). A significant proportion of this spending (14%) is on air passenger transport services. Such spending will lead to impacts which are captured as either direct or indirect effects. Only a few studies have sought to assess the local impact of inbound visitors at individual airports because it requires detailed visitor spending data across industries.

Recognising outbound tourism

A further impact of tourism, which has often not been considered by existing studies of local economic impact, is the role of airports in facilitating outbound tourism. ONS data show that in 2012 the UK ran a tourism deficit of £13.8bn because UK residents spent more when visiting countries abroad than visitors to the UK spent in the

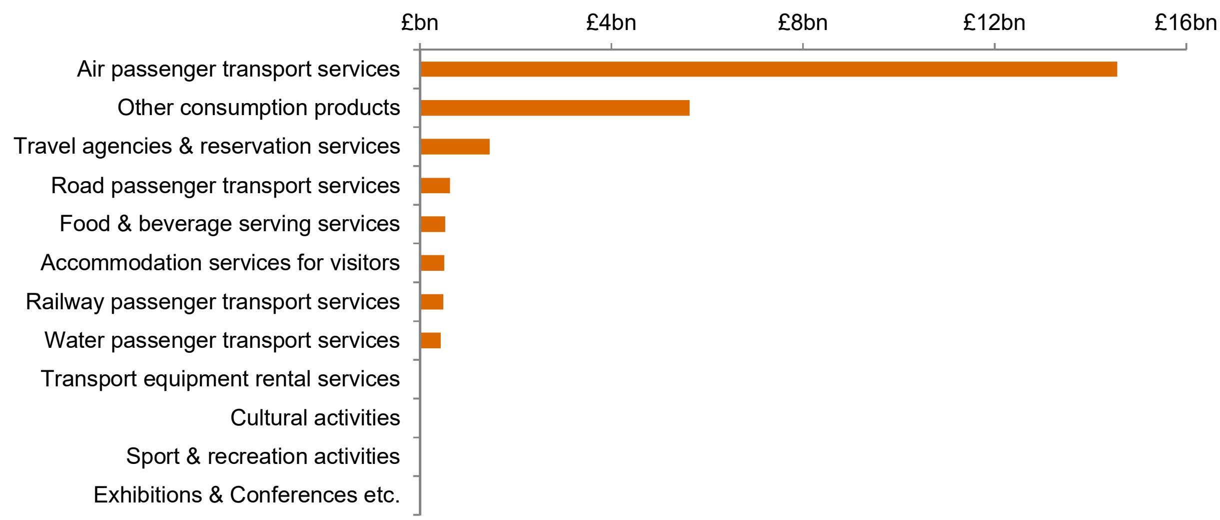
UK. If expenditure overseas would otherwise be spent in the local region of the airport, were it not for the increased availability of outbound flights, then this leakage would have a negative impact on the airport's local impact.

On the other hand, the satellite tourism accounts show that UK residents making overseas visits spent £24.2bn within the UK in 2011 (in addition to the amount they spent whilst in the UK) (see Figure 8). This was predominantly focused on air passenger transport services, demonstrating the role of air transport in generating this output (relative to other modes of transport).

Finally, although outbound tourism potentially has a negative effect on value added in the UK, its welfare effect may be positive if the outbound tourism facilitated by the airport improves individuals' economic welfare by increasing consumer surplus, relative to a constraint on the level of outbound tourism.

In conclusion, the effects of additional runway capacity need to be assessed on both inbound and outbound travellers.

Figure 8: Spending within the UK by residents making overseas visits by industry (2011)



Source: ONS (2013)

Methodological issues - estimating the local impact of tourism

As discussed above, a key challenge with estimating the local value-added (or employment) generated through tourism enabled by airport expansion is the need for detailed data on visitors' expenditure with and without additional capacity. Within this, a reliable breakdown by industry is needed to estimate the value-added component of the expenditure, while location -specific data are needed to estimate the share of the impact which is local to the airport. While these data can be collected through surveys, this cannot necessarily be done consistently across airports and, therefore, a degree of variation in the results would be expected.

In addition, impact studies need to recognise the marginal impact of an increase in airport capacity on the quantity of tourism. Apportioning all value-added generated by passenger spending to an airport inherently assumes that none of this activity would have otherwise occurred. It is likely that a share of this activity would be substituted either to another airport or another form of transport, which could lead to a positive impact in the local region, even in the absence of the airport.

A final important area to consider is the locality of the tourism impact. ONS data show that more than half of overseas visitors to the UK visit London. As a result, if London & the South East were defined as local areas for the airport, then a large share of the national benefit would be felt in the local economy. However, this would be expected to greatly decrease if a much narrower definition of 'local' were to be taken, such as the local authority area immediately adjacent to the airport. This further highlights the importance of the 'local' definition on the findings, and the relative magnitude of the different elements of impact.

Similar considerations are needed when assessing the local impacts of outbound tourism. It is possible that the increased presence of transport and tourism firms in the locality of an airport means that outbound tourism has a net positive impact at this level. This would occur if the value-added generated through the outbound tourism industry were greater than the value-added substituted away from local spending to spending abroad.

Impact on clustering & agglomeration

The available evidence suggests that the local catalytic effects of airports include attracting business investment and raising productivity. Combining these two effects may lead to the development of new concentrations of economic activity in the locality of the airport. In some cases, these may take the form of industry 'clusters' which benefit both from the proximity of the airport and each other.

These clusters have led to the development of 'aerotropolis' (Kasarda, 2000), or airport-city like business models, where airports are increasingly being seen as 'centres of economic activity' (Prosperi, 2007). As a result, many studies in the economic impact literature assess the benefits of 'clusters' of economic activity surrounding airports.

What are the benefits of clusters?

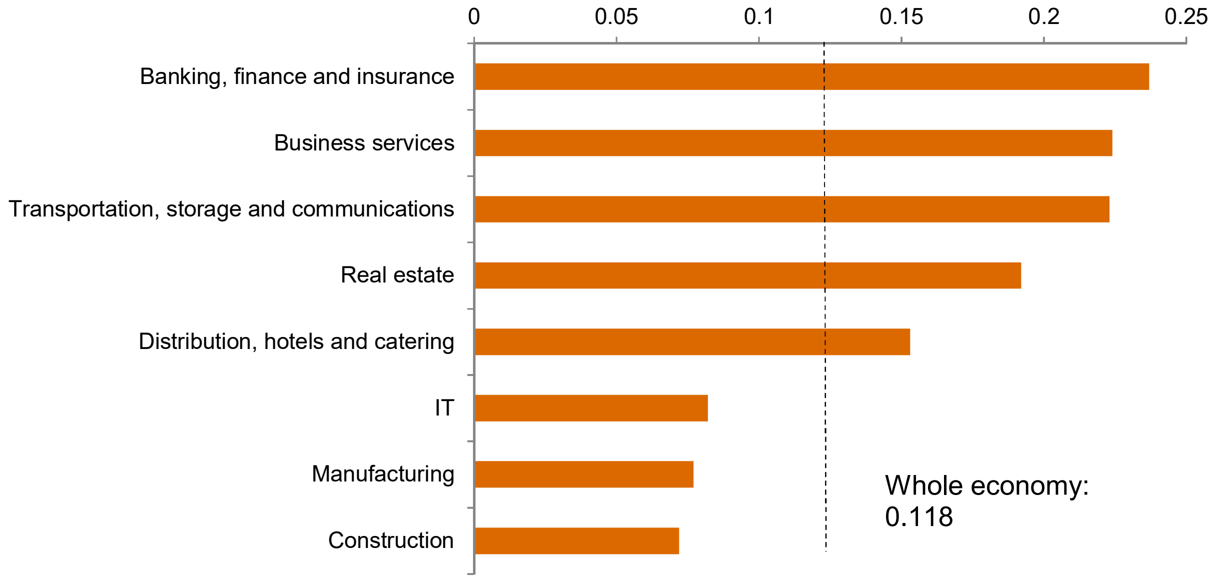
The positive effects of clustering economic activity are known as agglomeration economies. They arise where there is an efficiency gain for all firms within a cluster, resulting from their close proximity to each other. The majority of the literature on the topic (see, for example, DfT (2006) and Cohen & Paul (2008)) summarises the drivers of these benefits in three distinct categories:

- **Knowledge spillovers** – firms interact with, and learn from, each other within the cluster thereby facilitating efficient sharing of knowledge within the market;
- **Access to labour** – the cluster attracts skilled labour to an area, thus increasing firms' access to a high quality workforce and reducing search costs; and
- **Input effects** – the cluster attracts suppliers to locate nearby, providing firms with access to a greater range of specialised inputs, whilst also reducing transport costs.

A study by Rosenthal and Strange (2004) reviewed the literature which has attempted to quantify these benefits. It found that doubling the size of a city leads on average to an increase in productivity of 3-8%. This does not, however, fully capture the breadth of estimated impacts, or specific drivers which may alter the magnitude of this relationship.

For example, Graham (2007) showed that the impact varies greatly by industry, with productivity in banking, finance and insurance being more than three times as responsive to an increase in agglomeration as construction and manufacturing (see Figure 8). Here, agglomeration is proxied by the density of employment, while the elasticity of productivity estimates show how far a firm's productivity changes as the level of agglomeration changes. A score of 0.15 means that a 10% increase in agglomeration increases productivity by 1.5%. This implies that in order to estimate the positive impact of airport expansion it is necessary to identify how industry clusters would develop (including the degree of agglomeration which would occur).

Figure 9: Elasticity of productivity with respect to agglomeration by industry



Source: PwC analysis, BEA (2014)

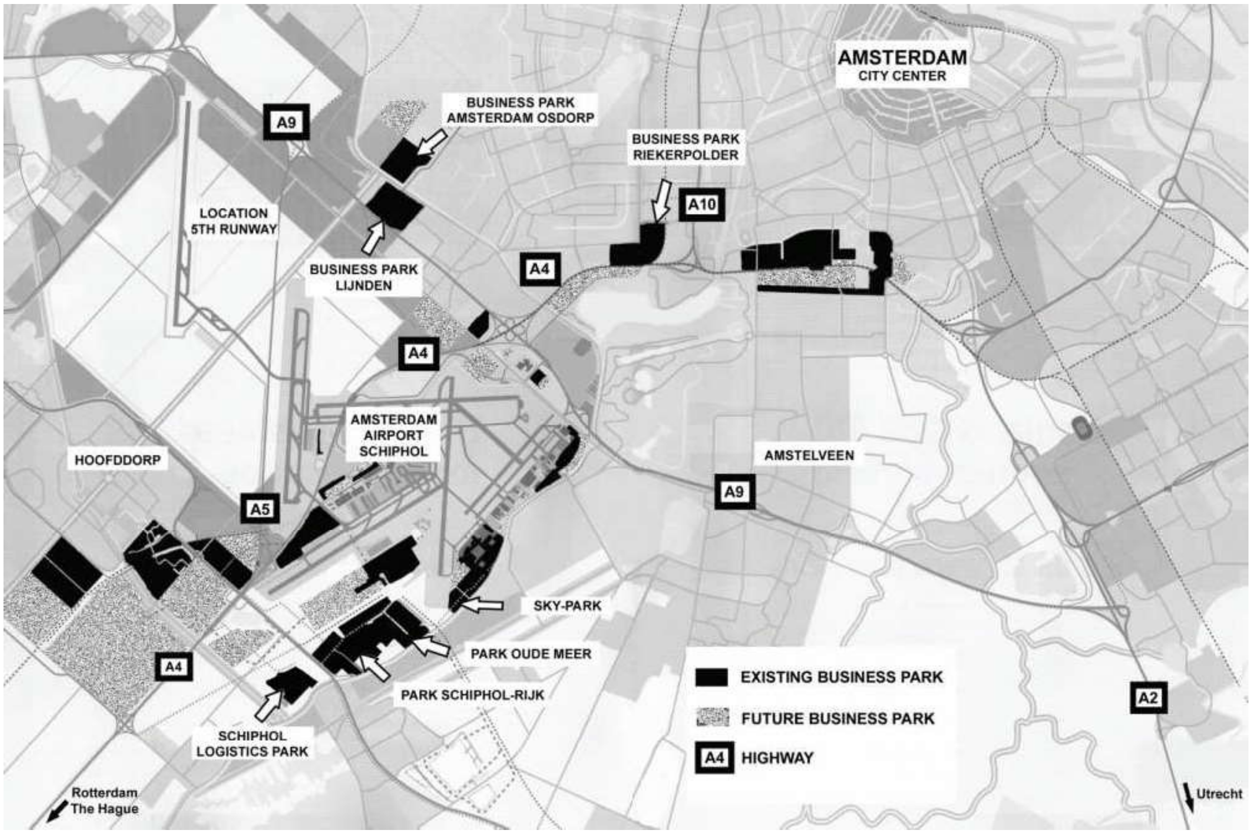
Examples of clustering around international airports

Although not typically considered as part of the economic impact of an airport, several studies have examined the role of airports in facilitating the development of clusters. Two such studies are summarised below: one is for Amsterdam Schiphol Airport and the other a comparison of three American airports. These studies demonstrate that there re different approaches for identifying and quantifying the role of an airport in generating industry clusters and also highlight the importance of the local context in determining the nature and scale of the clusters which develop.

Amsterdam Schiphol Airport

As can be seen from Figure 10, a number of business parks have been established in the vicinity of Schiphol Airport, which has an area 'larger than the extended historic centre of nearby Amsterdam'. Warffemuis (2007) looked at one particular element of this, the clusters of distribution centres that have developed in the area. Along with Rotterdam, these two sites contain more than half the distribution centres in the Netherlands.

Figure 10: Business parks in the Amsterdam area



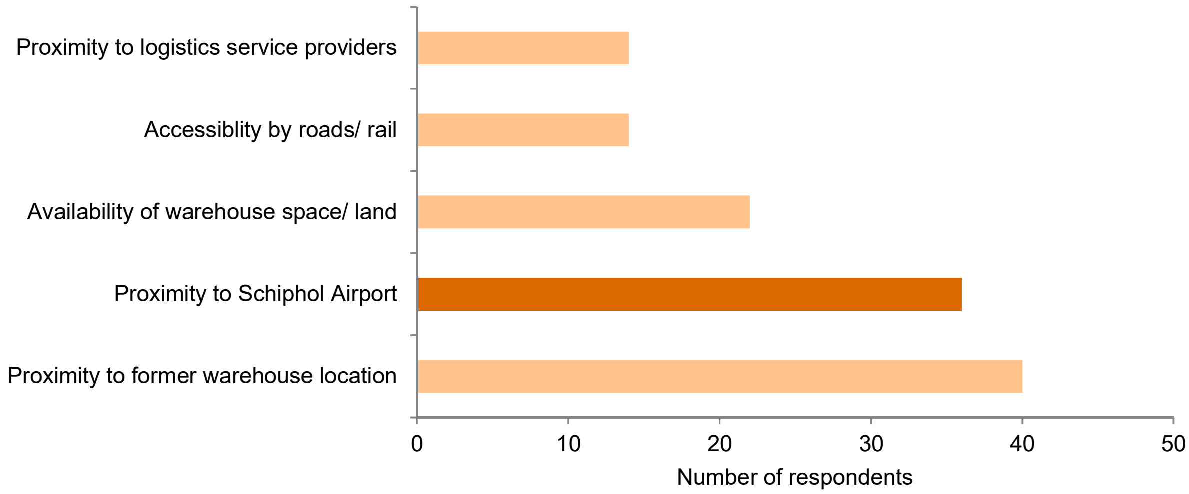
Source: Warffemuis (2007)

When surveying the distribution centres, Warffemuis showed that more respondents named location factors linked to the agglomeration benefits of clustering in motivating their investment decision than the presence of the airport itself (see Figure 11). Proximate access to vital products and services for the business (such as warehouses, transport links and service providers) was of particular importance. Warffemuis further demonstrated that only a minority of distribution centres located in the surrounding area were Schiphol-dependent due to the nature of their cargo and business activities. The remaining firms were at least partially influenced in their location decisions by the agglomerative benefits that the airport indirectly generated.

These findings have three clear implications for how the benefits of clustering in the locality of an airport should be considered:

- They demonstrate the potential of an airport to attract activity, beyond that directly requiring the airport for its success.
- They highlight the importance of the supporting services and infrastructure in facilitating the development of clusters. In this case, for example, the level of investment in transport infrastructure beyond that of the airport was vital in the decision making process of the distribution centres. As a result, airports highlighting the potential for business clusters to develop in the locality would need to demonstrate the availability of required sector-specific support services.
- The nature of the influences on this particular cluster shows the importance of understanding the local context. For example, limited availability of land or land-intensive warehouses and the lack of a developed logistic service provider industry would prohibit this particular model being recreated elsewhere.

Figure 11: Importance of location factors to distribution centres surrounding Schiphol Airport



Source: Adapted from Warffemuis (2007)

Atlanta, Dallas & Memphis airports

Prosperi (2007) investigated concentrations of economic activity around Atlanta (Hartfield-Jackson) International Airport, Dallas/ Fort Worth Airport and Memphis Airport. The different sector-specific concentrations are outlined in Table 9. These are the 'signature' collections as they represent the most distinct industry-specific collections of activity.

The report notes that the distribution of economic activity in these areas is not significantly different to typical urban centres. It argues that only the transport-related activity in each site and the finance and computer activity in Dallas are sufficiently densely concentrated to be described as "cluster-like", as opposed to "concentration-like". This evidence, therefore, suggests that while an airport may lead to an increased concentration of economic activity, it will not necessarily stimulate clustering behaviour beyond the existing distribution of industries in the locality.

Table 9: Sector-specific concentrations of economic activity surrounding airports

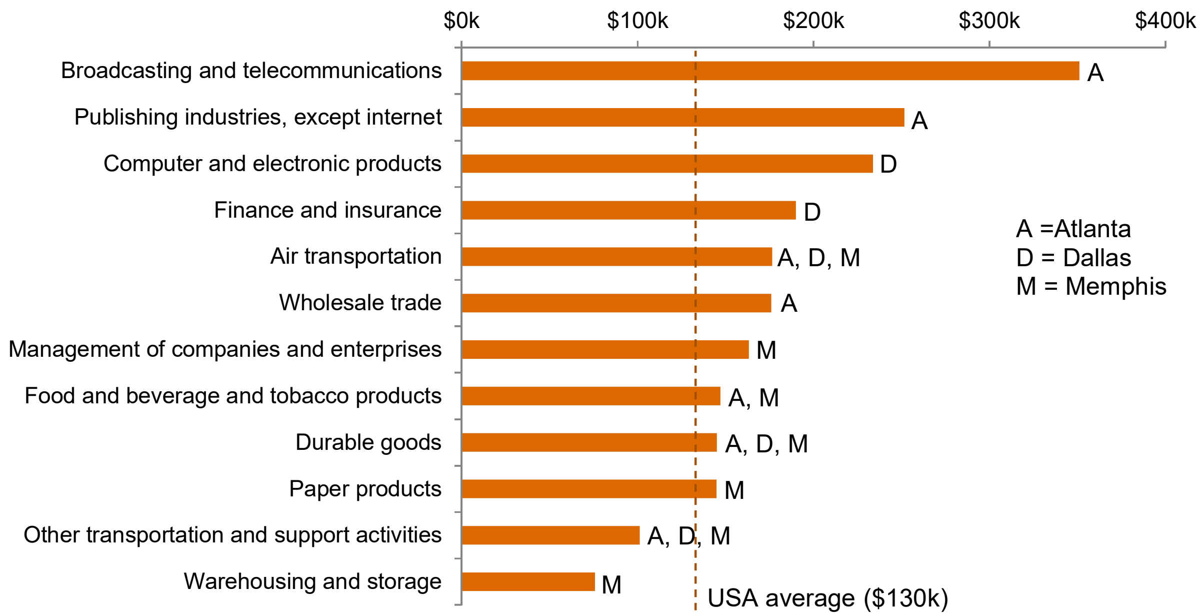
City	Transport-related activity	Communications	Finance & computers	Corporate headquarters	Food & food processing
Atlanta	✓	✓			✓
Dallas	✓		✓		
Memphis	✓			✓	✓

Source: PwC analysis, Propseri (2007)

Also evident from the study is the lack of consistency between the industries which choose to locate around different airports. This further reinforces the importance of the local context in understanding why a cluster forms. This means that, with the possible exception of aviation/ transport-related activity, no evidence suggests that any one particular industry cluster will be particularly likely to develop. The author recognises that these differences are driven by a blend of historic land use and economic features. For example, the long standing roles of Atlanta and Memphis as centres of inter-state and regional highway systems have made them suitable as communication hubs and locations for corporate headquarters respectively. Alternatively, the more recent development of Dallas/ Fort-Worth International Airport has provided 'fresh land' for new firms to locate within.

One implication of these differences is that the impact on the value-added generated by an airport cannot be easily predicted. Figure 12 shows the distribution of productivity (measured by value-added per FTE) across the industries which are most concentrated around one or more of the three airports. Both the range of industries, from paper products to finance and insurance, and the range in value-added per FTE, are evident. Although typically higher than the national average, the range in productivity represents a risk to any estimates of the positive impact of clustering.

Figure 12: Value-added per FTE by industry (2012)



Source: BEA (2014)

Methodological issues - measuring agglomeration benefits

Several studies have estimated the impact of agglomeration economies on productivity, often producing significantly different results. In addition to different local contexts, a further reason for these differences may be methodological.

The Department of Transport for Victoria (2012) highlights two separate aspects of methodology which may lead to measurement error in accurately estimating agglomeration effects:

- Controlling for bias; and
- Finding a suitable dataset.

The majority of studies estimate changes in productivity by specifying economic models which could be subject to bias if the models are mis-specified. For example, the presence of higher productivity firms in more densely populated areas could be the result of sorting, whereby more productive firms move to these areas, rather than the reverse. This would over-estimate the impact of agglomeration on productivity. The Department of Transport in Victoria notes that recent studies have attempted to control for this effect.

Studies would also need to ensure that agglomeration effects could be separated from the positive impact of proximity to a transport hub or being located in a large urban environment. For example, in the case of the UK, Overman et al (2009) concluded that there were no substantial benefits to industry-specific clustering, once these two factors were controlled for.

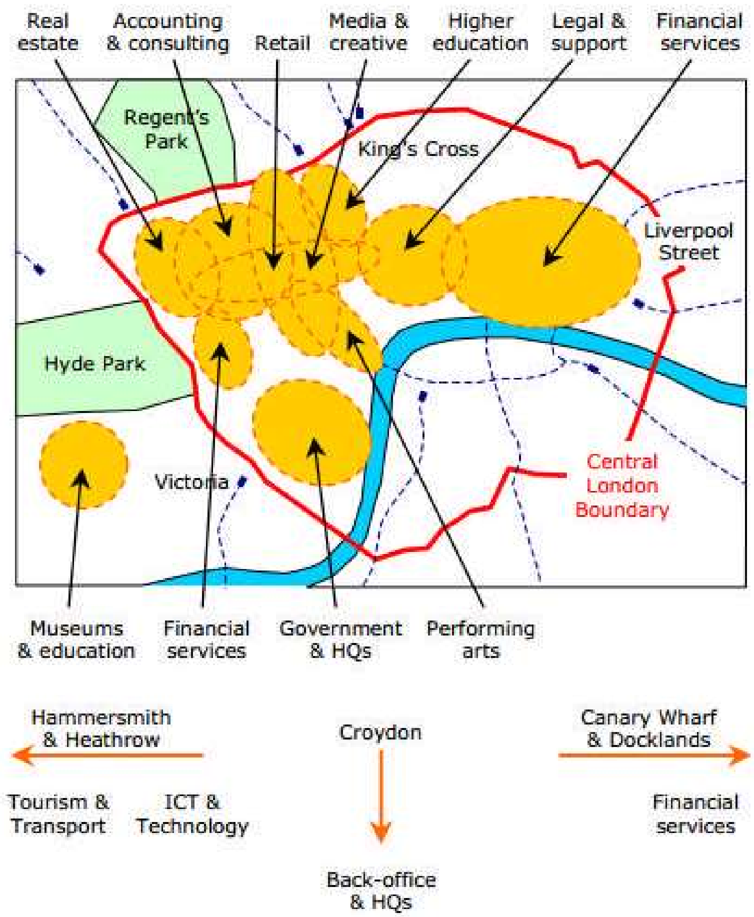
Finally, accurately estimating this impact requires detailed information about firm productivity, as well as information on the degree of agglomeration. For example, estimating agglomeration based on employment density (see Graham (2007) above), only accurately captures the 'access to labour' element of agglomeration economies, and provides little understanding of the significance of 'knowledge spillovers' or 'input effects'. As they are less tangible, these two elements are more difficult to estimate, but excluding them from the analysis means that some differences between areas will not be fully controlled for.

3.5 Industry structure in London

Our earlier analysis highlights the importance of understanding the local context when considering firm location decisions and clustering as area-specific factors play a key role in driving each of these. This section briefly looks at the existing analysis of industry cluster within London and highlights the role that its airports have played in developing them.

Figure 13 shows the Prime Minister's Strategy Unit map of industry clusters within London in 2004. It highlights the breadth of industries which are perceived to have formed clusters which are rarely separate from each other. It also shows the importance of Central London. Ten distinct clusters are identified there.

Figure 13: Summary map of industry clusters in London



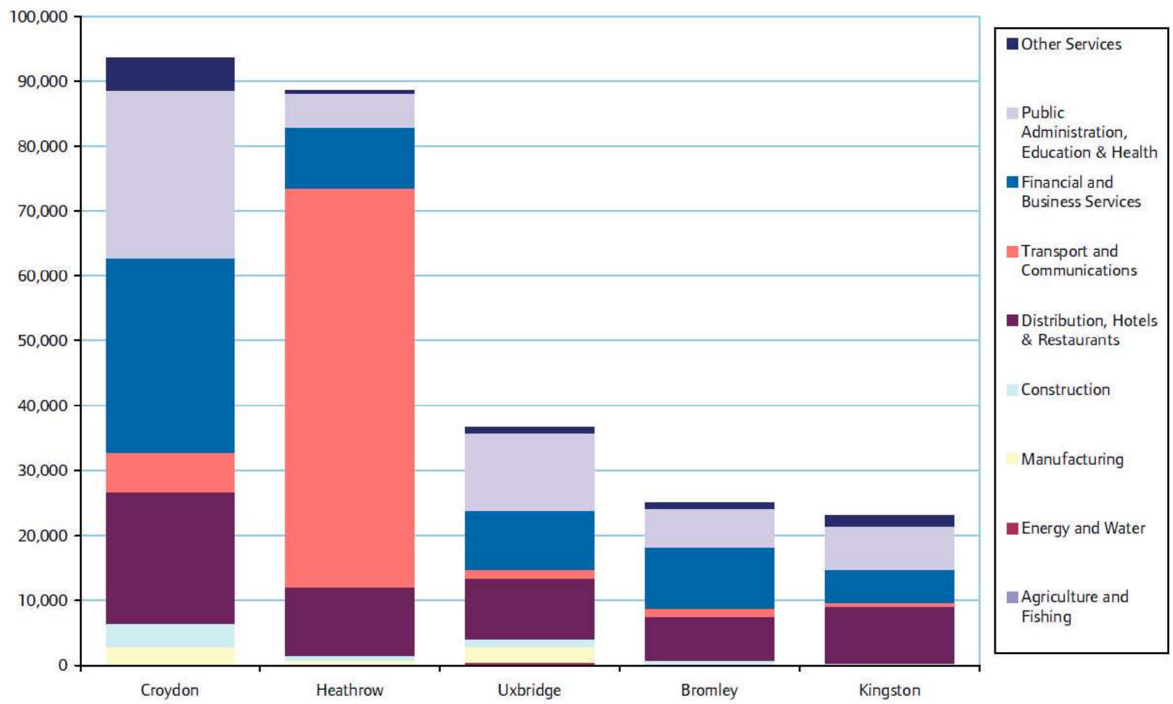
Source: Prime Minister's Strategy Unit (2004)

A similar picture emerges from more recent work to map industry-specific clusters, such as that of the London Councils in 2010 which shows that the majority of clusters are located in London's core, with additional clusters in the periphery. This distribution demonstrates the pull of London's centre in firms' location decisions. It seems likely that in the context of London the impact an airport has on access to this core will be of particular importance. Figure 13 also recognises that additional industry clusters exist in Outer London, most relevantly in the form of tourism & transport and ICT & technology clusters in Hammersmith & Heathrow.

This finding is consistent with that of Prosperi (2007), who identified that "cluster-like" concentrations of transport-related activity developed in the locality of airports in Atlanta, Dallas and Memphis. This finding is further demonstrated in Figure 14, taken from GLA Economics (2010), which identifies the magnitude of employment in transport & communications in the Heathrow area relative to other selected Outer London areas. It also specifies more precisely the nature of the cluster identified by the Prime Minister's Strategy Unit as "Tourism & Transport", as being more heavily weighted towards Transport and Communications, than areas of tourism spend such as Hotels & Restaurants.

These highlight the potential that an airport has to attract and support the development of clusters within London and suggests the types which are most likely to develop.

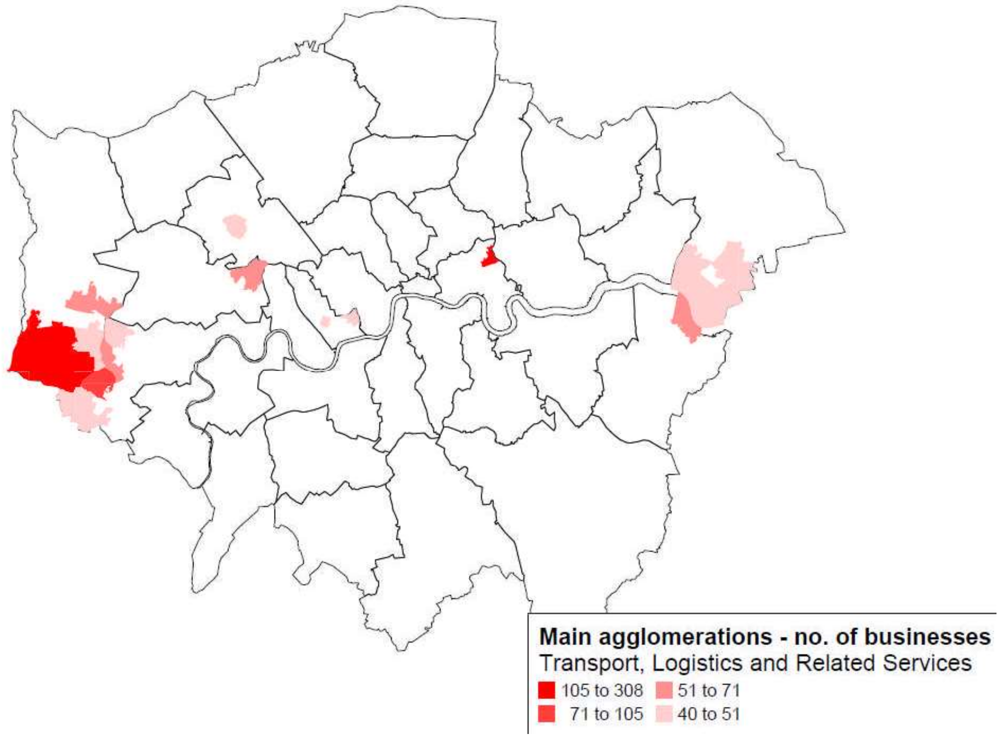
Figure 14: Employees in selected Outer London areas by broad industrial group



Source: GLA Economics (2010)

Analysis commissioned by the London Councils in 2010 further demonstrates the presence of Heathrow Airport's transport cluster - defined as a cluster of 'Transport, Logistics and Related Services' – see Figure 15. This highlights that, despite small pockets of activity elsewhere, the predominant transport industry hub is located in West London and can presumably be linked to the presence of Heathrow.

Figure 15: Transport and logistics clusters in London



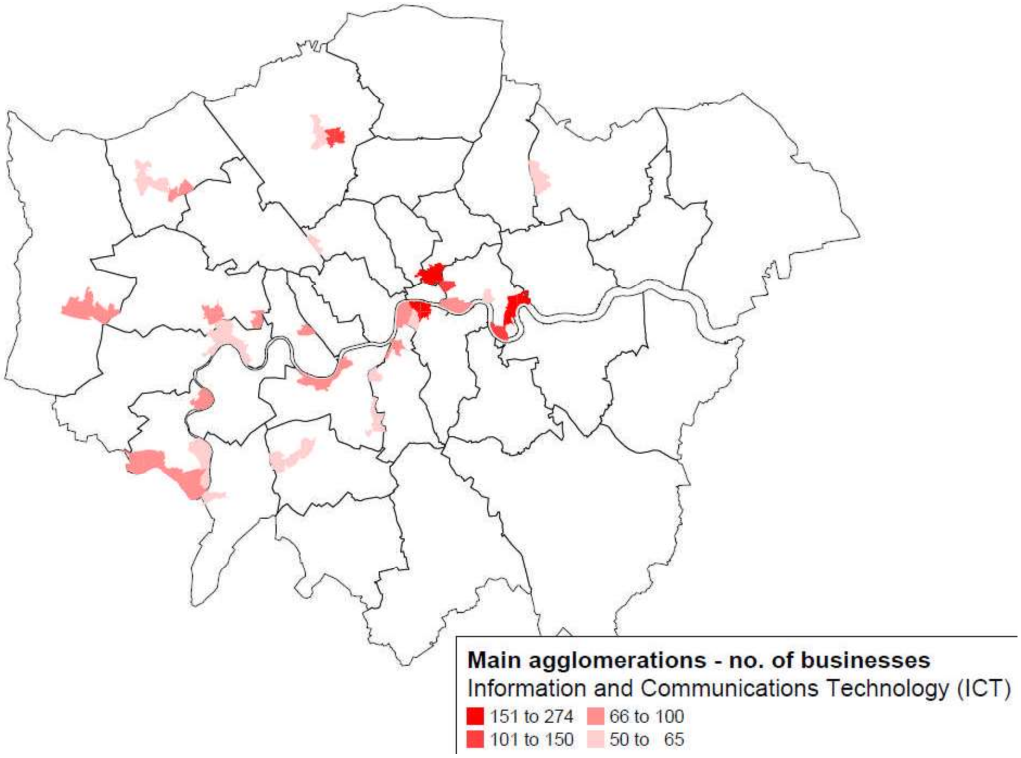
Source: London Councils (2010)

The second cluster highlighted by the Prime Ministers Strategy Unit in West London was ICT and Technology. Similar analysis from the London Councils (2010) is shown in Figure 16. It demonstrates that while these firms have tended to concentrate in West London, there appears to be little evidence of a cluster close to Heathrow.

Although the evidence on the distribution of firms is less concrete than in the case of transport-related activities, a 'Western Wedge' of economic activity is identified by both GLA Economics (2010) and the London Plan (Greater London Authority, 2011). This is described as "an economic corridor with historical specialisation in information technology that stretches from Central London through Heathrow and into the Thames Valley, including towns like Reading and Slough". This region, which is located around London Heathrow, is a key centre of international headquarters and contains industry concentrations:

- Video reproduction;
- Publishing;
- Motion picture and video production/ distribution;
- Radio & television activities;
- Scientific research and development; and
- Data processing and computer manufacturing.

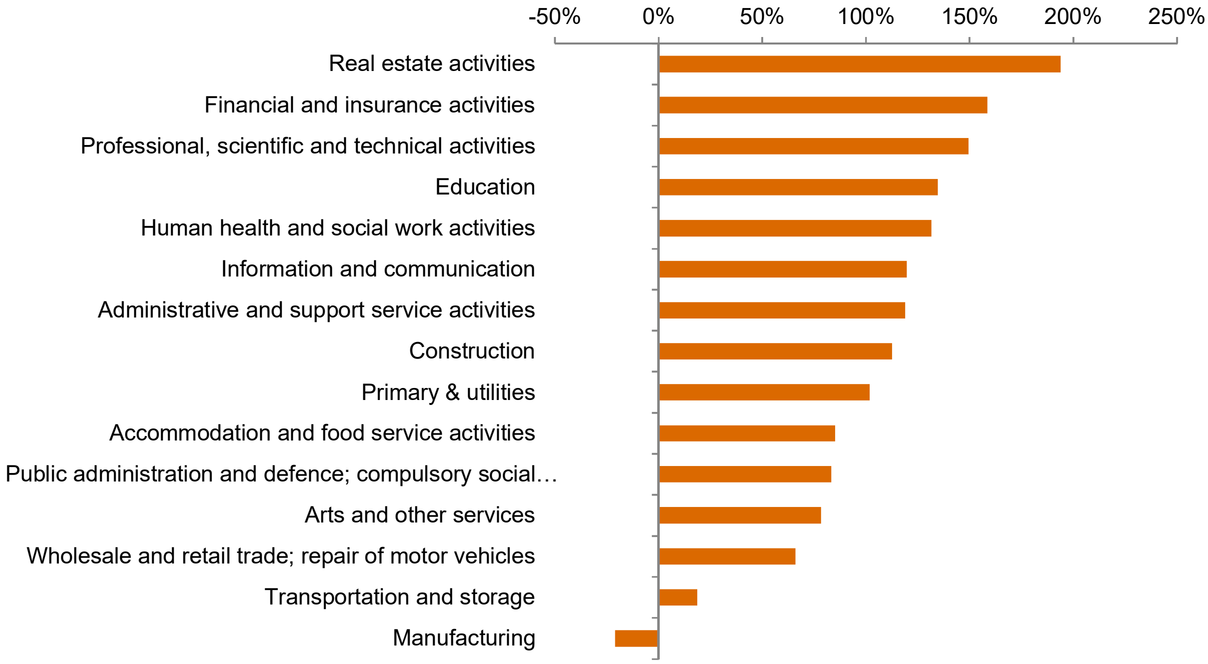
Figure 16: ICT clusters in London



Source: London Councils (2010)

A further element of London's industry clustering which needs to be considered is how the geographic distribution and magnitude of industry-specific value-added may change in future. Figure 17 summarises changes in the magnitude of the value-added generated by different industries between 1997 and 2011. This shows that there are big differences in the growth rates between the fastest growing industries, such as real estate and finance and insurance, and industries such as transportation and storage and manufacturing which have remained reasonably flat or decreased in magnitude of value-added. These growth rates suggest how the relative magnitudes of the value-added generated by different industries may differ in future, which would affect the potential impact generated by an activity cluster in the locality of an airport.

Figure 17: Change in GVA in London (1997-2011, current prices)



Source: PwC analysis, GLA Economics (2014)

4 Labour demand and supply

In this section we summarise the evidence of the impact of an airport, or airport expansion on employment and labour demand, both directly at/ around an airport and more widely. We also consider how local labour supply adjusts to changes in demand as a result of airport expansion.

As highlighted in the Heathrow and Gatwick case studies (see Appendices A and B), many jobs are created as a direct result of airport operations, with the vast majority of these based on or around the airport site. A significant change in airport capacity may, therefore, have a significant impact on local labour markets. This section explores the nature of the jobs created as a direct result of airport operations, specifically considering:

- The number of jobs supported;
- The types of job which are created;
- The skill mix of the workforce; and
- The productivity of the jobs.

Box 4: Labour demand and supply – key findings

Labour demand & supply

Our analysis of labour demand and supply has focused on two questions:

- What employment has been generated: direct (on- and off-site), indirect, induced and catalytic?
- Could the jobs be met by the local and wider area? What was the remaining 'net additional labour demand'?

Direct impacts

- Evidence from previous studies reveals a wide range of estimates of the direct impacts of aviation activity
- The average number of direct jobs generated for each million passengers handled ranges from under 500 to over 1,500
- The drivers of these differences include: the share of long-haul flights, the nature of the terminal and passenger experience, the level of freight transport and the business operating model
- In addition, differences in methodology also contribute: for example, different studies use different definitions of the 'scope' of the airport and aviation activity and adopt different approaches to converting headcount numbers into FTEs and this affects their comparability
- Our review of airport economic impact studies suggests that just over half of direct jobs created at airports are in airlines or other aviation industry firms: other major employment groups include government & security (9-18%) and ground transportation (6-15%)
- In the UK and USA, transport industry jobs are more skilled and more productive than the national average whereas jobs in the storage, trade and retail sectors tend on average to be relatively lower skilled
- The commuting patterns of direct employees (airport workers) are relatively consistent across those airports where information is available: over 75% live within a 30-minute drive of the airport, and the majority travels by car
- This pattern of commuting provides some indication of the geographic scale of the local labour market
- It is also relevant for considering the effectiveness and efficiency with which labour supply adjusts to changes in labour demand as a result of airport development

Indirect & induced impacts

- There is less evidence on the share of national indirect and induced employment impacts which are felt locally and regionally
- A key factor influencing the employment multipliers is the size of the local area being considered: all other things being equal, multipliers will be larger in larger areas because leakages from the 'local' economy will tend to be smaller
- Evidence from Sydney Airport suggests that the nature of the local labour market will need to adjust to accommodate the increase in supply
- Similarly, evidence from the Joseph Rowntree Foundation highlights that new unskilled workers have moved into local communities, while the existing workers have taken on higher skilled jobs
- These adjustment mechanisms determine how labour cost and pressure on social infrastructure will change with labour demand changes
- They can only be fully assessed through general equilibrium modelling

Catalytic impacts

Investment & productivity

- The evidence is mixed on the impact in the labour market of airport expansion since it depends on the nature of industries which locate in the locality: for example, Dallas/ Fort Worth International Airport has attracted high-productivity industries, such as computing, finance and insurance whereas evidence from Memphis International and Amsterdam Schiphol airports suggests concentrations of low productivity distribution and storage firms
- These differences indicate how the local economic geography and history affect the labour market demand through changing required skill mixes

Tourism

- The value added by tourism is associated with additional jobs in tourism intensive sectors, notably accommodation and transport
- What proportion of these jobs is local to the airport depends on the travel patterns of airport users in relation to their final destinations: for example, some are closer to the final visitor destination than others
- Further jobs will also be created through outbound tourism: the majority of these (60%) are in the air transport industry (i.e. direct or indirect jobs), with additional employment in areas such as retail (25%) and travel agencies (7%)
- Outbound tourism could also reduce value-added by facilitating the substitution of local expenditure for expenditure in other regions or abroad: local economic welfare may be enhanced by changes in the opportunity for travel
- How far an increase in airport capacity will lead to increases in outbound travel depends on levels of demand and price adjustments in the air transport market: for London runway capacity expansion this is being analysed through the DfT's transport modelling, which should be applied in this module

Clustering & agglomeration economies

- There is very little evidence in the existing literature on the impact that industry clustering around airports has on the level and nature of labour demand
- A wide range of industry clusters (including, transportation, telecommunications, publishing and distribution) have developed, and these have very different implications for productivity, skill mix and employee numbers

Table 10 highlights some of the key studies we refer to in this section besides those reviewed as part of the case studies: a full list of studies used is provided in Appendix G.

Table 10: Local employment - relevant studies

No.	Title	Authors	Year	Geographies covered
1	Economic Impact Study	Leigh Fisher	2011	Ottawa
2	2013 Economic Impact Study of San Francisco International Airport	EDRG	2013	San Francisco
3	Transportation and storage sector: skills assessment	UK Commission for Employment and Skills	2012	UK
4	Employment Generation and Airports	BITRE	2012	Australia

4.1 Labour demand

In the first part of the section we review the available evidence in relation to the local impact of airports on labour demand. We start by reviewing the scale of employment linked to airports and then consider the available evidence on the mix of skills and labour productivity.

Employment

Table 11 summarises the local direct, indirect and induced employment associated with airports in Europe and the rest of the world. Also shown – as another measure of the size of the airport - is the number of passengers handled.

Table 11: Summary of local employment linked to case study airports

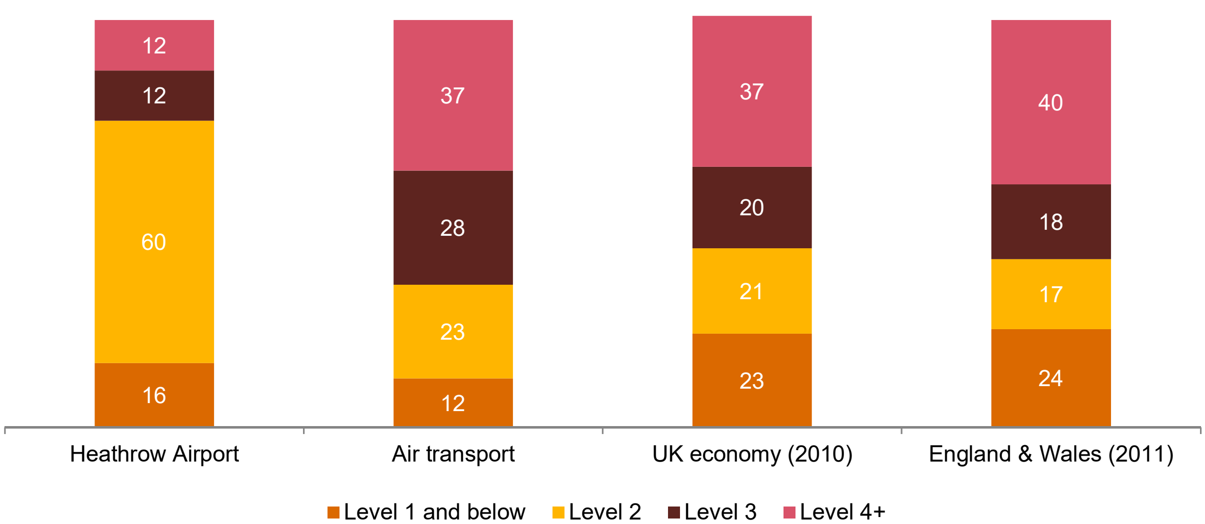
Airport	Study	Passengers (million)	Direct FTEs	Indirect FTEs	Induced FTEs	Total FTEs
London Heathrow	Optimal Economics (2011)	70	84,400	11,100	18,600	114,100
London Gatwick	BHC (2011)	34.2	24,900	1,900	6,400	33,200
Frankfurt am Main	INFRAS (2013)	58.04	78,000	38,300	39,200	155,500
JF Kennedy, New York	New York State (2010)	61.5	132,600	92,000	n/a	224,600
Paris Charles de Gaulle	BIPE (2012)	62	86,000	49,100	60,200	195,300
LaGuardia, New York	New York State (2010)	33.5	55,100	39,200	n/a	94,300
Manchester	York Aviation (2008)	21.2	19,300	12,900	9,000	41,200

Source: Compiled by PwC based on previous studies

Skills mix

The skills required of employees linked to an airport are a key dimension of labour demand. The UK Commission for Employment and Skills (2012) looked at skill levels within the transport and storage sector. It demonstrated, as shown in Figure 18, that the skill mix within the industry was broadly higher than that in the overall economy, when measured by the highest educational attainment. Specifically, the share of workers with Level 4 qualifications or above (broadly equivalent to a diploma, foundation degree or higher) was similar to the national average. The air transport industry, however, employed little over half the number of individuals with only a Level 1 qualification or below, relative to the national average. Also shown is the breakdown of the qualifications of Heathrow Airports' employees: this highlights the concentration of employees at Level 2.

Figure 18: Distribution of employees by highest educational attainment (2010)



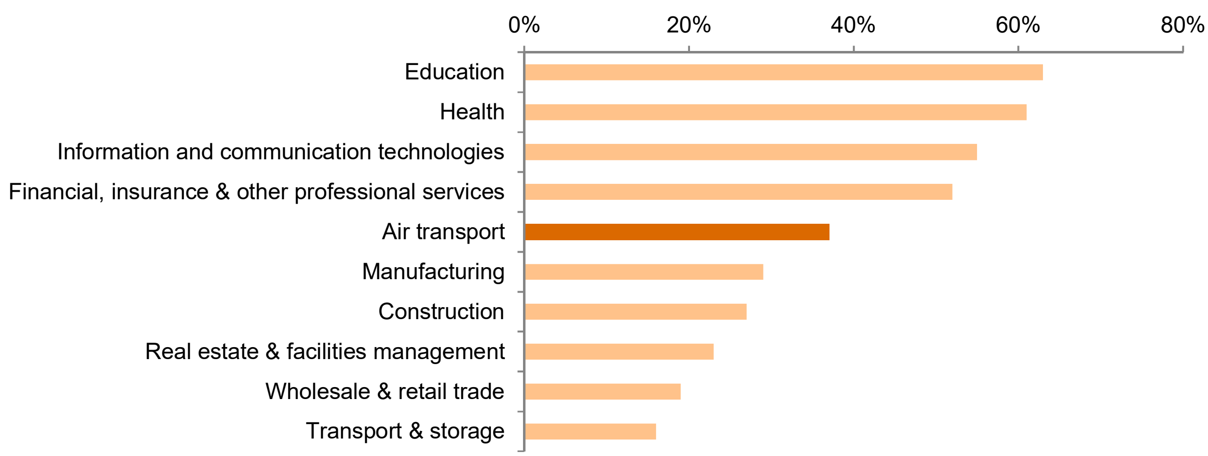
Sources: UK Commission for Employment and Skills (2012), Heathrow Related Employment, Optimal Economics (2011)

As highlighted by BITRE (2012), the most common occupations of those employed in the air transport sector were:

- Personal service occupations (36%);
- Associate professional and technical (23%); and
- Managers and senior officials (12%).

This suggests that the definition of workers in air transport excludes roles such as retail staff and cleaners, which are typically lower-skilled roles. This may explain the difference between these findings and those of Ernst & Young (2012) and Hakfoort (2001) who both identified that more than half the jobs associated with airport activity would be lower skilled. This difference highlights the importance of being able to understand which sectors are impacted at the local level and what level of skills are needed for the jobs created in order to assess the impact on local labour markets.

Figure 19: % of workers with Level 4 qualifications or higher by industry sector (2010)



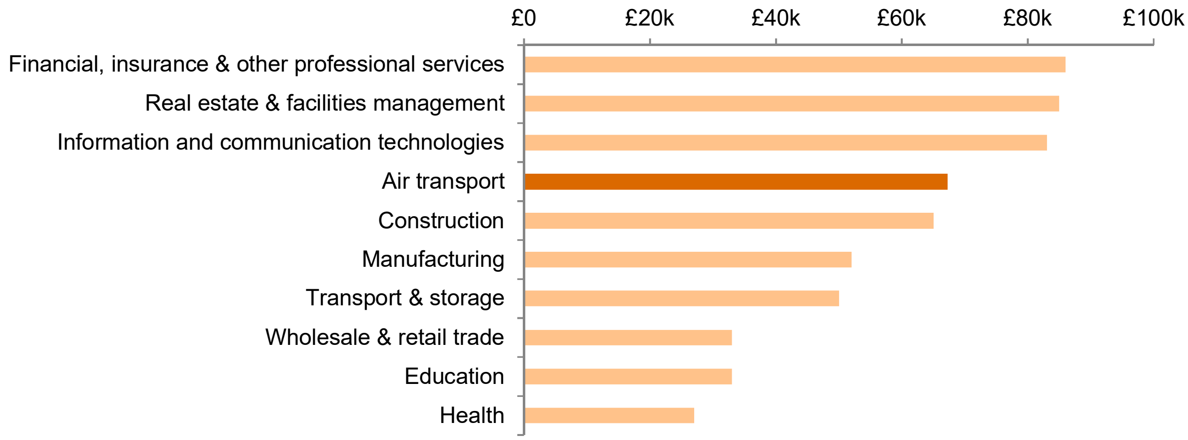
Source: UK Commission for Employment and Skills (2012)

Labour productivity

A further aspect of the labour market investigated by the UK Commission for Employment and Skills is the productivity of jobs in the transport and storage sector.

Figure 20 summarises this, showing that the average Gross Value Added (GVA) per head in the air transport sub-sector is approximately £67,000 (nearly 50% higher than the average across all industries). The chart also demonstrates that sectors such as wholesale & retail trade and wider transport & storage, which represent a significant share of direct jobs created by an airport (see Figure 15), are noticeably less productive.

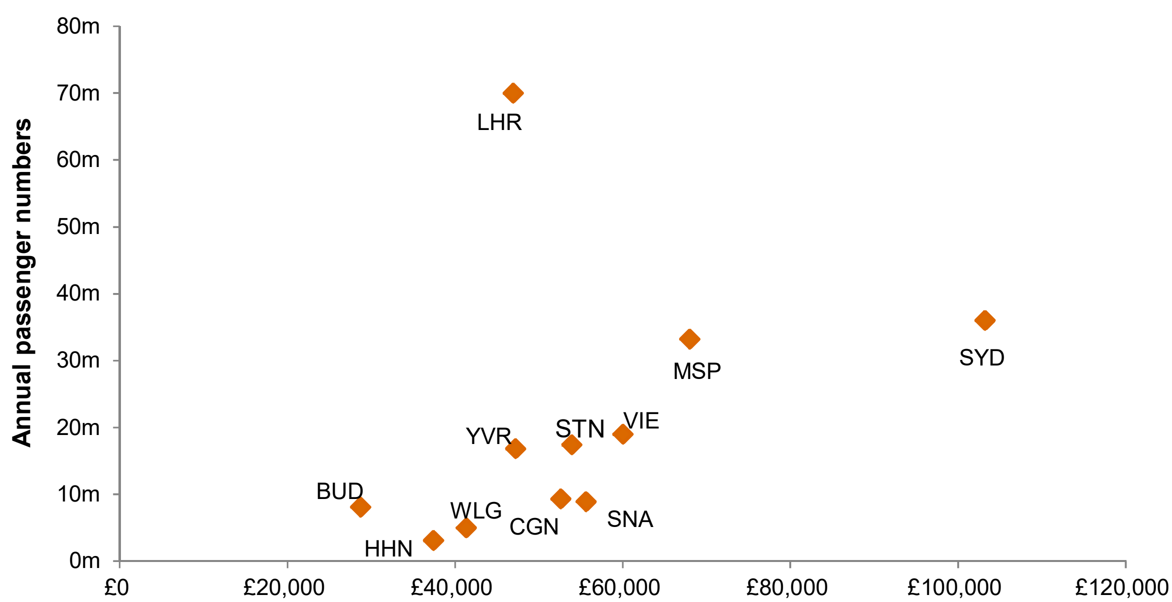
Figure 20: Value added per employee by industry sector (2010)



Source: PwC analysis, UK Commission for Employment and Skills (2012)

Aside from the industry-mix, it is also likely that the size and type of airport will impact on productivity. For example, it could be expected that larger airports would see higher productivity arising from economies of scale in areas such as procurement and financing. Using data from the 11 airports discussed earlier, Figure 21 shows the relationship between number of airports passengers and value-added per FTE. There appears to be a generally positive trend between the number of passengers at an airport and its productivity, potentially suggesting economies of scale in operation[20]. While these results cannot be used to specify the relationship - due to the small sample size, methodological differences between the studies and the specific local context of each example - they highlight a potential area of interest which could be investigated further through analysis of time series data or econometric modelling.

Figure 21: Value-added per FTE by passenger numbers



Source: PwC analysis

Key: BUD - Budapest, HHN – Frankfurt Hahn, WLG - Wellington, CGN –Colgne-Bonn , SNA –John Wayne (Orange County) , YVR - Vancouver , STN – Stansted, VIE – Vienna, MSP – Minneapolis-St Paul, SYD – Sydney, LHR - Heathrow

[20] This relationship would exclude a few outliers, most notably London Heathrow.

Indirect and induced employment

We also need to consider the extent to which airports support local indirect and induced employment.

The local impact of indirect and induced employment largely depends on the share of suppliers which are local to the airport. As shown through the distribution of output multipliers in Figure 5, this largely depends on the definition of 'local' which is used. Unlike the literature on direct employment, there is much less evidence on the share of indirect and induced employment impacts which are felt locally and regionally. The best example is the study of London Heathrow (see Appendix A).

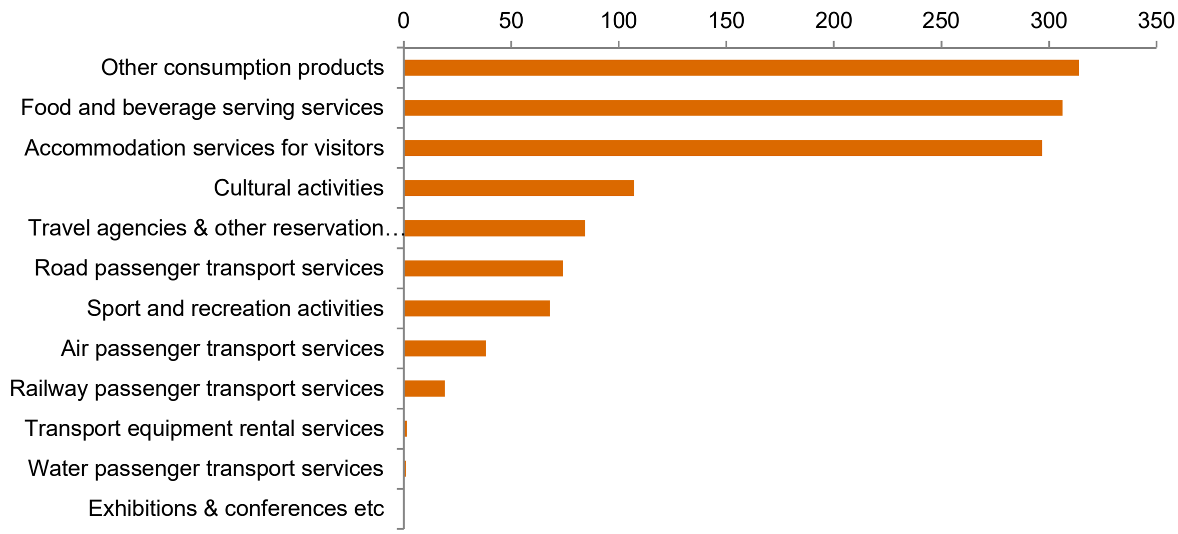
Catalytic employment

Evidence of the additional employment created through the catalytic impacts of an airport is limited. Such evidence as there is tends to focus on the impact arising from inbound tourism. In addition, there is no consistent evidence on the 'locality' of the impact.

Employment impact of tourism

Figure 22 shows the distribution of employment directly linked to tourism in the UK by sector. These estimates are based on data from the tourism satellite accounts.

Figure 22: Direct employees from tourism in the UK by industry group ('000 FTEs, 2011)



Source: Characteristics of Workers in Tourism, ONS (2013)

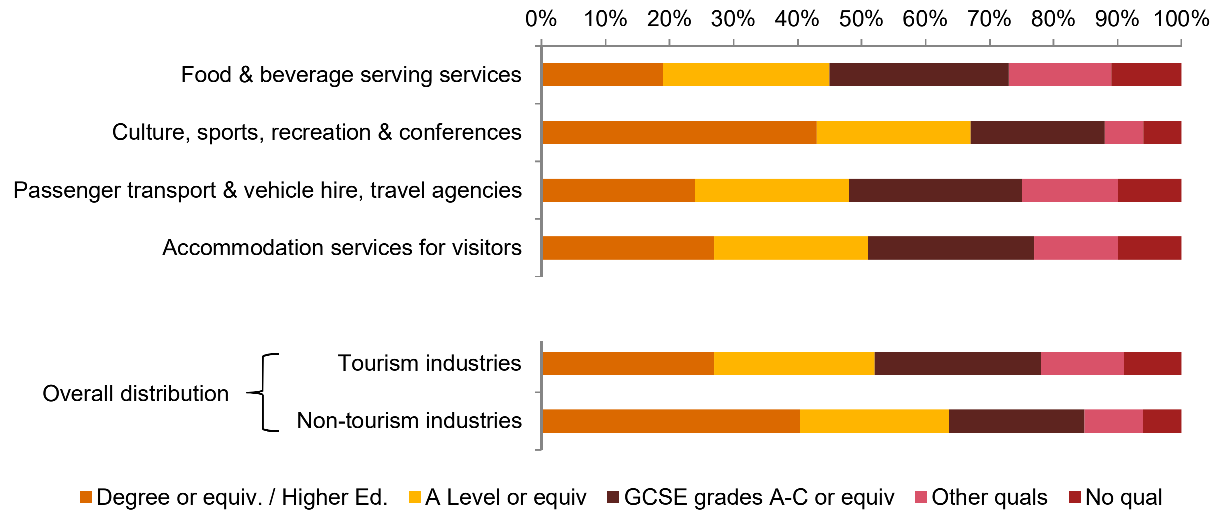
In addition to stimulating employment in the specific sectors highlighted above, the profile of employees in tourism industries in terms of qualifications is different to the UK as a whole. Figure 23 looks at the skill level of employees within the industry. It demonstrates that, aside from culture, sports, recreation & conferences, tourism typically employs individuals with lower skill levels (when measured according to highest educational attainment). Differences are also seen between the age, gender and ethnicity of employees in the tourism and non-tourism industries. All these factors would need to be considered when evaluating the impact of tourism on the local labour market, and the ability of the labour supply to react to this change in demand.

Box 5: Employment impacts of tourism linked to airports – evidence from the case studies

Two of our case studies have reviewed studies which have assessed the role of an airport in sustaining local tourism employment:

- A report for CDG estimates that around 52,600 jobs depend on spending by tourists using Charles de Gaulle airport in Paris
- A similar study in New York in 2004 estimated that 190,000 jobs depended on spending by domestic and international visitors using New York's airports

Figure 23: Distribution of highest education attainment for employees in tourism industries (2011)



Source: Characteristics of Workers in Tourism, ONS (2013)

4.2 Labour supply

Potential sources of labour supply

In this part of the section, we examine how airports secure their labour supply in order to meet changes in demand. Ernst & Young (2012) identify three potential sources of resident labour which would meet such demand:

- Unemployed residents in the local area seeking employment (above and beyond the long-run rate of structural unemployment);
- Inactive and underemployed residents in the local area seeking full-time employment; and
- Future resident labour force in the local area, above and beyond those employed by other new jobs.

Mobile labour comes from employees who choose to commute to their place of work. Its scale has implications for road and public transport use. We consider the available evidence on the place of residence of employees in relation to the airports where they work and the commuting pattern of airport workers.

A further dimension which needs to be considered is the matching of appropriate skills and experience to fill the roles which are created. In its analysis of a potential site for a new airport near Sydney, Ernst & Young (2012) found that, although total labour supply was expected to exceed demand by roughly 5,000 in 2060, this would be through an "over-supply" of 9,000 skilled workers and an "under-supply" of 4,000 unskilled workers. Rebalancing the labour market to meet the expected demand would require some combination of:

- Less skilled workers to be sourced from a wider area (which could be difficult since the extent that employees are prepared to travel is often linked to their skills/expected remuneration); and/or
- Persuading more skilled workers to accept less skilled roles (with a potential reduction in both their earnings and productivity).

This example highlights the importance of understanding the relationship between labour demand and supply in sufficient detail. Table 12 summarises some example indicators on the nature of the labour supply in three local authorities which house the largest airports in the South-East of England, relative to regional and national benchmarks. These data suggest that, relative to the benchmarks, these local areas have higher unemployment rates, a slightly lower skilled workforce (with the exception of Hillingdon) and an above average share of the labour force working in transport and communications. Only a limited understanding can be gained from this information alone, but it indicates the type of information which studies ought to consider.

Table 12: Labour supply indicators for selected local authorities and regions (2013)[21]

	Hillingdon (Heathrow)	Crawley (Gatwick)	Uttlesford (Stansted)	Largest London LAs		London	South East	UK
				Croydon	Barnet			
Economic activity rate- aged 16 to 64 (%)	77.6	82.9	86.5	81.0	77.5	76.8	80.0	77.3
Unemployment rate - aged 16+	8.4	13.1	N/A	8.4	5.5	8.5	5.7	7.5
% in employment working part-time - aged 16-64	21.3	18.6	17.7	25.3	23.0	21.5	26.3	25.5
% with degree or equivalent and above - aged 16-64	34.3	19.9	25.4	33.0	43.8	42.3	29.3	26.5
% with no qualifications - aged 16-64	6.8	9.5	5.6	6.1	4.4	7.8	6.5	9.7
% all in employment who are in professional occupations	19.5	13.3	19.9	20.8	27.0	25.0	21.3	19.7
% all in employment who work in transport and communications	17.8	19.1	9.2	11.6	9.3	12.0	10.3	8.8

Source: PwC analysis, NOMIS

Place of residence of airport employees

As the majority of the direct impacts from airport expansion are likely to be generated on the airport site, there will be pressure for the roles to be filled by residents local to the airport site. Understanding the geographic distribution of individuals who work on the airport site is useful as it helps to define the local area and the geographical breadth of the impacts. It can also be used as the basis for assessing the availability of labour within the local area and the potential impact on commuting patterns and supporting transport infrastructure.

Table 13: Place of residence of workforce at Heathrow Airport

	No. working at Heathrow	% of Heathrow workforce
Hounslow	10,760	14.6
Hillingdon	8,960	12.2
Ealing	5,760	7.8
Slough	4,090	5.6
Spelthorne	3,920	5.3
Local labour area	47,660	45.5
Other areas	25,770	54.5
Total	**73,430**	**100.0**

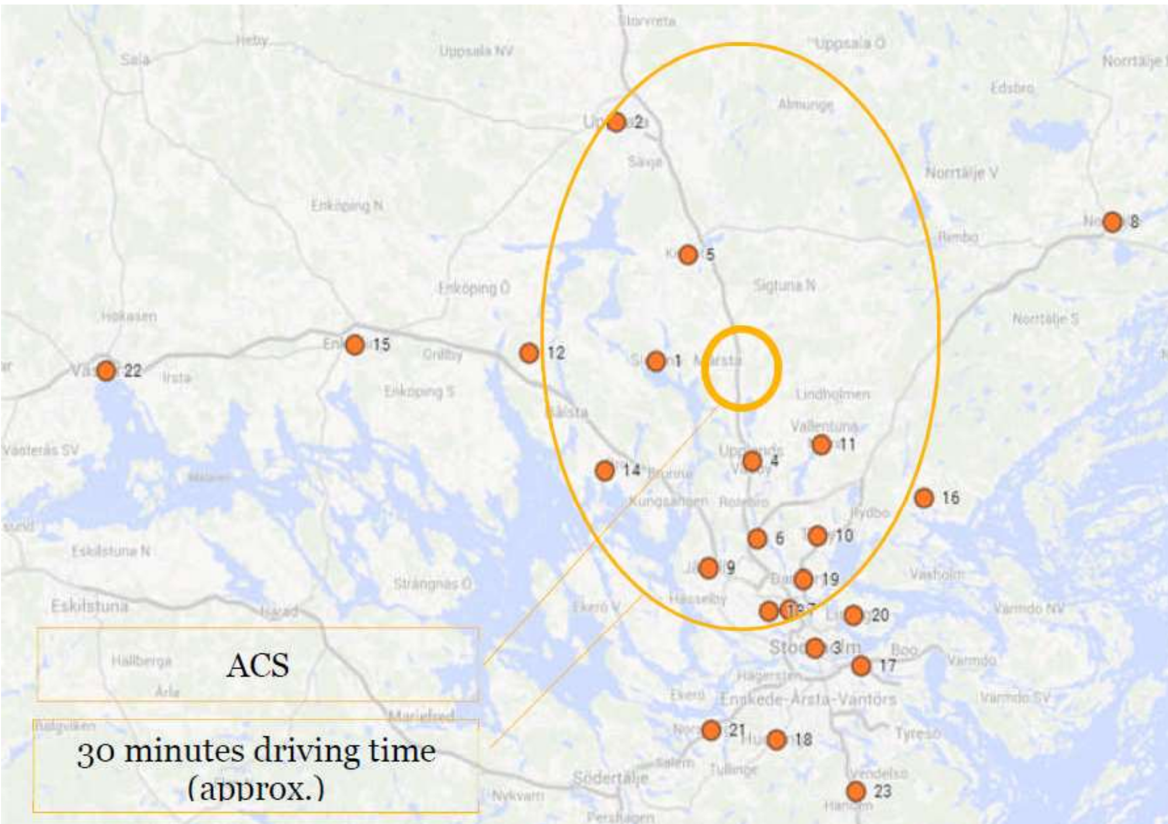
A number of studies have mapped this distribution. In in all cases the large majority of the on-site workers travel less than one hour. For example, some 60% of the airport employees at Frankfurt-am-Main Airport live within approximately 35 km of Frankfurt-am-Main airport. Nearly 75% of the direct employees at John Wayne Airport live in Orange County and therefore less than a 30 minute drive away from the airport. Looking more narrowly, more than half the employees live in the towns of Santa Ana, Orange and Costa Mesa, within a 15 minute drive. Similarly, nearly 90% of employees at Kingsland Smith Airport in Sydney live within a 50 minute

[21] Data is taken from the Annual Population Survey

drive of the airport, while more than 60% live in areas adjacent to the airport within a 15 minute drive. Both these examples are airports which are located in the centre of densely populated areas: Sydney Airport is a little over 10km from the centre of Sydney (with a population density of 380/km²) and Orange County is the second most densely populated county in California (density of over 1400/km²).

Alternatively, Stockholm Arlanda Airport is located in Sigtuna municipality (density of 120/km²). It is more than 35km away from the nearest cities of Stockholm and Uppsala. This does not, however, appear to impact significantly on the distribution of travel times for workers travelling to the site (see Figure 24). Again, over 75% of workers live within a 30-minute drive and nearly 90% live within an area extended to include Stockholm (which is a 32 minute drive away).

Figure 24: Areas with more than 100 workers commuting to Sigtuna (a close proximity for Arlanda Airport)



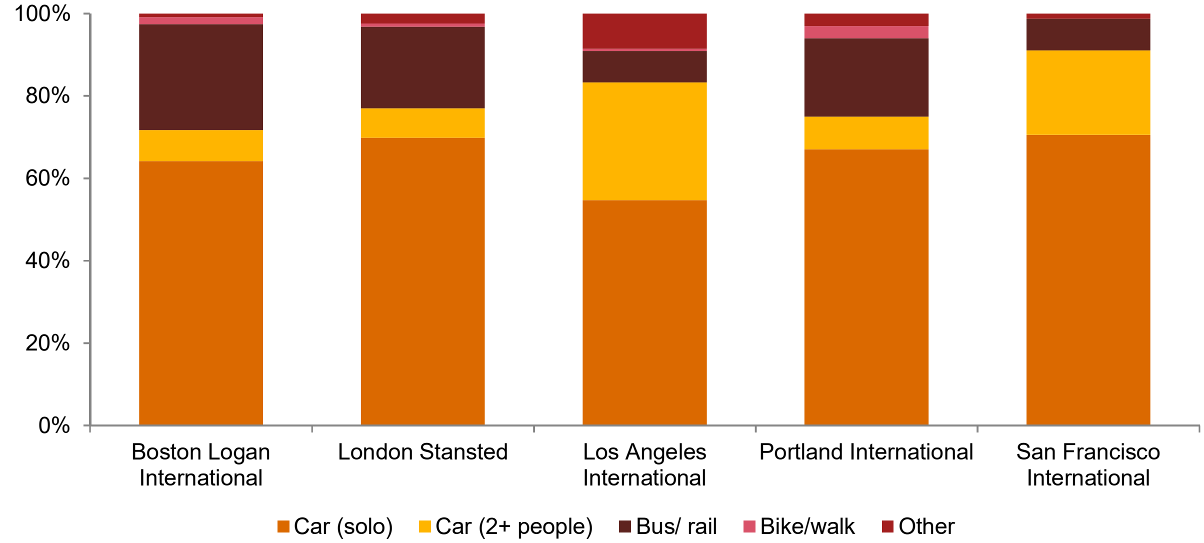
Source: PwC analysis

Commuting patterns

A final consideration in relation to the supply of direct labour is the commuting patterns of the workers at the airport. When combined with the understanding of the local area and the expected labour supply, this allows for analysis of how the local transport infrastructure will be able to cope with increases in demand.

Figure 25 shows the distribution of commuting methods at major international airports. This demonstrates that the majority of people (at least 70% in each case) use a car to drive to work, with the majority of those travelling alone. Despite the different infrastructure and geographical context of each airport, the commuting methods are reasonably similar, and do not differ greatly between Stansted and the four American airports. However, the differences which do exist, such as the increased use of carpooling in Los Angeles over bus/ rail use, demonstrate the importance of understanding the local context. Information at this level would be the very minimum needed to understand the potential impact of a change in capacity on local transport infrastructure.

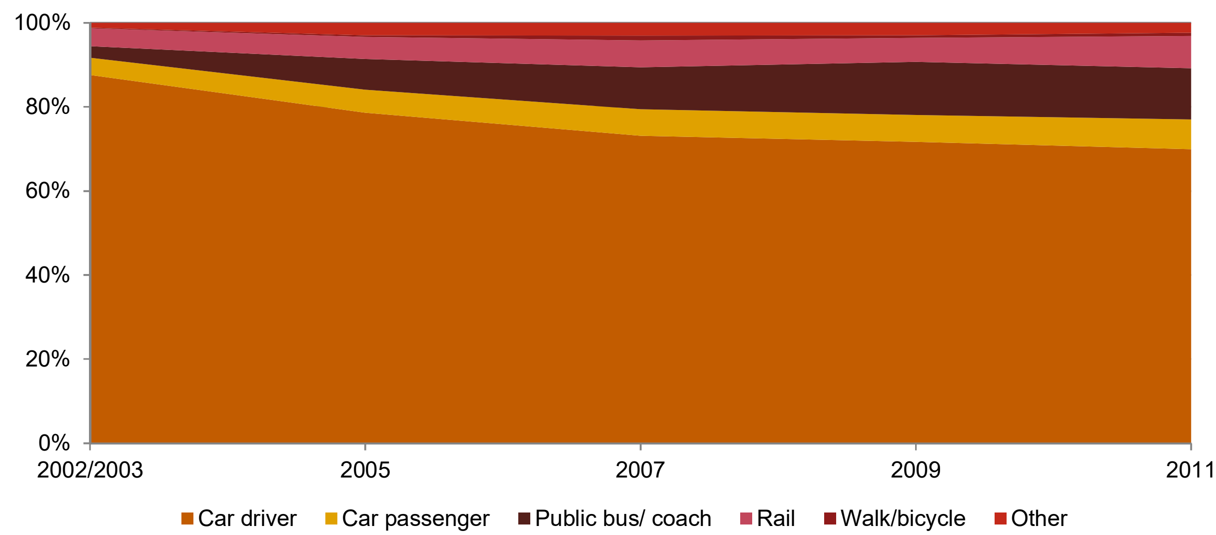
Figure 25: Distribution of commuting patterns by employees of major international airports



Source: Transportation Research Board (2012)

In addition to understanding the existing situation, studies would need to consider how this may change in future and with the introduction of a change in capacity. There is little evidence in the existing literature on the impact of a change in capacity on commuting methods, and any effect would be so specific to a local area that reasonably little could be learned from the findings. Figure 26 displays a more general trend, seen at London Stansted, of employees increasingly using means of transport other than the car. In particular, there appears to have been a large amount of switching to public buses and coaches. As a result, the use of alternatives to car transport has nearly trebled in less than 10 years. Trends such as this would be important to consider in any future projections of commuting patterns.

Figure 26: Change in commuting patterns to London Stansted (2002/03-2011)



Source: Transportation Research Board (2012)

5 Housing & land

This section summarises the impact of an airport, or airport expansion, on the need for, and availability of, housing, and the use of land at and around an airport. Two key questions which broadly cover the areas of interest with regards to this are:

- Housing: How do local housing markets adjust to airports and what factors influence individuals' decisions on whether to live in the locality of an airport?
- Land: What factors influence the location of real estate developments and how does local planning influence developments close of airports (or other transport infrastructure improvement)?

Box 6: Housing & land – key findings

Housing

Our analysis has examined two main questions:

- How much of the 'net additional labour demand' will add pressure to the local housing market and associated services?
- How much housing demand could there be from other sources, such as people wishing to live close to the airport for connectivity reasons?

Our key findings are that:

- To the extent that airport expansion increases direct and indirect employment in the local area, this will create pressure in the local housing market
- The extent of this pressure depends in part on the scale of the local area (geographically and the economically active population); changes in commuting patterns are also an important adjustment mechanism
- Evidence from the Joseph Rowntree Foundation in relation to Heathrow suggests that proximity to employment opportunities has affected the location decision of many residents
- How airport expansion affects local housing markets is ambiguous: on the one hand, it directly stimulates housing demand as more airport workers are needed, and indirectly as improved connectivity attracts mobile firms and/or enables existing firms to become more competitive (thus boosting their demand for labour). On the other hand, negative externalities associated with airport expansion (e.g. noise, congestion) can make the area less attractive so reducing housing demand
- McMillen (2004), for example, finds that the impact of 'severe noise' in reducing demand lowers house prices by 9.2%. The impact of additional airport capacity on noise is considered in module 5 of the Appraisal Framework.
- Conversely, demand for housing is shown to be increased by Lipscomb (2003) through the improved connectivity brought by an airport.

Land

Our analysis has examined the factors that influence the location of real estate developments and how local planning influences developments close to airports (or other transport infrastructure improvements)

Our key findings are that:

- The evidence demonstrates that the amount of land which is required in the locality of an airport varies greatly according to the local context.
- For example, Dallas/ Fort Worth airport covers 18,000 acres, of which 6,000 are for non-aviation activity. Most other airports are, however, considerably smaller
- Baker et al (2012) suggest that the nature of the land used by airports has changed with their recent development, stating that "large international airports in Europe, North America and Asia have varied functions beyond airport traffic and operate as metropolitan hubs with a diverse range of land uses"
- Similarly, CBRE research demonstrates how the role of land used by airports has changed, showing that occupiers of office space at airports are dominated by the technology and telecommunications (T&T) and manufacturing sectors
- The result of this has been to increase land rents on airports sites, to the extent that land at Amsterdam Schiphol is now more expensive than in the Amsterdam CBD. This type of adjustment mechanism with regards to an increase in demand will have a significant impact on the nature and level of land use in the vicinity of an airport.

Table 14 highlights some of the key studies referred to in this section besides those considered as part of the case studies. For a full list of studies used, please see Appendix G.

Table 14: Housing & land - key sources used

No.	Title	Author	Year
1	Airport Office Developments: Assessing the Potential for New Schemes	CBRE	2013
2	The Impact of Airport Noise on Residential Real Estate	Randall Bell	2001
3	Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line	Antoniou & Efthymiou	2013
4	Airport expansions and property values: the case of Chicago O'Hare Airport	Daniel P McMillen	2004
5	Developing tools to support complex infrastructure decision-making	Baker & Mahmood	2012

5.1 Housing

In this part of the Section, we briefly consider the limited available evidence on the influence of airports on (local) housing demand and value. This includes a report by the Joseph Rowntree Foundation on the local community surrounding Heathrow, however no similar study exists for the area around Gatwick. We focus on the factors that influence individuals' decisions on where to live in relation to an airport.

Factors influencing individuals' decisions to live in the locality of an airport

The development of transport infrastructure is an important driver of urban development. According to Efthiamou et al (2013), its impact on house prices "is either positive, due to the capitalization of the commuters' travel costs in the housing market of the area, or negative, when there are generated externalities (such as noise)".

Bell (2001) states that there are hundreds of detrimental conditions that affect property market values. Airport noise is recognised as an externality that is imposed on property owners, generally on a permanent basis. Empirical studies indicate that airport noise reduces residential property values. McMillen undertook research in 2004 which attempted to quantify the effect of airport noise on property values around one of the world's busiest airports, Chicago O'Hare. The author notes that "while much of the opposition to airport expansions focuses on aircraft noise, it is ironic that airports are actually becoming significantly quieter over time. New aircraft are much quieter than older planes, and the older aircraft are being retired. Indeed, a single model, the B72Q, which is being phased out by the major airlines, generated over 70% of the incidents of "severe noise" at O'Hare in 2001. In addition, airports have become quieter as night flights are reduced." Nevertheless, McMillen states that opponents of airport expansions continue to cite increased noise as a major complaint. Using transactions data from 1997, McMillen finds that home prices are 9.2% lower in the area affected by severe noise. However, it is suggested that as a result of aircraft becoming quieter, new runway reconfigurations and proposed changes to flight paths, the forecast net impact of the proposed additional runway at O'Hare was actually an increase in house prices by nearly $300 million.

In the case of Manchester Airport, sources cited in Efthymiou et al reached opposite conclusions when measuring the impact of the airport: Pennington (1990) found that aircraft noise created a negative impact, whilst Lipscomb (2003) concluded that increased accessibility led to an uplift in values. The length of time between these studies and the development in aircraft technology in the intervening period (as highlighted above) may explain the differences in findings. We note that the impact of airports on noise and quality of life is being considered more fully as part of other Modules.

Research published by the Joseph Rowntree Foundation in 2011 suggests that proximity to employment opportunities at Heathrow Airport has affected location decision-making for many local residents. The research considered community experiences and understandings of globalisation in the UK and examined the 'Heathrow

Village'[22] as a community that is outwardly connected and associated with a long history of immigration. As such, it has strong and diverse external connections in economic, social and cultural terms. The report described Heathrow Village as a 'tight', though ethnically diverse, community, on the basis that so many people worked at Heathrow in a variety of roles such as catering, transit, baggage handling and customer services. The authors state that "many people in the area are tied to Heathrow airport through their employment by a range of firms, which often operate through dense and complex global contractual relationships. The area contains a variety of ethnic groups, reflecting successive waves of inward migration from Ireland, south Asia and more recently Somalia, which continues to open the area up to broader global social and cultural flows and influences. By UK standards, the local labour market [around Heathrow Airport] is relatively buoyant, with low levels of unemployment and median earnings in line with the national average."

A local councillor interviewed by the researchers observed that as residents are upskilled they move further away from the airport: "And what quite often happens is that the really unskilled work tends to get taken up by the incoming communities… Because it's been easier to do those jobs and they've (the established communities) actually stepped up a grade. They're integrated into the wider society. So they step up and move out further which lets more people in."

This finding only provides one viewpoint; nevertheless, it suggests that the housing market in Heathrow Village is not seen as a desirable location in which residents want to settle; although employment levels are high, the dominance of unskilled workers may constrain house price growth on the basis of affordability.

5.2 Land

In the second part of this Section, we consider the limited available evidence on the influence of airports on land use and values. First, we examine the development of airport commercial markets and then consider how accessibility shapes commercial property developments. Second, we review how airports influence local economic and land use planning. Due to a lack of data availability around Heathrow, the second section focusses on the experience of Gatwick Airport.

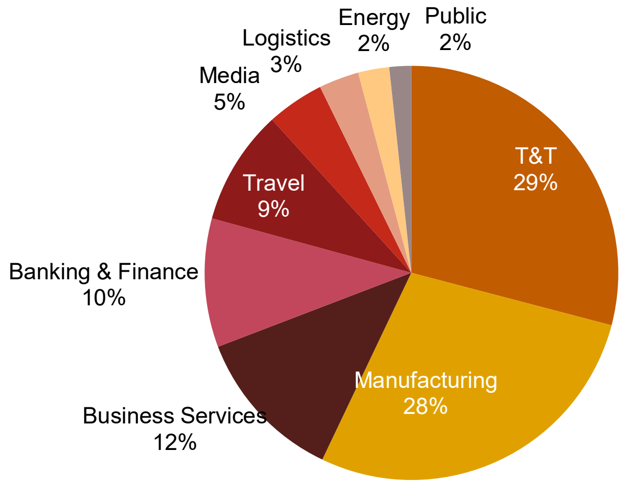
Airport commercial property markets

Baker et al (2012) state that the role and scale of major urban airports worldwide have changed over the past decade as a result of corporate and economic transformation. Modern airports can no longer be considered in isolation from the metropolis that they serve: "Large international airports in Europe, North America and Asia have varied functions beyond airport traffic and operate as metropolitan hubs with a diverse range of land uses. Most large international airports have developed land on the airport for commercial and light industrial purposes that are often not associated with aviation-related uses. The change in land use around the airport, coupled with the increasing use of the airport for international travel, has often placed demands on the transportation infrastructure that services the airport area. Included in this demand is a wide range of stakeholders, users and infrastructure providers that have differing goals, objectives, models and interests."

CBRE has assessed a number of European airport markets. Its research shows that in addition to companies which are directly related to aviation activity, occupiers of office space at airports are dominated by the technology and telecommunications (T&T) and manufacturing sectors (see Figure 27).

[22] Referring to the communities to the west of London around Heathrow airport, spanning the boroughs of Hillingdon, Hounslow and Ealing.

Figure 27: European airports occupier profile (2013)



Source: CBRE

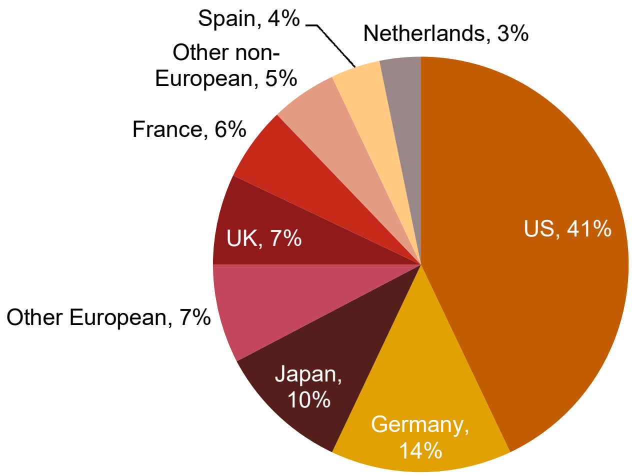
In terms of occupier trends, discussions with CBRE reveal that the large US hardware manufacturing firms who established office campuses around European airports in the late 1980s/1990s are currently consolidating their space in these locations, or are moving offices to more central areas. The new generation of technology firms that is driving demand from this sector prefers central locations in order to appeal to their target workforce. As a result, demand from this sector around airports is significantly lower than in the past. Manufacturing firms and travel related occupiers still have a tendency to locate in these areas – they are less concerned with locating in central markets and still benefit from the good connections and cheaper rents they typically find in the airport area.

According to CBRE, market conditions in the majority of non-central business districts, including airports, have been challenging during the economic downturn. Three general features have driven the airport-based office markets that have performed best during this period:

- Connectivity to other major global cities and to the local economy;
- Prominence in the region of established occupiers from the potential occupier's business sector; and
- Supply and location of suitable, high quality office space.

CBRE argues that the global connections at an airport are of particular significance to multinational firms based outside Europe. Figure 28 shows that more than half of occupiers originate from non-European locations. Of these, over 70% are located at an airport that had direct flights to the city of their global headquarters.

Figure 28: Country of origin of key European airport occupiers (2013)

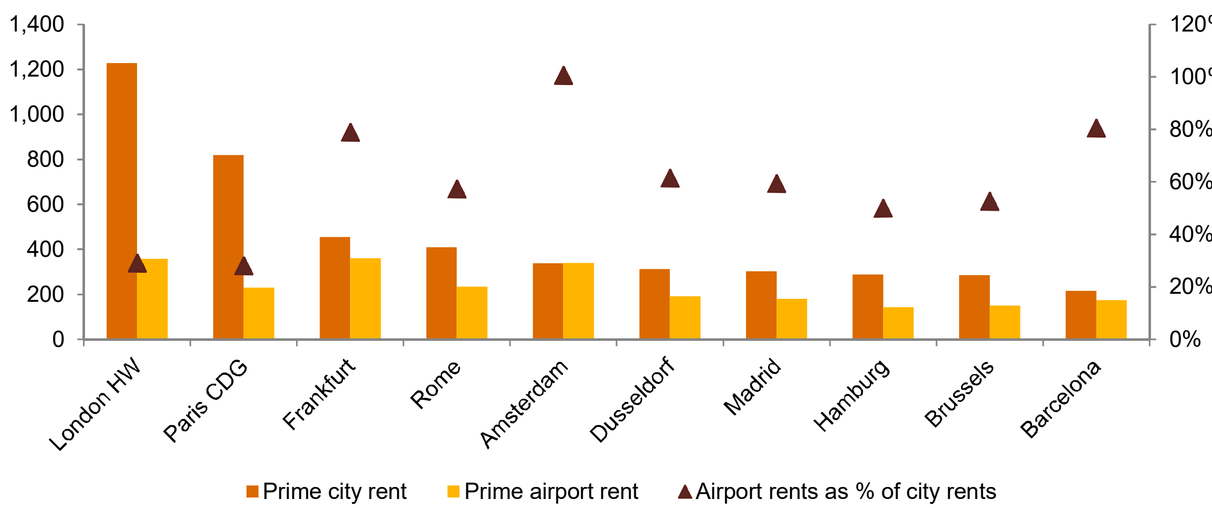


Source: CBRE

The level and quality of connections to the local economy are also important like global connectivity. Figure 29 highlights that the highest rents of the main European hub airports are achieved at Frankfurt and Amsterdam. In addition to being large hub airports, both have quick transfer times by train to the city centre (10-15 minutes), but are also connected to the high speed national and international rail networks (see, for example, the Frankfurt case study). Discussions with CBRE revealed that there have been a few examples of business services / banking companies setting up offices at airports; however these are only at airports which have very high grade central business district style office space and extremely quick connections to the central business district (less than 15 minutes).

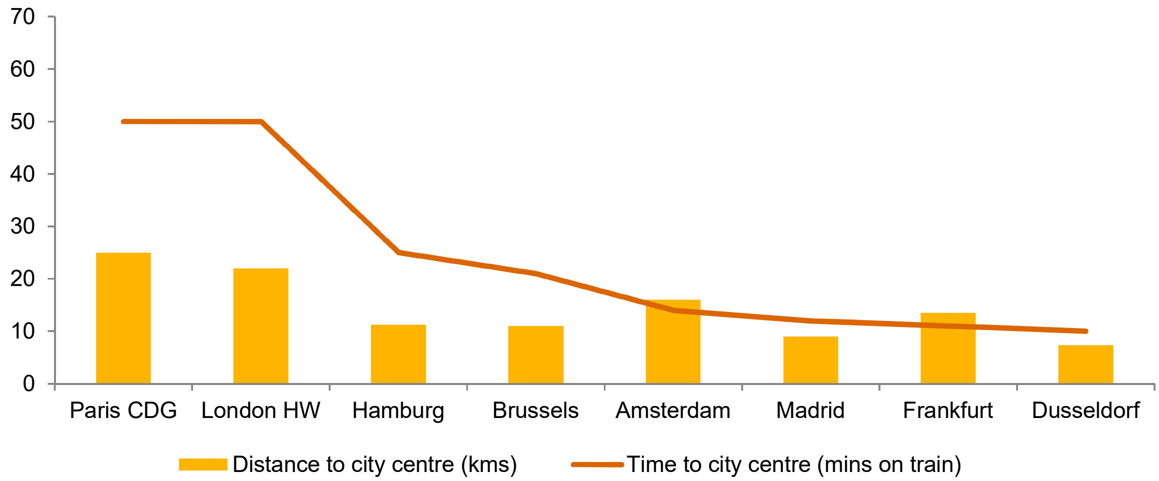
In contrast, average transfer times from Paris and Heathrow to the city centre are significantly longer (see Figure 30). The size of these airports and land pressures close to their perimeters have resulted in the location of business parks further from their perimeters .

Figure 29: Prime airport and city office rents (€/sq. m per annum)



Source: CBRE

Figure 30: Distance and time from airport to city centre

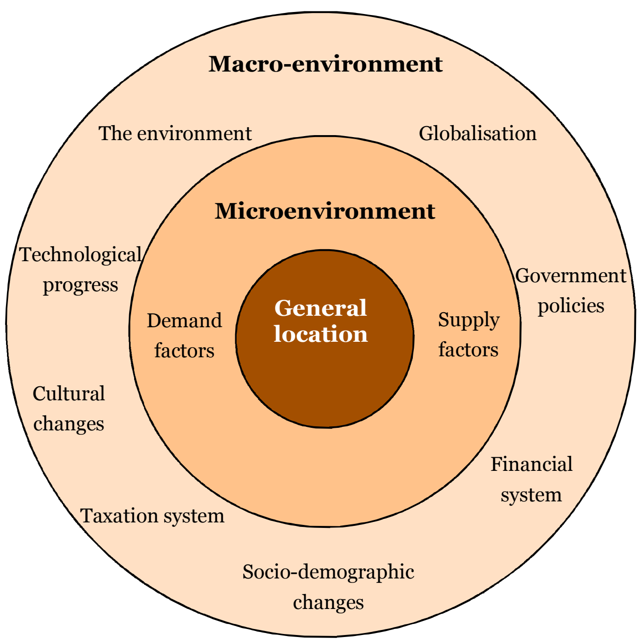


Source: CBRE

Influence of accessibility on location of commercial property developments

Rymarzak et al (2012)[23] provide a recent systematic review of the literature related to factors affecting the choice of location for real estate developments. The authors analyse factors connected with both the distant environment (the macro-environment) and those relating to the more immediate environment (the micro-environment). These factors are summarised in Figure 31.

Figure 31: Factors affecting general location choice



Source: Rymarzak et al (2012)

[23] Rymarzak, M and Siemińska, E (2012), "Factors affecting the location of real estate", Journal of Corporate Real Estate, Vol. 14 No. 4, pp. 214-225.

Regarding the macro-environment, the authors state that "the factor covering the widest range of issues in business activities, from a generic point of view, is government policy. By defining priorities and main directions for economic and social activities, the state creates specific conditions and principles for the functioning of various business entities… Therefore, government policy, in conjunction with the global situation, largely determines whether business is good or bad for a given entity, affecting the entities' financial situation and the nature of the location decisions it makes. The economic system and its degree of market freedom and impact are crucially important for the business' objectives, assessment of productivity levels, and therefore, location."

Once a business has decided to locate within a macro-environment, it will try to find a location that will best satisfy the needs of its planned operations (i.e. the micro-environment). Each location has a value which is determined by factors related to both supply and demand. On the demand side, factors that influence a location's attractiveness from a market perspective include the number of consumers, their purchasing power and transportation between consumers and the site; this may involve either delivery of goods to the buyers or the means for the buyers to get to the point of sale or service. Supply side factors are determined by the location's conditions that allow the specific business to be conducted, which directly or indirectly impact the size of investment outlays in the construction phase as well as the firm's net profitability level at this location. Supply side factors may include natural resources, human resources, technical facilities, raw materials and energy.

Table 15: Demand and supply factors affecting the general location choice of real estate

	Demand factors	Supply factors
Industrial space	• Number of consumers (buyers/clients) • Expected sales volume • Seasonality • Prices of substitute products • New household formations • Age composition of new households • Household income • Mortgage credit conditions	• Availability of natural resources (water, quantity, quality of minerals, agricultural, forest) and their prices • Availability of fuels (coal, oil, gas, electricity, fuel expandability, reserves) • Transportation methods and costs (water, rail, highway, air, access) • Human resources (wage rates, skill levels, productivity, availability) • Prices, productivity of production • Number and location of competitors
Retail space	• Population (number, density, growth rate, age and gender pattern, educational attainment) • Households (composition and size, income levels, average disposable income per capita) • Credit conditions and payment plans • Unemployment level • Internal, external migrations • Social mobility • Trend for delayed marriage and parenthood • Customer tastes and preferences • Prices of substitute products	• Number of existing retail outlets (number of major and less immediate competitors) • Retail outlet pattern and size • Proximity of transport networks • Retail saturation in area • Retail space vacancy rate • Growth rate of new outlets • Market share of individual retail facilities • Merchandise offered • Age of retail facilities • Technical standard of existing space • Parking capacity
Office space	• Unemployment level • Number of local firms • Type of business of local firms • Number of local firms (expanding or upgrading, ceasing business or leaving local market) • Number of new firms entering local	• Number of existing office buildings • Office building pattern and size • Accessibility to the client – location vs housing estates and transport networks • Office space vacancy rate • New office facilities growth rate

Demand factors	Supply factors
market • Office space per employee (square feet)	• Age, technical standard of existing space • Parking capacity • Recent absorption of space, including types of tenants or buyers • Market rents/sale prices • Developer expectations • Demolitions, conversions • Credit conditions

Source: Rymarzak et al (2012)

These findings were reinforced by the ULI/EY survey[24] of global real estate and public leaders which highlighted infrastructure as the top factor driving the location of commercial property development: 88% of survey respondents ranked infrastructure quality as a top or very important consideration when determining where real estate investments are made, with infrastructure scoring highest for public leaders (91%) and second to the top for private leaders (86%). In terms of the importance of different infrastructure categories, some interviewees noted that services such as water, electricity and telecommunications are part of the package of infrastructure elements that well-functioning cities are expected to provide and, therefore, differentiators are "proximity to transport, especially high-quality transit, good roads and bridges, and, for some real estate sectors, airport and passenger connections."

Land use planning around Gatwick and Heathrow airports

Finally, the Airports Commission asked each of the local authorities close to Heathrow and Gatwick Airports to provide relevant background information on how their approach to planning took into account the influence of the adjacent airports. Responses were provided for four areas: Crawley, Horsham, North West Sussex (covering Crawley, Horsham and Mid-Sussex) and Surrey. Very limited information was provided in relation to Heathrow Airport.

Two key documents provide some insight into the broad economic trends around Gatwick Airport:

- The North West Sussex Economic Appraisal (September 2009), which focuses on Crawley, Horsham and Mid-Sussex, covers the period from 2006 to 2026; and
- The North West Sussex Economic Growth Assessment (April 2014) covers the Gatwick Diamond (which includes Crawley, Horsham and Mid-Sussex as well as the Surrey districts of Epsom & Ewell, Reigate and Banstead, Mole Valley and Tandridge) and assesses the period from 2011 to 2031.

Both documents provide detailed analyses of alternative scenarios for economic development around Gatwick Airport, considering the implications for planning policy of potential changes in business and employment structure, housing, employment space and land use. Significantly, although both reports consider the effect of growth at Gatwick Airport, neither report considers a scenario in which Gatwick Airport would have a second runway.

Table 16 summarises the overall levels of employment growth and B class space requirement[25] and land requirement for each local authority arising from the different scenarios examined in the most recent, North West Sussex Economic Growth Assessment. Under the 2013 baseline scenario, employment is projected to increase by 35,700 between 2011 and 2031. Just under half (46%) of this growth (equivalent to around 16,500 jobs) is expected to arise in Crawley with almost 10,500 jobs in Mid Sussex and nearly 8,900 jobs in Horsham. The various alternative scenarios generate higher overall levels of employment growth than is implied by the baseline scenario.

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[24] Urban Land Institute and EY, Infrastructure 2014: Shaping the Competitive City, http://www.ey.com/Publication/vwLUAssets/EY_-_Infrastructure_2014:_shaping_the_competitive_city/$FILE/EY-infrastructure-2014-shaping-the-competitive-city.pdf

[25] B class space includes B1 Business (offices, research & development, light industry), B2 General Industrial and B8 Storage or Distribution (wholesale warehouses, distribution centres).

The analysis suggests that, in total, up to 48,000 jobs could be accommodated and supported across Northern West Sussex. This is equivalent to an increase of 35% over the baseline scenario and is contingent on relatively significant policy interventions and provision of new employment land.

Table 16: Headline scenario outputs by local authority (2011-2031)

Scenario		Northern West Sussex	Crawley	Horsham	Mid Sussex
Baseline Job Growth	Total employment	35,755	16,440	8,890	10,425
	Jobs per year	1,785	820	445	520
	Gross floorspace requirement (m2)	714,560	387,540	178,770	148,250
	Gross land requirement (ha)	144.2	77.2	36.3	30.7
Higher Growth	Total employment	46,275	20,130	12,720	13,425
	Jobs per year	2,320	1,010	640	670
	Gross floorspace requirement (m2)	896,010	435,300	218,630	242,080
	Gross land requirement (ha)	183.8	87.6	43.4	52.8
Potential Sites Capacity Potential	Total employment	48,000	22,440	15,135	Not modelled: as per baseline
	Jobs per year	2,400	1,120	760	
	Gross floorspace requirement (m2)	828,320	440,330	239,740	
	Gross land requirement (ha)	193.4	110.1	52.6	

*Source: NLP analysis *Note: totals rounded*

Appendix A. - *London Heathrow*

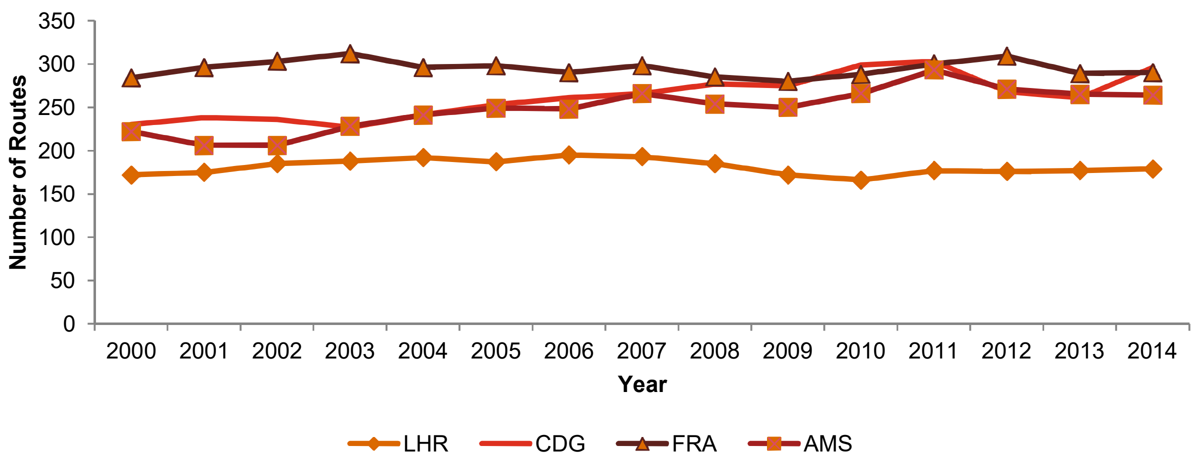
A.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to London Heathrow airport. We provide background information about the development of the airport since 2000. This includes route, passenger and airline data alongside a timeline of infrastructure developments. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing. The case study has drawn heavily on data published in 2011 by Optimal Economics, by far the most comprensive recent source of data, which has enabled analysis of Heathrow-related employment and GVA, as well as earnings, skill levels and employment type.

A.2. *Background*

Heathrow (LHR) is the third largest airport in the world in terms of passenger numbers (after Atlanta and Beijing) having served over 72 million passengers in 2013. Figure 32 highlights the consistently large number of connections at Frankfurt and the growth of the networks at Charles de Gaulle and Schiphol in comparison to that of Heathrow, which has fluctuated slightly but shows no significant growth:

Figure 32: Number of routes available at the major European hub airports (2000-2014)

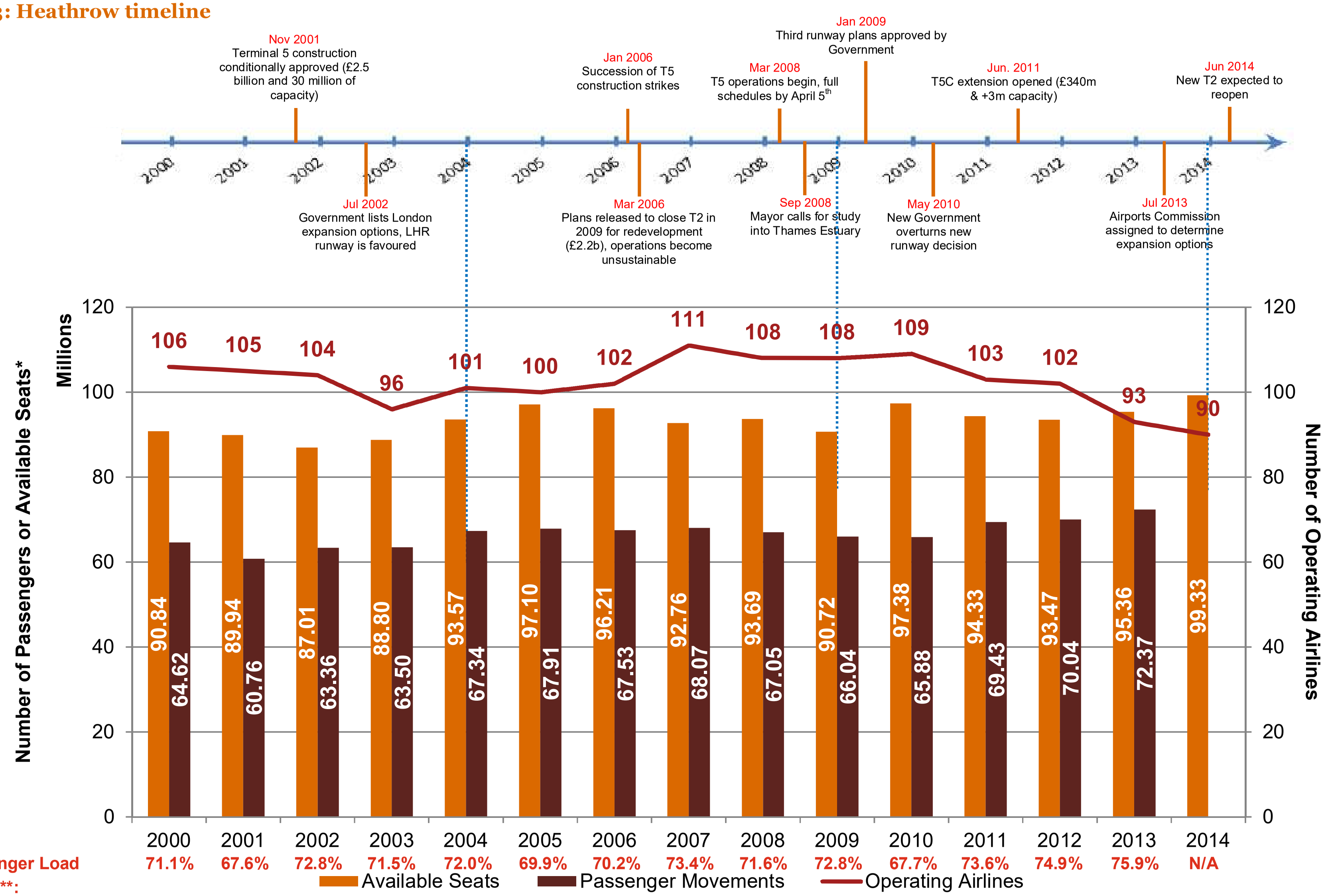


Source: SABRE Airport Data Intelligence

However, restricted capacity will cause airlines to focus on the most profitable routes and it has been estimated that, by 2030, constraints at Heathrow will limit the airport to serving as few as half the destinations provided by Charles de Gaulle (CDG), Schiphol (AMS) and Frankfurt (FRA), the other three major European hubs[26]. In the past fifteen years, Heathrow's principal infrastructure developments have been the construction of Terminal 5, which opened in spring 2008 and the modernization of Terminal 2, which is scheduled to open in 2014. The timeline in Figure 33 highlights both these infrastructure improvements and the trend in the number of operating airlines and passengers.

[26] Heathrow Airport Limited (2011), A Focus on the Economy Towards a Sustainable Heathrow
http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Afocusontheeconomy.pdf

Figure 33: Heathrow timeline



*Available departing seats multiplied by 2
** Passengers divided by available seats
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

It is difficult to credit the variation in capacity to one or a series of events as there are a lot of factors to take into account; simply because a new infrastructure development has been opened does not necessarily mean that available seats on flights will increase across the whole airport. The data highlight capacity growth of almost 6 million seats in the period in which infrastructure investment was made at the airport, although some of this capacity may be attributable to the increasing use of larger aircraft.

A.3. *Employment and value added*

The overall aim in increasing capacity at an airport is to be able to accommodate additional passengers. However, a thriving airport also draws new businesses to locate either onsite or nearby (e.g. cargo, logistics, retail, hotels, offices, car parking and light industrial space).

The passenger numbers of an airport can be directly related to the number of jobs available and the gross value added (GVA) to the local economy in terms of the income earned from the production of goods and services in the area.

A report carried out in 2004 for the Airports Council International (ACI) Europe regarding the social and economic impact of airports suggested an average of 950 on-site jobs are supported by every million passengers at airports in Europe[27]. This gives an indication of how important airports are economically at the local level throughout the continent.

Between 2008 and 2009, a survey was undertaken of on-site employees at Heathrow Airport. These results were analysed in 2011 to investigate the impact Heathrow had on employment both directly and indirectly across the UK. The summary of the findings is shown in Table 17.

Table 17: Total employment and GVA as a result of Heathrow (2010)[28]

	Local	London	Rest of UK
Employment (Jobs)			
Direct on-airport	76,600	76,600	76,600
Direct off-airport	7,700	7,700	7,700
Indirect	11,100	20,800	44,400
Induced	18,600	31,500	77,200
Total employment	114,000	136,600	205,900
GVA (£ billion)			
Direct on-airport	3.276	3.276	3.276
Direct off-airport	0.328	0.328	0.328
Indirect	0.656	1.358	2.462
Induced	1.065	2.059	3.616
Total GVA	5.304	7.021	9.680

Source: Heathrow Related Employment, Optimal Economics, 2011[29]

In this context direct employment is considered jobs where activity is directly related to Heathrow and is based either on- or off-site; indirect employment refers to the firms that supply the goods and services to businesses located at the airport; and induced is employment supported by the expenditure of those employees in the

[27] ACI Europe and York Aviation (2004), The Social and Economic Impact of Airports in Europe https://www.ryanair.com/doc/news/2012/ACI-Report.pdf

[28] Employment figures to the nearest 100. Although the direct on-site figures were from 2009 they were expected to hold for 2010.

[29] Optimal Economics (2011), Heathrow Related Employment http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Heathrow-Related-Employment-Report.pdf

previous categories. It is also worth noting that "Local" refers to local authorities in the immediate vicinity of Heathrow, i.e. Hillingdon, Hounslow, Spelthorne, Slough and Ealing (see Figure 33).

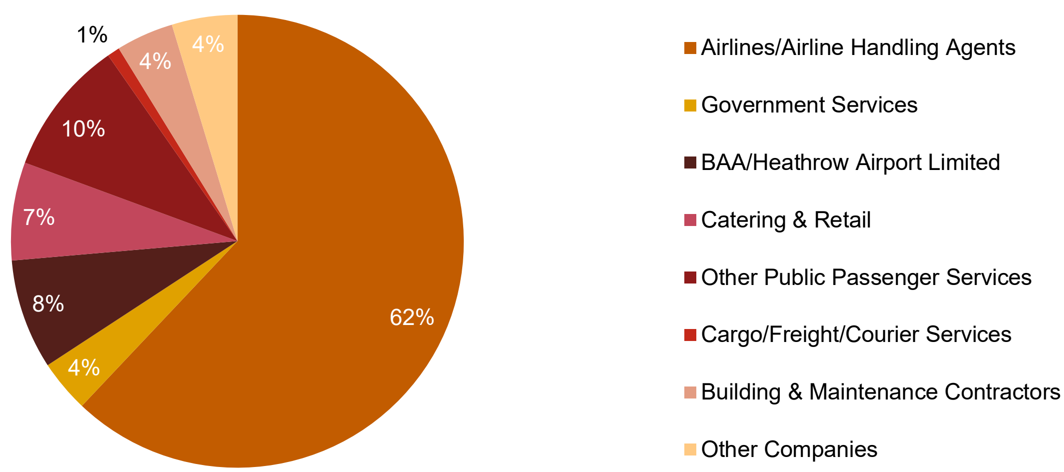
From the figures reported in the 2011 paper, it is evident that Heathrow exceeds the European average quoted by the ACI in 2004 of 950 employees per million passengers; in 2009, Heathrow served c. 66 million passengers and employed 76,600 staff on-site, giving a ratio of around 1,160 employees for every million passengers. Bearing in mind that the European employee numbers may have changed slightly since the survey, this still suggests that in European terms Heathrow has an above-average direct economic impact in the local area.

The 2011 study further breaks down on-site employment by sector. Figure 34 shows the split of employees by employment category and Figure 35 shows the split by employers. The majority of jobs come from airlines and airline associated services although this category has a significantly lower share in terms of employers (because these companies are much larger than other companies on-site).

It is almost expected that cargo/freight/courier services have the lowest share as Heathrow only operates an average of 69% of the freight carried by Charles de Gaulle and Frankfurt by weight (since 2007, FlightglobalPro). Also, since freight companies handle goods rather than passengers, as airlines do, it requires fewer staff to deliver their services.

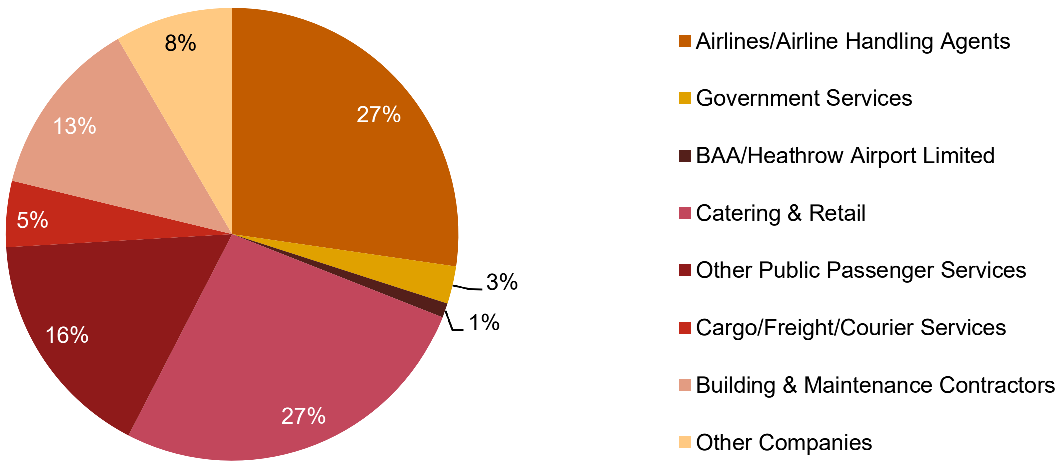
Of the employees surveyed at Heathrow in the study, 99% were permanent, 82% were full time and there was a 57:43 male/female split.

Figure 34: % of direct on-site employment by sector (2009)



Source: Heathrow Related Employment, Optimal Economics, 2011

Figure 35: % of direct on-site employers by sector (2009)



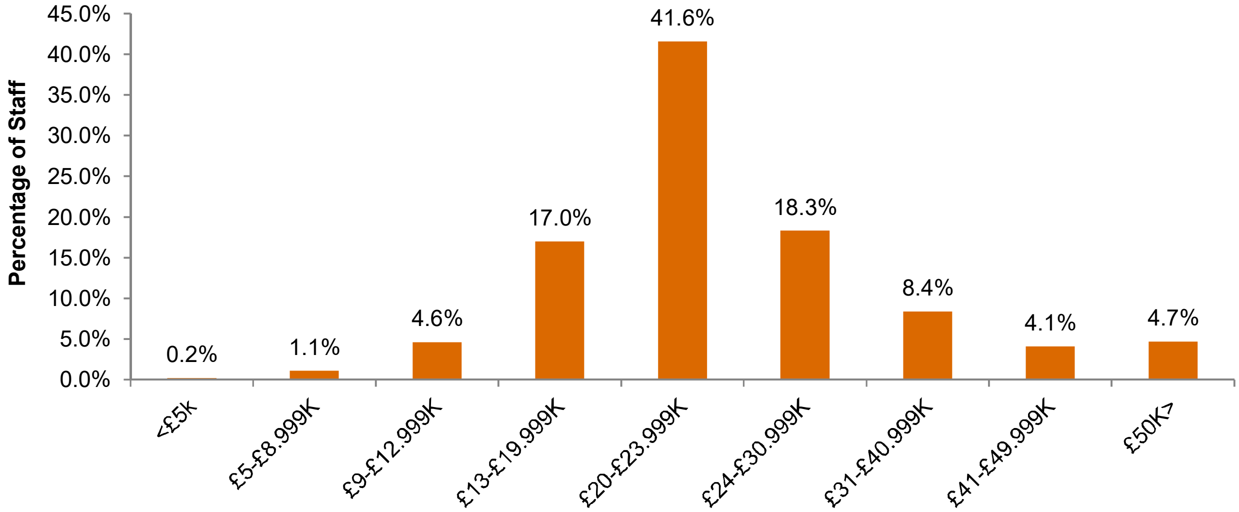
Source: Heathrow Related Employment, Optimal Economics, 2011

A.4. *Earnings and skills*

In 2010, the ONS estimated that salaries in an area contribute to 61% of that area's total GVA[30]; carrying this assumption through to Heathrow allows us to estimate a GVA of £3.3 billion in 2009 from direct on-site employment alone. Figure 36 highlights the distribution of salaries of on-site employees. The majority of staff earn between £20k and 23.999k. Figure 37 shows the split of employees at Heathrow by skill level: level 1 is considered competence associated with general education and gives hotel workers and cleaners as examples of jobs; level 2 occupations require knowledge provided by a good general education such as machine operators, retailing and secretarial positions; level 3 normally require post school study but not to a degree level, such as skilled engineering roles and construction trades; and level 4 covers professional and managerial positions which would usually require a degree or equivalent. The relevance of this pie chart is that almost 60% of the workers are level 2 which includes air cabin crew and baggage handlers ('Airlines/Airline Handling Agents' employer category).

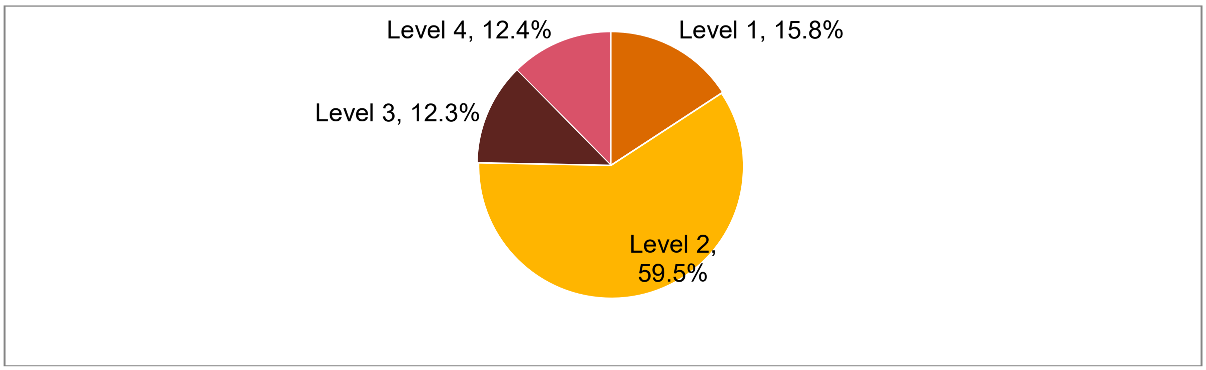
[30] Office for National Statistics (2010), Regional, sub-regional and local gross value added 2009
http://www.ons.gov.uk/ons/rel/regional-accounts/regional-gross-value-added--income-approach-/december-2010/regional--sub-regional-and-local-gross-value-added.pdf

Figure 36: % of LHR on-site employees by salary band (2009)



Source: Heathrow Related Employment, Optimal Economics, 2011

Figure 37: % of on-site employees by skill level (2009)

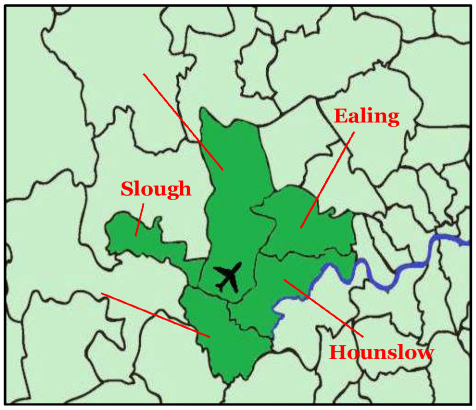


Source: Heathrow Related Employment, Optimal Economics, 2011

A.5. *Labour supply*

Figure 38 shows that Heathrow draws its workforce from a wide geographical area. Almost 55% of direct on-site employees live outside the five closest local authorities. This suggests that the economic impact of the direct, on-site employment of Heathrow extends beyond the local area since those who work at Heathrow and live in the surrounding region will spend some of their wages there, helping the induced effects locally.

Figure 38: Place of residence of Heathrow workforce (2009)

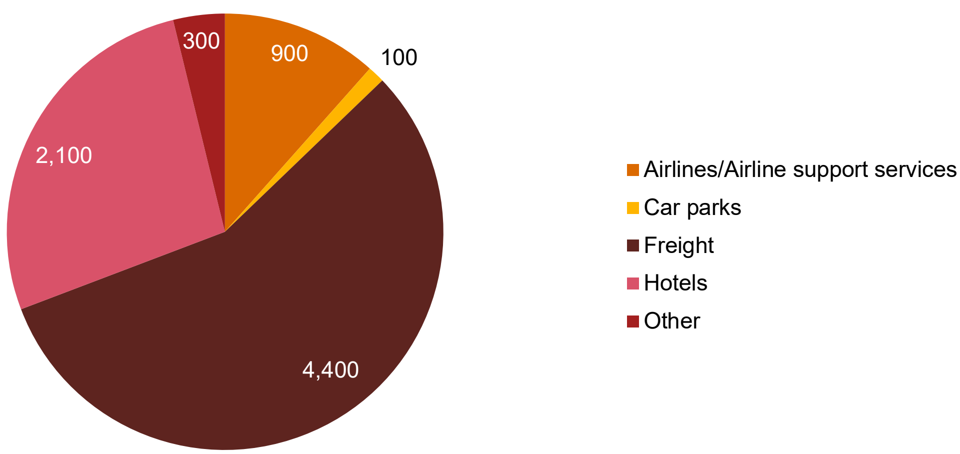


Local area	No. working at Heathrow	% of Heathrow workforce
Hounslow	10,760	14.6
Hillingdon	8,960	12.2
Ealing	5,760	7.8
Slough	4,090	5.6
Spelthorne	3,920	5.3
Local labour area	47,660	45.5
Other areas	25,770	54.5
Total	73,430	100.0

Source: Heathrow Related Employment, Optimal Economics, 2011

Direct off-airport employment was also estimated by the study and divided into the same business sectors as the on-site analysis, but limited to the five local authorities considered in the residency of on-site employment. The results are shown in Figure 39.

Figure 39: Direct off-site employment from LHR (2010)

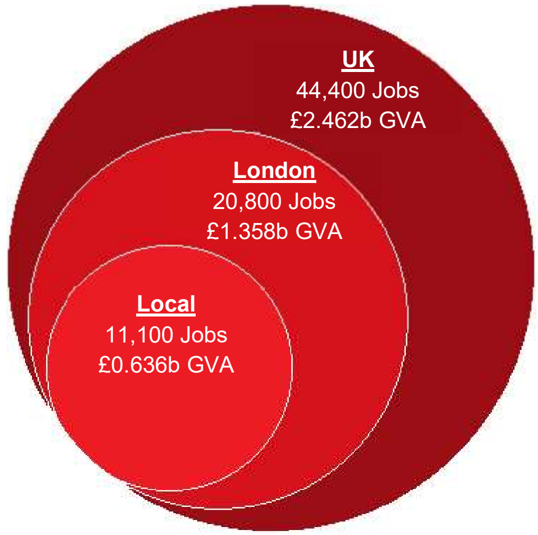


Source: Heathrow Related Employment, Optimal Economics, 2011

In contrast to on-site employment, direct off-site employment is dominated by freight services (which contributes 57% of the jobs). This is because freight companies tend to be based outside the perimeter of the airport but close enough to make the transport of goods to and from the airport convenient. The total contribution to GVA of Heathrow's off-site businesses is estimated as £0.3 billion.

Indirect employment at Heathrow (i.e. employment resulting from the purchases of goods and services by the companies that provide direct employment) was estimated using a survey of companies in early 2011 and applied to the local, regional and national economy. The results can be seen in Figure 40.

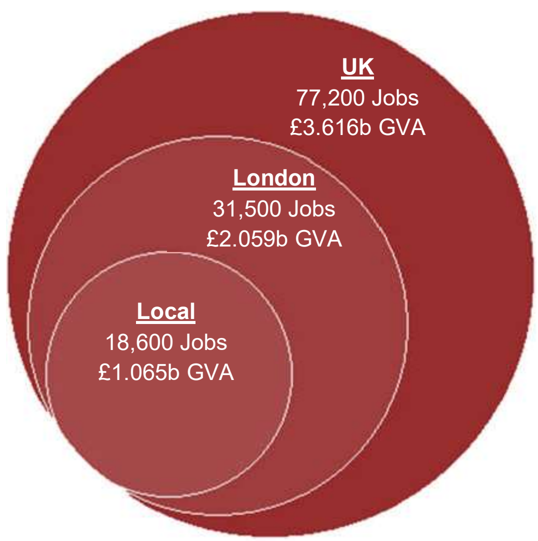
Figure 40: Indirect employment as a result of Heathrow (2010)



Source: Heathrow Related Employment, Optimal Economics, 2011

The study estimates the induced employment supported by the local expenditure of those whose jobs depend both directly and indirectly on the operation of Heathrow by adopting a multiplier and applying this to the figures obtained from direct and indirect analysis. The (assumed) multipliers depend on the size and structure of the economy being considered and multipliers of 1.2, 1.3 and 1.6 were chosen for induced employment on the local, regional and national economies respectively. The resulting employment estimates can be seen in Figure 41.

Figure 41: Induced employment as a result of Heathrow (2010)



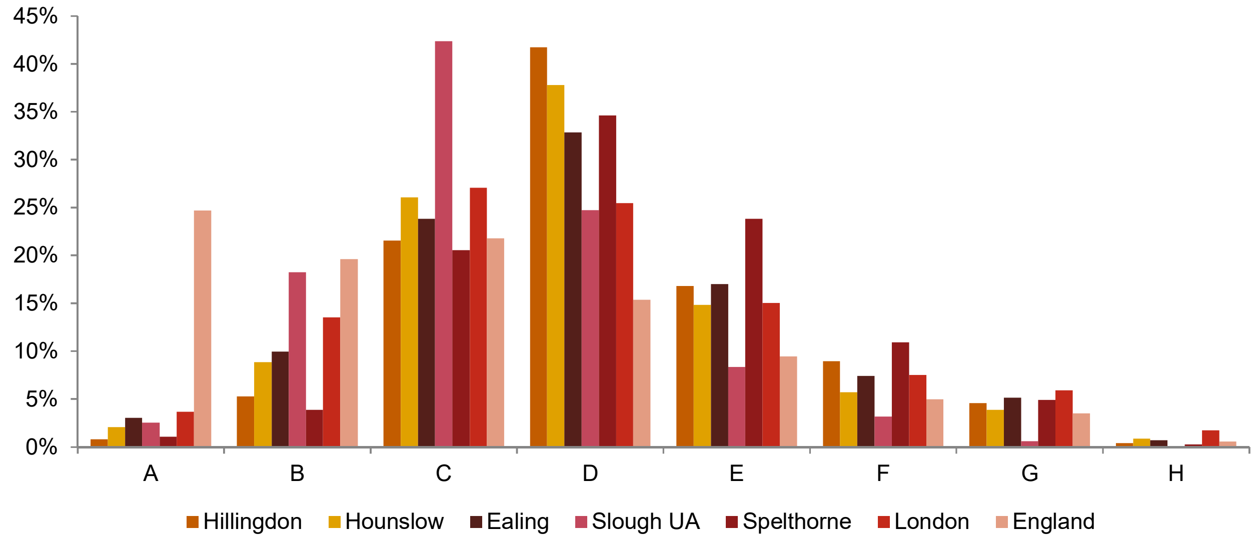
Source: Heathrow Related Employment, Optimal Economics, 2011

A.6. *Housing*

Analysis of ONS data was undertaken for the London Borough of Hillingdon, in which Heathrow is located. There are 105,089 dwellings in the Borough, the majority of which are in private ownership (82.5%), similar to the English average (82.1%).

Figure 42 shows the percentage of dwellings in the five local authorities closest to Heathrow Airport (Hillingdon, Hounslow, Ealing, Spelthorne & Slough), London and England within each Council Tax band[31]:

Figure 42: % of dwellings by Council Tax band (2011)



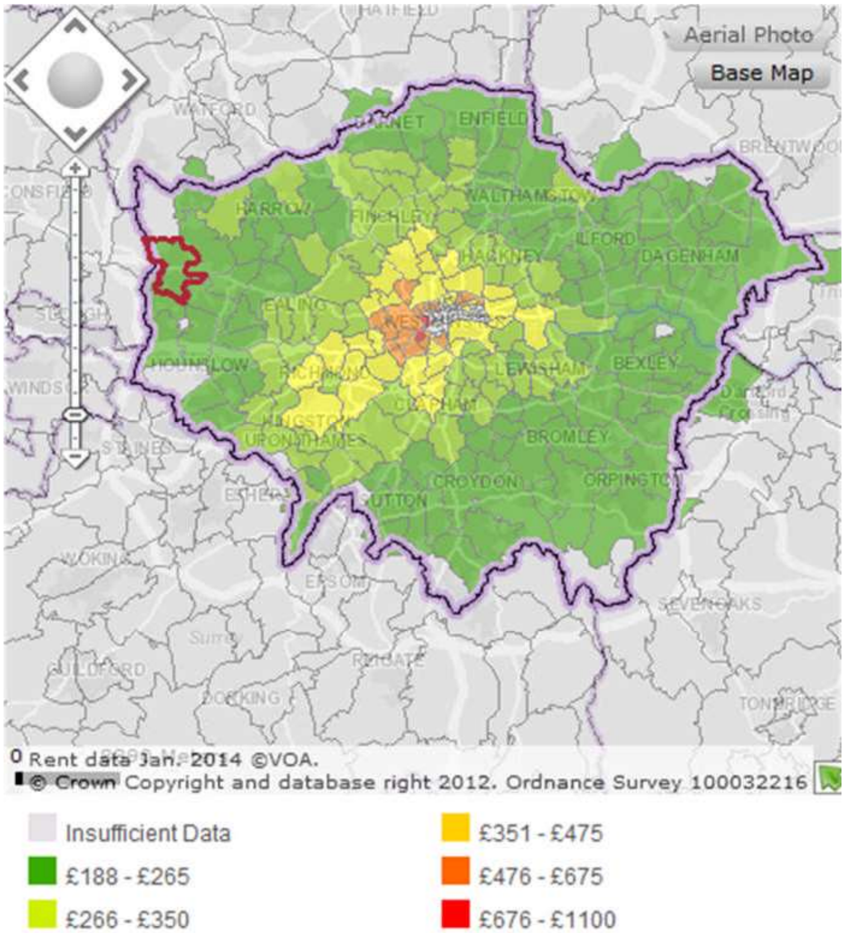
Source: ONS[32]

Rental values in the Borough are 28% lower than the Greater London median (based on a sample of 321 two bed properties in the Borough and 16,402 in the region). These data were derived from the London Rents Map, which shows average private sector rents for different types of homes, and is based on a sample of Valuation Office Agency data covering the last 12 months. Figure 43 highlights the inverse relationship between rental values and distance from central London. Hillingdon Borough is delineated in red.

[31] Council Tax Bandings (based on 1991 valuations): Band A - up to £40,000; B - £40,001 to £52,000; C - £52,001 to £68,000; D - £68,001 to £88,000; E - £88,001 to £120,000; F - £120,001 to £160,000; G - £160,001 to £320,000; and H - £320,001 and above.

[32] http://www.neighbourhood.statistics.gov.uk/dissemination/LeadKeyFigures.do?a=7&b=6275131&c=hillingdon&d=13&e=7&g=6329305&i=1001x1003x1004&m=0&r=1&s=1399399207893&enc=1

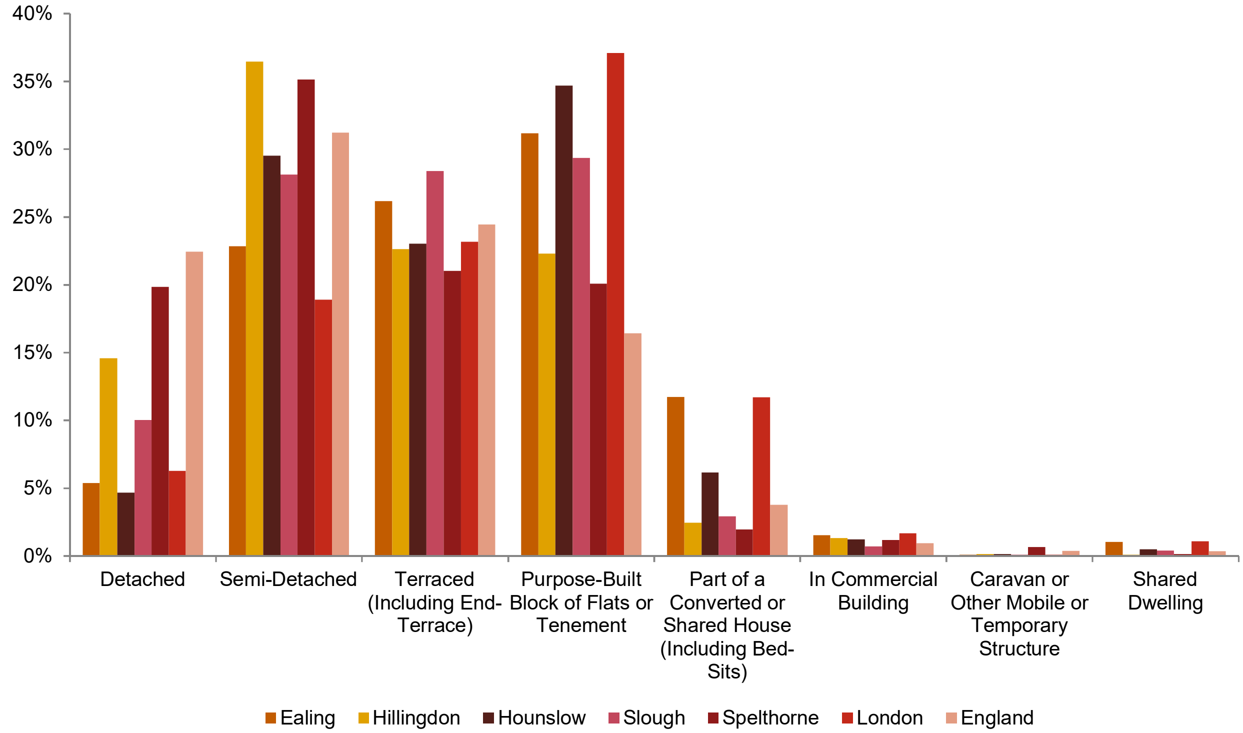
Figure 43: Greater London rental map for 2 bed properties (2014)



Source: http://www.london.gov.uk/rents/

The dominant types of housing clustered around Heathrow are semi-detached (36%) and terraced (23%) houses. At 22%, the proportion of apartments in Hillingdon is much lower than London as a whole (37%).

Figure 44: Housing - %of unshared dwellings (2011)



Source: ONS, 2011[33]

33 http://www.neighbourhood.statistics.gov.uk/dissemination/LeadTableView.do?a=7&b=6275131&c=hillingdon&d=13&e=7&g=6329305&i=1001x1003x1004&m=0&r=1&s=1399444048370&enc=1&dsFamilyId=2570

Appendix B. - *London Gatwick*

B.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to London Gatwick. We provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing.

B.2. *Background*

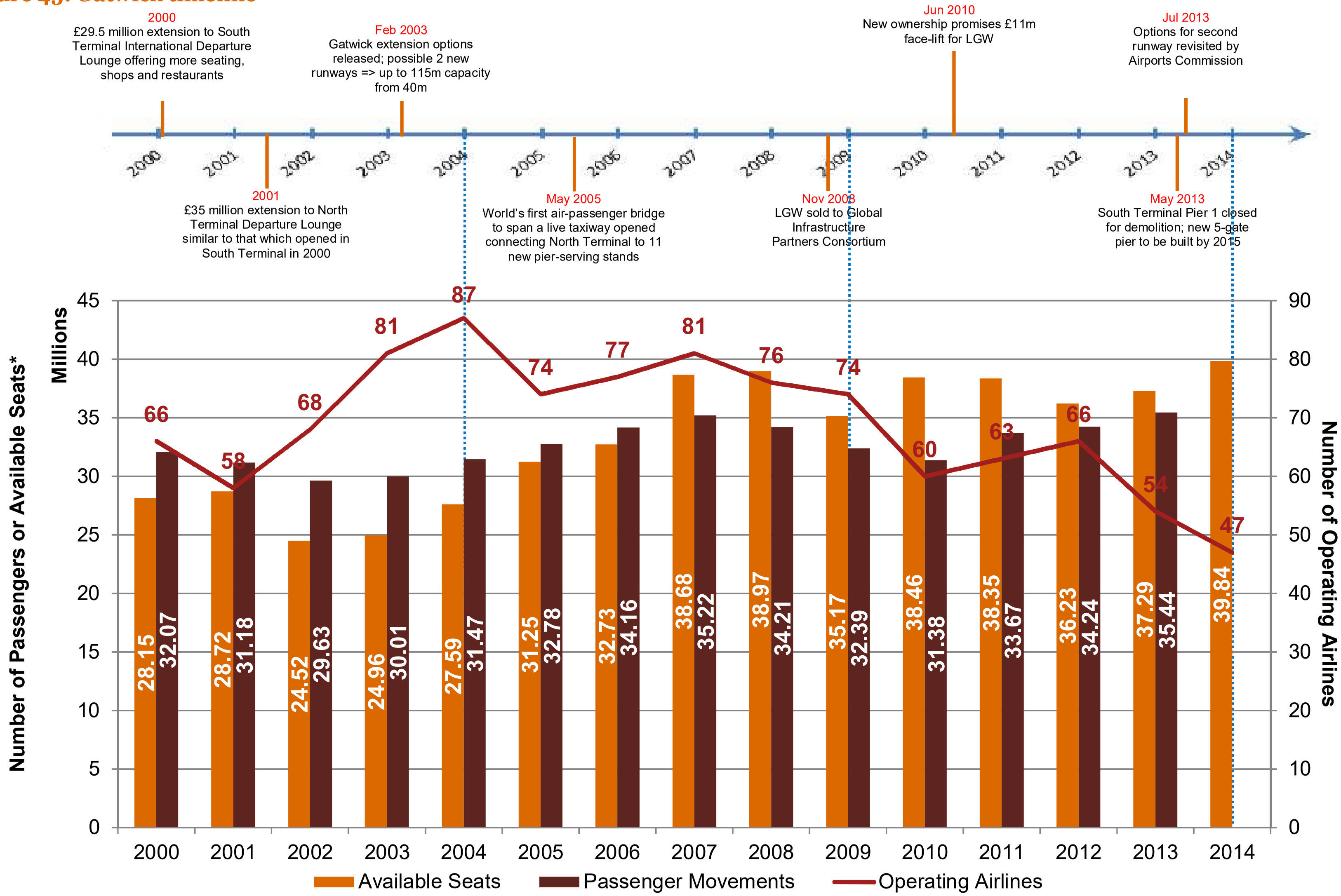
The number of available seats at Gatwick Airport has fluctuated despite the lack of any significant infrastructure developments over the last fifteen years, as shown by the red bars in Figure 45; only in recent years has Gatwick begun to experience capacity constraints. The largest effects have been the result of industry wide changes (i.e. the global financial crisis of 2008 along with the Open Skies agreement between the UK and the USA in the same year halted Gatwick's earlier growth, although there has been a marked shift to low cost carriers). Before the Open Skies Agreement airlines were restricted in where they could operate their transatlantic flights, but the agreement removed these restrictions, allowing more carriers to operate from Heathrow. As a result, a lot of airlines opted to leave Gatwick (also evident in 'Operating Airlines' line graph in Figure 40) and hence reduce the number of seats available on flights to/from LGW.

Major events at LGW are highlighted in the timeline below; investments in recent years have focused on improving facilities rather than building to accommodate additional capacity. Gatwick is currently the world's largest single-runway airport in terms of passenger numbers. The scope for expanding capacity depends on the development of a new runway; increasing the terminal capacity cannot be justified if the runway capacity (number of flights) cannot be increased to utilise it.

Passenger movements at Gatwick have fluctuated almost periodically over time (pink bars in Figure 40) and reached an all-time high in 2013 with 35.4 million passengers served. It is likely that available seats data provided in Figure 45 may be less than passengers served because the data source does not include charter flights which were common at Gatwick in the early 2000s, before low-cost carriers (LCCs) began to dominate the aviation industry.

Despite handling considerably fewer passengers than Heathrow (circa 50%), Gatwick currently offers more routes than all other London airports (see Figure 46). Since 2007 Gatwick has served more destinations than Heathrow, although more recently LHR has closed the gap. This lead in destinations served is partly because of the Open Skies Agreement which led to Gatwick introducing more short-haul flights as longer haul flights moved to Heathrow.

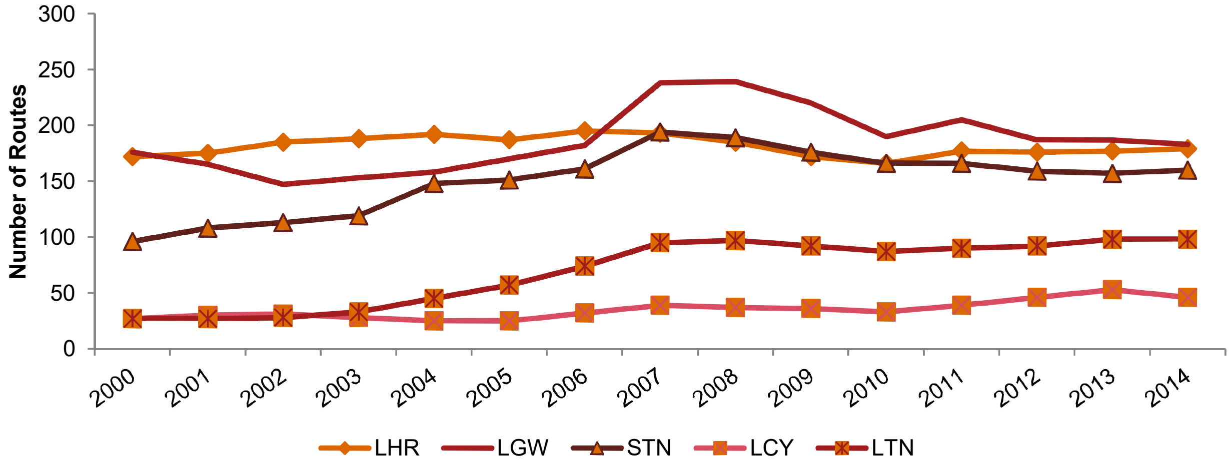
Figure 45: Gatwick timeline



Year	Available Seats (millions)	Passenger Movements (millions)	Operating Airlines
2000	28.15	32.07	66
2001	28.72	31.18	58
2002	24.52	29.63	68
2003	24.96	30.01	81
2004	27.59	31.47	87
2005	31.25	32.78	74
2006	32.73	34.16	77
2007	38.68	35.22	81
2008	38.97	34.21	76
2009	35.17	32.39	74
2010	38.46	31.38	60
2011	38.35	33.67	63
2012	36.23	34.24	66
2013	37.29	35.44	54
2014	39.84		47

NOTE: Available seats (using SABRE data) does not include charter flights, hence passenger numbers appear to be greater than the number of available seats pre-2007, before the rise of low-cost carriers,
*Available departing seats multiplied by 2
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

Figure 46: Number of routes available at London airports (2000-2014)



Source: SABRE Airport Data Intelligence

B.3. *Labour demand*

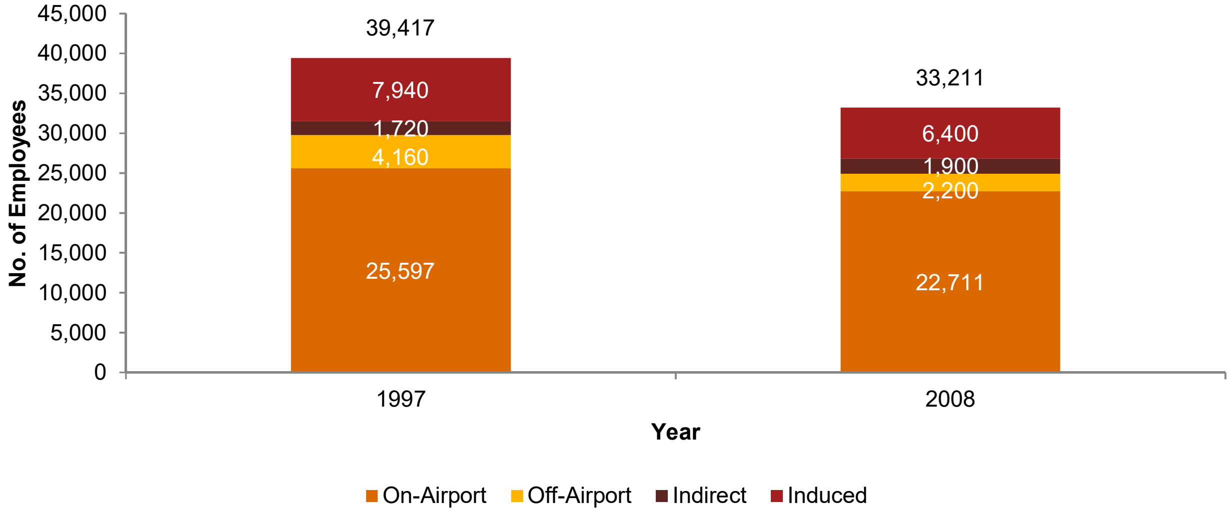
A study of employment linked to Gatwick airport by Berkeley Hanover Consulting Limited[34] (BHC) in 2011 estimated that over 33,000 jobs were supported by the airport's operations (based on 2009 statistics) (see Figure 47). These jobs constitute those directly dependent on Gatwick (both on- and off-site), indirect jobs that result from businesses that supply goods and services to the airport and induced employment that comes from spending by employees in both categories in the local area[35].

Between 1997 and 2008, the ratio of indirect to direct jobs at Gatwick airport fell from 54 off airport jobs for every 100 on-site jobs in 1997 to 46 off-airport jobs in 2008. The BHC explains this change in terms of the rapid development of LCCs at Gatwick which is seen as having adversely affected local hotels, cargo companies, caterers and car parking services. The report also argues that LCCs "tend to offer lower wages to their staff and negotiate tougher terms with support facilities than the national carriers" which may also have reduced the impact on value added.

[34] BHC (2011), Gatwick Airport Employment Generation to 2020 in the Context of the Local Labour Market

[35] Note that the BHC study only considers local effects whereas the Optimal Economics report referenced in the Heathrow case study also looks at the wider effect on London and the UK.

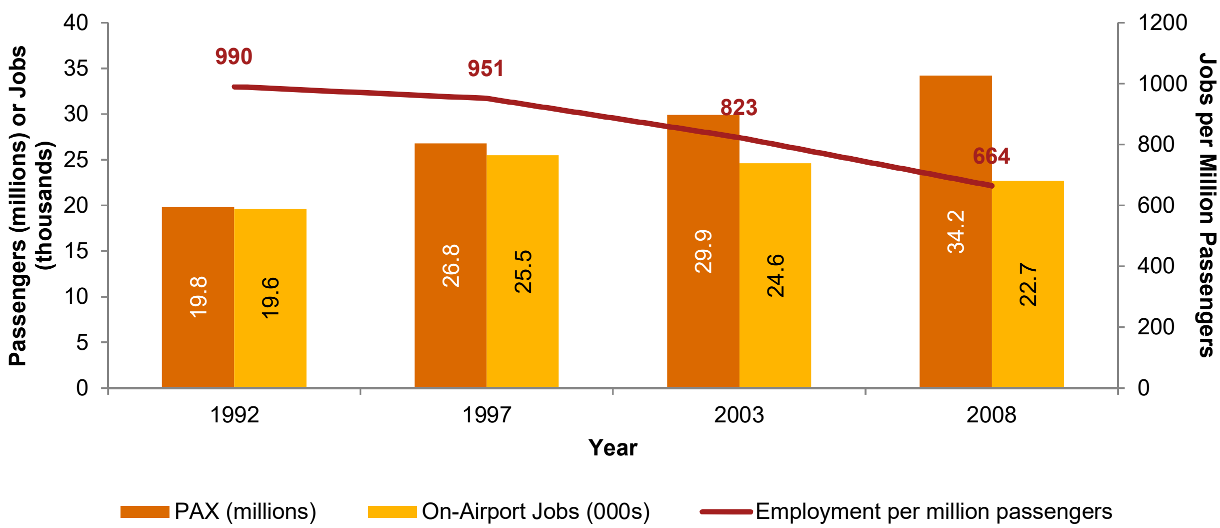
Figure 47: Estimated Gatwick related employment (1997 and 2008)



Source: BHC

Figure 48 shows the number of passengers served (in millions), the number of on-airport jobs (in thousands) and the ratio between the two for the years 1992, 1997, 2003 and 2008. This ratio, the number of employees per million passengers, can be compared with the average for European airports as a whole in 2003 of 950 on-site jobs per million passengers[36].

Figure 48: Employment at London Gatwick (1992-2008)



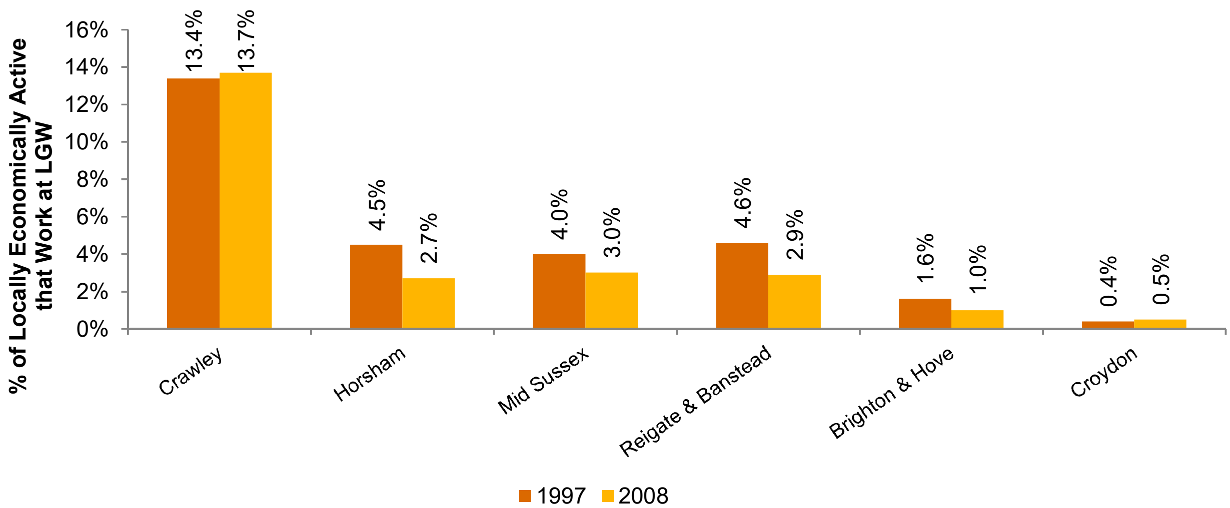
Source: BHC

[36] The Social and Economic Impact of Airports in Europe, York Aviation, 2004

B.4. *Labour supply*

One measure of how far the local economy depends on an airport is the analysis of the percentage of locally economically active persons that are employed there. Figure 49 highlights that the local borough of Crawley is highly dependent on Gatwick in terms of employment: 13.7% of working people in the area worked at the airport in 2008, a small increase from 13.4% in 1997. Crawley is the only local authority that has maintained its dependence on LGW over the 11-year period between surveys.

Figure 49: % of locally economically active persons that work at LGW by local authority (2009)



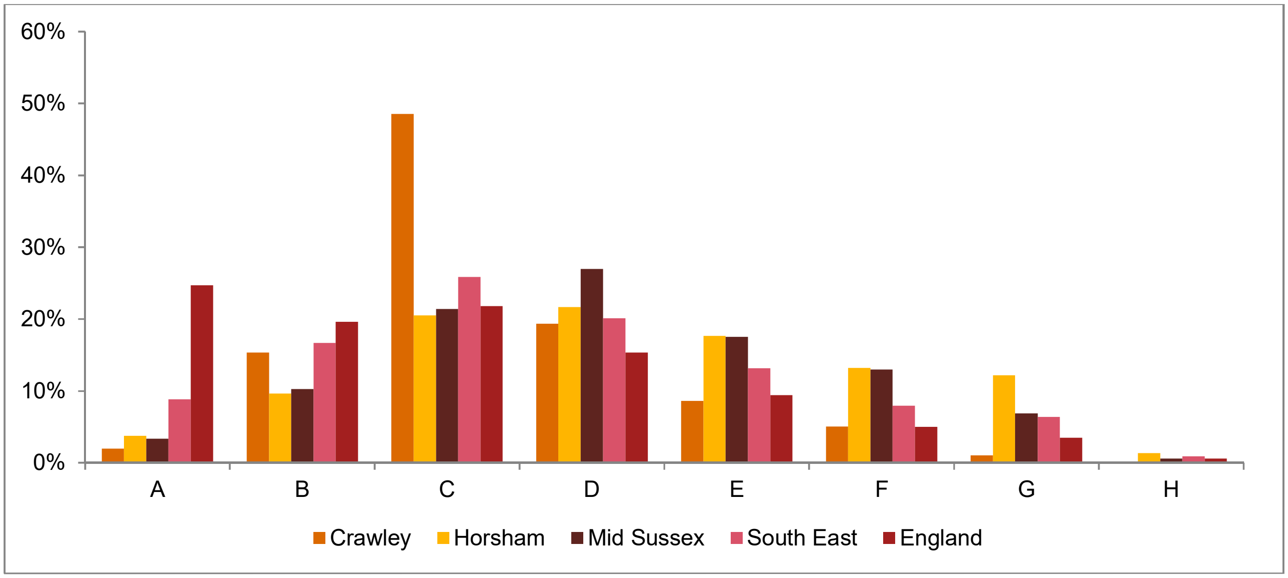
Source: BHC

B.5. *Housing*

Figure 50 highlights the proportion of dwellings in Crawley, Horsham and Mid Sussex, the South East and England that are within each Council Tax band[37].

[37] Council Tax Bandings (based on 1991 valuations): Band A - up to £40,000; B - £40,001 to £52,000; C - £52,001 to £68,000; D - £68,001 to £88,000; E - £88,001 to £120,000; F - £120,001 to £160,000; G - £160,001 to £320,000; and H - £320,001 and above.

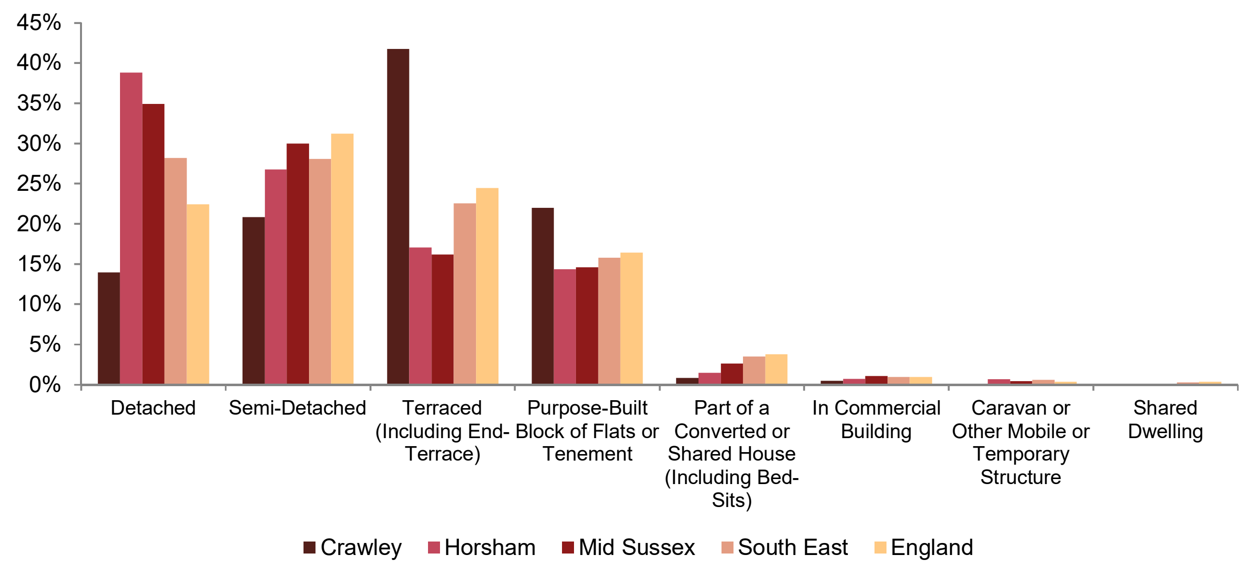
Figure 50: % of dwellings by Council Tax band (2011)



Source: ONS[38]

In terms of the housing supply around Gatwick, Figure 51 highlights that the dominant house type is terraced houses or bungalows (42% compared to the 23% in the South East and 26% in England). The proportion of purpose built apartments is also higher than average across England at 22%.

Figure 51: Housing - % of unshared dwellings (2011)



Source: ONS

[38] http://www.neighbourhood.statistics.gov.uk

Appendix C. - *Manchester*

C.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to Manchester airport. First, we provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local impact on business and services and employment.

C.2. *Background*

Manchester Airport is the third largest airport in the United Kingdom in terms of passenger numbers, serving over 20 million passengers in 201339.

The timeline in Figure 52 highlights the major infrastructure developments at Manchester Airport in the last 15 years, as well as trends in passenger movements, available seats, operating airlines and available routes. It suggests that passenger numbers and movements increased following the opening of Manchester Airport's second runway in March 2001. Subsequently, in line with the global trend, passenger numbers at Manchester Airport declined following the financial crisis in 2008; however, the data suggest signs of recovery. In 2013 Manchester served over 20 million passengers for the first time since 2008.

C.3. *Employment and value added*

York Aviation assessed the economic impact of Manchester Airport in 2008 focusing on two main metrics: the number of employees in terms of full-time equivalents (FTEs) and gross value added (GVA). Like other reports reviewed in these case studies, the impacts are split into direct on-airport, direct off-airport, indirect and induced. The estimates are shown in Table 18.

Table 18: Total employment and GVA as a result of Manchester Airport in 2007[40]

	Greater Manchester	Cheshire	Elsewhere in North West[41]	Total
Employment (FTEs)				
Direct on-airport	16,520	-	-	16,520
Direct off-airport	2,110	700	-	2,810
Indirect	10,150	2,310	460	12,920
Induced	7,100	1,620	320	9,040
Total employment	35,880	4,630	780	41,290
GVA (£ million)				
Direct on-airport	320	73	15	408
Direct off-airport	54	12	2	69
Indirect	243	55	11	310
Induced	170	39	8	217
Total GVA	788	179	36	1,004

Source: Economic Impact of MAG Airports: Update Report, York Aviation, 2008[42]

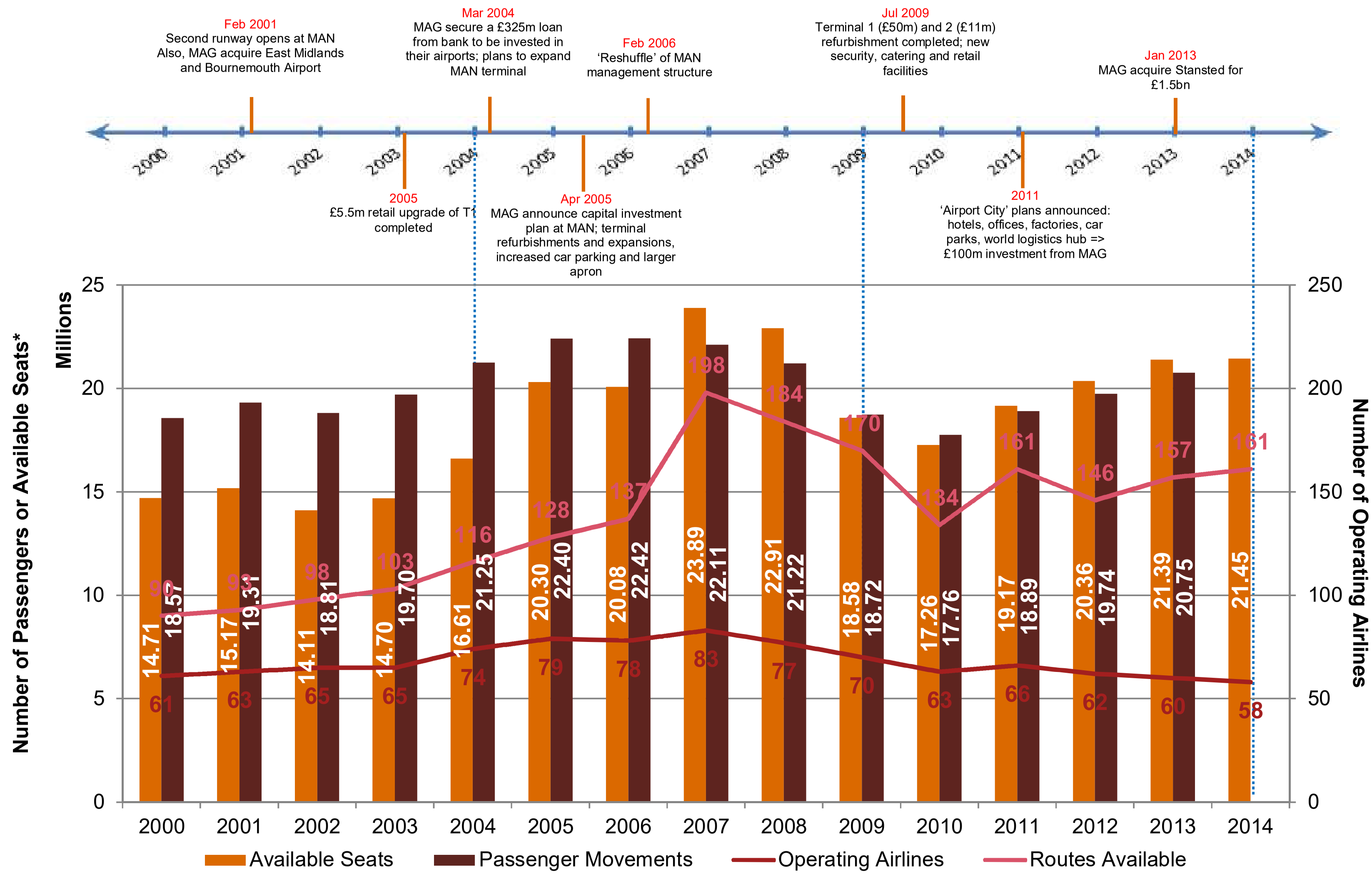
39 CAA Statistics http://www.caa.co.uk/docs/80/airport_data/2013Annual/Table_10_3_Terminal_Pax_2003_2013.pdf

40 Employment figures are rounded to the nearest 10 and GVA is rounded to the nearest £1 million

41 The York Aviation report estimates direct GVA elsewhere in the North West despite there being no direct employment.

42 York Aviation (2008), Economic Impact of MAG Airports: Update Report http://www.manchester.gov.uk/download/downloads/id/15427/economic_impact_of_the_mag_airports_update_report

Figure 52: Manchester Airport timeline



NOTE: Available seats (SABRE) does not count for charter flights, hence why pre-2007, before the rise of low-cost carriers, passenger numbers appear to be greater than the number of available seats

*Available departing seats multiplied by 2

Sources: Available seats, operating airlines and routes available obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

The focus is on the impacts in the surrounding area (i.e. Greater Manchester, Cheshire and the rest of the North West), rather than the national level. The estimates are based on the results of a survey at Manchester Airport in 2005/06 which have then been extrapolated to provide the results shown above by assuming that:

- Productivity growth on-site is 1.8% per annum (the historical growth rate between 1997 and 2005, and the lower band of growth found at large European airports43); and
- A growth rate of 2% per annum for the economy in the North West of England based on Cambridge Econometrics' regional forecasts from the time.

In 2007, services and employment at Manchester Airport were at their peak. The available seats and routes supported over 41,000 jobs and contributed over £1 billion in GVA to the regional economy in the North West (see Table 18). York Aviation also forecast Manchester Airport's future impact on the economy based on the 'high' and 'low' growth passenger forecasts taken from its Master Plan[44]. These forecasts were generated before the financial crisis and assume a consistent growth rate: in the 'high' growth case, 38 million passengers are estimated by 2015 compared with 17 million in 2013. The passenger forecasts were then used to project the economic impact of Manchester Airport in 2015 and subsequently 2030. The forecast employment (in FTEs) is shown in Figure 53 and the corresponding GVA in Figure 54.

[43] ACI Europe and York Aviation (2004), The Social and Economic Impact of Airports in Europe
https://www.ryanair.com/doc/news/2012/ACI-Report.pdf

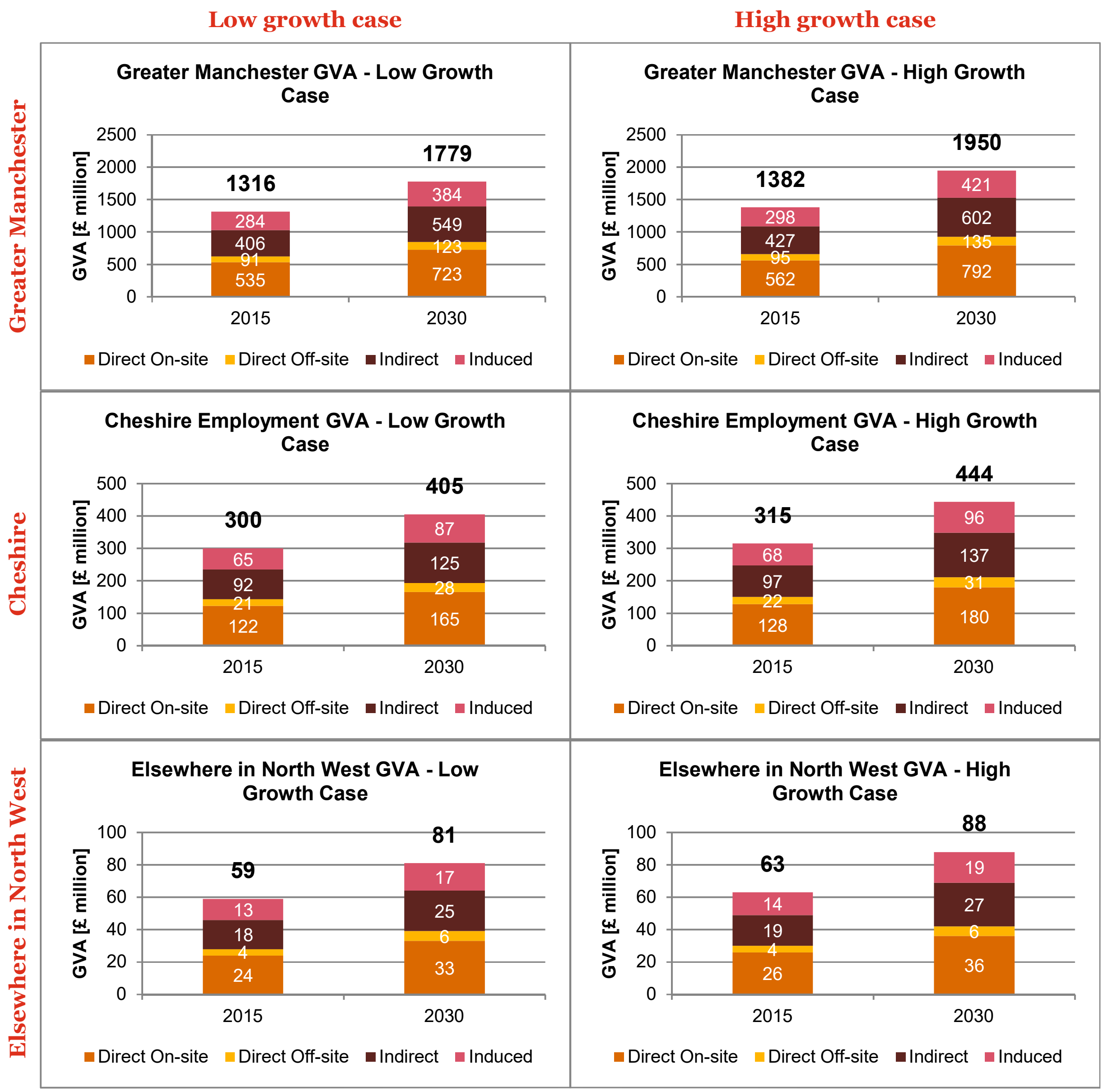
[44] Manchester Airport Master Plan
http://www.manchesterairport.co.uk/manweb.nsf/alldocs/10F56C819A51454E8025739300388C1D/$File/Masterplan.pdf

Figure 53: Employment forecasts for Manchester Airport (2015 and 2030)

Source: Economic Impact of MAG Airports: Update Report, York Aviation, 2008

The forecasts continue the trend seen in the 2007 estimates. The effect of the Airport diminishes with distance from the airport. The ratios between direct, indirect and induced employment are consistent across the different areas. Perhaps the most significant result is the difference between the low and high growth cases; high growth is predicted to contribute 4,350, 540 and 100 more jobs in Greater Manchester, Cheshire and the North West respectively by 2030 than the low growth case. Comparing the GVA forecasts individually in Figure 54 shows similar trends and ratios to those seen in Figure 53. Once again, the comparisons between the low and high growth scenarios show significant differences in the impact on GVA.

Figure 54: GVA forecasts for Manchester Airport (2015 and 2030)[45]



Source: Economic Impact of MAG Airports: Update Report, York Aviation, 2008

[45] Forecasts are based on low-growth (left hand plots) and high-growth (right hand plots) by direct, indirect and induced full-time equivalents in the Greater Manchester, Cheshire and North West regions

Appendix D. - *New York*

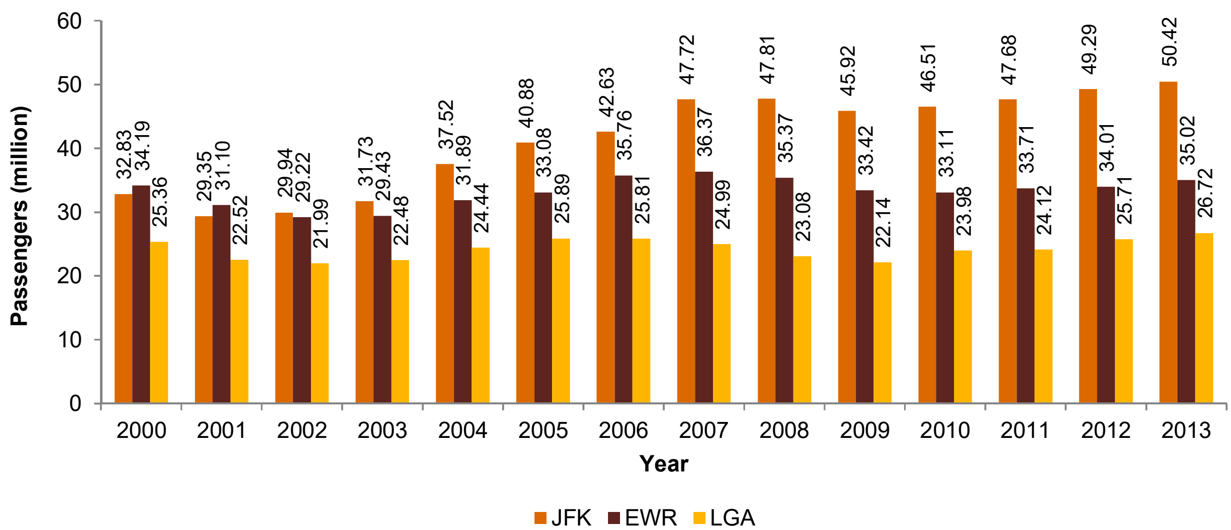
D.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to the New York airport system. We start by providing background information about the development of the airport system since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing.

D.2. *Background*

New York has one of the world's premier transport systems with two of the world's 50 busiest airports in terms of passenger traffic. Taken together, the three main commercial airports in the region served over 112 million passengers in 2013. Figure 50 shows the historical passenger numbers at John F. Kennedy Airport (JFK), Newark Liberty International Airport (EWR) and LaGuardia Airport (LGA). JFK has grown to dominate in terms of passengers served, despite EWR having served more annual passengers prior to 2002.

Figure 55: Passenger traffic at major airports in New York (2000-2013)



Source: Port Authority of New York and New Jersey[46]

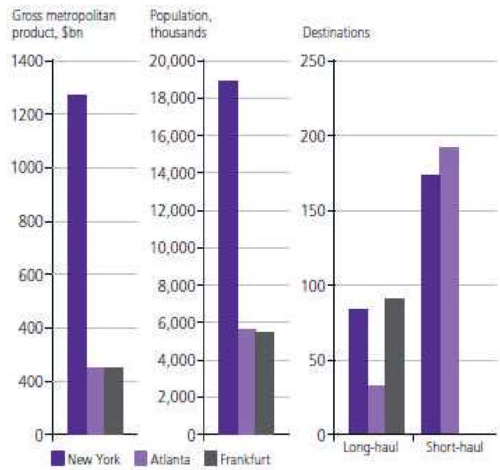
LaGuardia Airport mainly serves domestic flights, allowing JFK and Newark to operate international and long-haul routes. This approach was devised to allow New York to become a connection point across the Atlantic.

A lot of discussion relating to airport development in London uses New York as an example of how a major city can have more than one large airport; however, the main difference between London and New York is that New York has three national network airlines – Delta and American Airlines are based in JFK and United Airlines operates from Newark – whereas London only has one, British Airways. For this reason, aviation in New York is able to function under a two-hub system and why it may be more difficult for London to do the same. A report by Heathrow Airport Limited in 2012, 'One hub or none: The case for a single UK hub airport', suggests that New York's two large hub airports result in poorer connectivity than one would expect (see Box). Despite New

[46] www.panynj.gov

York being four times the size of Atlanta and Frankfurt, it has direct access to fewer short haul flights than Atlanta and fewer long haul flights than Frankfurt.[47]

Box 7: Comparison of connections at New York, Atlanta and Frankfurt



Source: One hub or none: The case for a single UK hub airport, Heathrow Airport Limited, 2012

Many of the airports controlled by the Port Authority of New York and New Jersey (PANYNJ) make the management and maintenance of their terminals the responsibility of the main airlines which operate from them. For example, Terminal 2 at JFK is exclusively used and operated by Delta Airlines which also operates from Terminal 4. Delta has a $1.4 billion development plan for Terminal 4, despite the fact that it also used by other international airlines including Singapore Airlines, Emirates, Etihad and KLM. Terminals 5, 7 and 8 at JFK are operated by JetBlue, British Airways and American Airlines respectively. Similarly, at Newark, Terminals A and C are operated by United Airlines and at LaGuardia Terminals C, D and most of A are under the control of Delta Airlines. This type of airport operating model results in ongoing infrastructure developments at these airports, and JFK in particular. Having separate terminals maintained and managed by different airlines encourages airlines to compete with each other to provide the best passenger experience. As a result, construction is continuous at the PANYNJ airports, as can be seen from the timeline for the three airports (see Figure 57). In the figure, available seats on flights and the number of operating airlines have been plotted in sequence with the timeline to see how these indicators were affected by infrastructure developments; note how at the turn of the century JFK utilised 10 terminals and now only operates 6, despite an increase in the scale of operations. This is a result of large expansions and developments of the terminals over the years and the desire to expand even further by demolishing old terminals to make way for newer, modern facilities.

All three New York airports suffered a substantial impact to their operations following the 9/11 attacks in 2001, with significant decrease in available seats and operating airlines. Whilst Newark and LaGuardia have yet to return to the same level of operations that they experienced prior to the attacks (although they have surpassed the annual passenger figures), JFK has gained. It is now the busiest airport in PANYNJ's portfolio. One between JFK and the other two airports is the volume of developments that has taken place; since 2003, a new phase in development or part of an expansion has opened at JFK almost every year. This emphasises the airports plan for growth and ultimately allows room for that growth to occur. Another difference is that JFK serves three times as many airlines as LaGuardia and twice as many as Newark.

D.3. *Economic impact*

These large scale operations of the three airports have a major contribution to the local economy of the New York and New Jersey area. This is summarised in Table 19.

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[47] Heathrow Airport Limited (2012), One hub or none: The case for a single UK hub airport http://mediacentre.heathrowairport.com/ImageLibrary/downloadmedia.ashx?MediaDetailsID=1105&SizeId=-1

A study of the economic effects of aviation in New York was carried out by PANYNJ in 2005. Its findings are summarised in terms of the jobs, wages and sales that were supported by operations at the airports, investments in the airports and tourism that resulted from people visiting the area via the airports. Whilst jobs are equivalent to employment as an impact metric (and thus similar to the other case studies), wages represent only a component of GVA and sales do not take into account the cost of sales (and thus will overstate the value added by the airports).

Table 19 incorporates all three of the PANYNJ case study airports together. Operations and tourism have the biggest economic impact on the region, but investments are the focus of the study. Table 20 shows the breakdown of the investment figures by airport both directly and as a whole. These demonstrate that together the three airports contribute nearly half a million jobs to the local economic area; this is substantially larger than comparative studies for other airports. This primarily occurs because the study covers an entire airport system, rather than an individual airport, and therefore captures the impact of a larger number of passengers (94 mppa) and cargo. In addition, the study area considered is very large, with a resident population of 19.7 million people. As discussed in Chapter 3, this will limit the amount of leakage from the local economy studied, and therefore increase the magnitude of the indirect and induced multipliers.

Table 19: Economic impact of aviation in New York City in terms of operations, investments and tourism from JFK, EWR and LGA (2004)

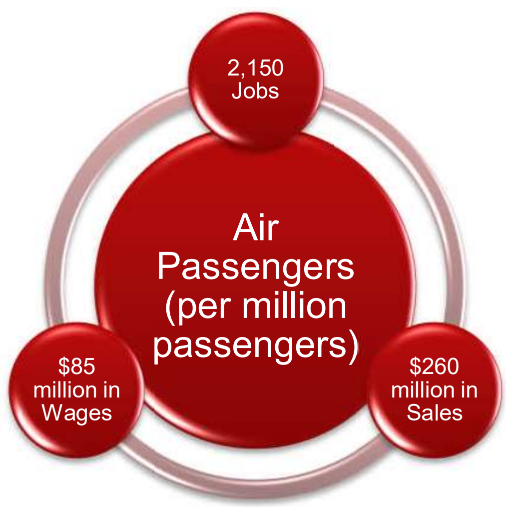
Impact	Operations	Investments	Tourism	Total
Jobs	278,890	14,500	192,280	485,670
Wages ($ billion)	13.1	0.724	6.6	20.5
Sales ($ billion)	37.1	2.4	17.6	57

Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005[48]

PANYNJ has analysed the economic impacts of the airports relative to the number of air passengers (per million) as shown in .

Figure 56.

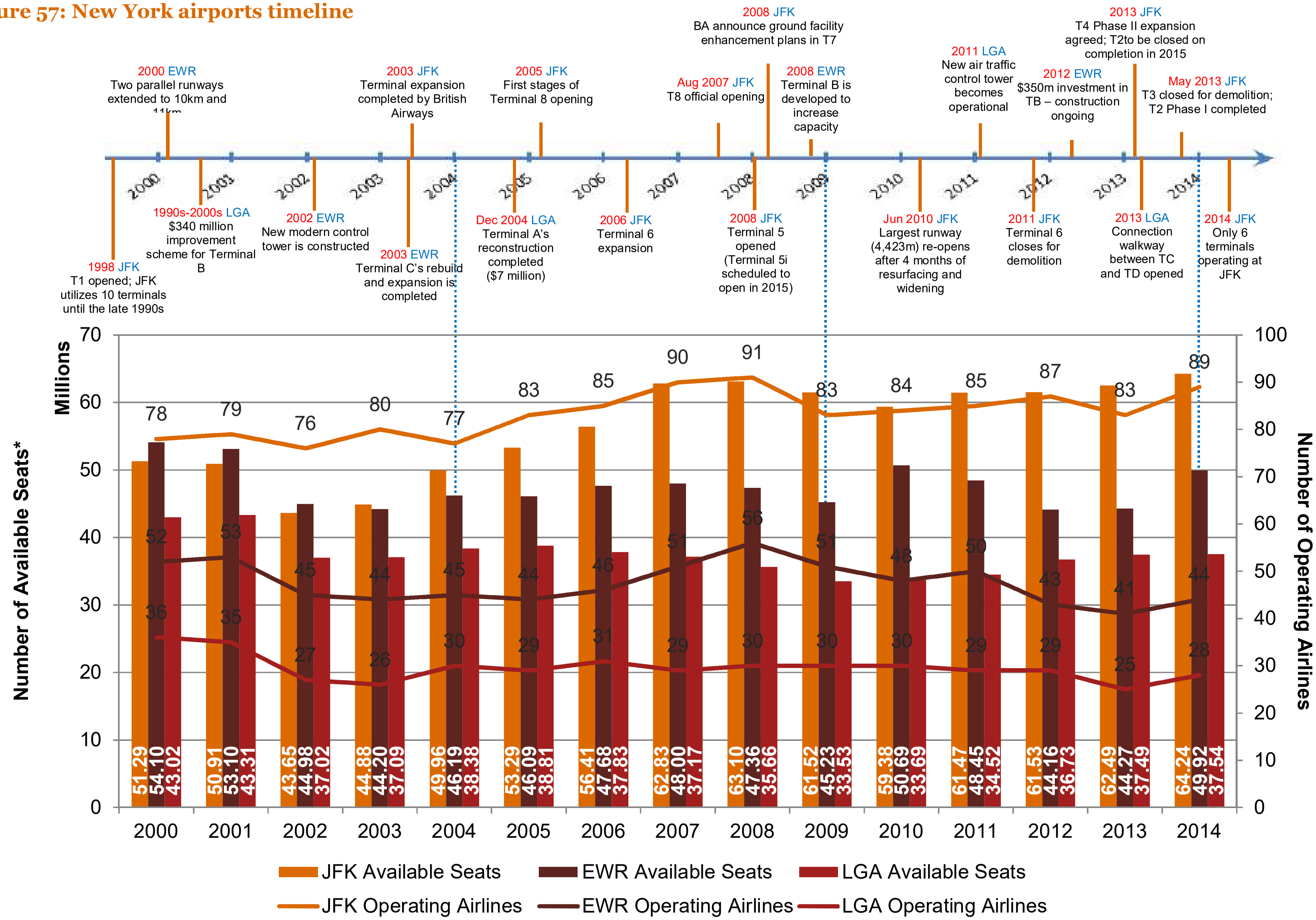
Figure 56: Economic impact per million passengers (connecting and non-connecting) (2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

[48]PANYNJ (2005), The Economic Impact of the Aviation Industry in the New York – New Jersey Metropolitan Region http://www.panynj.gov/about/pdf/reg-in-aviation-economic-impact.pdf

Figure 57: New York airports timeline



*Available departing seats multiplied by 2
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence

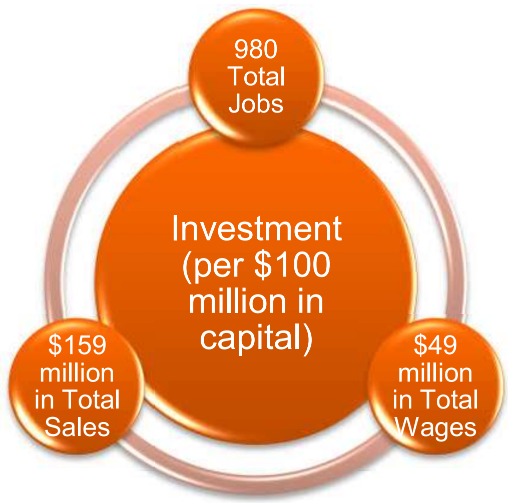
Table 20: Direct and total economic impact of all investments in airport infrastructure regionally in New York (2000-2004)

	EWR	JFK	LGA	Total
Direct impact				
Jobs	1,920	3,650	260	5,830
Wages ($ million)	108	213	14	335
Sales ($ million)	499	914	69	1,482
		Total impact		
Jobs	4,850	8,970	680	14,500
Wages ($ million)	240	451	33	724
Sales ($ million)	803	1,435	114	2,352

Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

As a result of ongoing infrastructure investment, JFK had a much larger economic effect than EWR and LGA; EWR contributed over 50% of the jobs, wages and sales that JFK supported between 2000 and 2004, and LGA contributed circa 7%. The study expressed the impact of each $100 million of capital investment (see Figure 58).

Figure 58: Economic impact per $100 million in capital spending (2000-2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

If this ratio has been maintained, this would imply that the $1.4 billion expansion programme for Terminal 4 at JFK (the first phase of which was completed in May 2013) will support 13,720 jobs, $0.7 billion in wages and over $2.2 billion in sales. It is evident that large infrastructure projects such as these have the potential for a significant impact on the local economy. This is before the developments are completed and the impacts of their operations are included. As Table 19 illustrates, these were many times larger between 2000 and 2004.

Table 21 provides a breakdown of the direct economic impact of EWR, JFK and LGA across different business sectors in 2004. It splits them into on-airport and off-airport impacts. On-airport operations have a larger impact. JFK contributes half of the combined impacts of the three airports (i.e. JFK alone supports roughly the same number of jobs and the same wages and sales as EWR and LGA combined).

Table 21: Direct impact of the aviation industry by airport by employment category (2004)

Impact	EWR			JFK			LGA		
	Jobs	Wages ($m)	Sales ($m)	Jobs	Wages ($m)	Sales ($m)	Jobs	Wages ($m)	Sales ($m)
On-airport									
Airlines	15,960	926	3,942	19,140	1,080	4,515	7,410	403	1,644
Tenants & Government	13,850	638	2,080	19,970	924	2,858	5,510	269	863
Sub-total	29,810	$1,564	$6,022	39,110	$2,004	$7,373	12,920	$672	$2,507
Off-airport									
Landside Access	3,710	156	461	4,280	176	513	3,230	131	403
Air Ticket Agencies	3,440	155	260	4,050	183	306	2,640	119	199
Truck Transportation	1,580	68	200	2,710	116	342	50	2	6
Banking & Insurance	580	44	196	740	56	252	360	27	121
Brokerage & Distribution	7,020	430	923	15,580	961	2,091	130	8	15
Airline Marketing & Government	2,000	126	356	2,930	169	416	1,010	64	188
Sub-total	18,330	$979	$2,396	30,290	$1,661	$3,920	7,420	$351	$932
Total	48,140	$2,543	$8,418	69,400	$3,665	$11,293	20,340	$1,023	$3,439
% of Industry	35%	35%	36%	50%	51%	49%	15%	14%	15%

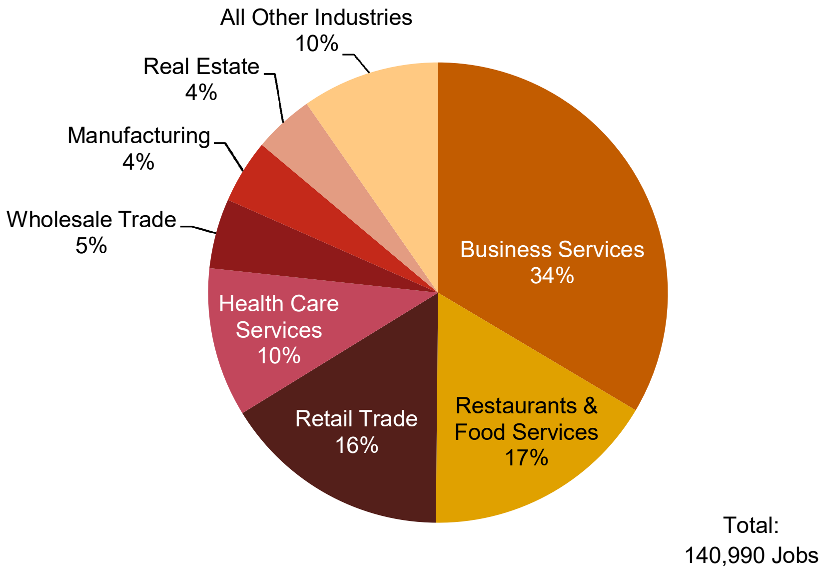
Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

Table 22: Total impact of the aviation industry by employment category (2004)

Impact	Jobs		Wages		Sales	
	Number	%	($m)	%	($m)	%
On-airport						
Airlines	96,360	57%	4,628	59%	14,108	61%
Tenants & Government	72,850	43%	3,174	41%	9,057	39%
Sub-total	169,210		$7,792		$23,165	
Off-airport						
Landside Access	21,930	20%	940	18%	2,640	19%
Air Ticket Agencies	18,280	17%	821	15%	1,721	12%
Truck Transportation	8,860	8%	392	7%	1,114	8%
Banking & Insurance	5,200	5%	302	6%	1,007	7%
Brokerage & Distribution	42,330	39%	2,196	41%	5,661	41%
Airline Marketing & Government	13,080	12%	671	13%	1,788	13%
Sub-total	109,680		$5,322		$13,931	
Total	278,890		$13,114		$37,096	

Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

Figure 59: Indirect jobs resulting from the aviation industry in New York by sector (2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

Figure 59 shows the types of jobs are generated (i.e. the main industries that benefit from aviation in New York) are business services, restaurant & food services and retail trade.

D.4. *Tourism*

Table 23 shows more recent estimates of the direct and indirect economic impacts of JFK and LaGuardia airports. Both sets of estimates are significantly larger than those provided earlier by PANYNJ – in part this is because the PANYNJ estimates do not take into account all off-site employment, for example freight.

Table 23: Economic impact of JFK and LaGuardia airports (2009)

JFK International	Direct	Indirect	Total
Employment	132,610	92,011	224,621
Income ($m)	$6,127	$4,756	$10,883
Output ($m)	$19,344	$10,970	$30,314
State and Local Taxes ($m)			$2,852

LaGuardia	Direct	Indirect	Total
Employment	55,142	39,225	94,367
Income ($m)	$2,200	$2,078	$4,278
Output ($m)	$7,120	$4,625	$11,745
State and Local Taxes ($m)			$1,105

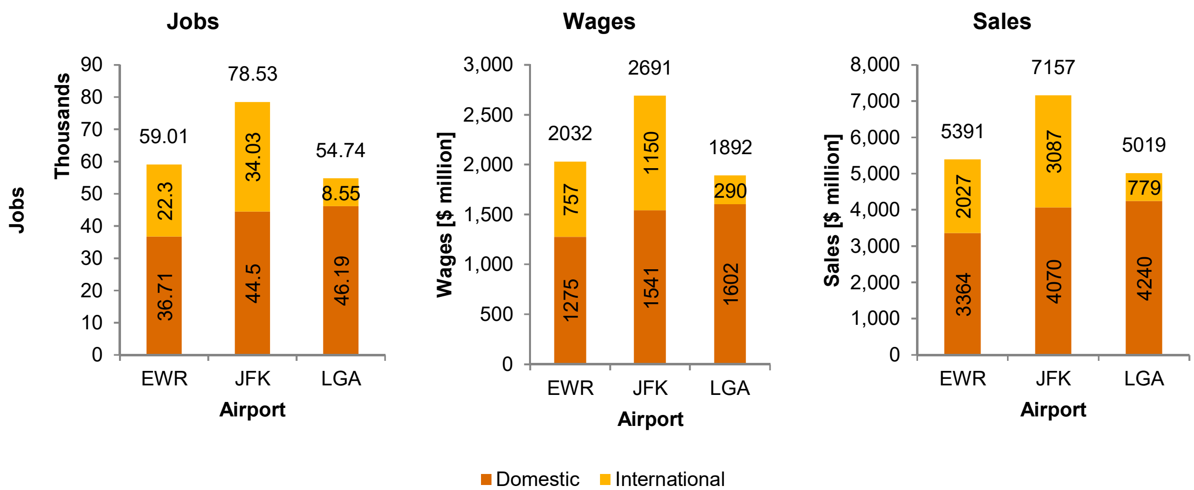
Source: New York State Economic Impacts of Aviation, New York State Department of Transportation, 2010[49]

[49] New York State Department of Transportation (2010), New York State Economic Impacts of Aviation
https://www.dot.ny.gov/divisions/operating/opdm/aviation/repository/NYS%20Economic%20Study%202010%20Technical%20Report_0.pdf
NOTE: EWR data were unavailable as EWR is in New Jersey

Another key economic impact of the airport system in the New York area is on tourism. Some indication of the economic impacts of tourists visiting New York can be seen in Figure 60. The main points to note are that:

- Domestic visitors add more to the local economy than international visitors at all airports;
- LaGuardia contributes more from domestic passengers than JFK and EWR, despite only providing 15% of the operational impacts (see Table 14); and
- JFK is significantly ahead when it comes to international tourism.

Figure 60: Economic impact of visitors to New York by airport by origin (2004)



Source: The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region, PANYNJ, 2005

It is clear that tourism from these airports has an important economic impact, creating over 190,000 jobs between 2000 and 2004 – 13 times that generated from airport investments in the same period – and $6.6 billion and $17.6 billion in wages and sales respectively across the same period.

D.5. *Economic impact of aviation in the USA*

Table 24 shows the economic impact of aviation as a whole in the USA in 2009. Comparing the economic impact of JFK and LGA to the USA as a whole suggests that these two airports contributed 3.3%, 4.1% and 3.4% in total USA jobs, wages and sales from the aviation industry.

Table 24: Estimated output, earnings and jobs attributable to the aviation industry in the USA (2009)

Description	Output ($bn)	Earnings ($bn)	Jobs ('000)
Airline operations	296.6	91.9	2,007
Airport operations	78.9	27.5	614
Civilian aircraft manufacturing	84.3	21.5	418
Civilian aircraft engine and engine parts manufacturing	20.9	5.6	112
Civilian other aircraft parts and equipment	72.2	21.5	454
Air couriers	72	21.5	637
Visitor expenditures	597	178.8	5,329
Travel arrangements	12.8	4	118
Sub-total – Commercial	1,234.8	372.2	9,690
General aviation operations	38.8	12	262
General aviation aircraft manufacturing	25.8	6.6	128

Description	Output ($bn)	Earnings ($bn)	Jobs ('000)
General aviation visitor expenditures	11.9	3.6	106
Sub-total – General Aviation	*76.5*	*22.1*	*496*
Total impact	1,311.2	394.4	10,186

Source: The Economic Impact of Civil Aviation on the U.S. Economy, U.S. Department of Transportation, Federal Aviation Administration, 2011[50]

[50] U.S. Department of Transportation, Federal Aviation Administration (2011), The Economic Impact of Civil Aviation on the U.S. Economy
http://www.faa.gov/air_traffic/publications/media/faa_economic_impact_rpt_2011.pdf

Appendix E. - ***Frankfurt am Main***

E.1. ***Introduction***

In this Appendix we summarise the evidence we have collected in relation to Frankfurt am Main airport. We provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing. Finally, we review the available evidence on the impact of the development of the airports intermodal connections on its role and impact.

E.2. ***Background***

Aviation is an important industry in Germany, with 66,000 people employed at airports (0.16% of the total workforce in Germany)[51]. Fraport operates and manages a number of airports globally, including Frankfurt am Main. Frankfurt am Main Airport is the largest airport in Germany in terms of passenger numbers, third in Europe after London Heathrow and Charles De Gaulle and ninth in the world. This case study focuses on its economic impact on the local region of Hessen (see Figure 61).

Figure 61: Location of Frankfurt am Main Airport

Source: http://en.wikipedia.org/wiki/File:Flugh%C3%A4fen_in_Deutschland.png

Frankfurt Airport has shown significant growth over recent years, with passenger numbers increasing by almost 9 million since 2000 (see Figure 63). Annual passenger numbers fluctuated slightly until the economic crisis of 2008; however, since the beginning of construction of the new runway in 2009, through its completion in 2011, to the most recent statistics of 2013, the number of passenger has grown significantly as have load factors. This is despite the decline in the number of airlines operating from Frankfurt; the airlines that have maintained a presence have focused on their most profitable routes and the airport has benefitted from this as a whole.

[51] Friedrich Ebert Stiftung (2003), Wachstum trotz Strukturwandel und Luftverkehrsteuer
http://library.fes.de/pdf-files/wiso/10252.pdf

The construction of the Airbus maintenance stand between 2005 and 2007 has allowed the airport to accommodate A380 aircraft, permitting wide-body aircraft and serving more passengers with fewer take-offs and landings, but the major development that has spurred this growth is the construction of the international train station. Although the Airport station was completed pre-2000, improvements in the technology of the trains has allowed for a faster and more efficient schedule of trains to and from the Airport. The long-distance station now operates, on average, 170 Inter City Express daily trains which travel across Germany and the short-distance station offers 400 S-Bahn trains and buses on a daily basis which serve the Rein-Main region – a journey to Frankfurt city takes only 15 minutes by these trains. These developments have allowed Frankfurt Airport to expand its catchment area for German passengers whilst maintaining its status as a connection point between Europe, the Middle East and the Americas.

E.3. *Economic impacts*

A study was carried out by INFRAS and BAKBASEL (both economic research and consultancy firms) for Fraport, the airport owner, in 2013 to investigate the economic impact of Frankfurt Airport on the surrounding region; this was then updated in February 2014. In this study, the effects of airport operations were measured by considering the number of jobs generated and the value added, both directly and indirectly and using broadly the same definitions of 'direct', 'indirect' and 'induced' as in the other case studies. The induced effect was also calculated using multipliers. The measures were produced every four years starting in 2000 and ending in 2012. Hence, they provide some indication of how the Airport's impact has changed over time.

The total impact can be seen in Figure 62. It shows that Frankfurt Airport's economic impact has increased steadily over the period between 2008 and 2012. It also shows that the induced impact is significantly larger than the direct and indirect impact.

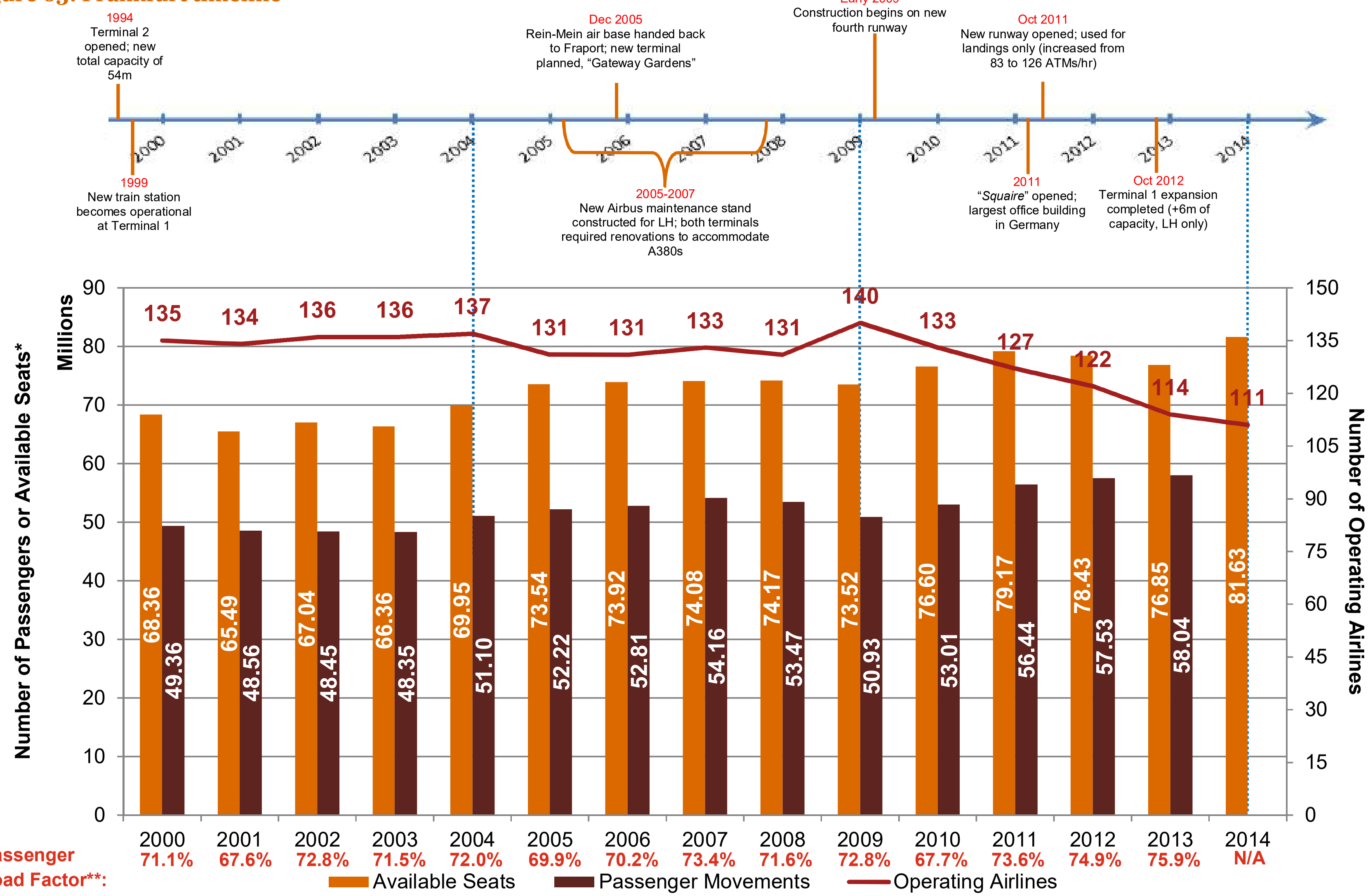
Figure 62: Economic impact of Frankfurt Airport

Year	2000	2004	2008	2012
Employment ('000 employees)				
Direct	*62.5*	*68.0*	*71.0*	*78.0*
Indirect	*38.1*	*38.2*	*36.8*	*38.3*
Induced	*93.9*	*76.8*	*46.6*	*39.2*
Total	*194.5*	*183.0*	*154.4*	*155.5*
Of which wages and salaries	*65.1*	*60.1*	*53.0*	*58.8*
GVA (€ billions)				
Direct	*5.65*	*5.89*	*6.31*	*6.63*
Indirect	*1.98*	*2.15*	*2.26*	*2.51*
Induced	*2.48*	*2.25*	*0.9*	*1.05*
Total	*10.11*	*10.29*	*9.47*	*10.19*
Of which wages and salaries	*3.39*	*3.38*	*3.25*	*3.85*

Source: Regional und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013[52]

[52] INFRAS (2013 – Updated Feb. 2014), Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt http://www.fraport.de/content/fraport/de/misc/binaer/konzern/flughafen-und-region/regionale--und-volkswirtschaftliche-bedeutung-des-flughafens/jcr:content.file/regional--und-volkswirtschaftliche-bedeutung-des-flughafen-frankfurts--aktualisierter-schlussbericht-februar-2014.pdf

Figure 63: Frankfurt timeline



*Available departing seats multiplied by 2
** Passengers divided by available seats
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from CAA Statistics, http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

The study also splits the impacts on employment between:

- Airline related (i.e. airlines, providers of general aviation, catering, technical operation (technology, maintenance, servicing of airplanes)) - see Figure 64;
- Airport related (i.e. airport operations, police/customs/further authorities, security and cleaning companies) - see Figure 65; and
- Non-aviation services on airports like stores, kiosks, banks, restaurants, travel agencies, car rentals, barber shops, consulting companies - see Figure 66.

Airlines make the largest economic contribution (an average of 66% of the direct and indirect jobs at Frankfurt Airport and 73% of the direct and indirect value added. The non-aviation companies, however, have a large impact, contributing €850 million and supporting almost 15,000 jobs in 2012. We note the development of each impact over time, particularly between 2008 and 2012. Within this period, passenger numbers increased, after an initial decline due to the global economic crisis, and each sector showed growth, even when the number of operating airlines was in decline. Importantly, non-aviation employment almost doubled and GVA did double in this period. These trends are reflected in Figure 67 and Figure 68.

Figure 64: Economic impact of Frankfurt Airport – Airline

Year	2000	2004	2008	2012
Employment (‘000 employees)				
Direct	*38.57*	*43.28*	*44.25*	*47.22*
Indirect	*28.69*	*28.99*	*27.84*	*28.40*
Induced	*73.04*	*64.74*	*41.79*	*35.44*
Total	*140.30*	*137.01*	*113.88*	*111.06*
GVA (€ billions)				
Direct	*4.01*	*4.38*	*4.61*	*4.66*
Indirect	*1.49*	*1.63*	*1.71*	*1.86*
Induced				
Total	*7.29*	*7.71*	*6.98*	*7.28*

Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Figure 65: Economic impact of Frankfurt Airport – Other airport

Year	2000	2004	2008	2012
Employment (‘000 employees)				
Direct	19.70	21.38	23.68	24.87
Indirect	7.64	8.04	8.08	7.82
Induced	18.69	11.18	5.23	4.91
Total	46.03	40.60	36.99	37.60
GVA (€ billions)				
Direct	1.41	1.33	1.56	1.70
Indirect	0.40	0.45	0.50	0.51
Induced	0.58	0.5	0.21	0.25
Total	2.39	2.28	2.27	2.46

Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Figure 66: Economic impact of Frankfurt Airport – Non-aviation

Year	2000	2004	2008	2012
Employment ('000 employees)				
Direct	4.24	3.33	3.07	5.92
Indirect	1.74	1.14	0.92	2.04
Induced	2.24	0.91	-0.45	-1.08
Total	8.22	5.38	3.54	6.88
GVA (€ billions)				
Direct	0.23	0.17	0.14	0.27
Indirect	0.09	0.06	0.06	0.13
Induced	0.11	0.07	0.02	0.05
Total	0.43	0.30	0.22	0.45

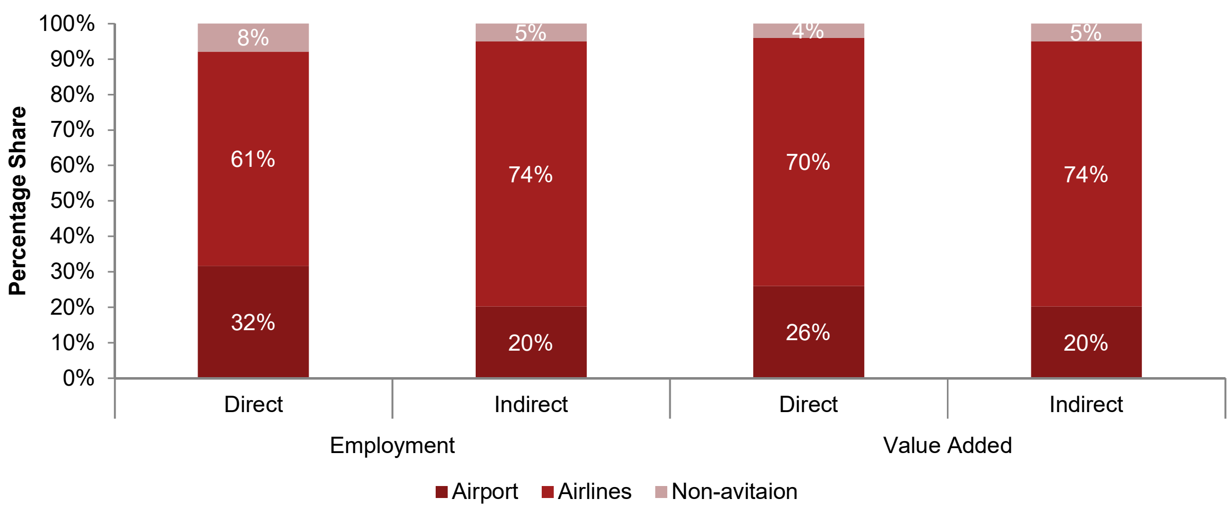
Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Of approximately 500 employers, the five biggest at Frankfurt am Main Airport are:

- Deutsche Lufthansa AG;
- Fraport AG;
- LSG Sky Chefs;
- German Federal Police; and
- International Mail Centre[53].

Figure 67 shows the distribution of direct and indirect employment and value added arising from Frankfurt Airport in 2012. The biggest contribution to value added is provided by airlines whose share is even greater if the indirect impacts are included. This is because airlines buy more services from outside the airport than airport related services. Airlines also account for the greatest proportion of the workforce. In the direct impact the proportions of airport and non-aviation services are bigger than their value added. This is because their activities are more labour-intensive (e.g. cleaning services, security, sales jobs, restaurant etc.).

Figure 67: Distribution of employment sectors in 2012



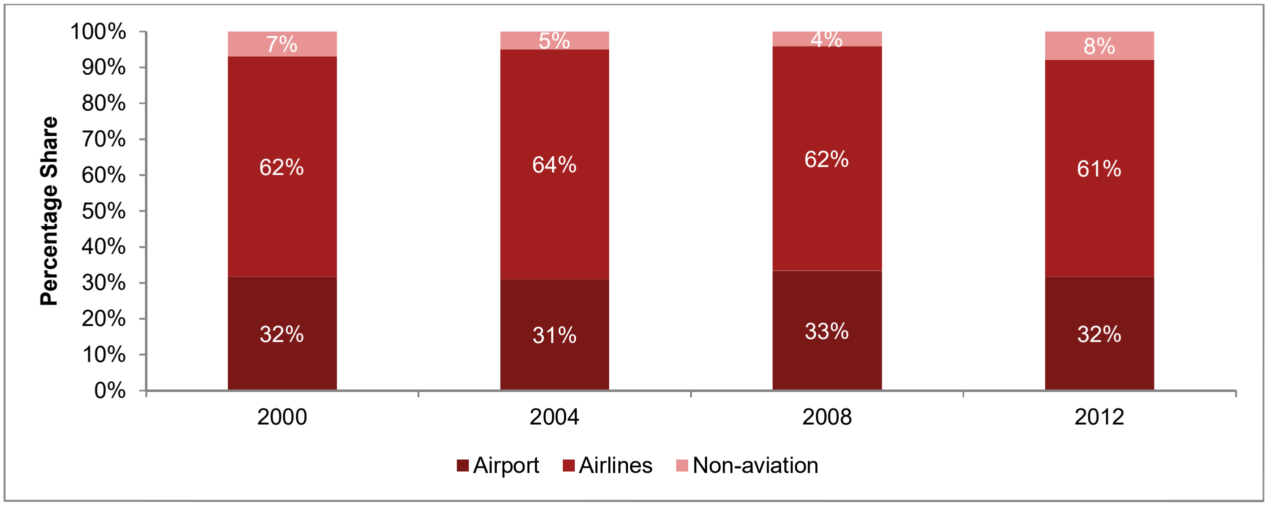
Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Note: Percentages may not total 100% due to rounding

53 Fraport AG, '2012 Facts and Figures on Frankfurt Airport'

Figure 68 suggests that airlines have slightly less impact on employment as time progresses and in recent years non-aviation has grown thanks to the opening of Squaire and Gateway Gardens. These effects are consistent across indirect effects and induced effects.

Figure 68: Development of direct employment sectors (2000-2012)



Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

Note: Percentages may not total 100% due to rounding

Figure 69 illustrates the age composition of employees and compares it to the region (Hessen) and the whole of Germany. Information on the age of those employed in Germany was unavailable on the same level as was known for Frankfurt so two of the groupings (25-50 and 50-55) have been plotted together to form a new group, 25-55. Frankfurt employs fewer people younger than 25 and older than 55 compared to the national average. The second part of

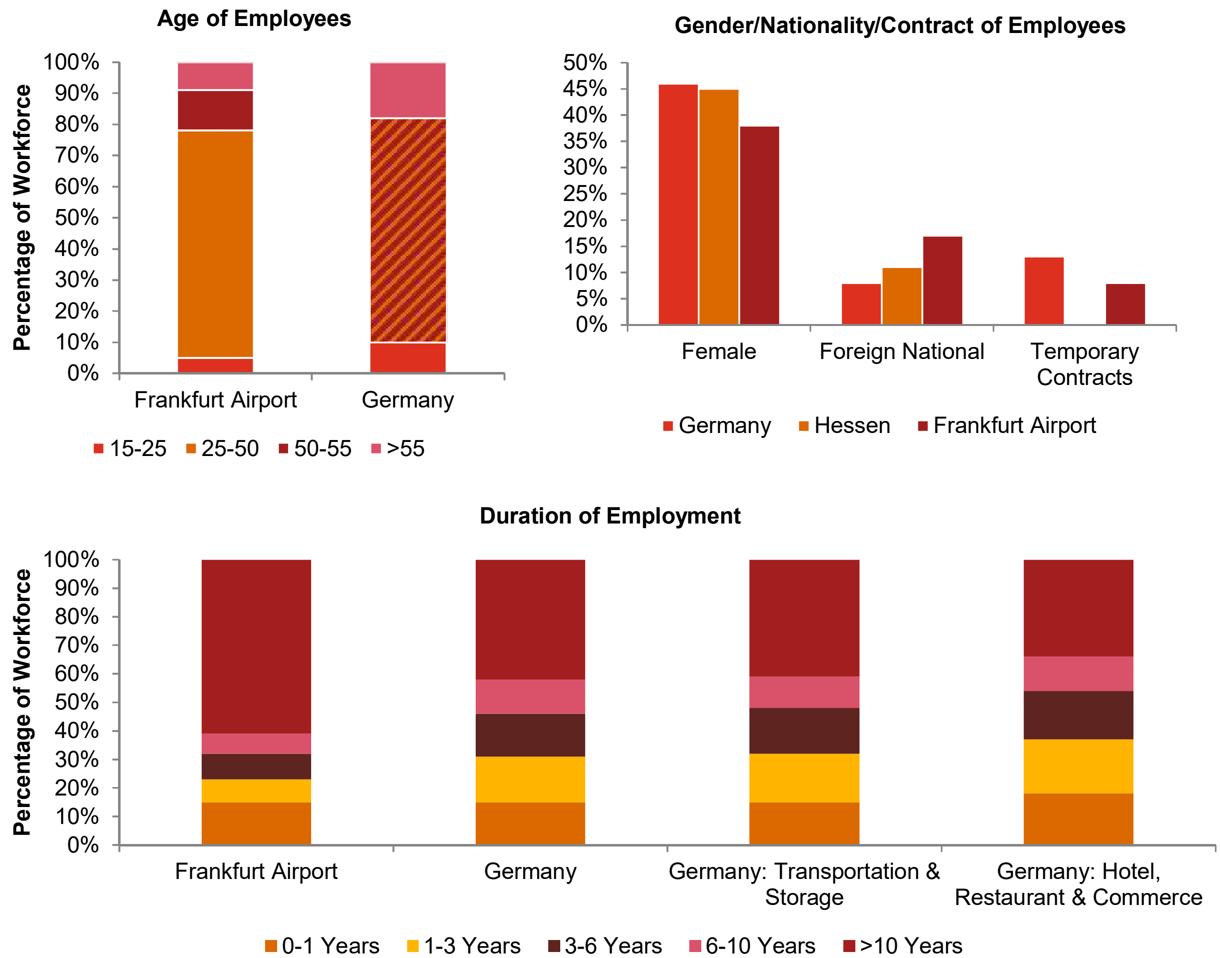
Figure 69 (top-right) shows the split of employment across the three locations by gender, foreign nationality and whether employed on a temporary contract. It shows that Frankfurt Airport has:

- A smaller proportion of female staff than the surrounding region of Hessen and Germany as a whole;
- A higher portion of staff who are foreign nationals (probably due to airlines from other countries having staff based at the airport for check-in services, along with tourist companies and businesses requiring multi-lingual staff); and
- A smaller percentage of staff on temporary contracts than the national average, implying that the jobs at the airport are more secure and less time-structured than the rest of Germany.

The last plot in

Figure 69 (bottom) shows the duration of employment at Frankfurt Airport compared to the rest of Germany and similar industries in Germany ('Transportation & Storage' and 'Hotel, Restaurant & Commerce'). The proportion of employees at Frankfurt Airport who have been employed for over 10 years is more than in the rest of Germany. This suggests that workers at Frankfurt Airport are more likely to make a career of their role and stay for more than 10 years than the rest of Germany and comparable sectors across Germany.

Figure 69: Characteristics of employees at Frankfurt Airport in comparisson to other regions



Source: Regional- und volkswirtschaftliche Bedeutung des Flughafens Frankfurt, INFRAS, 2013

**Statistical adjustment of Frankfurt Airport – some of the companies surveyed in the study did not respond so it is assumed that all of their employees (8,500) have been employed for less than 1 year*

Some 60% of the airport employees live within approximately 35 km of Frankfurt am Main airport:

- 16% in the city of Frankfurt;
- 16% in the Gross-Gerau area;
- 12% in the Offenbach area;
- 8% in the Mainz and Wiesbaden areas; and
- 6% in the Darmstadt area[54].

[54] Fraport AG, '2012 Facts and Figures on Frankfurt Airport'

E.4. *Intermodal connections at Frankfurt am Main*

E.4.1. Background

Frankfurt am Main Airport has seen the steady growth of its rail connections over the last 40 years (see Table 25). As a consequence, it now has two rail stations:

- The first regional train station (opened in 1992) is served by around 225 commuter and regional trains per day which carried 3.5 million passengers in 2013; and
- The more recent long-distance train station (opened in 1998) is served by around 180 high-speed distance trains per day which carried 5.6 million passengers in 2013 and provided connections through existing, improved or newly built high speed railway links.

The long-distance station cost €225 million to construct with €97 million coming from the Federal Government and the remaining €128 million from Fraport AG, the company which runs the airport. Above the railway station is the Frankfurt AirRail Centre (known as The Squaire) which was built by a private investor at a cost of about €1 billion (and opened in 2011)[55].

The two stations enable Frankfurt am Main Airport to offer integrated transport services to airport users.

Table 25: History of development of intermodal links at Frankfurt am Main Airport

Year	Developments
1972	• First airport in Germany to have own railway station and adjacent terminal –served only by local trains
1978	• Rail services extended to include infrequent semi-fast trains to wider catchment but no long distance trains
1980	• Local trains replaced by high frequency commuter trains from Frankfurt via the airport to Mainz – Wiesbaden • Airport regular stop for inter-city trains along the River Rhine to Nuremberg and Munich
1982	• Special trains run for Lufthansa connecting Dusseldorf, Cologne and Bonn: later extended to Stuttgart • Used exclusively by air travellers connecting in Frankfurt to/from flights of Lufthansa and co-operating airlines
1993	• Special trains ceased following merger of railway company • Partly replaced by a few public inter-city trains
1995	• Public inter-city trains stopped due to low demand • Lufthansa and Deutsche Bahn started the project which became AirRail in 2001
1999	• Second railway station opened dedicated to long-distance trains with three IC-routes as well as additional regional services on medium distances
2001	• Lufthansa and Deutsche Bahn started project which became AirRail
2002	• High-speed link opened to Cologne and Bonn in less than an hour • Additional InterCityExpress (ICE) routes enable Lufthansa to cease flights between Cologne and Frankfurt

Frankfurt am Main Airport was particularly suited to the development of inter-modal connections with long distance trains because it (already) served a large number of destinations, especially with inter-continental flights, some of which it was unique in Europe in offering. For that reason, a large proportion of passengers were transferring at Frankfurt to another flight.

Lufthansa, Deutsche Bahn and Frankfurt am Main Airport developed and implemented AirRail as a competitive airline product using high speed trains as a feeder for flights. It made regular trains with designated compartments for air travellers. The service is considered part of the air travel offered by Lufthansa (and the STAR Alliance) and is booked via the airline. It overcomes two challenges:

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[55] INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

- Long-distance trains run exclusively for air passengers are not viable (especially where competition exists with other carriers for high yield passengers); and
- Very short-haul flights (e.g. between Cologne and Frankfurt) are typically loss-making for the airline as there are insufficient origin-destination passengers to generate enough income to supplement the limited revenue from inter-continental ticket sales assigned to these short flights from transferring passengers.

Nonetheless, in developing its rail links, the Airport and its partners have needed to address some key barriers:

- Monopolistic structures which limit incentives on the supply side: for example, Deutsche Bahn and Lufthansa compete on some short haul routes which affects their willingness to co-operate in areas where they do not compete;
- Airport capacity constraints, reinforced by regulations (e.g. slot allocation, grandfather rights), which encourage Lufthansa to replace its short haul flights with train services so that it can start new intercontinental flights; and
- Split responsibilities for infrastructure provision between different tiers of government (i.e. Federal Government and Länder).

E.4.2. Expected benefits

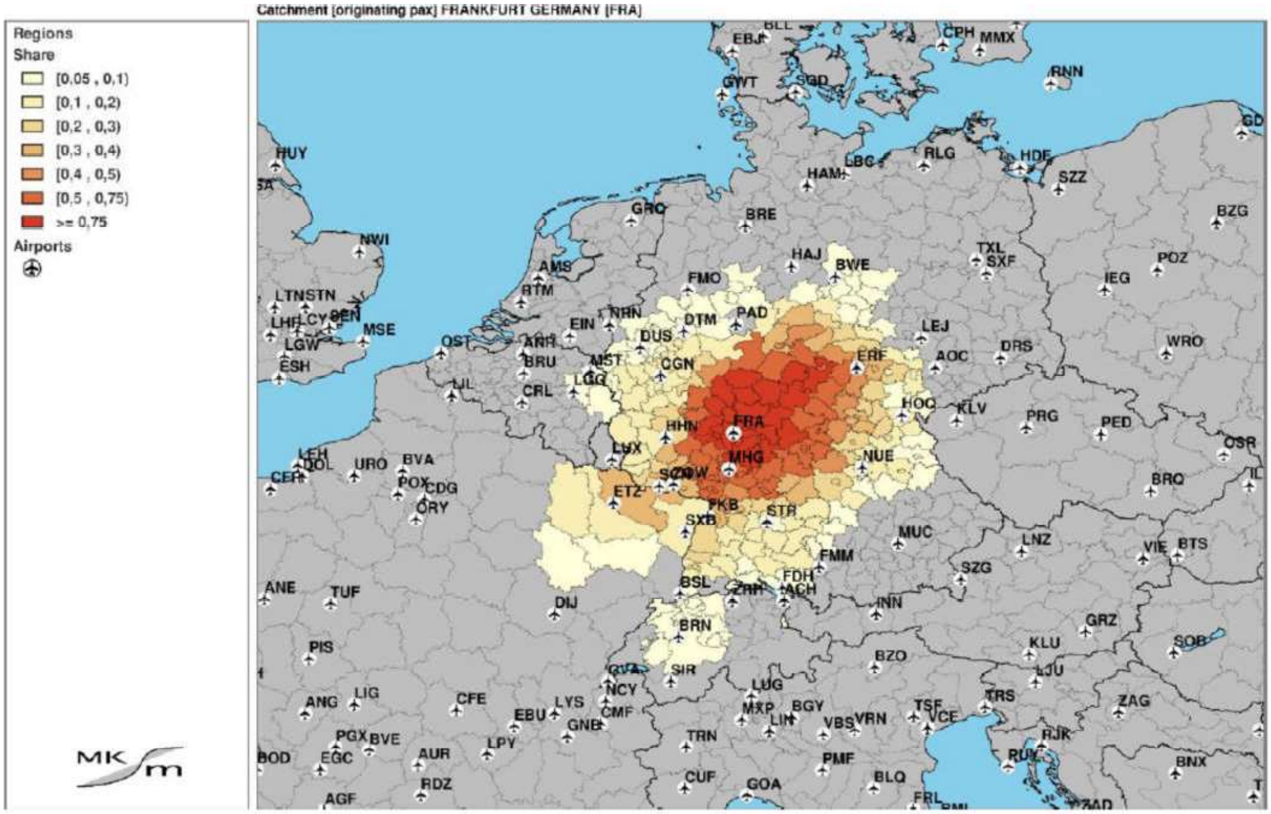
The expected benefits of the enhanced intermodal connections at Frankfurt am Main Airport are summarised in Table 26.

Table 26: Expected benefits of intermodal connections at Frankfurt am Main Airport

Beneficiary	Impact
Frankfurt Airport	• Faster access by high speed trains and alternative access mode to road • Improved competitive position compared to other gateway airports in continental Europe • Enlarged catchment area enabling more passengers to be handled: Figure 70 shows Frankfurt am Main Airport's (modelled) share of total demand for air transport in each area (excluding those where the market share is below 5%) and illustrates that, in addition to the Rhine-Main area, the catchment covers parts of Southwest Germany and Eastern France down to Switzerland in the South and the Ruhr area and parts of Belgium in the North West • Better (more profitable) use of constrained slots by long-haul instead of short-haul flights: and airport with capacity constraints prefers to increase the number of arriving and departing passengers in favour of twice counted transfer passengers because it allows an increased catchment, more destinations and more retail business
Railway:	• Greater share of passengers travelling to the airport compared to other feeder modes • Improved loads on long distance trains
Lufthansa:	• Stronger market position against competing airlines by offering a seamless transport chain to the traveller • Improved loads on own flights • Greater scope for cutting less commercially attractive short haul flights to hub and more scope for profitable use of slots with long-haul flights.
Other airlines	• Feeds additional passengers into long-haul flights where Frankfurt is spoke end of network and they do not have any (alliance) partner airline
Policy makers:	• Sustainable growth of the airport business in Germany meaning more jobs, more direct and indirect income • Improved accessibility of regions (not only close to airports) leading to time savings and more attractive regions for investments, employment and tourism

Source: PwC analysis

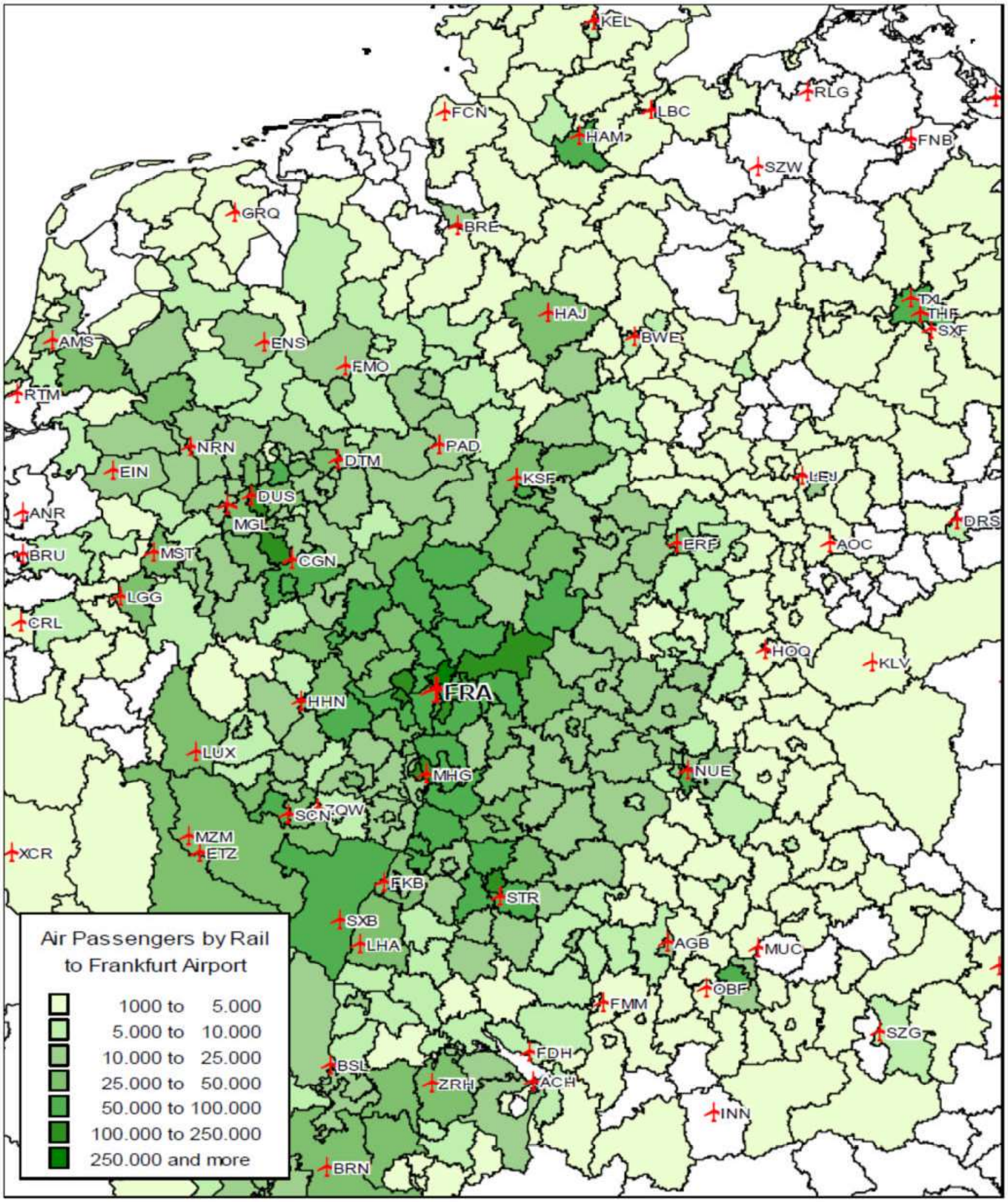
Figure 70: Catchment of Frankfurt airport



Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

Figure 71 shows the (modelled) origins of passengers expected to use public transport as a feeder mode at Frankfurt am Main Airport. Several highly populated areas, some distant from the Airport, show significant numbers of rail passengers, including Hamburg, Berlin, Hanover and Kassel in the north, the Dusseldorf / Cologne area in the west and the area of Mannheim, Karlsruhe and Stuttgart in the south.

Figure 71: Spatial distribution of air passengers using public transport as feeder mode



Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

Table 27 shows the (expected) mode of surface transport to and from Frankfurt am Main Airport based on data collected as part of the planning process for capacity enhancements at the Airport. It is evident that many rail passengers are not air-travel related (e.g. they are airport employees).

Table 27: Expected mode and purpose of surface transport to Frankfurt am Main Airport ('000 passenger movements per working day, 2005)

	Private / rental car	Taxi	Coach	Public transport	Total	Share of public transport (%)
Air passengers	29.7	11.5	2.9	21.0	65.1	36.7
Employees	55.0	0	0	29.1	84.1	34.6
Attendants	35.3	0	0	1.8	37.1	4.7
Visitors/customers	17.6	0	0	3.2	20.8	15.5
Rail passengers not airport related	1.9	0.6	0	2.3	4.8	48.2
Total	139.5	12.1	2.9	57.4	211.9	27.1

Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

E.4.3. Impact

Shows the change in the composition of air passengers at Frankfurt am Main Airport between 2000 and 2008. Although many (external) events affected this pattern (e.g. 9/11 and the emergence of low cost carriers), the number of passengers on domestic flights to and from Frankfurt decreased, while the number of European and Intercontinental passenger increased. This is significant given that the total number of passengers on domestic flights within Germany increased over the same period.

Table 28: Changing composition of air passengers at Frankfurt am Main Airport (2000-2008)

Type	2000	2008	Change 2000 - 2008
Domestic	8.8	6.38	-27.5%
European	22.94	25.24	+10,0%
Intercontinental	26.42	28.23	+6,9%
Total	49.36	53.47	+8,3%

Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

The introduction of AirRail led to many passengers choosing the train to connect for their (long-haul) flights at Frankfurt instead of using an ultra-short haul feeder flight. The rail capacity offered increased whilst the capacity on the equivalent flights decreased. Table 29 shows the number of air passengers in 2000 (before the opening of AirRail) and 2008 and the change over the period.

Table 29: Passenger figures for selected years at Frankfurt airport

Passengers from Frankfurt to ('000)	2000	2008	% change 2000 – 2008
Stuttgart	445.6	203.3	-54.4%
Cologne	316.9	0.9	-99.7%
Total	762.5	204.2	-73.2%

Source: INTERCONNECT, 2009, Factors affecting interconnectivity: Case Study: Frankfurt am Main Airport Connections

Not all the effects outlined (50% reduction on the Stuttgart route and 100% on Cologne route since 2000) can be assigned to AirRail as other factors also influenced the development of demand on these links:

- Some of the passengers arriving or leaving Frankfurt by rail do not use the AirRail concept, but travel with rail tickets issued by Deutsche Bahn;
- A change in route choice of passengers who refuse to use trains by transferring at Munich instead of Frankfurt to/from their connection flights; and
- A change in route choice or airport choice due to the increased number of destinations at the airports of Cologne or Dusseldorf (40 km from Cologne) within the last 10 years.

More generally, whilst the number of long-distance rail passengers at Frankfurt am Main Airport rose significantly following the development of the inter-modal connections, this masks several diverse effects:

- Some passengers travelled to/from the airport by long-distance train instead of:
  - A private car
  - A transfer connection from Frankfurt central station and a commuter train to the airport
  - A short haul feeder flight;
- Other passengers chose to use the new airport station as a starting point for their rail trips instead of other rail stations (e.g. Frankfurt Central, Mainz and Wiesbaden);
- Some passengers changed the routing of their travel (e.g. using a train to Frankfurt am Main Airport before flying to New York instead of flying on another route such as Dusseldorf – New York nonstop or Cologne – Amsterdam – New York);
- Some air passengers took additional flights because of the improved accessibility of Frankfurt am Main Airport whilst others substituted rail journeys for flights; and
- Employees took up a job at Frankfurt am Main Airport because it was easier for them to commute from their existing residence.

E.4.4. Conclusions

Although the evidence from Frankfurt am Main Airport needs to be interpreted with caution, it suggests that:

- To justify the costs of providing rail services, the airport needs to be attractive to passengers:
  - By offering a good enough range of services to attract sufficient passengers from a large catchment areas; and
  - By enabling them to use the rail network to access the airport without extending the travel-time.
- Providing through-ticketing solutions for intermodal travel with rail and air improves the attractiveness and effectiveness of the option, especially if the train segment is fully integrated with the air travel (like AirRail).
- Connecting airports to the railway network enables long-distance rail services to replace short haul flights: the number of air passengers on long-distance trains at Frankfurt am Main Airport more than doubled within a few years whilst the number of passengers on (short-haul) domestic flights decreased by more than a quarter (contrary to the wider trend in Germany).
- Switching from air to rail releases runway slots no longer needed for feeder flights for use by additional (long-haul) flights at the capacity constrained airport.

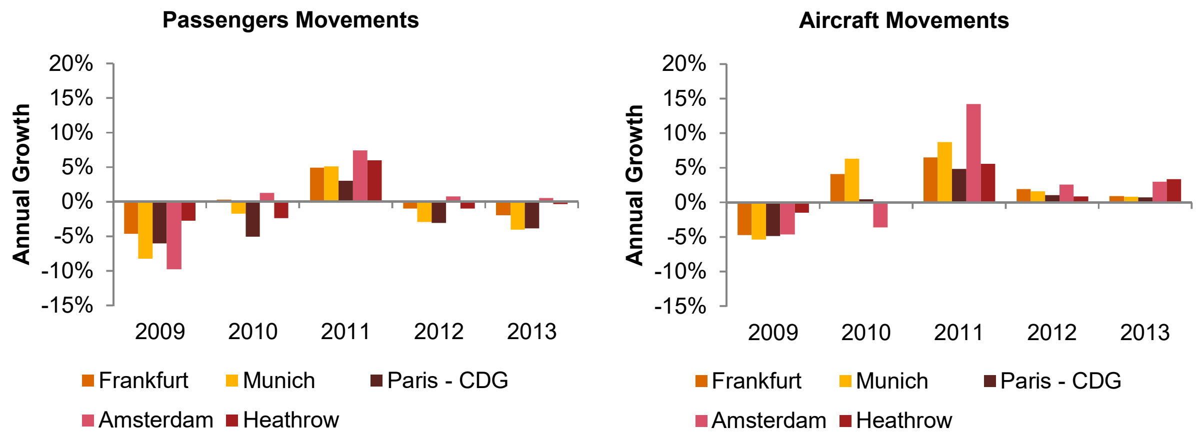
The transferability of concepts like AirRail to other airports depends on several conditions being met:

- Existing demand for rail travel is sufficient to make the rail service viable as trains operated exclusively for air passengers are not viable at the frequency level needed to provide attractive transfer times to/from connecting flights;
- Potential demand comes largely from passengers transferring at the airport (rather than local demand);
- The airport is connected to the railway network with its own railway station which is served by fast long-distance trains without transfers; and

- The travel-time on trains is not significantly more than 90 minutes, the typical elapsed time of a short-haul flight allowing for check-in time.
- Capacity constraints at the airports push airlines towards the substitution of short-haul flights.

Finally, with the additional runway completed in 2011, we compare the growth of Frankfurt am Main Airport with other European hub airports and others in Germany. Figure 72 shows that Frankfurt am Main has followed the same general trend as the other main European hubs, growing with the aviation industry.

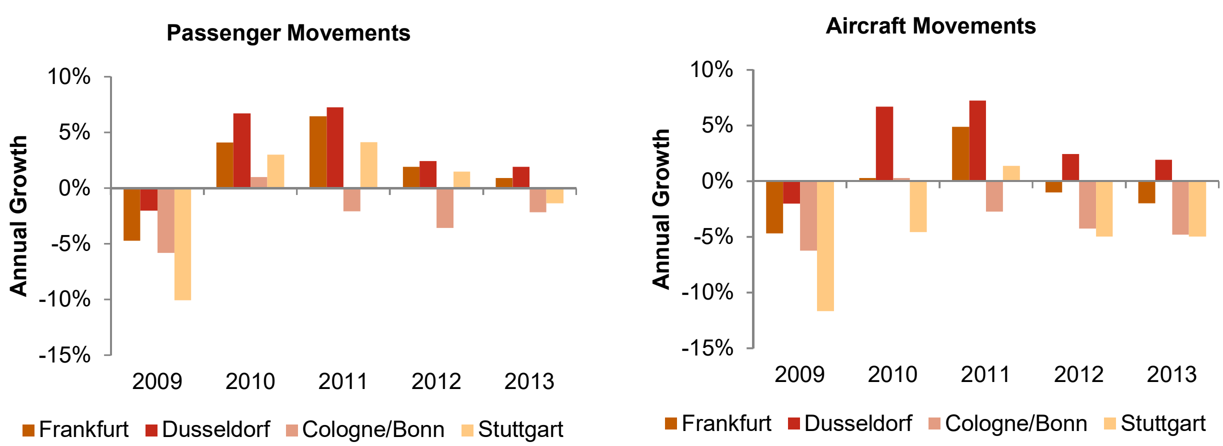
Figure 72: Growth of European hubs over time



Source: CAPA Centre for Aviation http://centreforaviation.com/

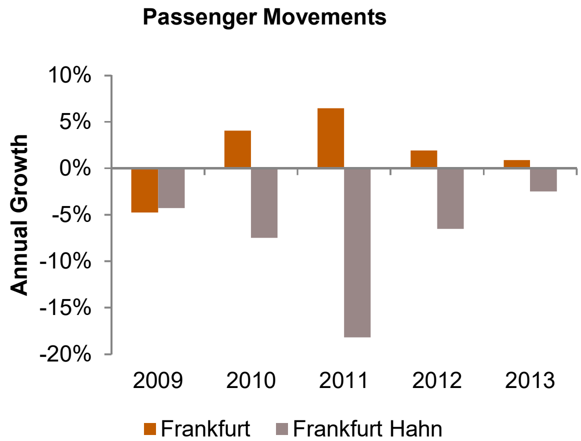
Of the four German airports considered in Figure 73, Dusseldorf has shown the most growth year-on-year and Cologne/Bonn generally has the least in terms of both passenger and aircraft movements. Frankfurt is in the middle following the general trend across these airports.

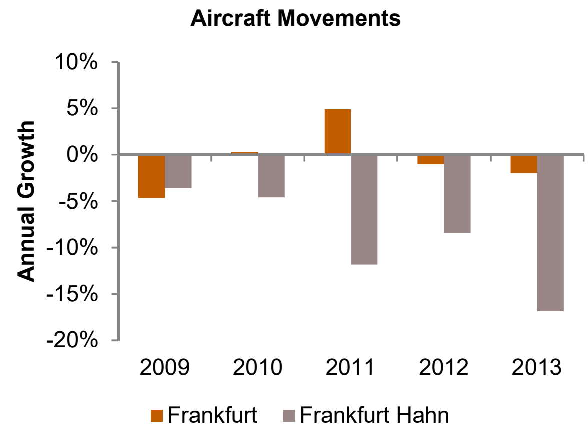
Figure 73: Growth of middle-sized neighbour airports over time



Source: CAPA Centre for Aviation http://centreforaviation.com/

Figure 74: Growth compared to Frankfurt Hahn over time





Source: CAPA Centre for Aviation http://centreforaviation.com/

Frankfurt Hahn operates on a much smaller scale than Frankfurt Main, serving 2.6 million passengers in 2013 compared to 58 million at Main. Since 2010, however, Frankfurt am Main has consistently grown in passenger numbers whereas Hahn has decreased each year. This suggests that expansion at Main has affected another airport – some of the new passengers utilising Main may have previously used Hahn if the new runway expansion had not been completed.

Figure 75: The Squaire

Source: http://www.thesquaire.com/GridFS/uploads/header_picture/picture/4eef754dd70a596b430000fc/display_mde_CGahl_thesquaire_36292.JPG

Another important attribute of Frankfurt Airport that sets is aside from others is the construction of 'The Squaire' (see Figure 75), the largest office space in Germany and is located on site as part of the long distance train station. There is 140,000 m² of useable space; 94,500 m2 of office space, 34,500 m2 for restaurants, cafes and bistros, 34,500 m2 for hotels (two Hiltons with a total of 583 rooms) and there are an additional 250 stores in Airport City – another development at Frankfurt which is separate from the Squaire. Such investment in business near an airport will appeal to a number of companies and draw businesses to relocate to the airport for convenient transport options; KPMG and Lufthansa are some of the main tenants. Between the Squaire and Airport City there are a number of services available, including a conference centre, a concierge service, doctors, fitness, cleaning services, day-care centres and barbers among others.

Appendix F. - *Paris (Charles de Gaulle)*

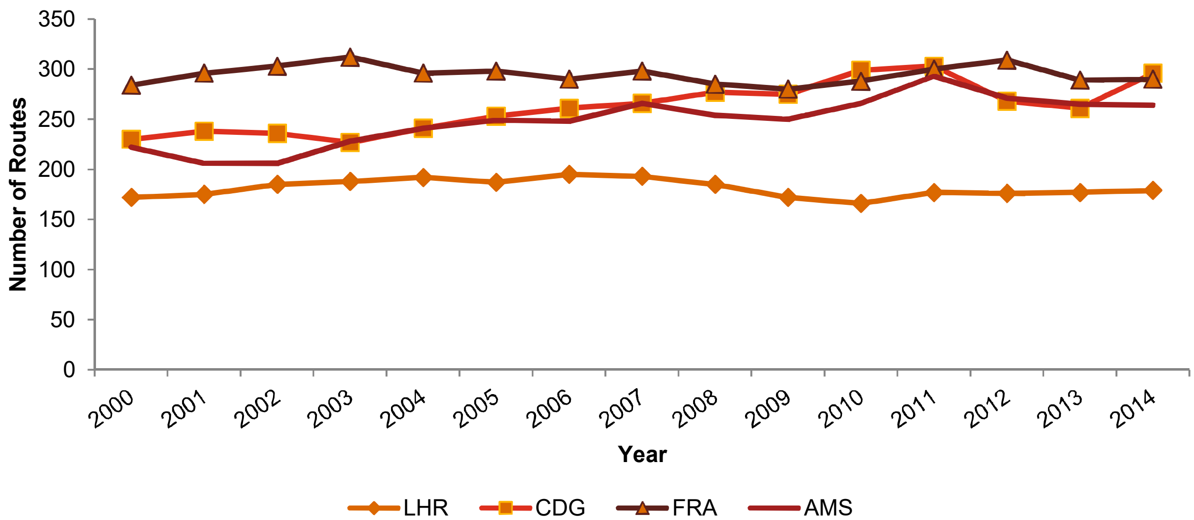
F.1. *Introduction*

In this Appendix we summarise the evidence we have collected in relation to Paris (Charles de Gaulle) airport. We provide background information about the development of the airport since 2000. We then summarise the available evidence in terms of local business and services, employment, labour supply and housing.

F.2. *Background*

Charles de Gaulle Airport (CDG) is the largest in France and the second largest in Europe in terms of passenger numbers, after Heathrow. Also, around 30% of CDG passenger traffic is connecting passengers[56]; Paris is in an attractive location for a hub between Europe, America and Africa. Figure 76 shows the number of available routes at CDG compared to its main European hub competitors; we note that CDG has seen the largest growth of connections over the past 15 years compared to Heathrow (LHR), Schiphol (AMS) and Frankfurt (FRA). In recent years, CDG's operator, Aéroports de Paris, has turned its focus to establishing CDG as a major European hub. The trend supports this.

Figure 76: Number of routes available at the major European hub airports (2000-2014)



Source: SABRE Airport Data Intelligence

Not all airport indicators have grown; the number of airlines operating from CDG has dropped since 2007 (see Figure 78) although this is consistent with operators choosing to focus on airlines that they benefit from (i.e. carriers from countries and regions that they wish to expand their network to). It can also be seen from Figure 78 that CDG handled more passengers in 2013 than ever before (62.05 million) whilst also achieving its highest load factor (80.4%). This implies that the airlines using Aéroports de Paris have become more efficient in their operations and have recovered from the situation in 2010 when scheduled capacity increased without the passenger demand leaving the load factor at 64.1% (see Figure 78).

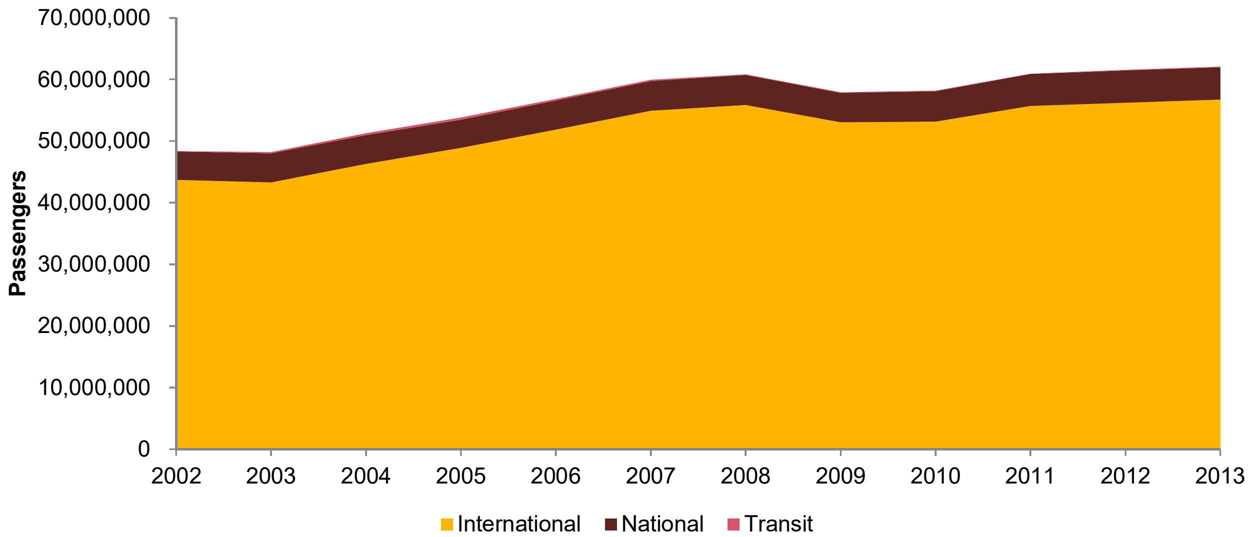
Figure 78 also shows the major infrastructure changes and developments at CDG. It provides an insight into how terminal capacity has changed over the years although it is difficult to attribute the change in available

[56] Charles de Gaulle Focus 2013 - http://www.aeroportsdeparis.fr/ADP/Resources/86ba4eb2-7daa-411f-bb96-5745ba410362-PARISCHARLESDEGAULLETERMINAUX.pdf

seats or passengers served to infrastructure changes without considering wider market trends (which also reflect world-wide trends rather than individual airport developments).

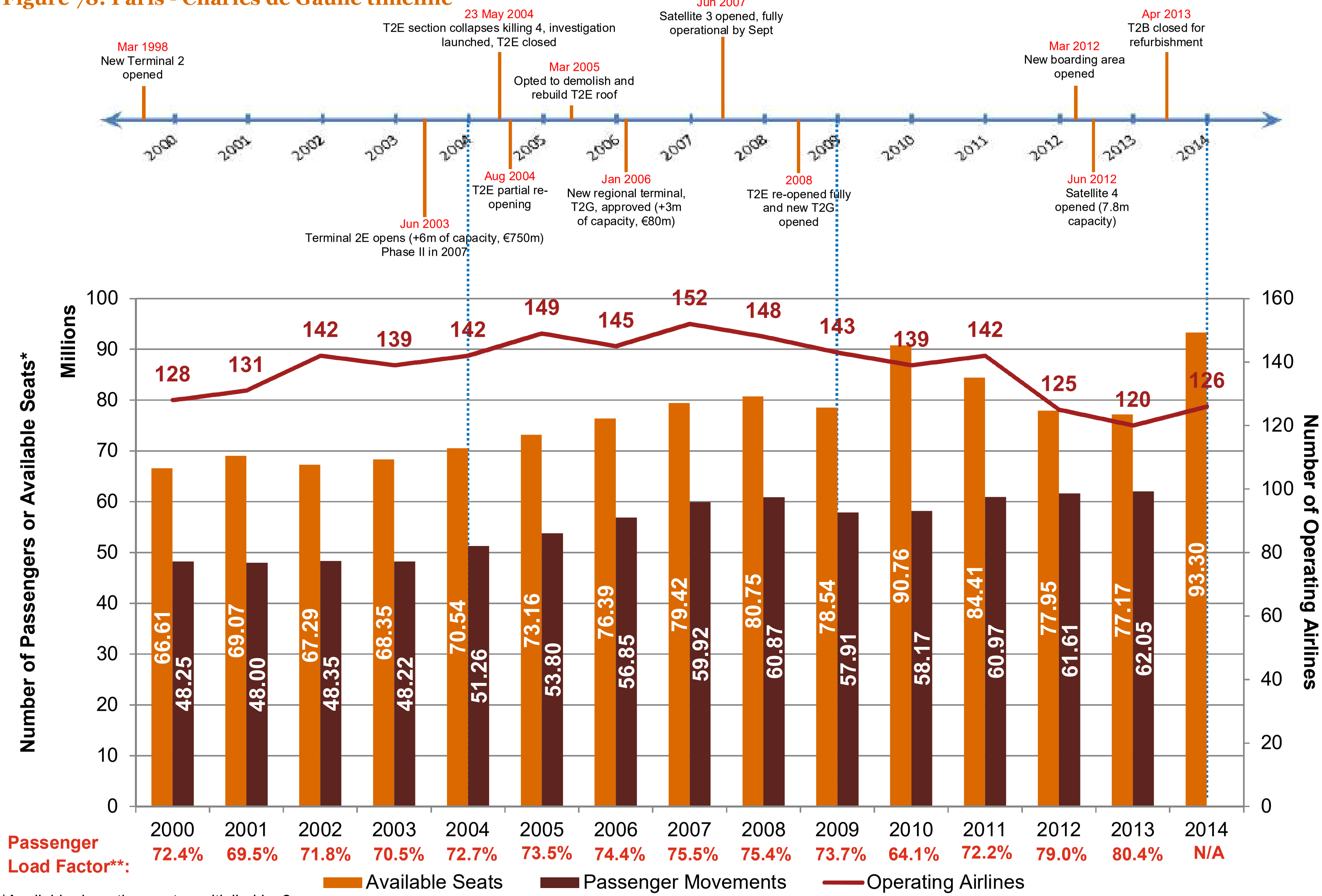
Figure 77 shows how the composition of passengers at Charles de Gaulle has changed since 2002. Over the period, the total number of passengers using the airport increased by 28%, with the number of national (i.e. domestic passengers growing at less than half the rate of international passengers – 14% compared to 30%).

Figure 77: Composition of passengers at Charles de Gaulle (2002-2013)



Source: www.aeroport.fr

Figure 78: Paris - Charles de Gaulle timeline

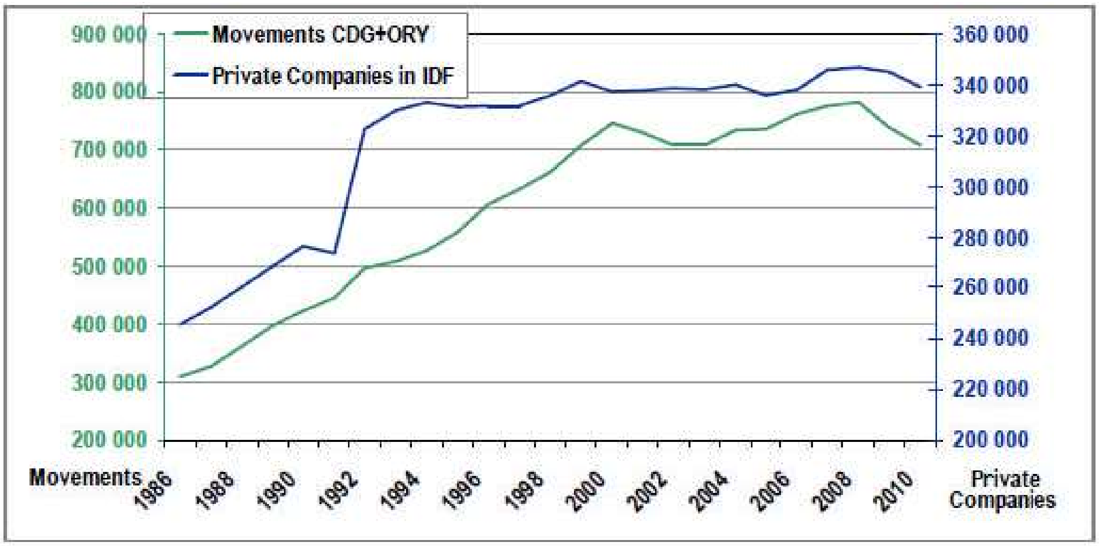


*Available departing seats multiplied by 2
** Passengers divided by available seats
Sources: Available seats and operating airlines obtained from SABRE Airport Data Intelligence
Passenger data retrieved from ACI Statistics, http://www.aci.aero/Data-Centre/Annual-Traffic-Data/Passengers/2011-final

F.3. *Economic impacts*

Aéroports de Paris manages three Parisian airports, CDG, Orly (ORY) and Le Bourget (LBG), which contribute significantly to the economy of the Ile-de-France region. A study, in 2012 by BIPE, of the economic impact of these airports found that the number of private companies established in the Ile-de-France region had grown broadly in line with the growth in the number of aircraft movements at CDG and ORY (see Figure 79)[57]. Some care, however, is needed in interpreting this correlation as it does not indicate causality.

Figure 79: Aircraft movements at CDG and ORY and the number of private companies in the Ile-de-France region (1986-2011)



Source: Evaluation des impacts économique et social des aéroports Paris-Charles de Gaulle, Paris-Orly, Paris-Le Bourget pour l'année 2010, BIPE 2012

Figure 80 shows the direct, indirect, induced and catalytic value added value the employment created by the aviation industry in Paris in 2010. The €29.6 billion of added value generated from the Paris airport system represented 5.8% of the total GDP in the Ile-de-France and 1.7% of GDP in France. We estimate that every additional million passengers in the Paris airport system contribute an additional €354.2 million in value added to the economy.

The number of jobs arising from the Parisian airports over the 15 years prior to the study has grown at 3.09% per annum (seven times more than the average across the Ile-de-France); 20,591 direct jobs were created by CDG over this period and 18,450 jobs were created (direct, indirect and induced) by CDG in 2010 alone. The study estimates that across the Paris airport system every one million additional passengers per annum creates 4,100 new jobs of which 1,400 are directly employed. The total of 340,290 jobs in 2010 represented 8.3% of employees in the Ile-de-France and 2% of jobs in France. This implies that the airports as a whole are less productive than the economy as a whole.

The Paris airports make a further impact through their influence on tourism. Between then, CDG and ORY serve 11.6 million international passengers each year (15% of the total international visitors to France) and spending by these visitors is estimated to support 70,200 jobs in the Ile-de-France region. This includes those visiting from other parts of France. Overall, CDG and ORY are linked with 14% of the jobs in the tourism industry in the Ile-de-France.

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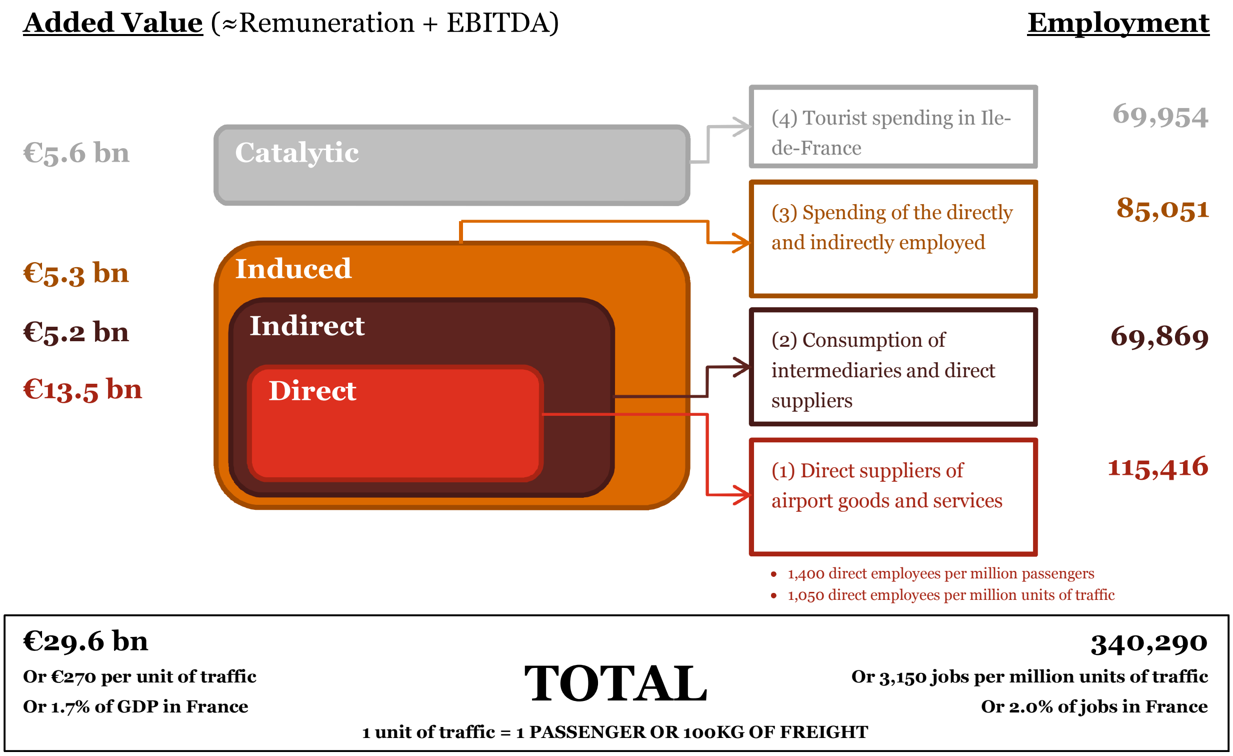
[57] CP Etude BIPE – Aéroports de Paris - http://www.aeroportsdeparis.fr/ADP/Resources/0800d383-60d8-44bb-8cfc-8aae6f6cacf3-CPEtudeBIPE.pdf

Figure 80: Total economic impact of Aéroports de Paris airports (value added and employment, 2010)

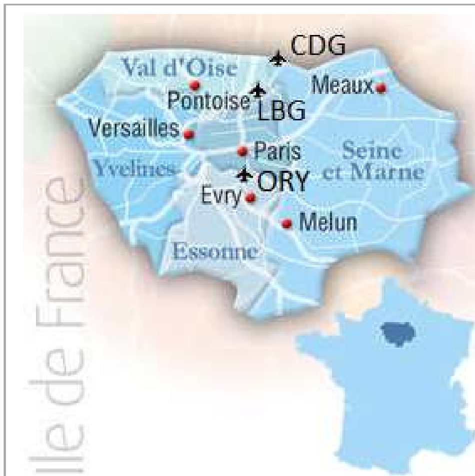


Source: Evaluation des impacts économique et social des aéroports Paris-Charles de Gaulle, Paris-Orly, Paris-Le Bourget pour l'année 2010, BIPE 2012

Figure 81 shows the economic impact of CDG in the Ile-de-France. It is evident that CDG contributes the majority of the economic impact of the Paris airport system in the Ile-de-France. Overall, CDG is responsible for 4.1% of the GDP in Ile-de-France and 1.2% of the GDP in France. Also, it is estimated that every one million additional passengers served annually by CDG generates an extra €364.1 million in total added value.

CDG is also responsible for 247,893 jobs (6.1% of employees in the Ile-de-France region) with 52,635 of these jobs engaged in meeting the needs of visitors to the region. Every one million additional passengers is estimated to support 4,300 jobs (of which 1,500 are directly employed by CDG). This is more than the average across the three Parisian airports.

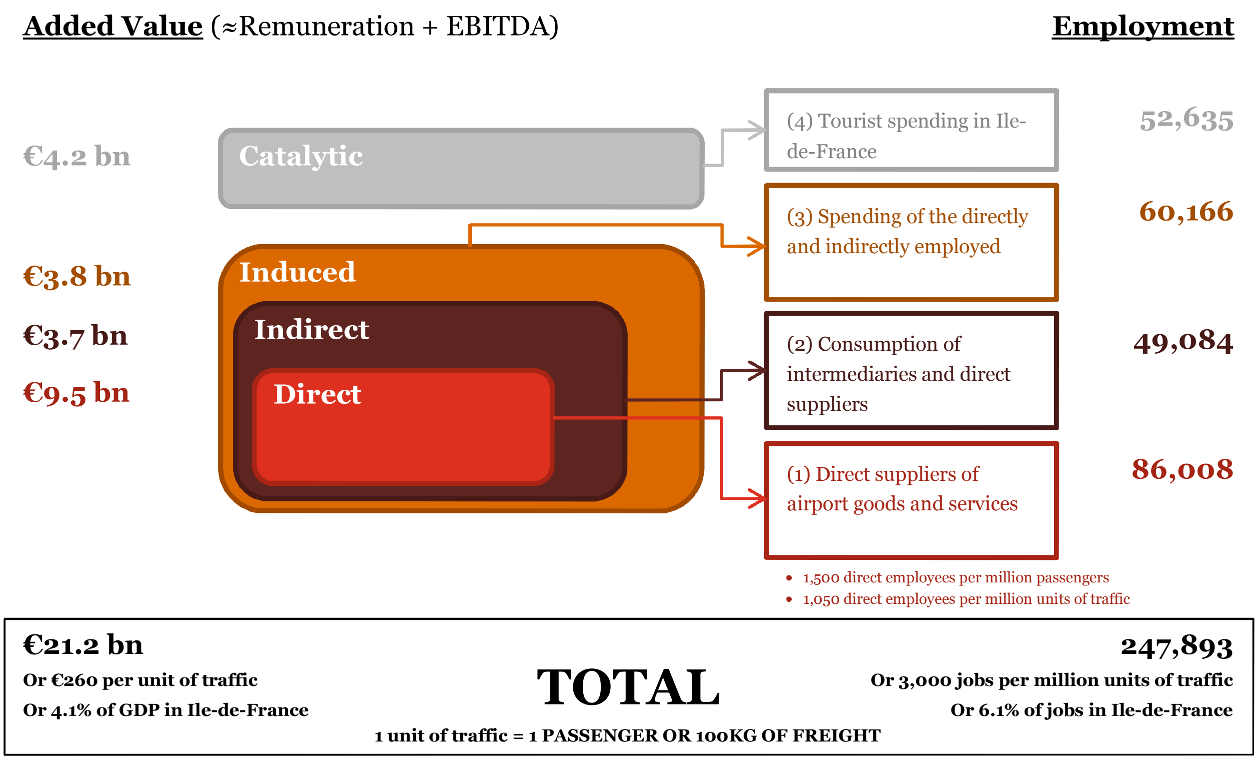
We have not been able to find earlier studies of the economic impact of CDG to enable us to investigate how its economic impact has changed over time as Aéroports de Paris has changed the focus of its operations towards connecting passengers and improved the infrastructure of the airport by constructing new piers to Terminal 2.



Source: http://www.holidayfrancedirect.co.uk/graphics/library/IledeFrance.jpg

Figure 81: Map of Ile-de-France with airports highlighted

Figure 82: Economic impact of Charles de Gaulle Airport (value added and employment, 2010)



Appendix G. - *Bibliography*

The table below lists the reports which have been reviewed as part of our research alphabetically by author.

Title	Author	Year	Airport and/or geography covered	Link
Frankfurt Airport: Special Edition	ACI Europe	2011	Frankfurt	http://www.airport-business.com/wp-content/page-flip/frankfurt-airport-official-report-2011/
London Gatwick Airport: Special Edition	ACI Europe	2011	Gatwick	https://www.aci-europe.org/component/downloads/downloads/2985.html
London Heathrow Airport: Special Edition	ACI Europe	2011	Heathrow	https://www.aci-europe.org/component/downloads/downloads/2987.html
Economic Impact of Canberra Airport	ACIL Tasmin	2011	Canberra	http://www.acilallen.com.au/cms_files/ACIL_CanberraAirport_2011.pdf
Paris-Charles de Gaulle Focus 2013	Aeroports de Paris	2013	Paris	https://www.aeroportsdeparis.fr/ADP/Resources/86ba4eb2-7daa-411f-bb96-5745ba410362-PARISCHARLESDEGAULLETERMINAUX.pdf
ACI Airport Economics Report	Airports Council International	2012	Global	http://www.aci.aero/Publications/ACI-Airport-Statistics/ACI-Airport-Economics-Report-2012
Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line	Antoniou & Efthymiou	2013	N/A	http://link.springer.com/article/10.1007%2Fs13676-013-0030-4#page-1
Cologne-Bonn Airport as an economic and location factor (Translated)	ARC, Booz Allen Hamilton	2008	Cologne-Bonn	http://www.koeln-bonn-airport.de/uploads/tx_download/2008_Wirtschaftsfaktor_CGN_Oekonomische%20Bedeutung.pdf
Connecting the region to the world	Atlanta	2009	Atlanta	http://www.atlanta-airport.com/docs/NewsRoom/2009_Economic_Impact_Study_report.pdf
Developing tools to support complex infrastructure decision-making	Baker & Mahmood	2012	N/A	http://www.emeraldinsight.com/journals.htm?articleid=17035945
The Impact of Airport Noise on Residential Real Estate	Bell, Randall	2001	Global	http://www.eltoroairport.org/issues/AirportNoise.pdf
Wellington Airport Impact Assessment	BERL	2008	Wellington	http://www.wellingtonairport.co.nz/documents/Wellington-Airport-Masterplan-January-2010.pdf

Title	Author	Year	Airport and/or geography covered	Link
Employment Generation and Airports	BITRE	2012	Australia	http://www.bitre.gov.au/publications/2013/files/is_046.pdf
The Economic Catalytic effects of Air Transport in Europe	Britton, Cooper & Tinsley	2005	EU	www.abstracts.aetransport.org/paper/download/id/2088
GDP by Industry Data	Bureau of Economic Analysis	2014	USA	http://www.bea.gov/industry/gdpbyind_data.htm
Airport Office Developments: Assessing the Potential for New Schemes	CBRE	2013	N/A	http://portal.cbre.eu/portal/page/portal/RRP/ResearchReportPublicFiles/EMEA_VP_AIRPORT_OFFICE_DEVELOPMENT_JULY_2013.pdf
Impact of Vancouver Airport on commercial property values	Cohen & Brown	2013	Vancouver	www.aeaweb.org/aea/2014conference/program/retrieve.php?pdfid=1225
Agglomeration, Productivity and Regional Growth: Production Theory Approaches	Cohen& Paul	2008	USA	http://www.fmpc.uconn.edu/are/seminar/Cohen/cohen_morrisonpaul_agglomeration.pdf
The knowledge economy, hub airports and accessibility. A location based perspective. The Case of Amsterdam-Schiphol.	Conventz & Thierstein	2011	Amsterdam	http://www-sre.wu.ac.at/ersa/ersaconfs/ersa11/e110830aFinal01569.pdf
European Cities Monitor	Cushman & Wakefield	2011	Europe	http://www.cushmanwakefield.co.uk/en-gb/research-and-insight/2012/european-cities-monitor-2011/
Airport expansions and property values: the case of Chicago O'Hare Airport	Daniel P McMillen	2004	Chicago	http://www.sciencedirect.com/science/article/pii/S0094119004000099
The Heathrow Phenomenon	Deloitte	2007	Heathrow	http://www.westlondon.com/wp-content/uploads/2011/10/Heathrow_Phenomenon.pdf
Economic Impact of a Western Sydney Airport	Deloitte	2013	Sydney	http://www.nswbusinesschamber.com.au/NSWBC/media/Misc/Lobbying/Thought%20leadership/FINAL-Thinking-Business-Western-Sydney-Airport.pdf
Job density, productivity and the role of transport	Department of Transport	2012	N/A	http://www.transport.vic.gov.au/__data/assets/pdf_file/0005/74228/Job-density-productivity-and-the-role-of-transport.pdf

Title	Author	Year	Airport and/or geography covered	Link
Stakeholder management and path dependence in large-scale transport infrastructure development: the port of Antwerp case	Dooms et al.	2013	Antwerp	http://www.sciencedirect.com/science/article/pii/S0966692312001524
The economic impact of the Budapest Airport on the local economy	Dusek, Lukovics & Bohl	2011	Budapest	http://www-sre.wu.ac.at/ersa/ersaconfs/ersa11/e110830aFinal01228.pdf
2013 Economic Impact Study of San Francisco International Airport	EDRG	2013	San Francisco	http://media.flysfo.com.s3.amazonaws.com/default/downloads/reports/SFOEconomicImpactReport2013.pdf
Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line	Efthymiou, Dimitrios and Antoniou, Constantinos	2013	Greece plus some global observation, including Manchester	http://link.springer.com/article/10.1007/s13676-013-0030-4/fulltext.html#Bib1
Economic and social analysis of potential airport sites	Ernst & Young	2012	Sydney	http://www.infrastructure.gov.au/aviation/scopingstudy/files/Ernst_and_Young-Economic_and_social_analysis_of_potential_airport_sites.pdf
The Impact of Airport Noise and Proximity on Residential Property Values	Espey, Molly and Lopez, Hilary	2002	US plus global observations	http://onlinelibrary.wiley.com/doi/10.1111/0017-4815.00135/abstract
2012 Facts & Figures on Frankfurt Airport	Fraport	2012	Frankfurt	http://www.frankfurt-airport.com/content/frankfurt_airport/en/misc/container/facts-and-figures-2011/jcr:content.file/zadafa-2012_e_lowres.pdf
The London Plan	GLA	2011	London	http://www.london.gov.uk/priorities/planning/london-plan
Economic Evidence Base	GLA Economics	2010	London	http://www.london.gov.uk/sites/default/files/evidence-base-2010-final-low.pdf
Regional, sub-regional and local gross value added estimates for London	GLA Economics	2014	London	https://www.london.gov.uk/priorities/business-economy/publications/gla-economics/regional-sub-regional-and-local-gross-value-added-estimates-for
Agglomeration, Productivity and Transport Investment	Graham	2007	N/A	http://www.ingentaconnect.com/content/lse/jtep/2007/00000041/00000003/art00003
The Regional Economic Impact of an Airport: The Case of Amsterdam Schiphol Airport	Hakfoort et al	2001	Amsterdam	http://dspace.ubvu.vu.nl/bitstream/handle/1871/22163/theregionaleconomicimpact.pdf;jsessionid=6369F93D3A3C116EED1F5794912DABE9?sequence=2
Heathrow: On-airport Employment Survey	Heathrow	2008/09	Heathrow	http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Employment-survey.pdf

Title	Author	Year	Airport and/or geography covered	Link
A Focus on the Economy: Towards a sustainable Heathrow	Heathrow	2011	Heathrow	http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/Afocusontheeconomy.pdf
Sea-Tac International Airport impact mitigation study	Helmuth, Obata & Kassabaum	1997	Seattle	http://airportnoiselaw.org/study912.html
Airline Network Benefits	IATA	2006	N/A	http://www.iata.org/whatwedo/Documents/economics/airline_network_benefits.pdf
Economic Impact Study for Colorado Airports	ICF SH&E	2013	Colorado	http://www.coloradodot.info/programs/aeronautics/PDF_Files/2013EIS_TECHRPT
Minneapolis- St.Paul International Airport	InterVISTAS	2012	Minneapolis -St. Paul	http://www.metroairports.org/documents/MSP-Economic-Impact-Study-2012-FINAL-REPORT_march2.aspx
John Wayne Airport Economic Impact Study	InterVISTAS	2014	John Wayne Airport, Orange County	http://www.ocair.com/reportspublications/EconomicImpact/JWAEconomicImpactStudy.pdf
City Momentum Index	Jones Lang LaSalle	2014	Global cities	http://www.jll.com/Research/City-Momentum-Index-January-2014.pdf?5fa7cce1-7f58-4872-b1b5-8bad50592d4f
High-level commercial and financial assessment of selected potential schemes	KPMG	2013	London & surrounding area	https://www.gov.uk/government/publications/airports-commission-interim-report
Economic Impact Study: Sacramento County Airport System	Leigh Fisher	2011	Sacramento	file:///C:/Users/899046/Downloads/SCAS_Economic_Impact_Study.pdf
Economic Impacts of Closure of Heathrow Airport	Leigh Fisher	2013	Heathrow	https://www.gov.uk/government/publications/airports-commission-interim-report
Economic Impact Study	Leigh Fisher	2011	Ottawa	http://ottawa-airport.ca/sites/default/files/yow/files/publications/2010_economic_impact_study.pdf
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Meta-analysis of airport noise and hedonic property values: problems and prospects	Nelson	2003	Canada & USA	http://econpapers.repec.org/article/tpejtecpo/v_3a38_3ay_3a2004_3ai_3a1_3ap_3a1-27.htm
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Title	Author	Year	Airport and/or geography covered	Link
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Estimating the Costs and Benefits of Regional Airport Subsidies: A Computable General Equilibrium Approach	Peter Forsyth	2006	Australia	http://www.garsonline.de/Downloads/060629/Forsyth%20-%20Paper%20-%20Regional%20Airport%20Subsidies.pdf
Air Capacity for Sydney	Peter Forsyth	2013	Sydney	http://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201302.pdf
Modelling the effect of airport noise on residential property values: an examination of the Manchester Airport second runway	Pitt, Michael and Jones, Mark	2000	Manchester plus global trends	http://www.ingentaconnect.com/content/mcb/069/2000/00000018/f0020013/art00001
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Transport and its infrastructure	Ribeiro & Kobayashi	2012	Global	http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter5.pdf
A comparison of the multipliers of IMPLAN, REMI and RIMS II: Benchmarking ready-made models for comparison	Rickman & Schwer	1995	USA	http://link.springer.com/article/10.1007%2FBF01581882
Evidence on the Nature and Sources of Agglomeration Economies	Rosenthal & Strange	2004	N/A	Handbook of Urban and Regional Economics
Factors affecting the location of real estate	Rymarzak & Sieminska	2012	N/A	Journal of Corporate Real Estate, Vol. 14 No. 4, pp. 214-225
Aviation and the Economy	SDG	2013	UK	https://www.gov.uk/government/publications/airports-commission-interim-report
The Economic Impact of the Aviation Industry on the New York – New Jersey Metropolitan Region	The Port Authority of NY & NJ	2005	New York & New Jersey	http://www.panynj.gov/about/pdf/reg-in-aviation-economic-impact.pdf

Title	Author	Year	Airport and/or geography covered	Link
Review of Heathrow Employment Impact Study	Transport for London	2013/14	Heathrow	http://beta.tfl.gov.uk/cdn/static/cms/documents/review-of-heathrow-employment-study.pdf
Airport Economic Impact Methods and Models	Transportation Research Board	2007	N/A	http://books.google.co.uk/books?id=NuF6lY48RRUC&lpg=PA24&ots=qVGIF2lGx2&dq=%22techniques%20used%20to%20regionalize%20national%20input-output%20coefficients%22&pg=PP1#v=onepage&q=%22techniques%20used%20to%20regionalize%20national%20input-output%20coefficients%22&f=false
Exploring Airport Employee Commute and Parking Strategies	Transportation Research Board	2012	USA/ UK	http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_036.pdf
The Economic Impact of Civil Aviation on the U.S. Economy	U.S. Department of Transportation Federal Aviation Administration	2011	USA	http://www.faa.gov/air_traffic/publications/media/faa_economic_impact_rpt_2011.pdf
Transportation and storage sector: skills assessment	UK Commission for Employment and Skills	2012	UK	https://www.gov.uk/government/publications/transportation-and-storage-sector-skills-assessment
Shaping the Competitive City	Urban Land Institute/ EY	2014	N/A	http://www.ey.com/Publication/vwLUAssets/EY_-_Infrastructure_2014:_shaping_the_competitive_city/$FILE/EY-infrastructure-2014-shaping-the-competitive-city.pdf
Vancouver International Airport 2010 Economic Impact Report	Vancouver Airport Authority	2011	Vancouver	http://www.yvr.ca/Libraries/2010_Annual_Report/2011_05_12_Economic_Impact_Summary_FINAL.sflb.ashx
Inbound Visitor Statistics	Visit Britain	2014	UK	http://www.visitbritain.org/insightsandstatistics/inboundvisitorstatistics/latestdata/
Overview of Land Use Transport Models	Wegener, Michael		Global	http://spiekermann-wegener.com/pub/pdf/MW_Handbook_in_Transport.pdf
The social and economic impact of airports in Europe	York Aviation	2004	Europe	https://www.ryanair.com/doc/news/2012/ACI-Report.pdf
The Economic Impact of Edinburgh Airport	York Aviation	2009	Edinburgh	http://www.scotlandsglobalhub.com/media/downloads/edinburgh-airport-economic-impact-
Economic Impact of the MAG Airports: Update Report	York Aviation	2008	Manchester	http://www.manchester.gov.uk/download/downloads/id/15427/economic_impact_of_the_mag_airports_update_report

Title	Author	Year	Airport and/or geography covered	Link
Economic Effects of Airports in Central Europe: A Critical Review of Empirical Studies and Their Methodological Assumptions	Zak & Getzner	2014	Central Europe	http://www.hrpub.org/download/20140105/AEB6-11802008.pdf

Appendix TR.4.2

Appendix TR4.2 Technical note:
Airport Passenger Traffic Generation

1. Introduction

1.1.1 This note has been prepared to respond to Fourth Written Question (FWQ) TR4.2 and provides an explanation of the reduction of vehicle movements in the AM peak, and explains the methodology behind the traffic movements as modelled in the original DCO TA and revised TA.

2. Traffic Generation Methodology

2.1 Passenger Flight Assumptions

2.1.1 The original TA set out the assumptions regarding passenger flights which were based on passenger flight patterns from comparable airports and information on anticipated flight carriers provided by the Applicant. Passenger movements were derived based on assumptions of numbers of passengers per carrier. Table 2.1 sets out the passenger movements.

Table 2.1 Total Passengers per Departure Flights and Arrival Flights Per Hour

Time Period	Departure Flights	Arrival Flights
06:00 - 07:00	170.10	
07:00 - 08:00	340.20	
08:00 - 09:00	52	170.10
09:00 - 10:00		170.10
10:00 - 11:00		
11:00 - 12:00		170.10
12:00 - 13:00		52
13:00 - 14:00	170.10	170.10
14:00 - 15:00	170.10	170.10
15:00 - 16:00	340.20	170.10
16:00 - 17:00	170.10	170.10
17:00 - 18:00	52	
18:00 - 19:00	340.20	52
19:00 - 20:00	170.10	170.10
20:00 - 21:00		170.10
21:00 - 22:00		170.10
22:00 - 23:00		170.10
TOTAL	**1975.10**	**1975.10**

2.1.2 Vehicle movements were based on:

- Modal splits;
- Vehicle occupancy; and
- Passenger arrival and times.

2.1.3 The following sections summarise the traffic generation calculations for the original TA and the revised TA.

2.2 Original TA

2.2.1 Table 2.2 sets out the modal splits and vehicle occupancy assumptions and subsequent vehicle numbers.

Table 2.2 Original DCO – Modal Split and Vehicle Occupancies

	Bus	Taxi	Car Parked	Car Drop Off	Rail (bus)	Shared Taxi	Total
Modal Split	9%	5%	35%	35%	10%	6%	100%
Passenger No	15	9	60	60	17	10	170
Vehicle Occupancy (passengers per vehicle)	38	1.92	1.92	1.92	38	6	
Vehicle Number	1	4	31	31	1	2	70

2.2.2 As set out in Appendix ISH7 – 30 of Summary of Applicant's Case put Orally - Traffic and Transport hearing and associated appendices [REP8-017], there were two errors which had been applied to the traffic generation in the original TA which carried through to the revised TA:

- double counting of in and out trips for passenger departure and arrival flights.
- departure trips out of the airport following a passenger arrival flight were allocated in the same time period as the flight arrival rather than 1 hour after arrival as identified in the TA.

2.2.3 The original TA traffic flows in the AM peak hour are based on all vehicles associated with the passenger flight arrival between 08:00 and 09:00 arriving and departing in that hour. In addition, the vehicle arrivals and departures for bus, taxi, car drop, rail (then bus) and shared taxi were doubled. Table 2.3 shows the calculation, noting that there are some discrepancies due to rounding of numbers.

Table 2.3 Original TA – AM Peak Hour Traffic Flows

Bus		Taxi		Car Parked		Car Drop Off		Rail (bus)		Shared Taxi		Total		
Arr	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Two-way**
2	2	8	8	0	31	62	62	2	2	4	4	78	109	187

2.2.4 Table 2.4 shows the correct flows in the AM peak hour which comprise vehicle arrivals but also accounts for buses and taxis arriving and departing. It is assumed that there are four bus arrivals and four bus departures per hour.

Table 2.4 Original TA – AM Peak Hour Corrected Traffic Flows

Bus		Taxi		Car Parked		Car Drop Off		Rail (bus)		Shared Taxi		Total		
Arr	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Two-way**
2	2	4	4			31		2	2	2	2	41	10	51

2.3 Revised TA

2.3.1 Table 2.5 sets out the modal splits and vehicle occupancy assumptions and subsequent vehicle numbers.

Table 2.5 Original DCO – Modal Split and Vehicle Occupancies

	Bus	Taxi	Car Parked	Car Drop Off	Rail (bus)	Shared Taxi	Total
Modal Split	10%	6%	37%	37%	10%	-	100%
Passenger No	17	10	63	63	17	-	170
Vehicle Occupancy (passengers per vehicle)	38	1.92	1.92	1.92	38	-	
Vehicle Number	1	5	33	33	1	-	73

2.3.2 The revised TA traffic flows in the AM peak hour are based on all vehicles associated with the passenger flight arrival between 08:00 and 09:00 arriving and departing in that hour. In addition, the vehicle arrivals and departures for bus, taxi, car drop, rail (then bus) and shared taxi were doubled. Table 2.6 shows the calculation noting that there are some discrepancies due to rounding of numbers.

Table 2.6 Revised TA – AM Peak Hour Traffic Flows

Bus		Taxi		Car Parked		Car Drop Off		Rail (bus)		Shared Taxi		Total		
Arr	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Two-way**
2	2	11	11	0	33	66	66	2	2	0	0	80	113	193

2.3.3 Table 2.7 shows the correct flows in the AM peak hour which comprise vehicle arrivals, but also accounts for buses and taxis arriving and departing. . It is assumed that there are four bus arrivals and four bus departures per hour.

Table 2.7 Revised TA – AM Peak Hour Corrected Traffic Flows

Bus		Taxi		Car Parked		Car Drop Off		Rail (bus)		Shared Taxi		Total		
Arr	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Arr**	**Dep**	**Two-way**
2	2	5	5			33		2	2	0		42	9	51

2.3.4 Table 2.8 presents the difference between the amended passenger traffic generation and the passenger traffic generation presented in the DCO TA and the RTA noting that there are some discrepancies due to rounding of numbers.

Table 2.8 AM Peak Hour Passenger Traffic Generation Comparison

Assessment	Arrivals	Departures	Two-way
Original Transport Assessment	78	109	187
Revised Transport Assessment	80	113	193
Updated Revised Transport Assessment	42	9	51

Issued by

[redacted] ....

Glyn Price

Approved by

[redacted] .....

Bev Coupe

Appendix TR.4.25

Junctions 9

ARCADY 9 - Roundabout Module

Filename: Jct 6_A253_Willetts Hill_R1_AM_validated.j9
Path: V:\Projects\38199 Manston Airport DCO EIA\4 Design\Transport\MAY 2019 - Jucntion Moddeling - URGENT\Base Models to Use\Jct 6
Report generation date: 18/05/2019 15:45:29

Summary of junction performance

	AM					PM				
	Queue (Veh)	Delay (min)	RFC	LOS	Network Residual Capacity	Queue (Veh)	Delay (min)	RFC	LOS	Network Residual Capacity
	2039 Growthed Traffic									
1 - A299 E	31.5	1.09	1.01	F	-27 % [3 - A253 Canterbury Road (W)]	30.3	1.01	1.00	F	-49 % [3 - A253 Canterbury Road (W)]
2 - Willetts Hill S	0.2	0.09	0.20	A		0.1	0.07	0.11	A	
3 - A253 Canterbury Road (W)	29.0	4.67	1.14	F		250.4	38.28	1.90	F	
4 - A299 (N)	101.4	4.87	1.15	F		151.1	7.51	1.22	F	
5 - Seamark Road	0.1	0.09	0.12	A		0.1	0.09	0.13	A	
	2039 + Dev Traffic									
1 - A299 E	67.2	2.01	1.06	F	-29 % [3 - A253 Canterbury Road (W)]	50.5	1.53	1.04	F	-49 % [3 - A253 Canterbury Road (W)]
2 - Willetts Hill S	0.3	0.09	0.21	A		0.1	0.07	0.11	A	
3 - A253 Canterbury Road (W)	32.2	5.84	1.16	F		260.2	40.32	1.92	F	
4 - A299 (N)	154.5	7.93	1.23	F		201.3	9.80	1.27	F	
5 - Seamark Road	0.1	0.09	0.12	A		0.1	0.09	0.13	A	

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Network Residual Capacity indicates the amount by which network flow could be increased before a user-definable threshold (see Analysis Options) is met.

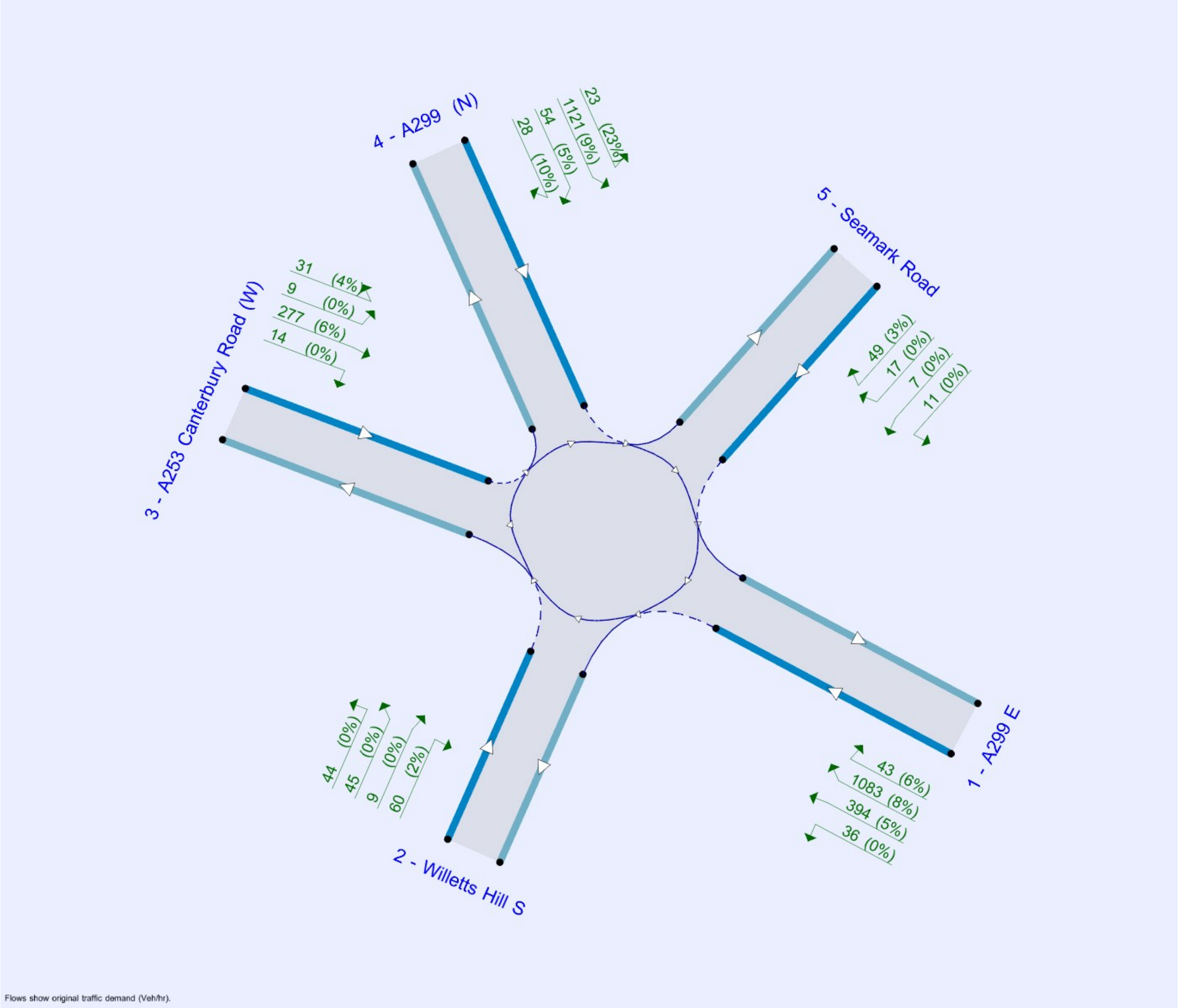
File summary

File Description

Title	(untitled)
Location	
Site number	
Date	29/09/2017
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	GLOBAL\adam.guy
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	mph	Veh	Veh	perHour	min	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	Residual capacity criteria type	RFC Threshold	Average Delay threshold (min)	Queue threshold (PCU)
5.75			✓	Delay	0.85	0.60	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D6	2039 Growthed Traffic	AM	ONE HOUR	07:30	09:00	15	✓
D7	2039 Growthed Traffic	PM	ONE HOUR	16:30	18:00	15	✓
D9	2039 + Dev Traffic	AM	ONE HOUR	07:30	09:00	15	✓
D10	2039 + Dev Traffic	PM	ONE HOUR	16:30	18:00	15	✓

Analysis Set Details

ID	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	✓	100.000	100.000

2039 Growthed Traffic, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	3 - A253 Canterbury Road (W) - Roundabout Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (min)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3, 4, 5	2.78	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-27	3 - A253 Canterbury Road (W)

Arms

Arms

Arm	Name	Description
1	A299 E	
2	Willetts Hill S	
3	A253 Canterbury Road (W)	
4	A299 (N)	
5	Seamark Road	

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - A299 E	7.10	7.41	13.0	43.9	75.0	18.5	
2 - Willetts Hill S	2.49	8.24	27.5	19.7	76.0	30.0	
3 - A253 Canterbury Road (W)	4.70	8.79	31.2	16.8	76.0	35.0	
4 - A299 (N)	7.36	7.36	0.0	17.6	76.8	44.5	
5 - Seamark Road	3.16	7.58	11.2	29.1	75.0	31.5	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
1 - A299 E	0.606	2387
2 - Willetts Hill S	0.497	1797
3 - A253 Canterbury Road (W)	0.557	2236
4 - A299 (N)	0.528	2103
5 - Seamark Road	0.468	1565

The slope and intercept shown above include any corrections and adjustments.

Arm Capacity Adjustments

Arm	Type	Reason	Percentage capacity adjustment (%)
1 - A299 E	Percentage		80.00
2 - Willetts Hill S	Percentage		100.00
3 - A253 Canterbury Road (W)	Percentage		24.00
4 - A299 (N)	Percentage		68.00

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D6	2039 Growthed Traffic	AM	ONE HOUR	07:30	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - A299 E		ONE HOUR	✓	1556	100.000
2 - Willetts Hill S		ONE HOUR	✓	158	100.000
3 - A253 Canterbury Road (W)		ONE HOUR	✓	331	100.000
4 - A299 (N)		ONE HOUR	✓	1226	100.000
5 - Seamark Road		ONE HOUR	✓	84	100.000

Origin-Destination Data

Demand (Veh/hr)

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	36	394	1083	43
	2 - Willetts Hill S	60	0	44	45	9
	3 - A253 Canterbury Road (W)	277	14	0	31	9
	4 - A299 (N)	1121	54	28	0	23
	5 - Seamark Road	11	7	17	49	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	0	5	8	6
	2 - Willetts Hill S	2	0	0	0	0
	3 - A253 Canterbury Road (W)	6	0	0	4	0
	4 - A299 (N)	9	5	10	0	23
	5 - Seamark Road	0	0	0	3	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (min)	Max Queue (Veh)	Max LOS	Average Demand (Veh/hr)	Total Junction Arrivals (Veh)
1 - A299 E	1.01	1.09	31.5	F	1428	2142
2 - Willetts Hill S	0.20	0.09	0.2	A	145	217
3 - A253 Canterbury Road (W)	1.14	4.67	29.0	F	304	456
4 - A299 (N)	1.15	4.87	101.4	F	1125	1688
5 - Seamark Road	0.12	0.09	0.1	A	77	116

Main Results for each time segment

07:30 - 07:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1171	293	126	1726	0.679	1163	1088	0.0	2.1	0.105	A
2 - Willetts Hill S	119	30	1207	1146	0.104	118	83	0.0	0.1	0.058	A
3 - A253 Canterbury Road (W)	249	62	964	378	0.659	242	361	0.0	1.8	0.422	D
4 - A299 (N)	923	231	303	1206	0.765	911	903	0.0	3.1	0.196	B
5 - Seamark Road	63	16	1151	966	0.065	63	63	0.0	0.1	0.066	A

07:45 - 08:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1399	350	150	1714	0.816	1390	1291	2.1	4.2	0.181	B
2 - Willetts Hill S	142	36	1442	1022	0.139	142	98	0.1	0.2	0.068	A
3 - A253 Canterbury Road (W)	298	74	1153	352	0.845	288	431	1.8	4.1	0.836	F
4 - A299 (N)	1102	276	362	1186	0.930	1078	1079	3.1	9.1	0.476	D
5 - Seamark Road	76	19	1365	860	0.088	75	75	0.1	0.1	0.077	A

08:00 - 08:15

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1713	428	171	1704	1.005	1642	1402	4.2	21.9	0.636	E
2 - Willetts Hill S	174	43	1704	883	0.197	174	110	0.2	0.2	0.084	A
3 - A253 Canterbury Road (W)	364	91	1368	323	1.128	312	509	4.1	17.1	2.468	F
4 - A299 (N)	1350	337	404	1171	1.153	1162	1276	9.1	55.9	1.867	F
5 - Seamark Road	92	23	1481	802	0.115	92	86	0.1	0.1	0.085	A

08:15 - 08:30

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1713	428	172	1704	1.005	1675	1411	21.9	31.5	1.088	F
2 - Willetts Hill S	174	43	1735	867	0.201	174	111	0.2	0.2	0.087	A
3 - A253 Canterbury Road (W)	364	91	1391	320	1.139	317	518	17.1	29.0	4.672	F
4 - A299 (N)	1350	337	409	1169	1.154	1168	1299	55.9	101.4	4.171	F
5 - Seamark Road	92	23	1491	798	0.116	92	87	0.1	0.1	0.085	A

08:30 - 08:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1399	350	157	1711	0.818	1505	1401	31.5	4.9	0.411	C
2 - Willetts Hill S	142	36	1556	961	0.148	142	106	0.2	0.2	0.073	A
3 - A253 Canterbury Road (W)	298	74	1236	341	0.873	330	463	29.0	21.0	4.556	F
4 - A299 (N)	1102	276	402	1172	0.941	1160	1163	101.4	86.9	4.873	F
5 - Seamark Road	76	19	1482	802	0.094	76	80	0.1	0.1	0.083	A

08:45 - 09:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1171	293	147	1716	0.683	1182	1391	4.9	2.2	0.115	A
2 - Willetts Hill S	119	30	1231	1133	0.105	119	98	0.2	0.1	0.059	A
3 - A253 Canterbury Road (W)	249	62	978	376	0.663	324	372	21.0	2.3	1.686	F
4 - A299 (N)	923	231	378	1180	0.782	1166	924	86.9	26.0	2.965	F
5 - Seamark Road	63	16	1475	805	0.079	63	70	0.1	0.1	0.081	A

2039 Growthed Traffic, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	3 - A253 Canterbury Road (W) - Roundabout Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (min)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3, 4, 5	9.00	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-49	3 - A253 Canterbury Road (W)

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D7	2039 Growthed Traffic	PM	ONE HOUR	16:30	18:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - A299 E		ONE HOUR	✓	1621	100.000
2 - Willetts Hill S		ONE HOUR	✓	94	100.000
3 - A253 Canterbury Road (W)		ONE HOUR	✓	568	100.000
4 - A299 (N)		ONE HOUR	✓	1348	100.000
5 - Seamark Road		ONE HOUR	✓	88	100.000

Origin-Destination Data

Demand (Veh/hr)

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	100	330	1123	68
	2 - Willetts Hill S	40	0	16	34	4
	3 - A253 Canterbury Road (W)	498	21	0	29	20
	4 - A299 (N)	1273	49	14	0	12
	5 - Seamark Road	29	9	6	44	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	1	2	4	4
	2 - Willetts Hill S	0	0	0	0	0
	3 - A253 Canterbury Road (W)	3	6	0	5	0
	4 - A299 (N)	4	0	10	0	34
	5 - Seamark Road	14	0	0	3	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (min)	Max Queue (Veh)	Max LOS	Average Demand (Veh/hr)	Total Junction Arrivals (Veh)
1 - A299 E	1.00	1.01	30.3	F	1487	2231
2 - Willetts Hill S	0.11	0.07	0.1	A	86	129
3 - A253 Canterbury Road (W)	1.90	38.28	250.4	F	521	782
4 - A299 (N)	1.22	7.51	151.1	F	1237	1855
5 - Seamark Road	0.13	0.09	0.1	A	81	121

Main Results for each time segment

16:30 - 16:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1220	305	104	1797	0.679	1212	1313	0.0	2.1	0.101	A
2 - Willetts Hill S	71	18	1185	1186	0.060	71	131	0.0	0.1	0.054	A
3 - A253 Canterbury Road (W)	428	107	982	388	1.102	365	274	0.0	15.7	1.641	F
4 - A299 (N)	1015	254	430	1220	0.832	997	917	0.0	4.5	0.252	C
5 - Seamark Road	66	17	1352	857	0.077	66	76	0.0	0.1	0.076	A

16:45 - 17:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1457	364	121	1789	0.815	1449	1475	2.1	4.1	0.172	B
2 - Willetts Hill S	85	21	1417	1067	0.079	84	153	0.1	0.1	0.061	A
3 - A253 Canterbury Road (W)	511	128	1174	362	1.409	361	327	15.7	53.0	6.210	F
4 - A299 (N)	1212	303	443	1216	0.997	1161	1092	4.5	17.1	0.744	E
5 - Seamark Road	79	20	1517	781	0.101	79	87	0.1	0.1	0.085	A

17:00 - 17:15

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1785	446	134	1783	1.001	1716	1515	4.1	21.4	0.602	E
2 - Willetts Hill S	103	26	1677	933	0.111	103	172	0.1	0.1	0.072	A
3 - A253 Canterbury Road (W)	625	156	1395	333	1.880	333	386	53.0	126.2	16.447	F
4 - A299 (N)	1484	371	436	1218	1.218	1215	1291	17.1	84.5	2.669	F
5 - Seamark Road	97	24	1552	765	0.127	97	99	0.1	0.1	0.090	A

17:15 - 17:30

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1785	446	134	1783	1.001	1749	1515	21.4	30.3	1.012	F
2 - Willetts Hill S	103	26	1709	916	0.113	103	174	0.1	0.1	0.074	A
3 - A253 Canterbury Road (W)	625	156	1420	329	1.899	329	393	126.2	200.3	29.971	F
4 - A299 (N)	1484	371	434	1219	1.218	1218	1315	84.5	151.0	5.907	F
5 - Seamark Road	97	24	1552	765	0.127	97	100	0.1	0.1	0.090	A

17:30 - 17:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1457	364	123	1788	0.815	1559	1514	30.3	4.8	0.360	C
2 - Willetts Hill S	85	21	1521	1013	0.083	85	161	0.1	0.1	0.065	A
3 - A253 Canterbury Road (W)	511	128	1255	351	1.453	351	350	200.3	240.1	35.743	F
4 - A299 (N)	1212	303	438	1217	0.996	1211	1168	151.0	151.1	7.515	F
5 - Seamark Road	79	20	1557	762	0.104	79	92	0.1	0.1	0.088	A

17:45 - 18:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1220	305	115	1792	0.681	1231	1528	4.8	2.2	0.109	A
2 - Willetts Hill S	71	18	1205	1176	0.060	71	141	0.1	0.1	0.054	A
3 - A253 Canterbury Road (W)	428	107	996	386	1.107	386	280	240.1	250.4	38.280	F
4 - A299 (N)	1015	254	451	1213	0.837	1205	931	151.1	103.7	6.363	F
5 - Seamark Road	66	17	1577	754	0.088	66	79	0.1	0.1	0.087	A

2039 + Dev Traffic, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	3 - A253 Canterbury Road (W) - Roundabout Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (min)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3, 4, 5	4.47	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-29	3 - A253 Canterbury Road (W)

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D9	2039 + Dev Traffic	AM	ONE HOUR	07:30	09:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - A299 E		ONE HOUR	✓	1645	100.000
2 - Willetts Hill S		ONE HOUR	✓	160	100.000
3 - A253 Canterbury Road (W)		ONE HOUR	✓	331	100.000
4 - A299 (N)		ONE HOUR	✓	1311	100.000
5 - Seamark Road		ONE HOUR	✓	84	100.000

Origin-Destination Data

Demand (Veh/hr)

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	36	394	1172	43
	2 - Willetts Hill S	62	0	44	45	9
	3 - A253 Canterbury Road (W)	277	14	0	31	9
	4 - A299 (N)	1206	54	28	0	23
	5 - Seamark Road	11	7	17	49	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	0	5	8	6
	2 - Willetts Hill S	2	0	0	0	0
	3 - A253 Canterbury Road (W)	6	0	0	4	0
	4 - A299 (N)	9	5	10	0	23
	5 - Seamark Road	0	0	0	3	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (min)	Max Queue (Veh)	Max LOS	Average Demand (Veh/hr)	Total Junction Arrivals (Veh)
1 - A299 E	1.06	2.01	67.2	F	1509	2264
2 - Willetts Hill S	0.21	0.09	0.3	A	147	220
3 - A253 Canterbury Road (W)	1.16	5.84	32.2	F	304	456
4 - A299 (N)	1.23	7.93	154.5	F	1203	1804
5 - Seamark Road	0.12	0.09	0.1	A	77	116

Main Results for each time segment

07:30 - 07:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1238	310	126	1725	0.718	1229	1150	0.0	2.5	0.119	A
2 - Willetts Hill S	120	30	1272	1111	0.108	120	82	0.0	0.1	0.061	A
3 - A253 Canterbury Road (W)	249	62	1031	369	0.676	242	361	0.0	1.9	0.449	D
4 - A299 (N)	987	247	304	1206	0.819	970	968	0.0	4.1	0.241	B
5 - Seamark Road	63	16	1212	935	0.068	63	62	0.0	0.1	0.069	A

07:45 - 08:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1479	370	148	1714	0.863	1466	1345	2.5	5.7	0.230	B
2 - Willetts Hill S	144	36	1517	981	0.147	144	97	0.1	0.2	0.072	A
3 - A253 Canterbury Road (W)	298	74	1231	342	0.871	287	430	1.9	4.6	0.941	F
4 - A299 (N)	1179	295	362	1186	0.994	1130	1156	4.1	16.4	0.732	E
5 - Seamark Road	76	19	1417	833	0.091	75	74	0.1	0.1	0.079	A

08:00 - 08:15

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1811	453	166	1706	1.062	1677	1413	5.7	39.2	0.970	F
2 - Willetts Hill S	176	44	1738	865	0.204	176	106	0.2	0.3	0.087	A
3 - A253 Canterbury Road (W)	364	91	1420	316	1.153	307	494	4.6	18.9	2.740	F
4 - A299 (N)	1443	361	400	1173	1.231	1169	1327	16.4	84.9	2.761	F
5 - Seamark Road	92	23	1487	799	0.116	92	83	0.1	0.1	0.085	A

08:15 - 08:30

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1811	453	167	1706	1.062	1699	1418	39.2	67.2	2.010	F
2 - Willetts Hill S	176	44	1760	853	0.206	176	106	0.3	0.3	0.089	A
3 - A253 Canterbury Road (W)	364	91	1437	314	1.162	311	499	18.9	32.2	5.273	F
4 - A299 (N)	1443	361	405	1171	1.233	1171	1343	84.9	153.1	6.199	F
5 - Seamark Road	92	23	1492	797	0.116	92	83	0.1	0.1	0.085	A

08:30 - 08:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1479	370	152	1712	0.864	1687	1404	67.2	15.1	1.539	F
2 - Willetts Hill S	144	36	1735	866	0.166	144	105	0.3	0.2	0.083	A
3 - A253 Canterbury Road (W)	298	74	1395	319	0.932	310	484	32.2	29.2	5.836	F
4 - A299 (N)	1179	295	389	1177	1.002	1173	1316	153.1	154.5	7.931	F
5 - Seamark Road	76	19	1481	802	0.094	76	81	0.1	0.1	0.083	A

08:45 - 09:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1238	310	143	1717	0.721	1288	1419	15.1	2.7	0.156	A
2 - Willetts Hill S	120	30	1335	1078	0.112	121	96	0.2	0.1	0.063	A
3 - A253 Canterbury Road (W)	249	62	1076	363	0.687	351	379	29.2	3.8	3.053	F
4 - A299 (N)	987	247	405	1171	0.843	1163	1022	154.5	110.4	6.848	F
5 - Seamark Road	63	16	1498	794	0.080	63	70	0.1	0.1	0.082	A

2039 + Dev Traffic, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Geometry	3 - A253 Canterbury Road (W) - Roundabout Geometry	Effective flare length is over 30m, which is outside the normal range. Treat capacities with increasing caution.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (min)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3, 4, 5	10.23	F

Junction Network Options

Driving side	Lighting	Network residual capacity (%)	First arm reaching threshold
Left	Normal/unknown	-49	3 - A253 Canterbury Road (W)

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D10	2039 + Dev Traffic	PM	ONE HOUR	16:30	18:00	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCU Factor for a HV (PCU)
✓	✓	HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - A299 E		ONE HOUR	✓	1667	100.000
2 - Willetts Hill S		ONE HOUR	✓	94	100.000
3 - A253 Canterbury Road (W)		ONE HOUR	✓	568	100.000
4 - A299 (N)		ONE HOUR	✓	1396	100.000
5 - Seamark Road		ONE HOUR	✓	88	100.000

Origin-Destination Data

Demand (Veh/hr)

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	102	330	1167	68
	2 - Willetts Hill S	40	0	16	34	4
	3 - A253 Canterbury Road (W)	498	21	0	29	20
	4 - A299 (N)	1321	49	14	0	12
	5 - Seamark Road	29	9	6	44	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		1 - A299 E	2 - Willetts Hill S	3 - A253 Canterbury Road (W)	4 - A299 (N)	5 - Seamark Road
From	1 - A299 E	0	1	2	5	4
	2 - Willetts Hill S	0	0	0	0	0
	3 - A253 Canterbury Road (W)	3	6	0	5	0
	4 - A299 (N)	5	0	10	0	34
	5 - Seamark Road	14	0	0	3	0

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (min)	Max Queue (Veh)	Max LOS	Average Demand (Veh/hr)	Total Junction Arrivals (Veh)
1 - A299 E	1.04	1.53	50.5	F	1530	2294
2 - Willetts Hill S	0.11	0.07	0.1	A	86	129
3 - A253 Canterbury Road (W)	1.92	40.32	260.2	F	521	782
4 - A299 (N)	1.27	9.80	201.3	F	1281	1921
5 - Seamark Road	0.13	0.09	0.1	A	81	121

Main Results for each time segment

16:30 - 16:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1255	314	104	1785	0.703	1246	1341	0.0	2.3	0.110	A
2 - Willetts Hill S	71	18	1217	1165	0.061	71	132	0.0	0.1	0.055	A
3 - A253 Canterbury Road (W)	428	107	1014	383	1.117	361	273	0.0	16.7	1.737	F
4 - A299 (N)	1051	263	426	1210	0.868	1028	949	0.0	5.6	0.300	C
5 - Seamark Road	66	17	1379	840	0.079	66	75	0.0	0.1	0.078	A

16:45 - 17:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1499	375	119	1777	0.843	1488	1485	2.3	5.0	0.200	B
2 - Willetts Hill S	85	21	1454	1043	0.081	84	153	0.1	0.1	0.063	A
3 - A253 Canterbury Road (W)	511	128	1212	356	1.435	355	326	16.7	55.6	6.615	F
4 - A299 (N)	1255	314	437	1207	1.040	1175	1130	5.6	25.7	1.002	F
5 - Seamark Road	79	20	1525	772	0.102	79	87	0.1	0.1	0.087	A

17:00 - 17:15

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1835	459	132	1772	1.036	1730	1506	5.0	31.3	0.793	E
2 - Willetts Hill S	103	26	1691	919	0.113	103	170	0.1	0.1	0.074	A
3 - A253 Canterbury Road (W)	625	156	1416	328	1.905	328	379	55.6	129.9	17.251	F
4 - A299 (N)	1537	384	430	1209	1.271	1208	1314	25.7	108.0	3.463	F
5 - Seamark Road	97	24	1541	765	0.127	97	97	0.1	0.1	0.090	A

17:15 - 17:30

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1835	459	132	1772	1.036	1759	1506	31.3	50.5	1.530	F
2 - Willetts Hill S	103	26	1718	905	0.114	103	172	0.1	0.1	0.075	A
3 - A253 Canterbury Road (W)	625	156	1437	325	1.922	325	385	129.9	204.9	31.102	F
4 - A299 (N)	1537	384	429	1210	1.271	1209	1334	108.0	189.9	7.486	F
5 - Seamark Road	97	24	1540	765	0.127	97	98	0.1	0.1	0.090	A

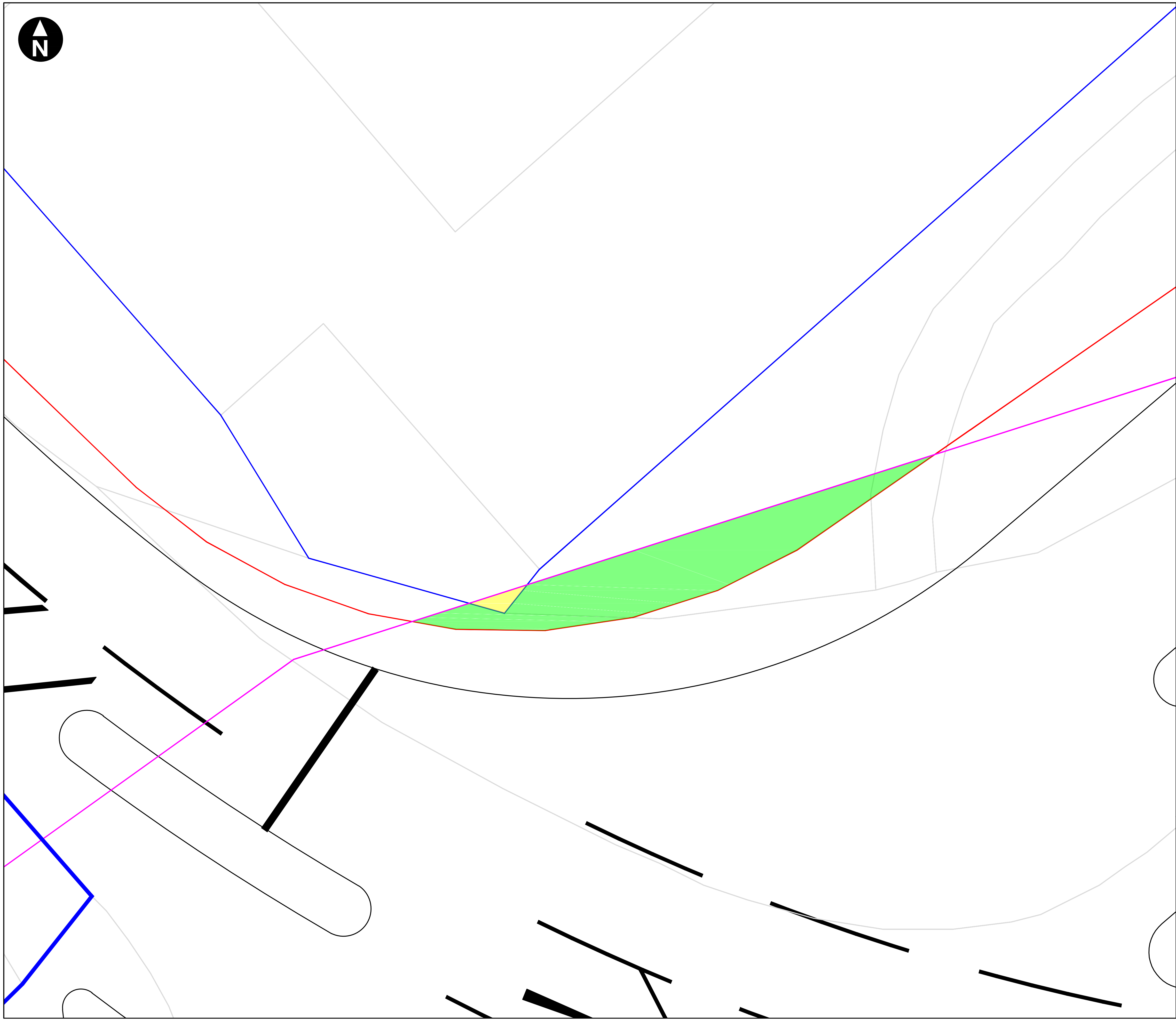
17:30 - 17:45

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1499	375	120	1777	0.843	1675	1502	50.5	6.4	0.858	F
2 - Willetts Hill S	85	21	1630	951	0.089	85	165	0.1	0.1	0.069	A
3 - A253 Canterbury Road (W)	511	128	1351	337	1.515	337	364	204.9	248.3	37.662	F
4 - A299 (N)	1255	314	428	1210	1.037	1209	1260	189.9	201.3	9.800	F
5 - Seamark Road	79	20	1543	764	0.104	79	94	0.1	0.1	0.088	A

17:45 - 18:00

Arm	Total Demand (Veh/hr)	Junction Arrivals (Veh)	Circulating flow (Veh/hr)	Capacity (Veh/hr)	RFC	Throughput (Veh/hr)	Throughput (exit side) (Veh/hr)	Start queue (Veh)	End queue (Veh)	Delay (min)	Unsignalised level of service
1 - A299 E	1255	314	113	1781	0.705	1271	1519	6.4	2.4	0.121	A
2 - Willetts Hill S	71	18	1243	1152	0.061	71	141	0.1	0.1	0.055	A
3 - A253 Canterbury Road (W)	428	107	1033	380	1.125	380	280	248.3	260.2	40.322	F
4 - A299 (N)	1051	263	446	1204	0.873	1198	968	201.3	164.6	9.174	F
5 - Seamark Road	66	17	1565	754	0.088	66	79	0.1	0.1	0.087	A

Appendix TR.4.29



Key

Existing based on Ordnance Survey map

Proposed scheme

Proposed secondary signal head with right turn indicative arrow

Intervisibility area

Highways boundary

DCO boundary

Visibility outside Highway Boundary

Visiblity outside DCO boundary

0 m 5 m

Scale 1:100 @ A3

Manston Airport DCO
Fourth Written Questions Responses

Appendix 4.29 - Junction 12 visibility

June 2019

wood.

R:\Projects\38199 Manston Airport DCO EIA\4 Design\AutoCAD\38199-Lon155C.dwg Originator: ADAM.GUY

Technical note:
Manston Airport DCO
Appendix Tr4.29ii

1. Introduction

1.1.1 This Technical Note has been produced in response to TR4.31 of the Examining Authority's Fourth Written Question TR4.29.ii. and provides the junction modelling with additional intergreen time to enable right turners to discharge with no opposing traffic.

1.1.2 The results are shown in Table 2.1 and the junction model output is included in Appendix A.

Table 1.1 Junction 12 – Additional Intergreen Results

	2039 Revised TA Baseline + Development				2039 Revised TA Baseline + Development + Additional Intergreen			
	AM		PM		AM		PM	
	MMQ	DOS	MMQ	DOS	MMQ	DOS	MMQ	DOS
Manston Road (North)	16.6	62.5	10.4	66.6	17.1	64.2	11..0	71
Manston Road (East)	3.1	23	6.4	82.6	3.1	26.1	7.1	87.7
Spitfire Way	28.4	82.5	19.2	84.1	29.4	84.8	20.5	87.7
Manston Road (West)	13.6	81.1	4.6	62.5	14.3	84.2	5	73.3
Total	61.7	-	40.6	-	63.9	-	32.6	-
PRC	9.1%		7.0%		6.2%		2.6%	

1.1.3 The results show marginal increases in queues and Degrees of Saturation, and demonstrate that the junction is operating within capacity.

Issued by

[redacted]

Approved by

[redacted]

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Third party disclaimer

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Management systems

This document has been produced by Wood Environment & Infrastructure Solutions UK Limited in full compliance with our management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Appendix A
LinSig Modelling

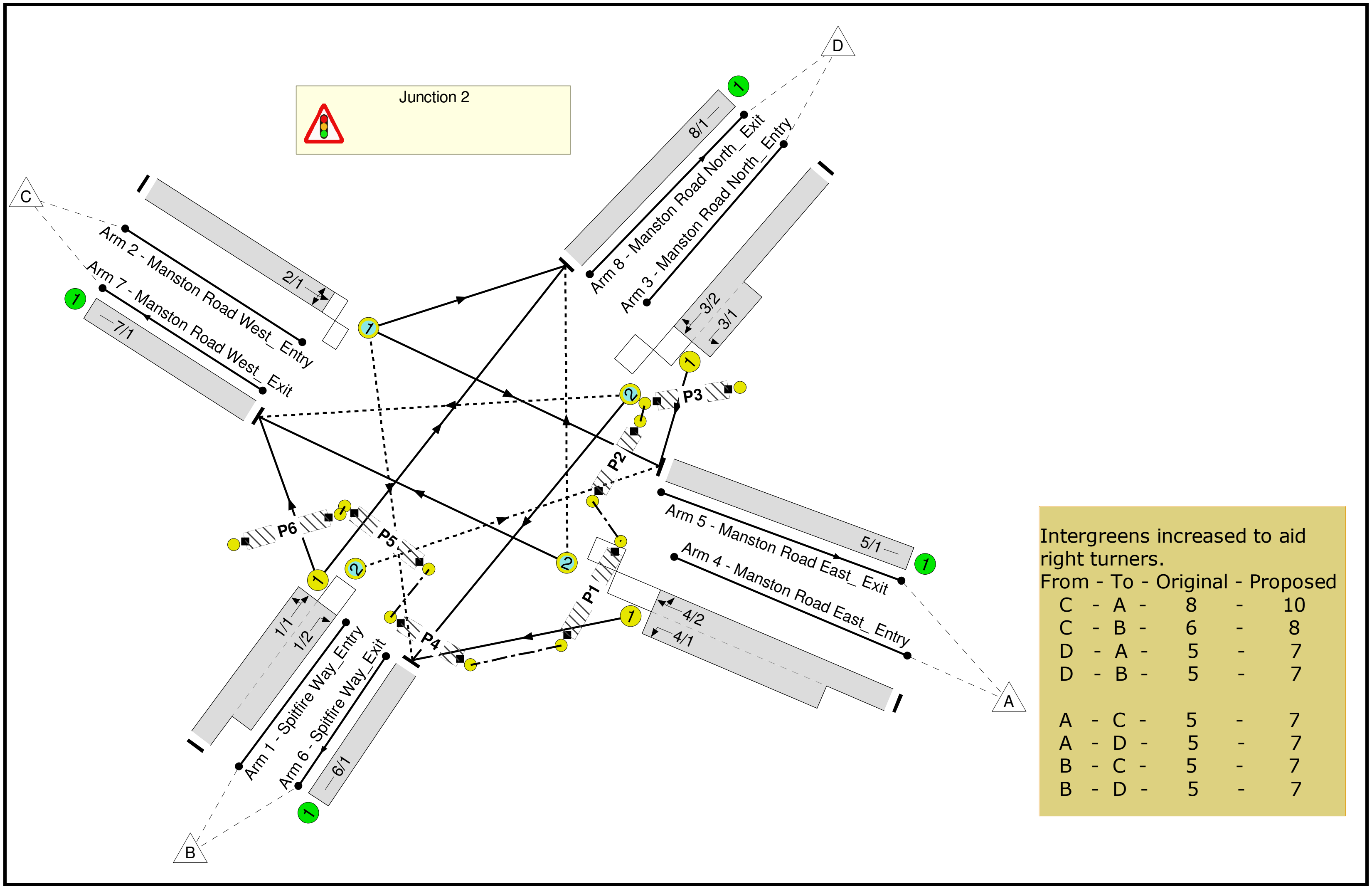
Full Input Data And Results

User and Project Details

Project:	
Title:	
Location:	
File name:	Spit_Manton Rd Prop Jct_RevD_Added 2s Intergreen.lsg3x
Author:	
Company:	
Address:	
Notes:	

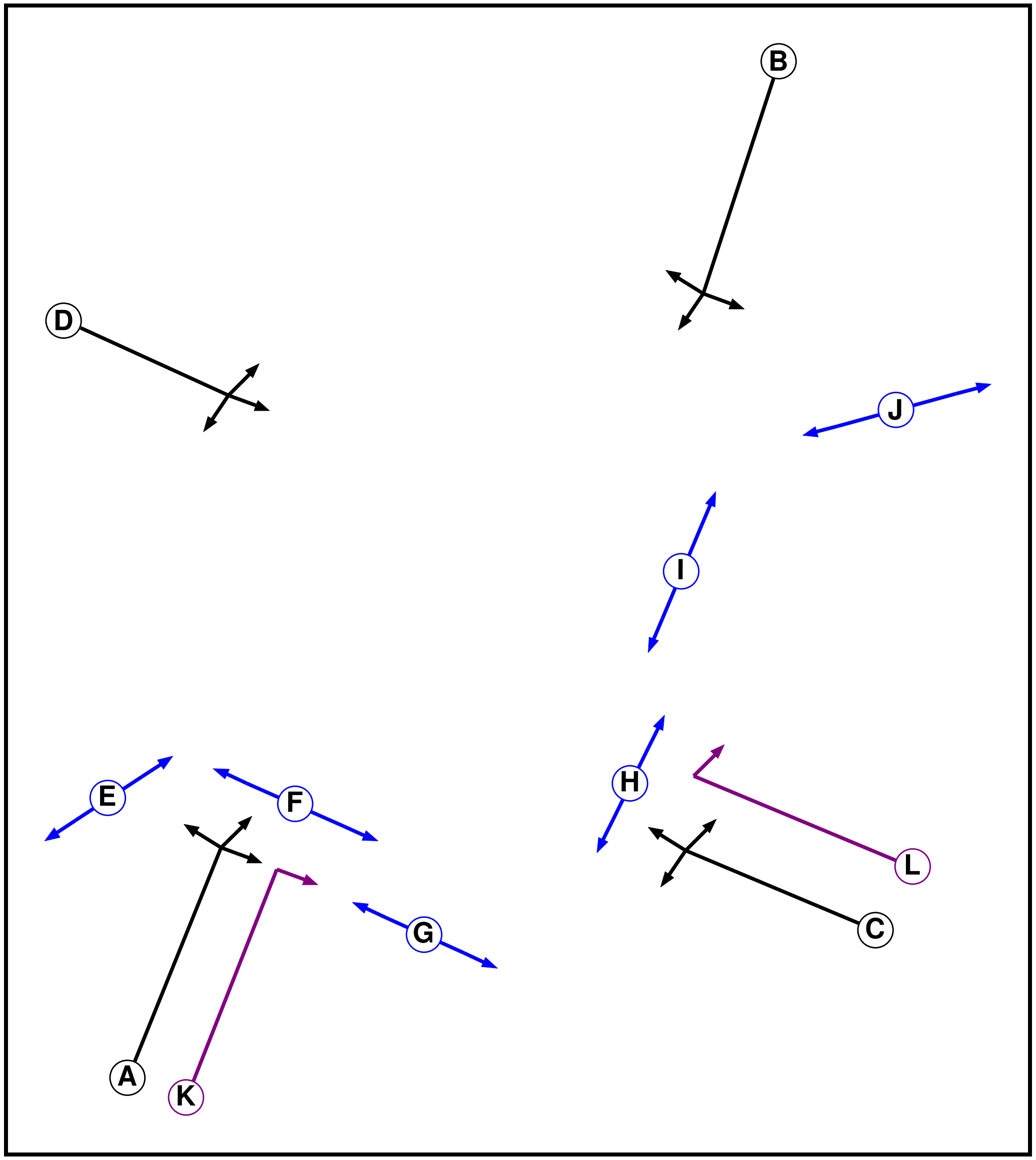
Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Full Input Data And Results

Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Traffic		7	7
E	Pedestrian		6	6
F	Pedestrian		7	7
G	Pedestrian		7	7
H	Pedestrian		7	7
I	Pedestrian		7	7
J	Pedestrian		7	7
K	Ind. Arrow	A	4	4
L	Ind. Arrow	C	4	4

Full Input Data And Results

Phase Intergreens Matrix

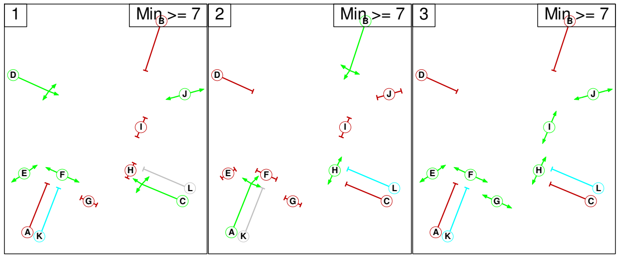
		Starting Phase											
		A	B	C	D	E	F	G	H	I	J	K	L
Terminating Phase	A		-	7	7	5	5	-	-	8	-	-	-
	B	-		7	7	-	-	9	-	-	5	-	-
	C	10	8		-	-	-	6	5	-	-	-	-
	D	7	7	-		-	-	8	-	8	-	-	-
	E	8	-	-	-		-	-	-	-	-	-	-
	F	8	-	-	-	-		-	-	-	-	-	-
	G	-	8	8	8	-	-		-	-	-	-	-
	H	-	-	8	-	-	-	-		-	-	-	-
	I	6	-	-	6	-	-	-	-		-	-	-
	J	-	6	-	-	-	-	-	-	-		-	-
	K	-	-	-	-	-	-	-	-	-	-		-
	L	-	-	-	-	-	-	-	-	-	-	-	

Phases in Stage

Stage No.	Phases in Stage
1	C D E F J
2	A B H
3	E F G H I J

Full Input Data And Results

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

From Stage \ To Stage	1	2	3
1		10	8
2	8		9
3	8	8	

Full Input Data And Results

Give-Way Lane Input Data

Junction: Junction 2												
Lane	**Movement**	**Max Flow when Giving Way (PCU/Hr)**	**Min Flow when Giving Way (PCU/Hr)**	**Opposing Lane**	**Opp. Lane Coeff.**	**Opp. Mvmnts.**	**Right Turn Storage (PCU)**	**Non-Blocking Storage (PCU)**	**RTF**	**Right Turn Move up (s)**	**Max Turns in Intergreen (PCU)**
1/2 (Spitfire Way_Entry)	5/1 (Right)	1440	0	3/2	1.09	To 6/1 (Ahead)	2.00	-	0.50	2	3.00
				3/1	1.09	All					
2/1 (Manston Road West_ Entry)	6/1 (Right)	1439	0	4/2	1.09	To 7/1 (Ahead)	2.00	1.00	0.50	2	1.00
				4/1	1.09	All					
3/2 (Manston Road North_ Entry)	7/1 (Right)	1439	0	1/1	1.09	All	4.00	2.00	0.50	4	3.00
4/2 (Manston Road East_ Entry)	8/1 (Right)	1439	0	2/1	1.09	To 5/1 (Ahead) To 8/1 (Left)	5.00	2.00	0.50	5	3.00

Full Input Data And Results

Lane Input Data

Junction: Junction 2												
Lane	**Lane Type**	**Phases**	**Start Disp.**	**End Disp.**	**Physical Length (PCU)**	**Sat Flow Type**	**Def User Saturation Flow (PCU/Hr)**	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Turns**	**Turning Radius (m)**
1/1 (Spitfire Way_Entry)	U	A	2	3	60.0	Geom	-	3.30	0.00	Y	Arm 7 Left	22.89
											Arm 8 Ahead	Inf
1/2 (Spitfire Way_Entry)	O	A K	2	3	11.0	Geom	-	2.93	0.00	Y	Arm 5 Right	22.91
2/1 (Manston Road West_ Entry)	O	D	2	3	60.0	Geom	-	4.18	0.00	Y	Arm 5 Ahead	66.37
											Arm 6 Right	13.30
											Arm 8 Left	15.38
3/1 (Manston Road North_ Entry)	U	B	2	3	5.0	Geom	-	5.00	0.00	Y	Arm 5 Left	11.68
3/2 (Manston Road North_ Entry)	O	B	2	3	60.0	Geom	-	3.00	0.00	Y	Arm 6 Ahead	Inf
											Arm 7 Right	23.83
4/1 (Manston Road East_ Entry)	U	C	2	3	12.0	Geom	-	3.00	0.00	Y	Arm 6 Left	32.95
4/2 (Manston Road East_ Entry)	O	C L	2	3	60.0	Geom	-	3.00	0.00	Y	Arm 7 Ahead	80.73
											Arm 8 Right	8.93
5/1 (Manston Road East_ Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
6/1 (Spitfire Way_Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
7/1 (Manston Road West_ Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
8/1 (Manston Road North_ Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-

Full Input Data And Results

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
1: '2039 + Dev + Link Road (AM)'	07:45	08:45	01:00	
2: '2039 + Dev + Lind Road (PM)'	16:45	17:45	01:00	

Scenario 1: '2039 + Dev + Link Road (AM)' (FG1: '2039 + Dev + Link Road (AM)', Plan 1: 'Network Control Plan')

Traffic Flows, Desired

Desired Flow :

	Destination					
Origin		A	B	C	D	Tot.
	A	0	103	1	10	114
	B	102	0	4	880	986
	C	177	40	0	144	361
	D	69	628	46	0	743
	Tot.	348	771	51	1034	2204

Traffic Lane Flows

Lane	Scenario 1: 2039 + Dev + Link Road (AM)
Junction: Junction 2	
1/1 (with short)	986(In) 884(Out)
1/2 (short)	102
2/1	361
3/1 (short)	69
3/2 (with short)	743(In) 674(Out)
4/1 (short)	103
4/2 (with short)	114(In) 11(Out)
5/1	348
6/1	771
7/1	51
8/1	1034

Full Input Data And Results

Lane Saturation Flows

Junction: Junction 2								
Lane	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Allowed Turns**	**Turning Radius (m)**	**Turning Prop.**	**Sat Flow (PCU/Hr)**	**Flared Sat Flow (PCU/Hr)**
1/1 (Spitfire Way_Entry)	3.30	0.00	Y	Arm 7 Left	22.89	0.5 %	1944	1944
				Arm 8 Ahead	Inf	99.5 %		
1/2 (Spitfire Way_Entry)	2.93	0.00	Y	Arm 5 Right	22.91	100.0 %	1791	1791
2/1 (Manston Road West_ Entry)	4.18	0.00	Y	Arm 5 Ahead	66.37	49.0 %	1913	1913
				Arm 6 Right	13.30	11.1 %		
				Arm 8 Left	15.38	39.9 %		
3/1 (Manston Road North_ Entry)	5.00	0.00	Y	Arm 5 Left	11.68	100.0 %	1874	1874
3/2 (Manston Road North_ Entry)	3.00	0.00	Y	Arm 6 Ahead	Inf	93.2 %	1907	1907
				Arm 7 Right	23.83	6.8 %		
4/1 (Manston Road East_ Entry)	3.00	0.00	Y	Arm 6 Left	32.95	100.0 %	1832	1832
4/2 (Manston Road East_ Entry)	3.00	0.00	Y	Arm 7 Ahead	80.73	9.1 %	1659	1659
				Arm 8 Right	8.93	90.9 %		
5/1 (Manston Road East_ Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
6/1 (Spitfire Way_Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
7/1 (Manston Road West_ Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
8/1 (Manston Road North_ Exit Lane 1)	Infinite Saturation Flow						Inf	Inf

Full Input Data And Results

Scenario 2: '2039 + Dev + Link Road (PM)' (FG2: '2039 + Dev + Lind Road (PM)', Plan 1: 'Network Control Plan')

Traffic Flows, Desired

Desired Flow :

	Destination					
Origin		A	B	C	D	Tot.
	A	0	86	172	27	285
	B	93	0	11	827	931
	C	83	24	0	76	183
	D	18	495	114	0	627
	Tot.	194	605	297	930	2026

Traffic Lane Flows

Lane	Scenario 2: 2039 + Dev + Link Road (PM)
Junction: Junction 2	
1/1 (with short)	931(In) 838(Out)
1/2 (short)	93
2/1	183
3/1 (short)	18
3/2 (with short)	627(In) 609(Out)
4/1 (short)	86
4/2 (with short)	285(In) 199(Out)
5/1	194
6/1	605
7/1	297
8/1	930

Full Input Data And Results

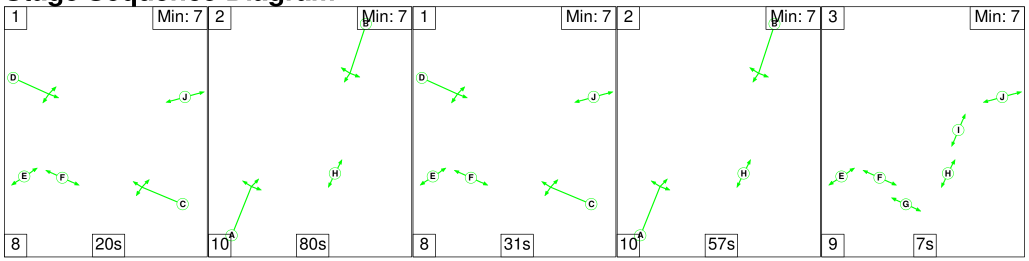
Lane Saturation Flows

Junction: Junction 2								
Lane	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Allowed Turns**	**Turning Radius (m)**	**Turning Prop.**	**Sat Flow (PCU/Hr)**	**Flared Sat Flow (PCU/Hr)**
1/1 (Spitfire Way_Entry)	3.30	0.00	Y	Arm 7 Left	22.89	1.3 %	1943	1943
				Arm 8 Ahead	Inf	98.7 %		
1/2 (Spitfire Way_Entry)	2.93	0.00	Y	Arm 5 Right	22.91	100.0 %	1791	1791
2/1 (Manston Road West_ Entry)	4.18	0.00	Y	Arm 5 Ahead	66.37	45.4 %	1908	1908
				Arm 6 Right	13.30	13.1 %		
				Arm 8 Left	15.38	41.5 %		
3/1 (Manston Road North_ Entry)	5.00	0.00	Y	Arm 5 Left	11.68	100.0 %	1874	1874
3/2 (Manston Road North_ Entry)	3.00	0.00	Y	Arm 6 Ahead	Inf	81.3 %	1893	1893
				Arm 7 Right	23.83	18.7 %		
4/1 (Manston Road East_ Entry)	3.00	0.00	Y	Arm 6 Left	32.95	100.0 %	1832	1832
4/2 (Manston Road East_ Entry)	3.00	0.00	Y	Arm 7 Ahead	80.73	86.4 %	1843	1843
				Arm 8 Right	8.93	13.6 %		
5/1 (Manston Road East_ Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
6/1 (Spitfire Way_Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
7/1 (Manston Road West_ Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
8/1 (Manston Road North_ Exit Lane 1)	Infinite Saturation Flow						Inf	Inf

Full Input Data And Results

Scenario 1: '2039 + Dev + Link Road (AM)' (FG1: '2039 + Dev + Link Road (AM)', Plan 1: 'Network Control Plan')

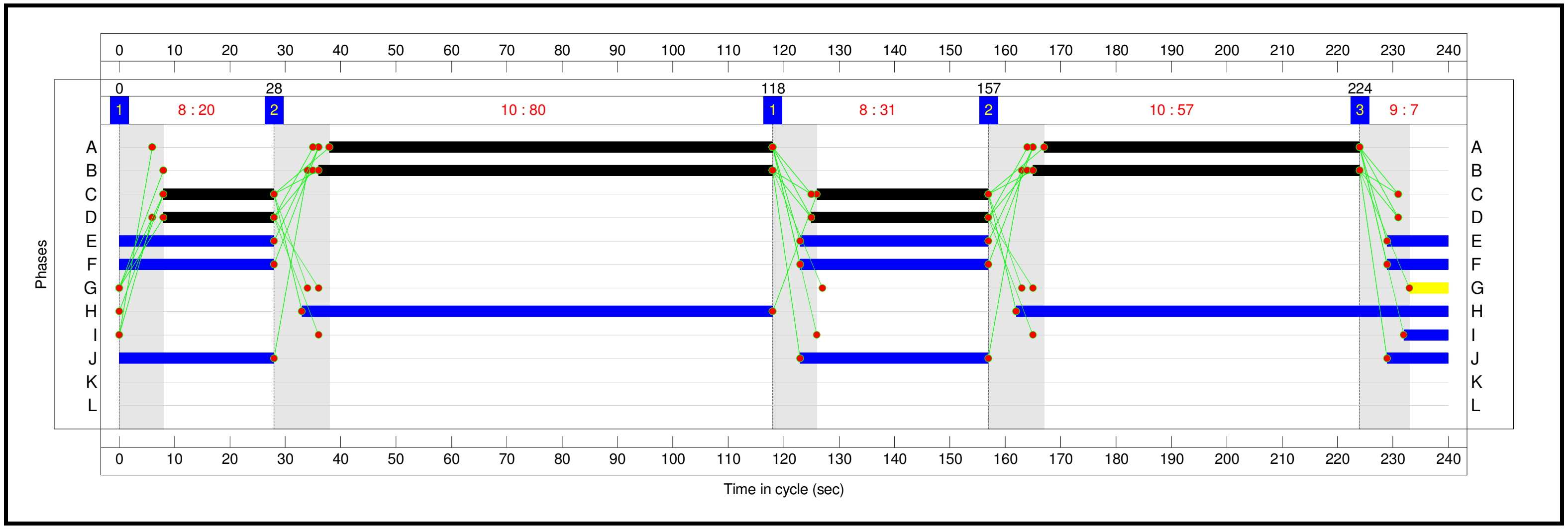
Stage Sequence Diagram



Stage Timings

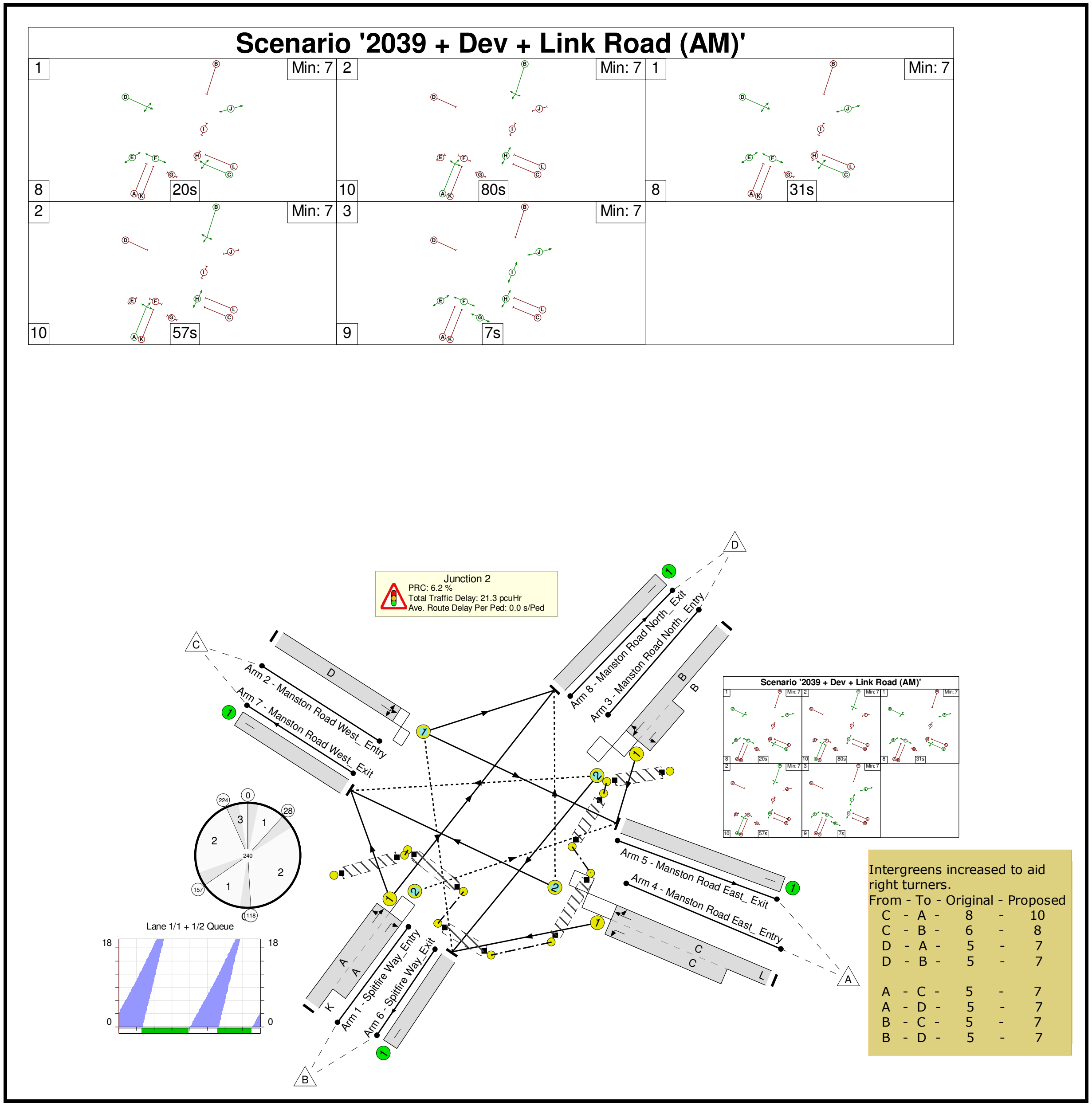
Stage	1	2	1	2	3
Duration	20	80	31	57	7
Change Point	0	28	118	157	224

Signal Timings Diagram



Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Network Results

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**84.8%**
Junction 2	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**84.8%**
1/1+1/2	Spitfire Way_Entry Right Left Ahead	U+O	N/A	N/A	A	K	2	137	0	986	1944:1791	1043+120	84.8 : 84.8%
2/1	Manston Road West_ Entry Ahead Right Left	O	N/A	N/A	D		2	52	-	361	1913	429	84.2%
3/2+3/1	Manston Road North_ Entry Left Ahead Right	O+U	N/A	N/A	B		2	141	-	743	1907:1874	1050+107	64.2 : 64.2%
4/2+4/1	Manston Road East_ Entry Left Ahead Right	O+U	N/A	N/A	C	L	2	51	0	114	1659:1832	42+395	26.1 : 26.1%
5/1	Manston Road East_ Exit	U	N/A	N/A	-		-	-	-	348	Inf	Inf	0.0%
6/1	Spitfire Way_Exit	U	N/A	N/A	-		-	-	-	771	Inf	Inf	0.0%
7/1	Manston Road West_ Exit	U	N/A	N/A	-		-	-	-	51	Inf	Inf	0.0%
8/1	Manston Road North_ Exit	U	N/A	N/A	-		-	-	-	1034	Inf	Inf	0.0%
Ped Link: P1	Unnamed Ped Link	-	N/A	-	H		2	163	-	0	-	0	0.0%
Ped Link: P2	Unnamed Ped Link	-	N/A	-	I		1	8	-	0	-	0	0.0%
Ped Link: P3	Unnamed Ped Link	-	N/A	-	J		2	73	-	0	-	0	0.0%
Ped Link: P4	Unnamed Ped Link	-	N/A	-	G		1	7	-	0	-	0	0.0%
Ped Link: P5	Unnamed Ped Link	-	N/A	-	F		2	73	-	0	-	0	0.0%
Ped Link: P6	Unnamed Ped Link	-	N/A	-	E		2	73	-	0	-	0	0.0%

Full Input Data And Results

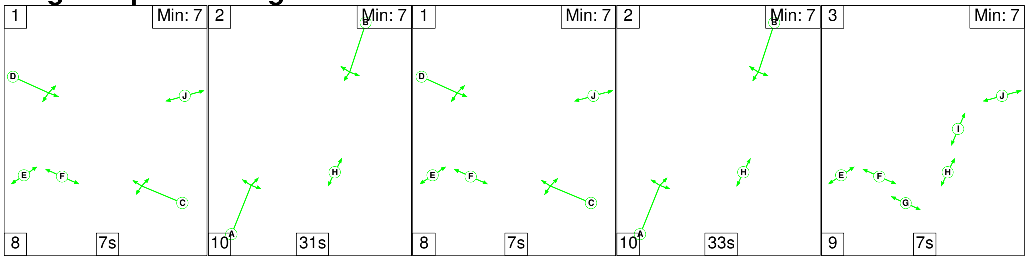
Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**191**	**0**	**7**	**14.2**	**6.3**	**0.8**	**21.3**	**-**	**-**	**-**	**-**
Junction 2	**-**	**-**	**191**	**0**	**7**	**14.2**	**6.3**	**0.8**	**21.3**	**-**	**-**	**-**	**-**
1/1+1/2	986	986	102	0	0	5.4	2.7	0.4	8.5	31.0	26.7	2.7	29.4
2/1	361	361	39	0	1	4.5	2.5	0.0	7.0	69.4	11.8	2.5	14.3
3/2+3/1	743	743	45	0	1	3.2	0.9	0.3	4.4	21.4	16.2	0.9	17.1
4/2+4/1	114	114	5	0	5	1.2	0.2	0.0	1.4	45.5	2.9	0.2	3.1
5/1	348	348	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	771	771	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	51	51	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	1034	1034	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
Ped Link: P1	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P2	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P3	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P4	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P5	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P6	0	0	-	-	-	-	-	-	-	-	-	-	-

C1 PRC for Signalled Lanes (%): 6.2 Total Delay for Signalled Lanes (pcuHr): 21.30 Cycle Time (s): 240
PRC Over All Lanes (%): 6.2 Total Delay Over All Lanes(pcuHr): 21.30

Full Input Data And Results

Scenario 2: '2039 + Dev + Link Road (PM)' (FG2: '2039 + Dev + Lind Road (PM)', Plan 1: 'Network Control Plan')

Stage Sequence Diagram

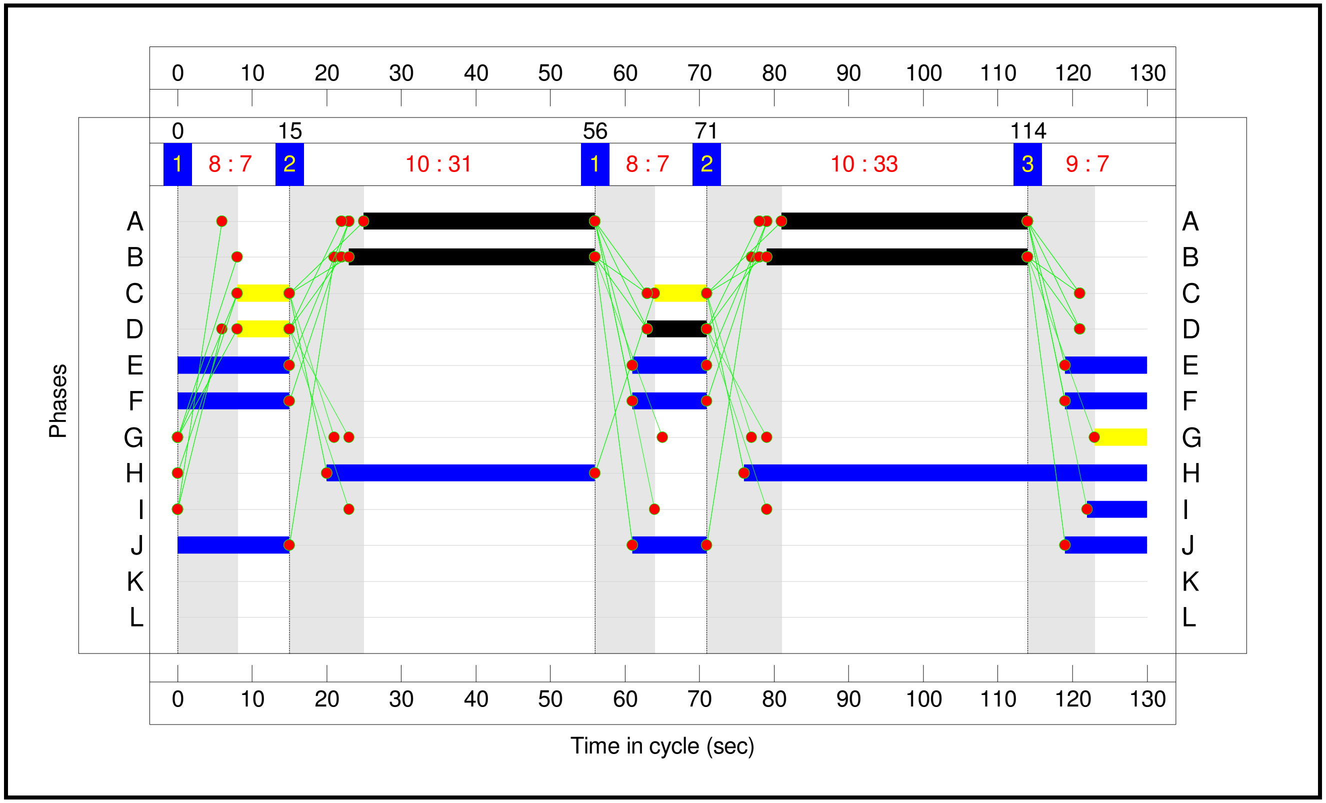


Stage Timings

Stage	1	2	1	2	3
Duration	7	31	7	33	7
Change Point	0	15	56	71	114

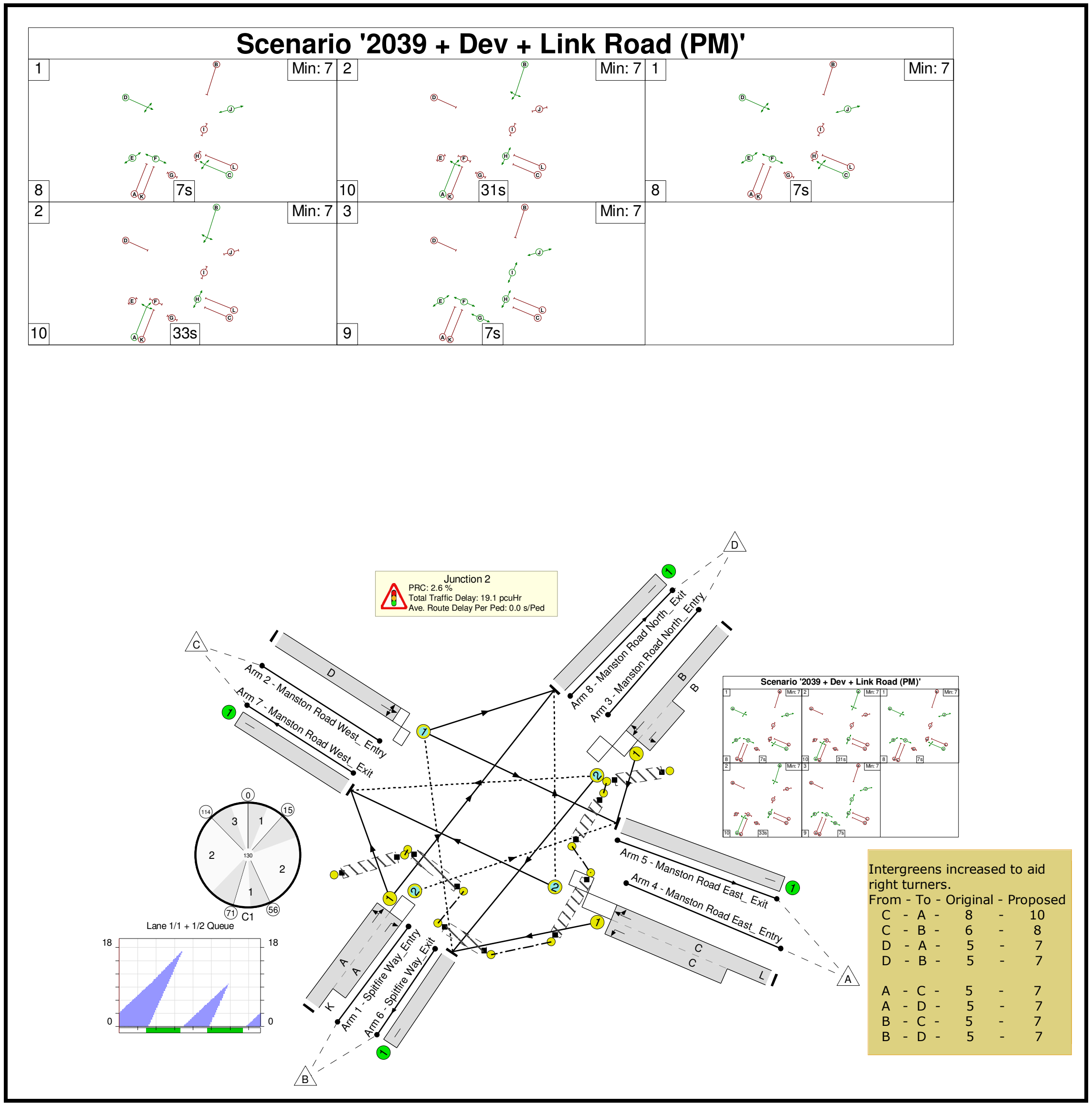
Full Input Data And Results

Signal Timings Diagram



Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Network Results

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**87.7%**
Junction 2	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**87.7%**
1/1+1/2	Spitfire Way_Entry Right Left Ahead	U+O	N/A	N/A	A	K	2	64	0	931	1943:1791	956+106	87.7 : 87.7%
2/1	Manston Road West_ Entry Ahead Right Left	O	N/A	N/A	D		2	15	-	183	1908	250	73.3%
3/2+3/1	Manston Road North_ Entry Left Ahead Right	O+U	N/A	N/A	B		2	68	-	627	1893:1874	857+25	71.0 : 71.0%
4/2+4/1	Manston Road East_ Entry Left Ahead Right	O+U	N/A	N/A	C	L	2	14	0	285	1843:1832	227+98	87.7 : 87.7%
5/1	Manston Road East_ Exit	U	N/A	N/A	-		-	-	-	194	Inf	Inf	0.0%
6/1	Spitfire Way_Exit	U	N/A	N/A	-		-	-	-	605	Inf	Inf	0.0%
7/1	Manston Road West_ Exit	U	N/A	N/A	-		-	-	-	297	Inf	Inf	0.0%
8/1	Manston Road North_ Exit	U	N/A	N/A	-		-	-	-	930	Inf	Inf	0.0%
Ped Link: P1	Unnamed Ped Link	-	N/A	-	H		2	90	-	0	-	0	0.0%
Ped Link: P2	Unnamed Ped Link	-	N/A	-	I		1	8	-	0	-	0	0.0%
Ped Link: P3	Unnamed Ped Link	-	N/A	-	J		2	36	-	0	-	0	0.0%
Ped Link: P4	Unnamed Ped Link	-	N/A	-	G		1	7	-	0	-	0	0.0%
Ped Link: P5	Unnamed Ped Link	-	N/A	-	F		2	36	-	0	-	0	0.0%
Ped Link: P6	Unnamed Ped Link	-	N/A	-	E		2	36	-	0	-	0	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network	**-**	**-**	**160**	**0**	**98**	**9.3**	**9.0**	**0.8**	**19.1**	**-**	**-**	**-**	**-**
Junction 2	**-**	**-**	**160**	**0**	**98**	**9.3**	**9.0**	**0.8**	**19.1**	**-**	**-**	**-**	**-**
1/1+1/2	931	931	93	0	0	3.7	3.4	0.2	7.3	28.3	17.1	3.4	20.5
2/1	183	183	10	0	14	1.4	1.3	0.0	2.8	54.5	3.7	1.3	5.0
3/2+3/1	627	627	49	0	65	1.9	1.2	0.5	3.7	21.1	9.8	1.2	11.0
4/2+4/1	285	285	8	0	19	2.2	3.1	0.0	5.3	67.5	4.0	3.1	7.1
5/1	194	194	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	605	605	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	297	297	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
8/1	930	930	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
Ped Link: P1	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P2	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P3	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P4	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P5	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P6	0	0	-	-	-	-	-	-	-	-	-	-	-

C1 PRC for Signalled Lanes (%): 2.6 Total Delay for Signalled Lanes (pcuHr): 19.10 Cycle Time (s): 130
PRC Over All Lanes (%): 2.6 Total Delay Over All Lanes(pcuHr): 19.10

Technical note:
Manston Airport DCO
Appendix TR4.31

1. Introduction

1.1.1 This Technical Note has been produced in response to TR4.31 of the Examining Authority's Fourth Written Question TR4.31.i:

KCC response to second written question TR.2.42 raised concern that the proposed scheme of mitigation (in the revised TA) results in significantly increased queue lengths on the College Road approach to the junction. The Applicant's response to third written question TR.3.29 sets out that:

"*The issue of queue lengths on College Road can be addressed by minor modifications to the signal timings if reductions in queuing on this arm is a priority*".

i. Provide evidence to show this would be the case.

2. Junction Modelling

2.1.1 A LinSig Model has been run with modifications to the signal timings to produce shorter queues on College Road. The results are presented in Table 2.1, which also shows the 2039 Base model results, and the model output is included in Appendix A.

Table 2.1 Junction 15 – Modelling Results

	2039 Base				2039 Base Development + Mitigation			
	AM		PM		AM		PM	
	MMQ	DOS	MMQ	DOS	MMQ	DOS	MMQ	DOS
College Rd	43	116.8	66	128.2	40.1	103.6	46.5	121
Manston Rd	183	141.8	89	109.8	196.5	146	25.4	98.8
Hartsdown Rd	216	144.2	174	171.3	131.7	122.8	87.7	119.2
Total	442		329		368.3		159.6	
PRC	-60.2		-90.4		-62.3		-34.5	

2.1.2 The results demonstrate reduced queuing along College Road in the AM peak hours.

Issued by

[redacted]

Approved by

[redacted] ....

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Third party disclaimer

Management systems

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Appendix A
LinSig Modelling

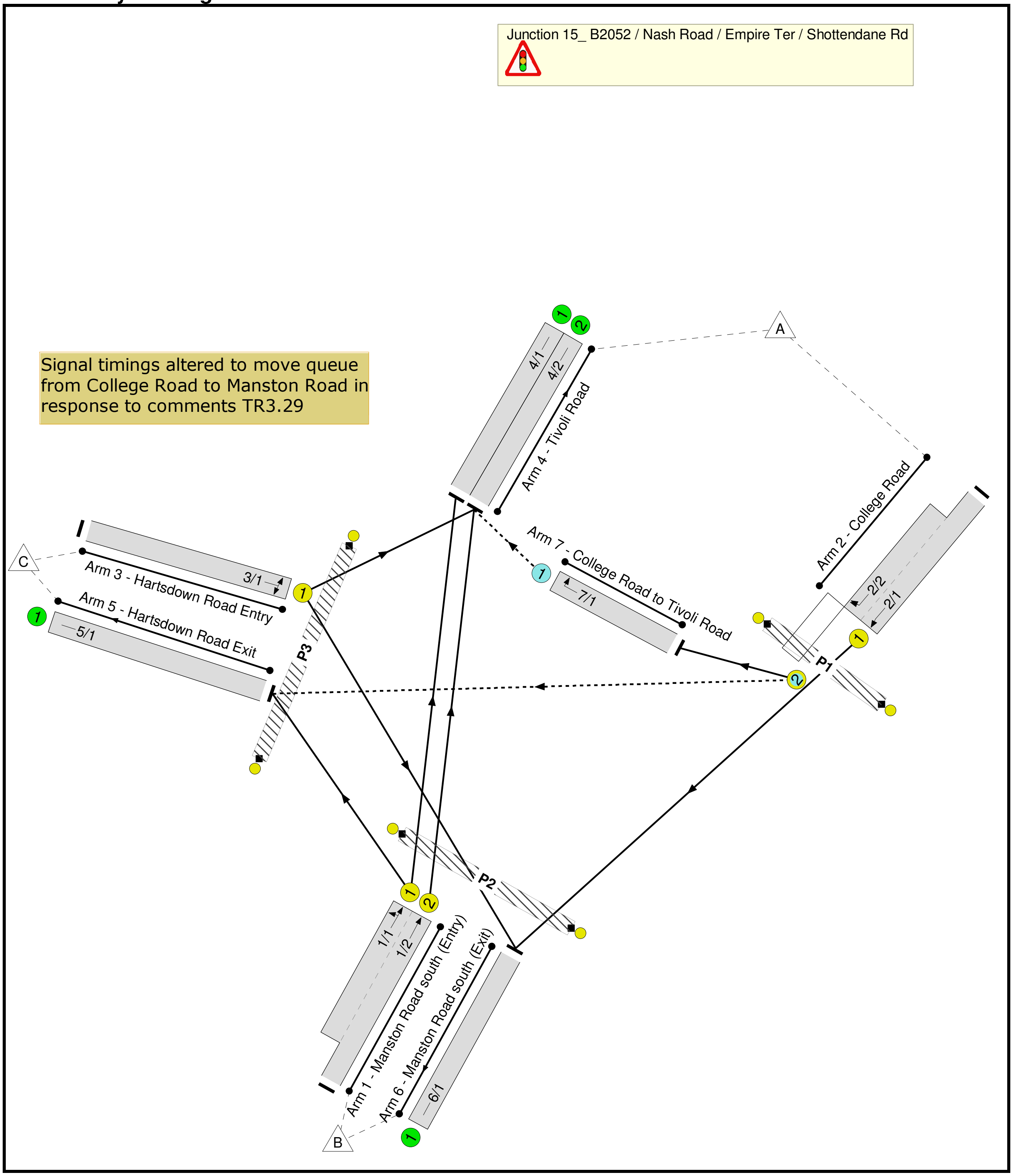
Full Input Data And Results

User and Project Details

Project:	**Manston Airport DCO EIA**
Title:	**Junction 15**
Location:	
File name:	Junction 15_Mitigation-No NashRd_LP_Mit_RevB.lsg3x
Author:	FOUDA
Company:	Wood
Address:	LEAMINGTON SPA- GABLES HOUSE, KENILWORTH-ROAD,WARWICKSHIRE CV32 6JX
Notes:	

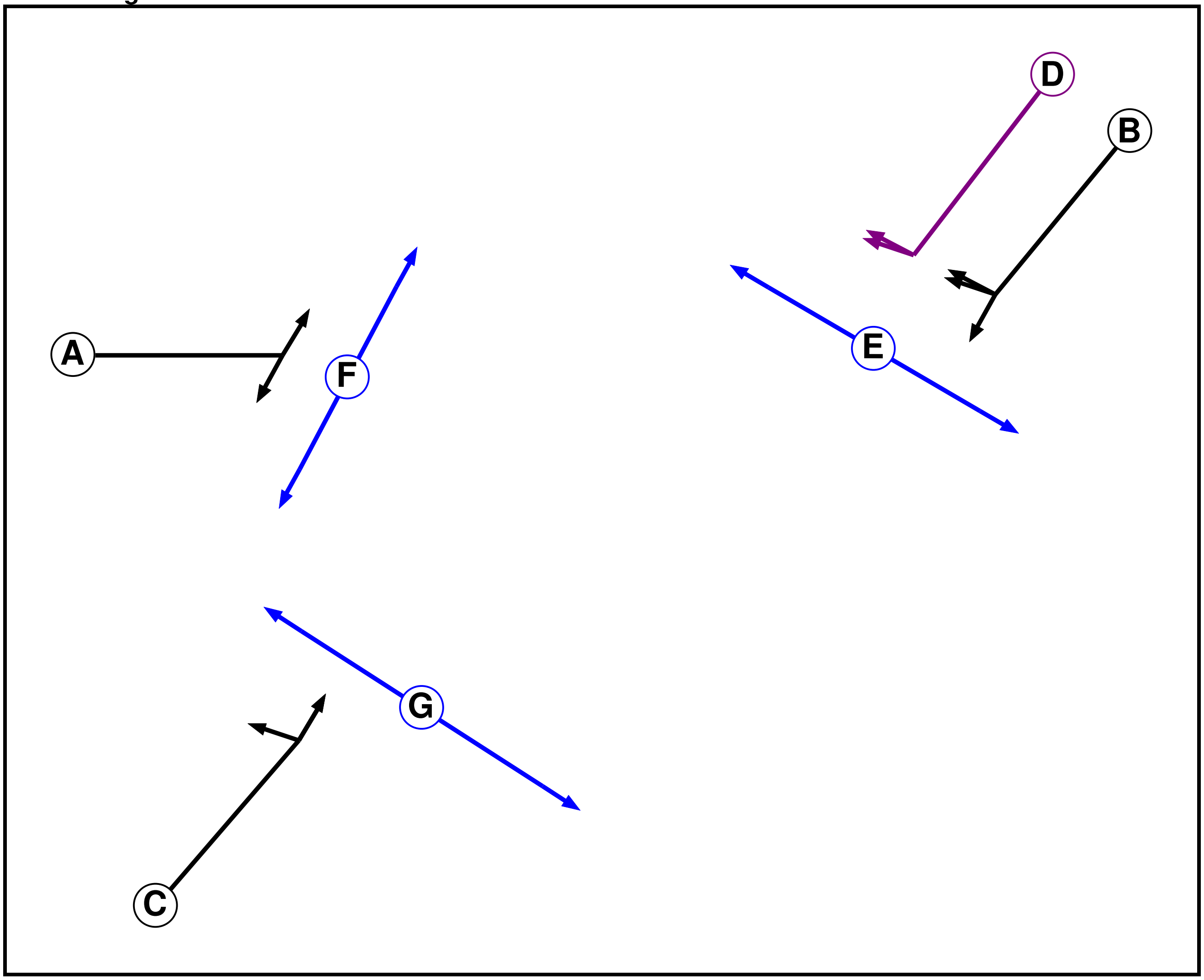
Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Phase Diagram



Phase Input Data

Phase Name	Phase Type	Assoc. Phase	Street Min	Cont Min
A	Traffic		7	7
B	Traffic		7	7
C	Traffic		7	7
D	Ind. Arrow	B	4	4
E	Pedestrian		6	6
F	Pedestrian		6	6
G	Pedestrian		6	6

Full Input Data And Results

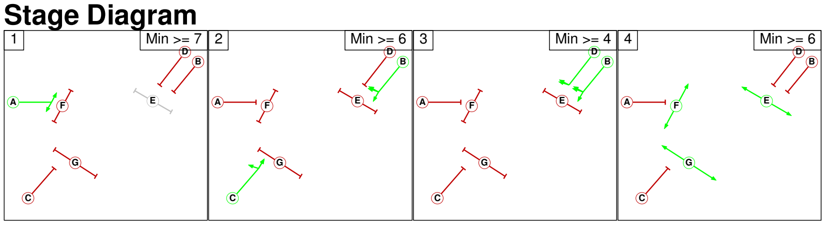
Phase Intergreens Matrix

Terminating Phase \ Starting Phase	A	B	C	D	E	F	G
A		6	5	5	-	5	10
B	5		-	-	5	-	9
C	5	-		5	-	9	6
D	5	-	5		5	11	-
E	-	8	-	8		-	-
F	10	-	10	10	-		-
G	13	13	13	-	-	-	

Phases in Stage

Stage No.	Phases in Stage
1	A
2	B C
3	B D
4	E F G

Stage Diagram



Phase Delays

Term. Stage	Start Stage	Phase	Type	Value	Cont value
There are no Phase Delays defined					

Prohibited Stage Change

From Stage \ To Stage	1	2	3	4
1		6	X	10
2	5		5	9
3	5	5		11
4	13	13	X	

Full Input Data And Results

Give-Way Lane Input Data

Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd											
Lane	**Movement**	**Max Flow when Giving Way (PCU/Hr)**	**Min Flow when Giving Way (PCU/Hr)**	**Opposing Lane**	**Opp. Lane Coeff.**	**Opp. Mvmnts.**	**Right Turn Storage (PCU)**	**Non-Blocking Storage (PCU)**	**RTF**	**Right Turn Move up (s)**	**Max Turns in Intergreen (PCU)**
2/2 (College Road)	5/1 (Right)	1439	0	1/1	1.09	All	5.00	5.00	0.50	5	3.00
				1/2	1.09	All					
7/1 (College Road to Tivoli Road)	4/2 (Right)	850	0	3/1	0.35	To 4/2 (Left)	-	-	-	-	-
				1/1	0.35	None					

Lane Input Data

Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd												
Lane	**Lane Type**	**Phases**	**Start Disp.**	**End Disp.**	**Physical Length (PCU)**	**Sat Flow Type**	**Def User Saturation Flow (PCU/Hr)**	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Turns**	**Turning Radius (m)**
1/1 (Manston Road south (Entry))	U	C	2	3	11.0	Geom	-	3.46	0.00	Y	Arm 4 Ahead	124.26
											Arm 5 Left	18.80
1/2 (Manston Road south (Entry))	U	C	2	3	60.0	Geom	-	3.25	0.00	N	Arm 4 Ahead	71.38
2/1 (College Road)	U	B	2	3	60.0	Geom	-	3.29	0.00	Y	Arm 6 Ahead	70.25
2/2 (College Road)	O	B D	2	3	13.0	Geom	-	3.31	0.00	Y	Arm 5 Right	14.18
											Arm 7 Right	9.40
3/1 (Hartsdown Road Entry)	U	A	2	3	60.0	Geom	-	3.68	0.00	Y	Arm 4 Left	12.64
											Arm 6 Right	24.22
4/1 (Tivoli Road)	U		2	3	60.0	Inf	-	-	-	-	-	-
4/2 (Tivoli Road)	U		2	3	60.0	Inf	-	-	-	-	-	-
5/1 (Hartsdown Road Exit)	U		2	3	60.0	Inf	-	-	-	-	-	-
6/1 (Manston Road south (Exit))	U		2	3	60.0	Inf	-	-	-	-	-	-
7/1 (College Road to Tivoli Road)	O		2	3	60.0	Geom	-	3.25	0.00	Y	Arm 4 Right	15.00

Traffic Flow Groups

Flow Group	Start Time	End Time	Duration	Formula
3: '2039 + Dev Traffic - AM Peak'	07:45	08:45	01:00	
4: '2039 + Dev Traffic - PM Peak'	16:45	17:45	01:00	

Scenario 1: '2039 AM Peak' (FG1: '2039 BASE AM', Plan 1: '2039 Base AM')

Traffic Flows, Desired

Desired Flow :

	Destination				
Origin		A	B	C	Tot.
	A	3	224	209	436
	B	764	0	208	972
	C	577	514	0	1091
	Tot.	1344	738	417	2499

Traffic Lane Flows

Lane	Scenario 1: 2039 AM Peak
Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	
1/1 (short)	397
1/2 (with short)	972(In) 575(Out)
2/1 (with short)	436(In) 224(Out)
2/2 (short)	212
3/1	1091
4/1	189
4/2	1155
5/1	417
6/1	738
7/1	3

Lane Saturation Flows

Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd								
Lane	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Allowed Turns**	**Turning Radius (m)**	**Turning Prop.**	**Sat Flow (PCU/Hr)**	**Flared Sat Flow (PCU/Hr)**
1/1 (Manston Road south (Entry))	3.46	0.00	Y	Arm 4 Ahead	124.26	47.6 %	1872	1872
				Arm 5 Left	18.80	52.4 %		
1/2 (Manston Road south (Entry))	3.25	0.00	N	Arm 4 Ahead	71.38	100.0 %	2037	2037
2/1 (College Road)	3.29	0.00	Y	Arm 6 Ahead	70.25	100.0 %	1903	1903
2/2 (College Road)	3.31	0.00	Y	Arm 5 Right	14.18	98.6 %	1759	1759
				Arm 7 Right	9.40	1.4 %		
3/1 (Hartsdown Road Entry)	3.68	0.00	Y	Arm 4 Left	12.64	52.9 %	1816	1816
				Arm 6 Right	24.22	47.1 %		
4/1 (Tivoli Road Lane 1)	Infinite Saturation Flow						Inf	Inf
4/2 (Tivoli Road Lane 2)	Infinite Saturation Flow						Inf	Inf
5/1 (Hartsdown Road Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
6/1 (Manston Road south (Exit) Lane 1)	Infinite Saturation Flow						Inf	Inf
7/1 (College Road to Tivoli Road)	3.25	0.00	Y	Arm 4 Right	15.00	100.0 %	1764	1764

Scenario 2: '2039 PM Peak' (FG2: '2039 BASE PM', Plan 2: '2039 Base PM')

Traffic Flows, Desired

Desired Flow :

	Destination				
Origin		A	B	C	Tot.
	A	12	250	228	490
	B	818	0	275	1093
	C	435	235	0	670
	Tot.	1265	485	503	2253

Traffic Lane Flows

Lane	Scenario 2: 2039 PM Peak
Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	
1/1 (short)	456
1/2 (with short)	1093(In) 637(Out)
2/1 (with short)	490(In) 250(Out)
2/2 (short)	240
3/1	670
4/1	181
4/2	1084
5/1	503
6/1	485
7/1	12

Lane Saturation Flows

Lane	Lane Width (m)	Gradient	Nearside Lane	Allowed Turns	Turning Radius (m)	Turning Prop.	Sat Flow (PCU/Hr)	Flared Sat Flow (PCU/Hr)
Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd								
1/1 (Manston Road south (Entry))	3.46	0.00	Y	Arm 4 Ahead	124.26	39.7 %	1862	1862
				Arm 5 Left	18.80	60.3 %		
1/2 (Manston Road south (Entry))	3.25	0.00	N	Arm 4 Ahead	71.38	100.0 %	2037	2037
2/1 (College Road)	3.29	0.00	Y	Arm 6 Ahead	70.25	100.0 %	1903	1903
2/2 (College Road)	3.31	0.00	Y	Arm 5 Right	14.18	95.0 %	1756	1756
				Arm 7 Right	9.40	5.0 %		
3/1 (Hartsdown Road Entry)	3.68	0.00	Y	Arm 4 Left	12.64	64.9 %	1805	1805
				Arm 6 Right	24.22	35.1 %		
4/1 (Tivoli Road Lane 1)	Infinite Saturation Flow						Inf	Inf
4/2 (Tivoli Road Lane 2)	Infinite Saturation Flow						Inf	Inf
5/1 (Hartsdown Road Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
6/1 (Manston Road south (Exit) Lane 1)	Infinite Saturation Flow						Inf	Inf
7/1 (College Road to Tivoli Road)	3.25	0.00	Y	Arm 4 Right	15.00	100.0 %	1764	1764

Scenario 3: '2039 + Dev Traffic - AM Peak' (FG3: '2039 + Dev Traffic - AM Peak', Plan 3: '2039 B+D AM')

Traffic Flows, Desired

Desired Flow :

	Destination				
		A	B	C	Tot.
Origin	A	3	244	234	481
	B	802	0	229	1031
	C	517	545	0	1062
	Tot.	1322	789	463	2574

Traffic Lane Flows

Lane	Scenario 3: 2039 + Dev Traffic - AM Peak
Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	
1/1 (short)	436
1/2 (with short)	1031(In) 595(Out)
2/1 (with short)	481(In) 244(Out)
2/2 (short)	237
3/1	1062
4/1	207
4/2	1115
5/1	463
6/1	789
7/1	3

Lane Saturation Flows

Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd								
Lane	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Allowed Turns**	**Turning Radius (m)**	**Turning Prop.**	**Sat Flow (PCU/Hr)**	**Flared Sat Flow (PCU/Hr)**
1/1 (Manston Road south (Entry))	3.46	0.00	Y	Arm 4 Ahead	124.26	47.5 %	1872	1872
				Arm 5 Left	18.80	52.5 %		
1/2 (Manston Road south (Entry))	3.25	0.00	N	Arm 4 Ahead	71.38	100.0 %	2037	2037
2/1 (College Road)	3.29	0.00	Y	Arm 6 Ahead	70.25	100.0 %	1903	1903
2/2 (College Road)	3.31	0.00	Y	Arm 5 Right	14.18	98.7 %	1759	1759
				Arm 7 Right	9.40	1.3 %		
3/1 (Hartsdown Road Entry)	3.68	0.00	Y	Arm 4 Left	12.64	48.7 %	1820	1820
				Arm 6 Right	24.22	51.3 %		
4/1 (Tivoli Road Lane 1)	Infinite Saturation Flow						Inf	Inf
4/2 (Tivoli Road Lane 2)	Infinite Saturation Flow						Inf	Inf
5/1 (Hartsdown Road Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
6/1 (Manston Road south (Exit) Lane 1)	Infinite Saturation Flow						Inf	Inf
7/1 (College Road to Tivoli Road)	3.25	0.00	Y	Arm 4 Right	15.00	100.0 %	1764	1764

Scenario 4: '2039 + Dev Traffic - PM Peak' (FG4: '2039 + Dev Traffic - PM Peak', Plan 4: '2039 B+D PM')

Traffic Flows, Desired

Desired Flow :

	Destination				
		A	B	C	Tot.
Origin	A	5	230	222	457
	B	791	0	292	1083
	C	518	252	0	770
	Tot.	1314	482	514	2310

Traffic Lane Flows

Lane	Scenario 4: 2039 + Dev Traffic - PM Peak
Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	
1/1 (short)	453
1/2 (with short)	1083(In) 630(Out)
2/1 (with short)	457(In) 230(Out)
2/2 (short)	227
3/1	770
4/1	161
4/2	1153
5/1	514
6/1	482
7/1	5

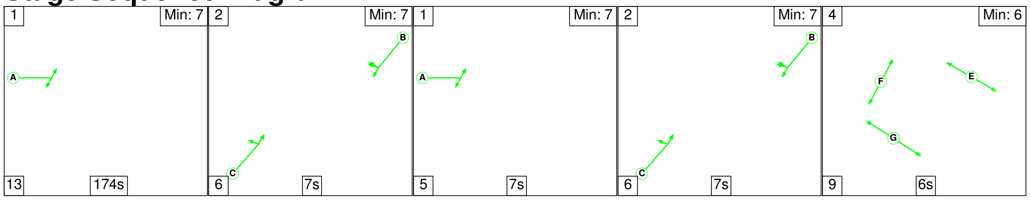
Lane Saturation Flows

Junction: Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd								
Lane	**Lane Width (m)**	**Gradient**	**Nearside Lane**	**Allowed Turns**	**Turning Radius (m)**	**Turning Prop.**	**Sat Flow (PCU/Hr)**	**Flared Sat Flow (PCU/Hr)**
1/1 (Manston Road south (Entry))	3.46	0.00	Y	Arm 4 Ahead	124.26	35.5 %	1857	1857
				Arm 5 Left	18.80	64.5 %		
1/2 (Manston Road south (Entry))	3.25	0.00	N	Arm 4 Ahead	71.38	100.0 %	2037	2037
2/1 (College Road)	3.29	0.00	Y	Arm 6 Ahead	70.25	100.0 %	1903	1903
2/2 (College Road)	3.31	0.00	Y	Arm 5 Right	14.18	97.8 %	1758	1758
				Arm 7 Right	9.40	2.2 %		
3/1 (Hartsdown Road Entry)	3.68	0.00	Y	Arm 4 Left	12.64	67.3 %	1803	1803
				Arm 6 Right	24.22	32.7 %		
4/1 (Tivoli Road Lane 1)	Infinite Saturation Flow						Inf	Inf
4/2 (Tivoli Road Lane 2)	Infinite Saturation Flow						Inf	Inf
5/1 (Hartsdown Road Exit Lane 1)	Infinite Saturation Flow						Inf	Inf
6/1 (Manston Road south (Exit) Lane 1)	Infinite Saturation Flow						Inf	Inf
7/1 (College Road to Tivoli Road)	3.25	0.00	Y	Arm 4 Right	15.00	100.0 %	1764	1764

Full Input Data And Results

Scenario 1: '2039 AM Peak' (FG1: '2039 BASE AM', Plan 1: '2039 Base AM')

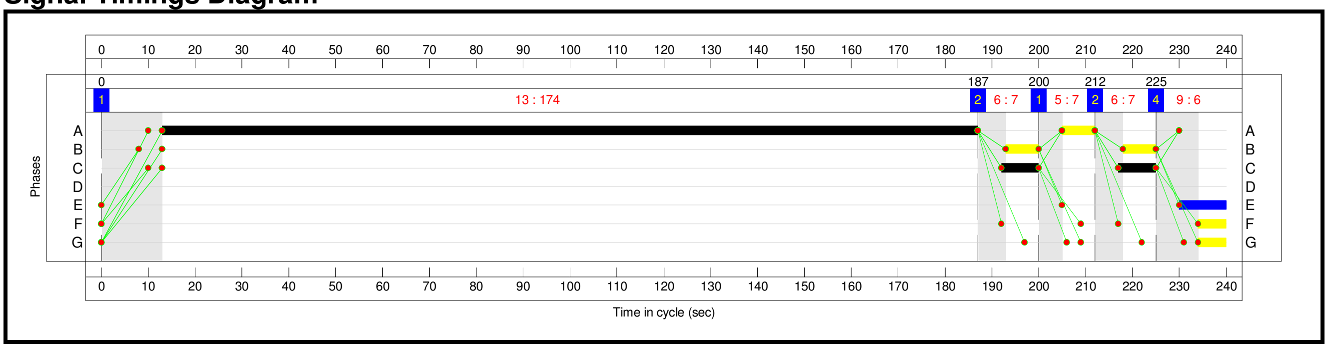
Stage Sequence Diagram



Stage Timings

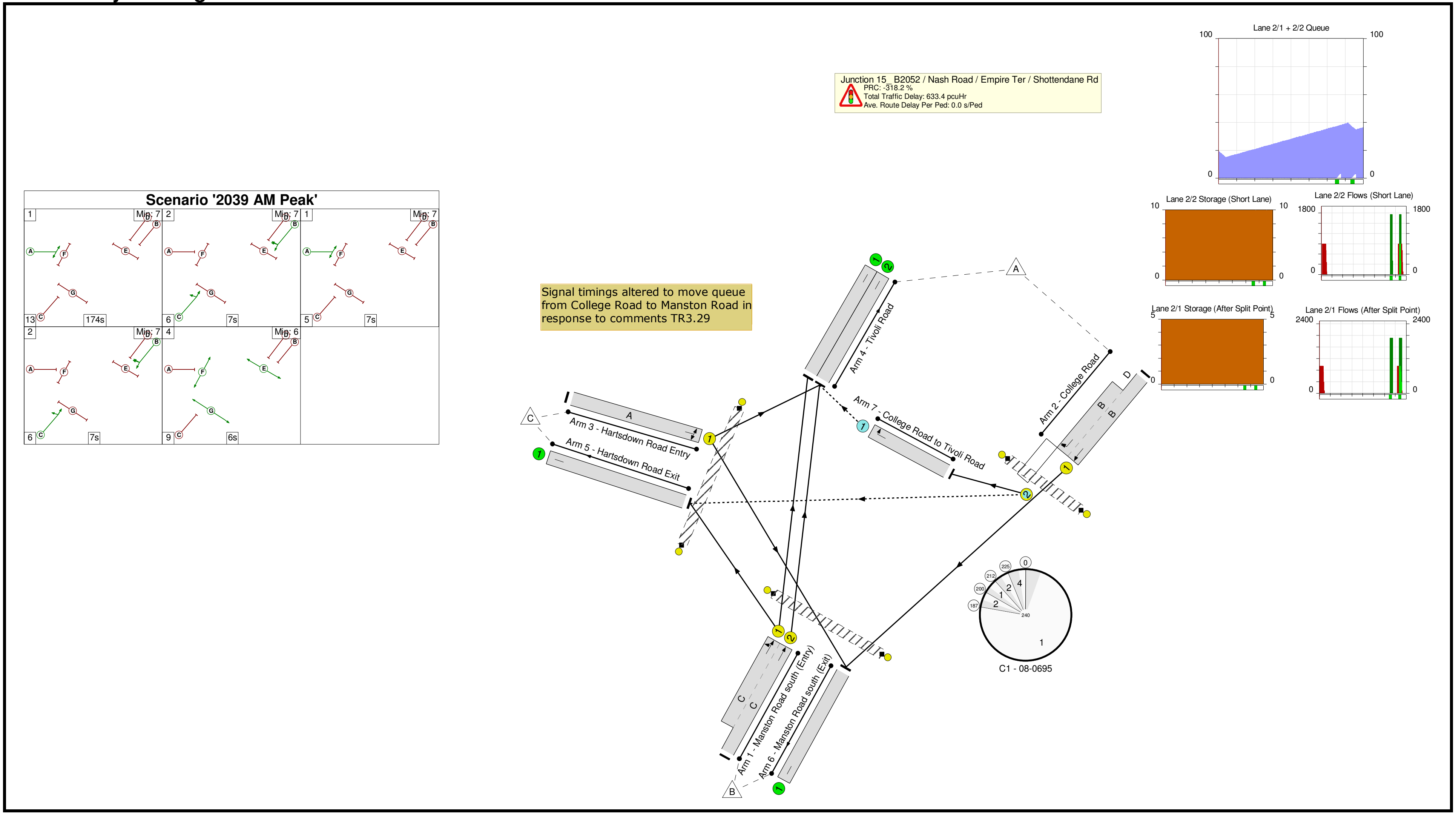
Stage	1	2	1	2	4
Duration	174	7	7	7	6
Change Point	0	187	200	212	225

Signal Timings Diagram



Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Network Results

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Junction 15	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**376.4%**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**376.4%**
1/2+1/1	Manston Road south (Entry) Ahead Left	U	N/A	N/A	C		2	16	-	972	2037:1872	153+105	376.4 : 376.4%
2/1+2/2	College Road Right Ahead Right2	U+O	N/A	N/A	B	D	2	14	0	436	1903:1759	127+91	176.6 : 232.2%
3/1	Hartsdown Road Entry Left Right	U	N/A	N/A	A		2	181	-	1091	1816	1385	78.8%
4/1	Tivoli Road	U	N/A	N/A	-		-	-	-	189	Inf	Inf	0.0%
4/2	Tivoli Road	U	N/A	N/A	-		-	-	-	1155	Inf	Inf	0.0%
5/1	Hartsdown Road Exit	U	N/A	N/A	-		-	-	-	417	Inf	Inf	0.0%
6/1	Manston Road south (Exit)	U	N/A	N/A	-		-	-	-	738	Inf	Inf	0.0%
7/1	College Road to Tivoli Road Right	O	N/A	N/A	-		-	-	-	3	1764	648	0.2%
Ped Link: P1	Unnamed Ped Link	-	N/A	-	E		1	10	-	0	-	0	0.0%
Ped Link: P2	Unnamed Ped Link	-	N/A	-	G		1	6	-	0	-	0	0.0%
Ped Link: P3	Unnamed Ped Link	-	N/A	-	F		1	6	-	0	-	0	0.0%

Full Input Data And Results

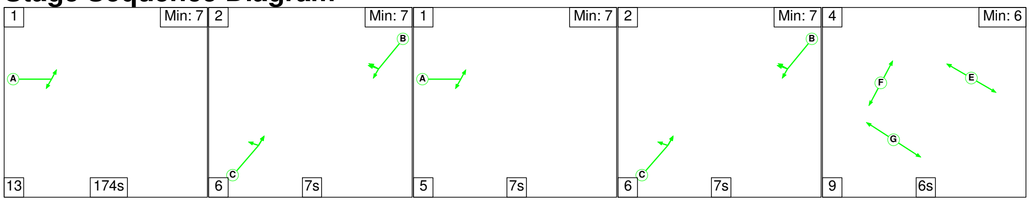
Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Junction 15	**-**	**-**	**0**	**1**	**90**	**162.0**	**469.3**	**2.1**	**633.4**	**-**	**-**	**-**	**-**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**0**	**1**	**90**	**162.0**	**469.3**	**2.1**	**633.4**	**-**	**-**	**-**	**-**
1/2+1/1	972	258	-	-	-	119.3	357.6	-	476.8	1765.9	142.4	357.6	499.9
2/1+2/2	436	218	0	0	90	38.3	109.9	2.1	150.3	1241.0	39.8	109.9	149.7
3/1	1091	1091	-	-	-	4.5	1.8	-	6.3	20.8	39.0	1.8	40.8
4/1	50	50	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
4/2	731	731	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	145	145	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	641	641	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	1	1	0	1	0	0.0	0.0	-	0.0	2.8	0.0	0.0	0.0
Ped Link: P1	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P2	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P3	0	0	-	-	-	-	-	-	-	-	-	-	-

C1 - 08-0695 PRC for Signalled Lanes (%): -318.2 Total Delay for Signalled Lanes (pcuHr): 633.40 Cycle Time (s): 240
PRC Over All Lanes (%): -318.2 Total Delay Over All Lanes(pcuHr): 633.40

Full Input Data And Results

Scenario 2: '2039 PM Peak' (FG2: '2039 BASE PM', Plan 2: '2039 Base PM')

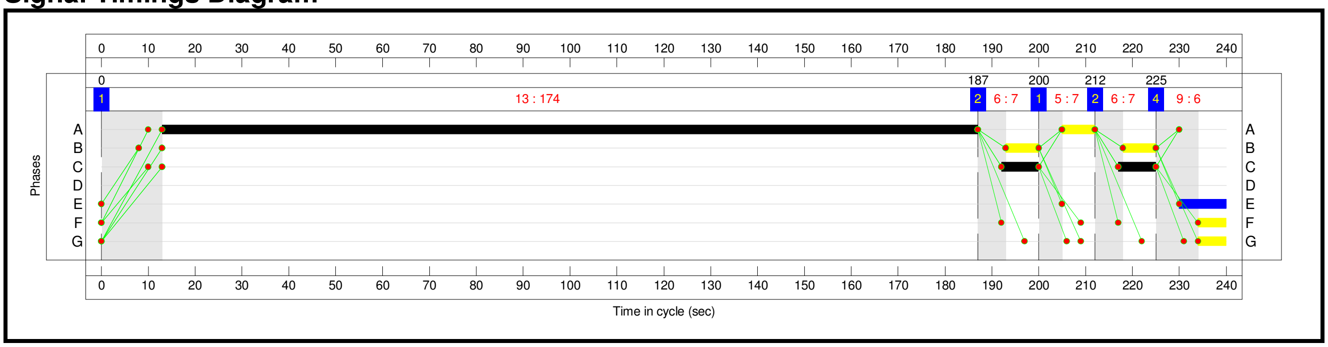
Stage Sequence Diagram



Stage Timings

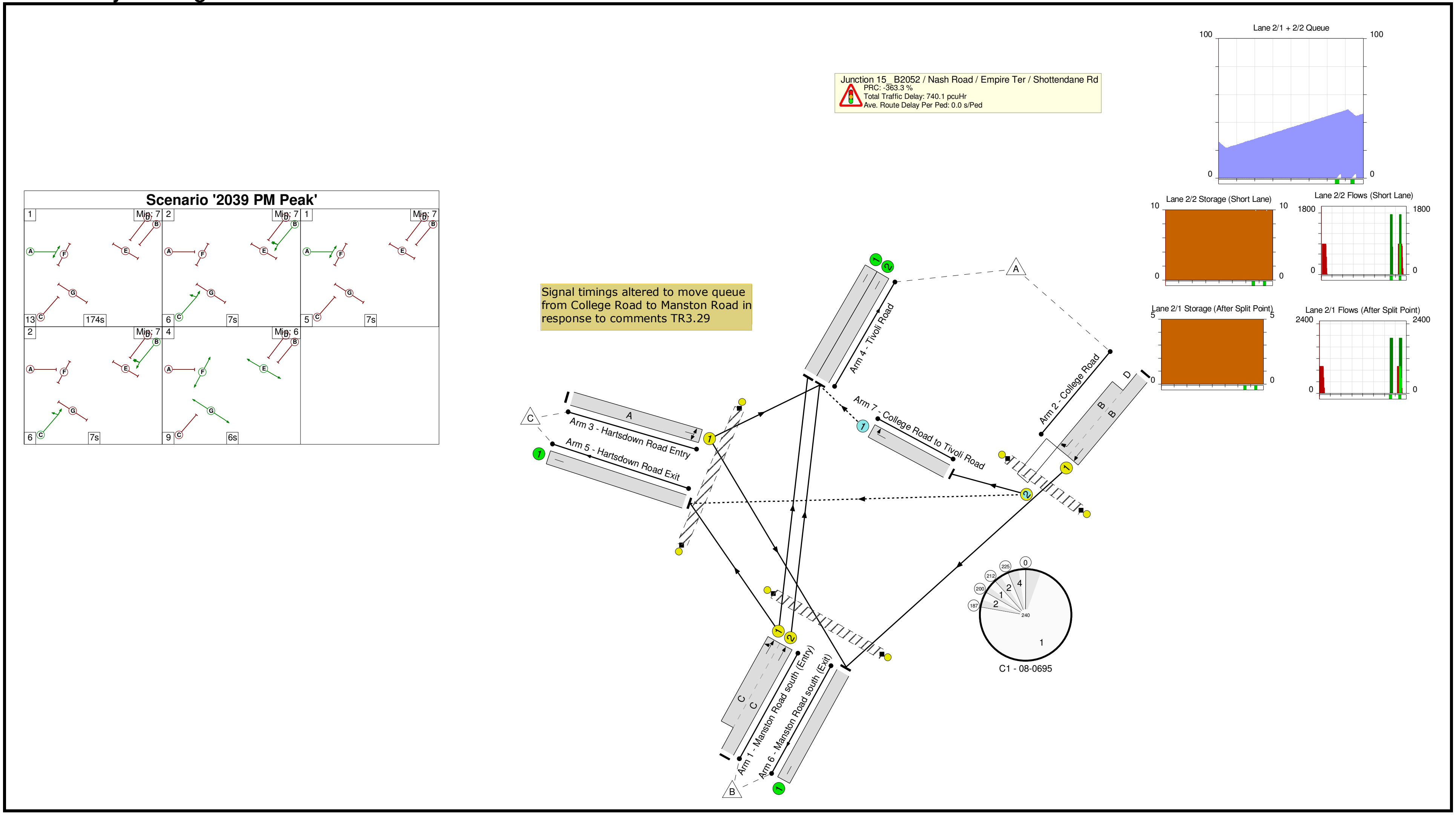
Stage	1	2	1	2	4
Duration	174	7	7	7	6
Change Point	0	187	200	212	225

Signal Timings Diagram



Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Network Results

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Junction 15	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**417.0%**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**417.0%**
1/2+1/1	Manston Road south (Entry) Ahead Left	U	N/A	N/A	C		2	16	-	1093	2037:1862	153+109	417.0 : 417.0%
2/1+2/2	College Road Right Ahead Right2	U+O	N/A	N/A	B	D	2	14	0	490	1903:1756	127+95	197.1 : 253.3%
3/1	Hartsdown Road Entry Left Right	U	N/A	N/A	A		2	181	-	670	1805	1376	48.7%
4/1	Tivoli Road	U	N/A	N/A	-		-	-	-	181	Inf	Inf	0.0%
4/2	Tivoli Road	U	N/A	N/A	-		-	-	-	1084	Inf	Inf	0.0%
5/1	Hartsdown Road Exit	U	N/A	N/A	-		-	-	-	503	Inf	Inf	0.0%
6/1	Manston Road south (Exit)	U	N/A	N/A	-		-	-	-	485	Inf	Inf	0.0%
7/1	College Road to Tivoli Road Right	O	N/A	N/A	-		-	-	-	12	1764	698	0.7%
Ped Link: P1	Unnamed Ped Link	-	N/A	-	E		1	10	-	0	-	0	0.0%
Ped Link: P2	Unnamed Ped Link	-	N/A	-	G		1	6	-	0	-	0	0.0%
Ped Link: P3	Unnamed Ped Link	-	N/A	-	F		1	6	-	0	-	0	0.0%

Full Input Data And Results

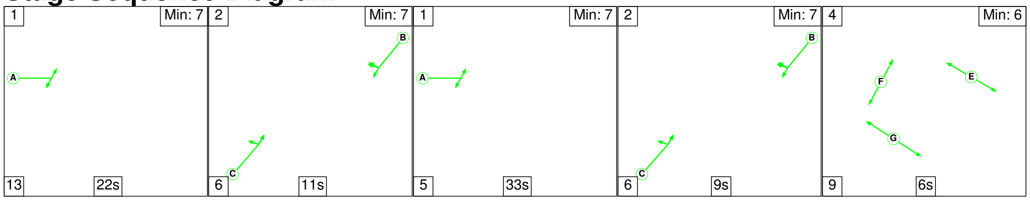
Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Junction 15	**-**	**-**	**0**	**5**	**90**	**186.3**	**551.7**	**2.1**	**740.1**	**-**	**-**	**-**	**-**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**0**	**5**	**90**	**186.3**	**551.7**	**2.1**	**740.1**	**-**	**-**	**-**	**-**
1/2+1/1	1093	262	-	-	-	138.5	416.1	-	554.6	1826.6	164.5	416.1	580.6
2/1+2/2	490	222	0	0	90	46.5	135.1	2.1	183.7	1349.9	49.3	135.1	184.4
3/1	670	670	-	-	-	1.3	0.5	-	1.8	9.7	12.7	0.5	13.2
4/1	43	43	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
4/2	593	593	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	156	156	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	362	362	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	5	5	0	5	0	0.0	0.0	-	0.0	2.6	0.0	0.0	0.0
Ped Link: P1	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P2	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P3	0	0	-	-	-	-	-	-	-	-	-	-	-

C1 - 08-0695 PRC for Signalled Lanes (%): -363.3 Total Delay for Signalled Lanes (pcuHr): 740.13 Cycle Time (s): 240
PRC Over All Lanes (%): -363.3 Total Delay Over All Lanes(pcuHr): 740.13

Full Input Data And Results

Scenario 3: '2039 + Dev Traffic - AM Peak' (FG3: '2039 + Dev Traffic - AM Peak', Plan 3: '2039 B+D AM')

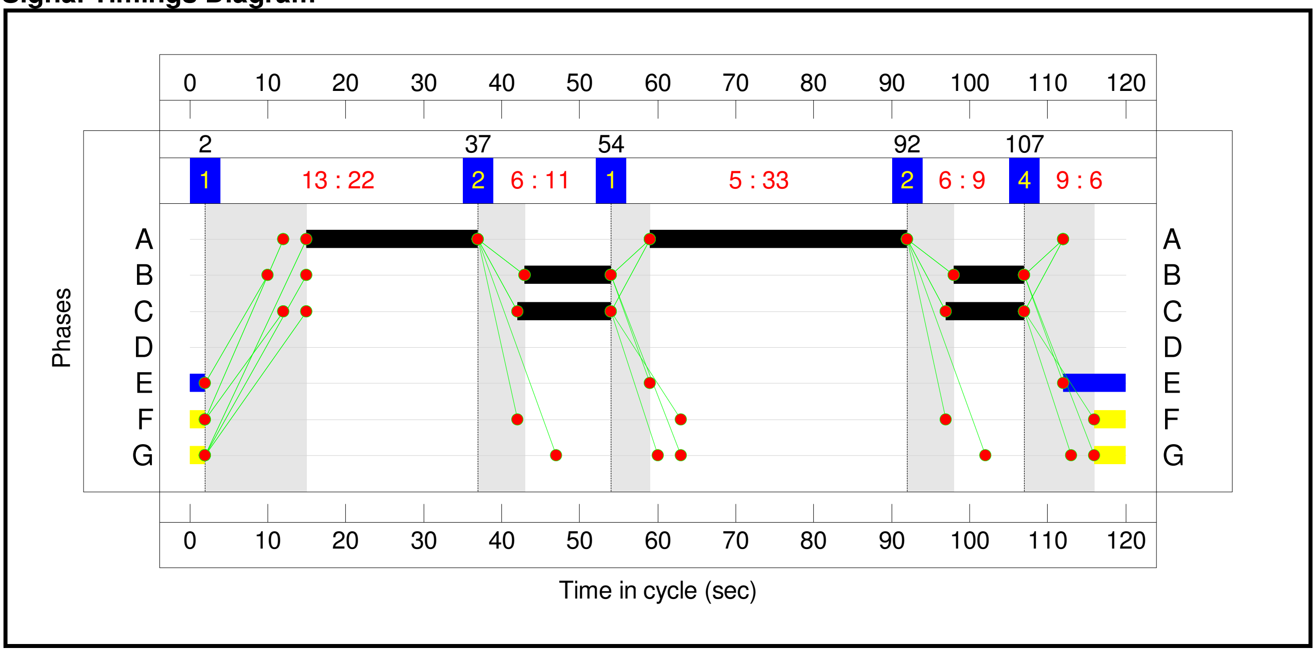
Stage Sequence Diagram



Stage Timings

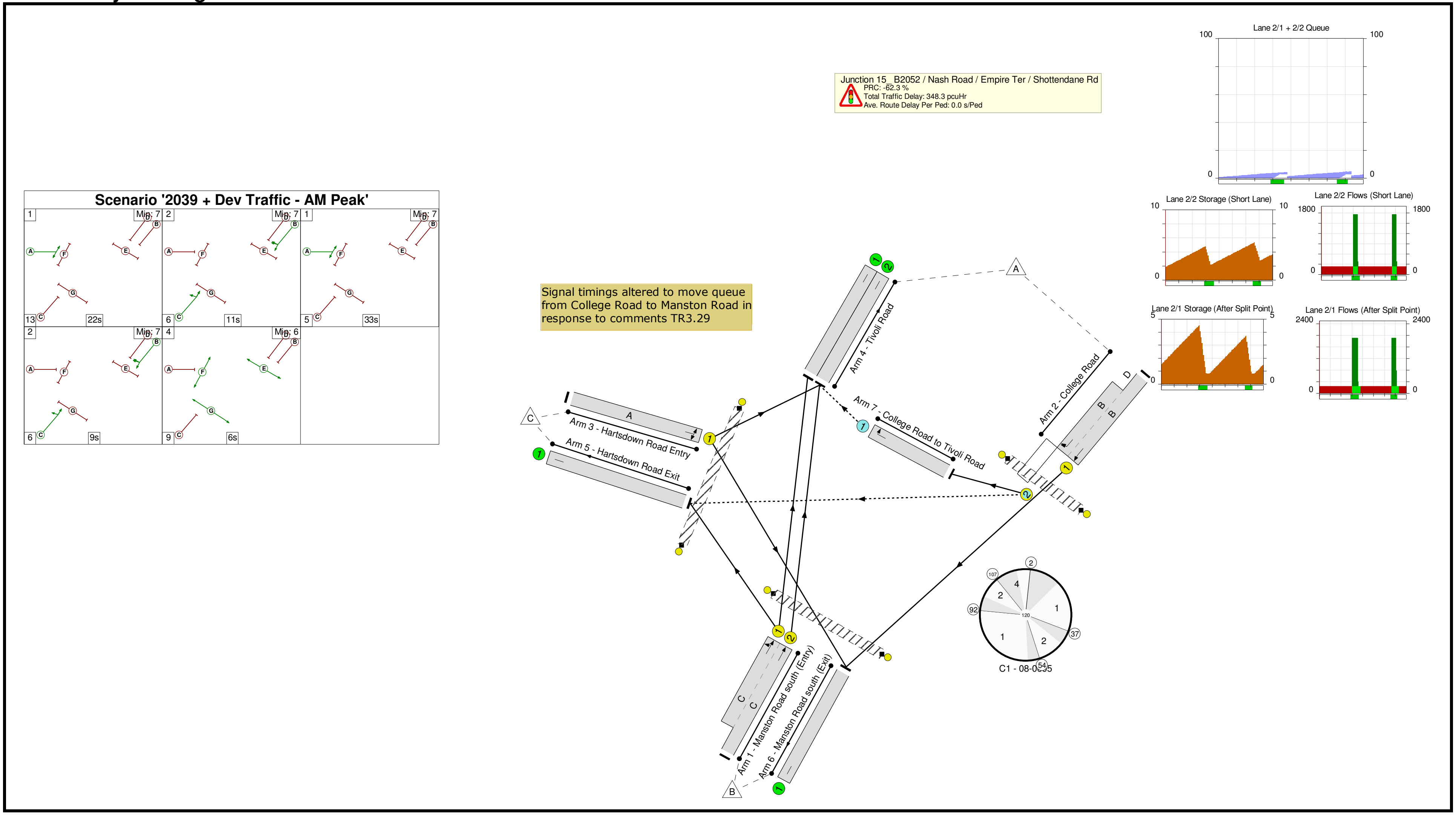
Stage	1	2	1	2	4
Duration	22	11	33	9	6
Change Point	2	37	54	92	107

Signal Timings Diagram



Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Network Results

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Junction 15	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**146.0%**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**N/A**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**146.0%**
1/2+1/1	Manston Road south (Entry) Ahead Left	U	N/A	N/A	C		2	22	-	1031	2037:1872	407+299	146.0 : 146.0%
2/1+2/2	College Road Right Ahead Right2	U+O	N/A	N/A	B	D	2	20	0	481	1903:1759	236+182	103.6 : 130.0%
3/1	Hartsdown Road Entry Left Right	U	N/A	N/A	A		2	55	-	1062	1820	865	122.8%
4/1	Tivoli Road	U	N/A	N/A	-		-	-	-	207	Inf	Inf	0.0%
4/2	Tivoli Road	U	N/A	N/A	-		-	-	-	1115	Inf	Inf	0.0%
5/1	Hartsdown Road Exit	U	N/A	N/A	-		-	-	-	463	Inf	Inf	0.0%
6/1	Manston Road south (Exit)	U	N/A	N/A	-		-	-	-	789	Inf	Inf	0.0%
7/1	College Road to Tivoli Road Right	O	N/A	N/A	-		-	-	-	3	1764	703	0.3%
Ped Link: P1	Unnamed Ped Link	-	N/A	-	E		1	10	-	0	-	0	0.0%
Ped Link: P2	Unnamed Ped Link	-	N/A	-	G		1	6	-	0	-	0	0.0%
Ped Link: P3	Unnamed Ped Link	-	N/A	-	F		1	6	-	0	-	0	0.0%

Full Input Data And Results

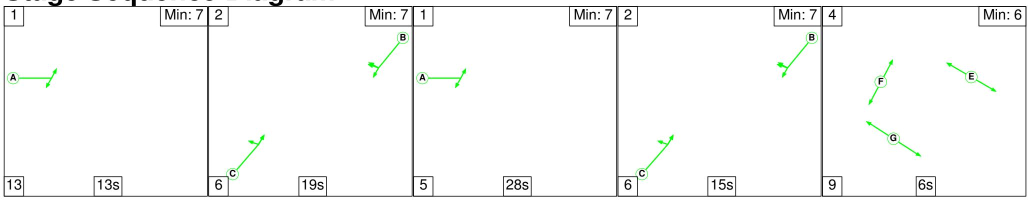
Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Junction 15	**-**	**-**	**0**	**2**	**180**	**45.4**	**300.5**	**2.4**	**348.3**	**-**	**-**	**-**	**-**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**0**	**2**	**180**	**45.4**	**300.5**	**2.4**	**348.3**	**-**	**-**	**-**	**-**
1/2+1/1	1031	706	-	-	-	24.4	164.1	-	188.5	658.1	32.4	164.1	196.5
2/1+2/2	481	426	0	0	180	4.2	35.0	2.4	41.6	311.4	5.1	35.0	40.1
3/1	1062	865	-	-	-	16.8	101.4	-	118.2	400.6	30.4	101.4	131.7
4/1	142	142	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
4/2	831	831	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	337	337	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	688	688	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	2	2	0	2	0	0.0	0.0	-	0.0	2.6	0.0	0.0	0.0
Ped Link: P1	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P2	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P3	0	0	-	-	-	-	-	-	-	-	-	-	-

C1 - 08-0695 PRC for Signalled Lanes (%): -62.3 Total Delay for Signalled Lanes (pcuHr): 348.25 Cycle Time (s): 120
PRC Over All Lanes (%): -62.3 Total Delay Over All Lanes(pcuHr): 348.25

Full Input Data And Results

Scenario 4: '2039 + Dev Traffic - PM Peak' (FG4: '2039 + Dev Traffic - PM Peak', Plan 4: '2039 B+D PM')

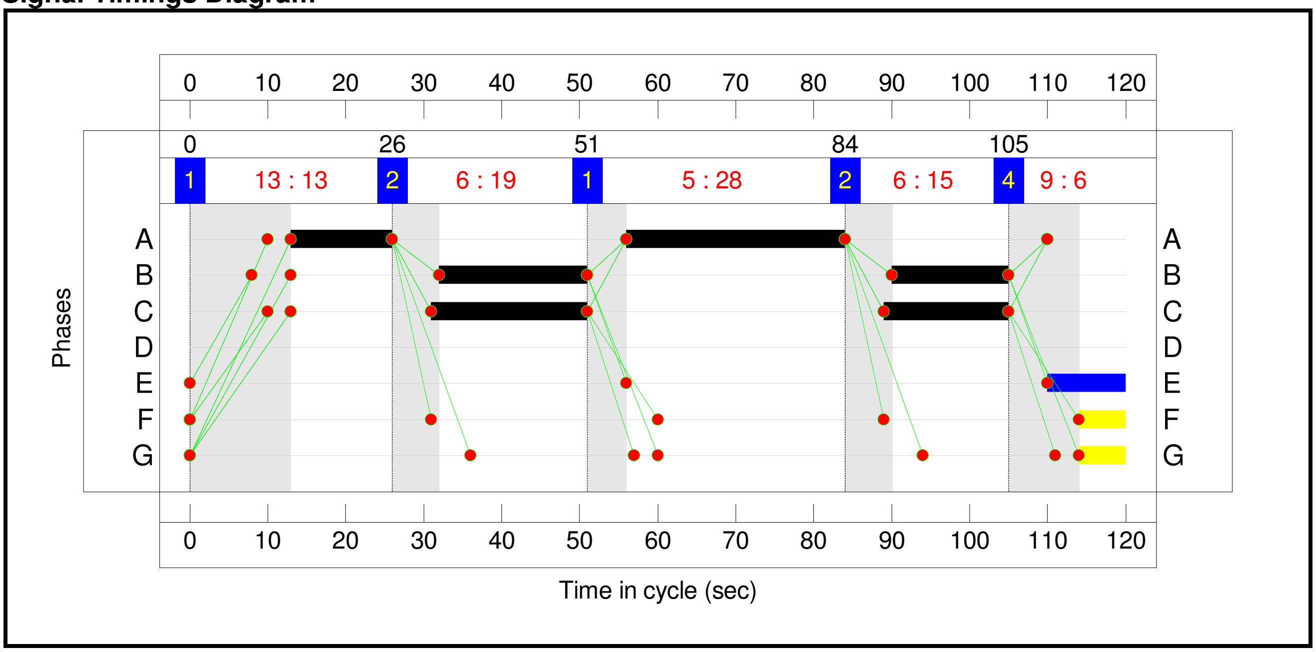
Stage Sequence Diagram



Stage Timings

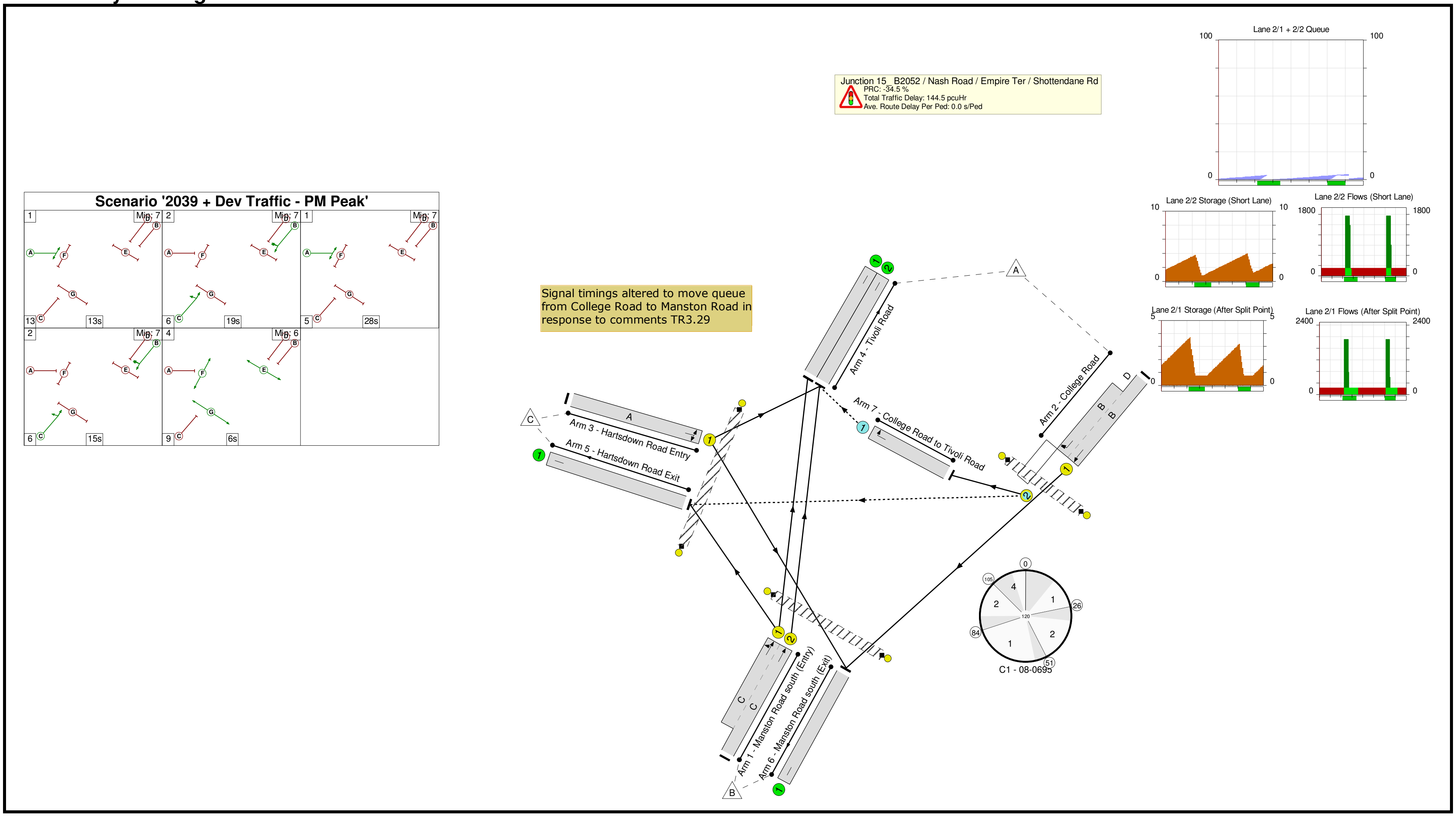
Stage	1	2	1	2	4
Duration	13	19	28	15	6
Change Point	0	26	51	84	105

Signal Timings Diagram



Full Input Data And Results

Network Layout Diagram



Full Input Data And Results

Network Results

Item	Lane Description	Lane Type	Controller Stream	Position In Filtered Route	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)
Network: Junction 15	-	-	**N/A**	-	-		-	-	-	-	-	-	**121.0%**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	-	-	**N/A**	-	-		-	-	-	-	-	-	**121.0%**
1/2+1/1	Manston Road south (Entry) Ahead Left	U	N/A	N/A	C		2	36	-	1083	2037:1857	638+458	98.8 : 98.8%
2/1+2/2	College Road Right Ahead Right2	U+O	N/A	N/A	B	D	2	34	0	457	1903:1758	190+188	121.0 : 121.0%
3/1	Hartsdown Road Entry Left Right	U	N/A	N/A	A		2	41	-	770	1803	646	119.2%
4/1	Tivoli Road	U	N/A	N/A	-		-	-	-	161	Inf	Inf	0.0%
4/2	Tivoli Road	U	N/A	N/A	-		-	-	-	1153	Inf	Inf	0.0%
5/1	Hartsdown Road Exit	U	N/A	N/A	-		-	-	-	514	Inf	Inf	0.0%
6/1	Manston Road south (Exit)	U	N/A	N/A	-		-	-	-	482	Inf	Inf	0.0%
7/1	College Road to Tivoli Road Right	O	N/A	N/A	-		-	-	-	5	1764	698	0.6%
Ped Link: P1	Unnamed Ped Link	-	N/A	-	E		1	10	-	0	-	0	0.0%
Ped Link: P2	Unnamed Ped Link	-	N/A	-	G		1	6	-	0	-	0	0.0%
Ped Link: P3	Unnamed Ped Link	-	N/A	-	F		1	6	-	0	-	0	0.0%

Full Input Data And Results

Item	Arriving (pcu)	Leaving (pcu)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Uniform Delay (pcuHr)	Rand + Oversat Delay (pcuHr)	Storage Area Uniform Delay (pcuHr)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Max. Back of Uniform Queue (pcu)	Rand + Oversat Queue (pcu)	Mean Max Queue (pcu)
Network: Junction 15	**-**	**-**	**3**	**4**	**180**	**21.1**	**120.8**	**2.6**	**144.5**	**-**	**-**	**-**	**-**
Junction 15_ B2052 / Nash Road / Empire Ter / Shottendane Rd	**-**	**-**	**3**	**4**	**180**	**21.1**	**120.8**	**2.6**	**144.5**	**-**	**-**	**-**	**-**
1/2+1/1	1083	1083	-	-	-	6.0	13.5	-	19.5	64.9	11.9	13.5	25.4
2/1+2/2	457	429	3	0	180	2.6	42.4	2.6	47.5	374.3	4.1	42.4	46.5
3/1	770	646	-	-	-	12.6	64.9	-	77.5	362.3	22.8	64.9	87.7
4/1	161	161	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
4/2	1069	1069	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
5/1	475	475	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
6/1	441	441	-	-	-	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0
7/1	4	4	0	4	0	0.0	0.0	-	0.0	2.6	0.0	0.0	0.0
Ped Link: P1	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P2	0	0	-	-	-	-	-	-	-	-	-	-	-
Ped Link: P3	0	0	-	-	-	-	-	-	-	-	-	-	-

C1 - 08-0695 PRC for Signalled Lanes (%): -34.5 Total Delay for Signalled Lanes (pcuHr): 144.52 Cycle Time (s): 120
PRC Over All Lanes (%): -34.5 Total Delay Over All Lanes(pcuHr): 144.53

Appendix TR.4.32

[redacted]

From:
Sent:
To:
Cc:
Subject:

[redacted]

Dear Adam,

We are in receipt of your recent email and attachments in respect of the above:

- 40820r13i1   Designers Response to RSA1

Our Road Safety Audit Team has reviewed the proposals to address the issues raised in the Road Safety Audit Stage 1 (Preliminary Design Stage) report in respect of the above and confirm that the measures proposed in the Designer's Response appear appropriate in road safety terms and that we have no further observations to make.

We trust the above is satisfactory but should you need any clarification or assistance please do not hesitate to get in contact.

Kind regards,

Anthony

[redacted]

Badingham Limited

Transport Planning & Highway Engineering

[redacted]

Registered Office: 43-45 Devizes Road, Swindon, SN1 4BG
Company No. 6961250   VAT No. 994 3305 95

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Technical note:
RSA Stage 1:Designers Response- A254/B2052 Junction

1. Introduction

This Technical note forms the Designers Response to the Stage 1 Road Safety Audit (RSA) conducted by Badingham limited for works associated with a Mitigation Scheme to improve the A254/B2052 junction located in Thanet. The junction was identified to require mitigation works as part of the Manston Airport TA.

Badingham Limited has been provided with the latest preliminary mitigation scheme designs, at this junction the mitigation scheme is proposed to add pedestrian crossings to the A254 north and B2052 College Road east arms of the junction, provide an appropriate road marking scheme to compliment the new pedestrian crossings and also to revise the stage sequence to include the new pedestrian crossings and additional capacity at the junction.

The designer's response to each of the issues raised by the safety audit team is provided in the following sections. The text included within the RSA has been transposed into this document, a full copy of the original RSA is provided within **Appendix A**.

2. Designers Response

Problem 4.1

Location: College Road (east) and Ramsgate Road (north)

Summary: Lack of facilities for cyclists.

No cycling facilities are provided on these approaches. There is a risk of collisions between cyclists and vehicles, particularly involving HGVs squeezing cyclists against barrier fencing when turning left.

Recommendation: It is recommended that facilities are incorporated within the design.

Designers Response: The recommendation to provide cycle facilities at this junction has been noted. In the next stage of design consideration will be made of any potential cycle facilities that could be provided as part of the scheme. It is however noted that the current signalled scheme does not provide any cycle advanced stop lines.

3. General Comments

Sections 5 -7

As part of the detailed design package of works a signage, lighting and drainage strategy will be provided.

Issued by

[redacted]

Chris Morris

Approved by

[redacted]

....

Bev Coupe

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Third party disclaimer

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Management systems

This document has been produced by Wood Environment & Infrastructure Solutions UK Limited in full compliance with our management systems, which have been certified to ISO 9001, ISO 14001 and OHSAS 18001 by LRQA.

Appendix A
Road Safety Audit – Stage 1

A254 Ramsgate Road/B2052 College Road, Margate, Kent

Proposed Highway Works

Road Safety Audit – Stage 1

(Preliminary Design)

Client: RSP

26th April 2019

Badingham
Transport Planning & Highway Engineering Consultants
16 Ashley Piece
Ramsbury, Marlborough
Wiltshire
SN8 2QE

T. +44(0)1672 521320
contact@badinghamuk.com
www.badinghamuk.com

DOCUMENT ISSUE

Issue / Revision:	Issue 1			
Description / Status:	Final			
Date:	27/04/2019			
Prepared:	A. R. J. Setter			
Signature:	[redacted]			
Document Check:	D. F. Rogers			
Signature:	[redacted]			
Technical Check:	D. F. Rogers			
Signature:	[redacted]			
Authorised:	A. R. J. Setter			
Signature:	[redacted]			
File Reference:	0781 Manston Airport - 16 - RSA1 - Issue 1.docx			

CONTENTS

SECTION 1: INTRODUCTION

General

1.1 This Road Safety Audit Stage 1 (Preliminary Design) report has been undertaken at the request of the Highway Authority. It has been prepared on behalf of RSP and relates to proposed highway works at the A254 Ramsgate Road/B2052 College Road junction, Margate. The works are associated with the redevelopment of Manston Airport, Kent.

1.2 Thanet District Council is the local planning authority. Kent County Council is the local highway authority for the area.

Audit Team

1.3 A. R. J. Setter — BA (Hons) MSc CMILT MCIHT AMICE MSoRSA CoC
Badingham Limited

D. F. Rogers — JP CEng BEng (Hons) MICE FIHE MSoRSA
Ashburn Partnership

Audit Brief

1.4 The Road Safety Audit has been undertaken in accordance with the Road Safety Audit Brief contained in Appendix 1.

1.5 The terms of reference for this Road Safety Audit are described in GG119. The Audit Team has not been made aware of any departures from standard.

1.6 The Road Safety Audit Team has examined and reported only on the road safety implications of the scheme as presented and has not examined or verified the compliance of the design to any other criteria.

Main Parties to the Audit

1.7 The following are the main parties to the audit:

- Client Organisation: RSP
- Overseeing Organisation: Kent County Council
- Design Organisation: Wood Plc

1.8 The Audit Team visited the site together on Tuesday 26th March 2019 between 10.00am and 10.30am. The weather was fine and surfaces were dry. There were no adverse traffic conditions to affect the audit. Photographs of the site and surrounding area are included where relevant.

1.9 The location of the site is shown on Figure 1 Site Location Plan and Figure 2 Aerial Photo. The area of the audit extends solely to the works shown on the drawings included in the Audit Brief. Any issues identified are cross-referenced by paragraph number to the Audit Plan (Figure 3).

1.10 The works comprise proposed improvements to the existing 5-arm signal crossing. This is a busy urban junction, with crossing facilities, lying within a 30mph speed limit. Some approaches are situated on downhill gradients.

1.11 Thirteen collisions are recorded within the latest five-year period 2013 to 2018. Four resulted in serious injuries and there were nine slight injury accidents. A total of seventeen casualties were reported. No highway deficiencies were noted as contributory factors.

SECTION 2: ITEMS RAISED AT PREVIOUS AUDITS

2.1 No previous audits have been undertaken.

SECTION 3: VEHICULAR AND HIGHWAY ISSUES

3.1 No observations.

SECTION 4: NON-MOTORISED USERS

4.1 PROBLEM

Location: College Road (east) & Ramsgate Road (north).

Summary: Lack of facilities for cyclists.

4.1.1 No facilities for cyclists are provided on these approaches. There is a risk of collisions between cyclists and vehicles, particularly involving HGVS ‘squeezing’ cyclists against barrier fencing when turning left.

RECOMMENDATION

4.1.2 It is recommended that facilities for cyclists are incorporated within the design.

Photo 1 -View north on Ramsgate Road.

SECTION 5: ROAD MARKINGS AND SIGNAGE

5.1 No signing details have been provided. A suitable package of signage information will need to be provided as part of any further detailed design.

SECTION 6: STREET LIGHTING

6.1 No street lighting details have been provided. A suitable package of street lighting information will need to be provided as part of any further detailed design.

SECTION 7: DRAINAGE

7.1 No drainage information is provided. A suitable package of drainage information will need to form part of any further detailed design.

SECTION 8: AUDIT STATEMENT

8.1 This audit has been undertaken in accordance with DMRB Standard GG119.

Road Safety Audit Team Leader

A. R. J. Setter BA (Hons) MSc CMILT MCIHT AMICE MSoRSA CoC

Director - Badingham Limited

16 Ashley Piece, Ramsbury, Marlborough, Wiltshire, SN8 2QE

Signed: [redacted] Date: 27th April 2019

Audit Team Member

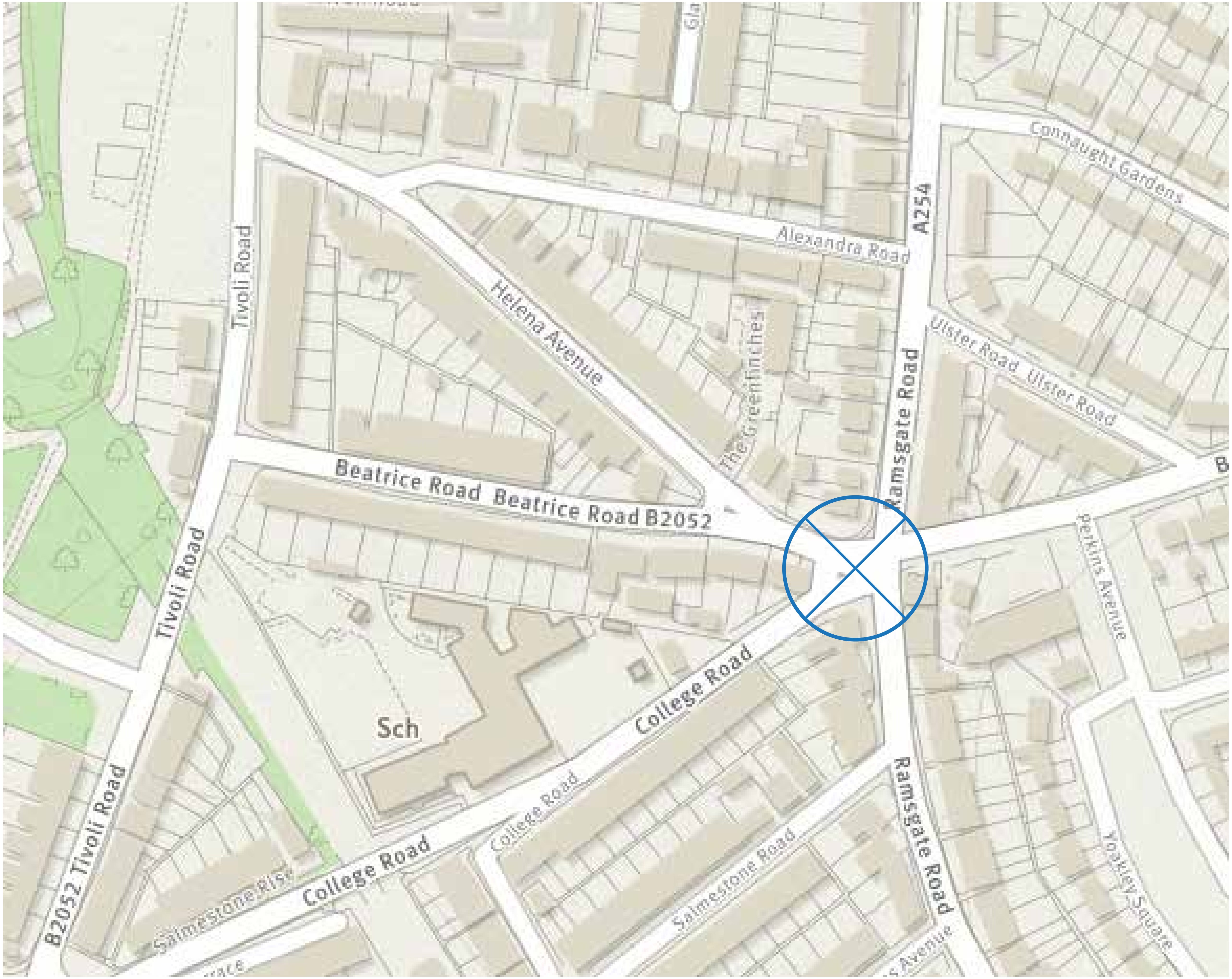
D. F. Rogers JP CEng BEng (Hons) MICE MSoRSA FIHE

Partner - Ashburn Partnership

5 Mayfield, Upper Wanborough, Swindon, SN4 0ED

Signed: [redacted] Date: 27th April 2019

FIGURES



North

Notes:

1. Do not scale from this drawing.
2. All dimensions must be checked on site.

Rev.	Date	Initials	Amendments

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Transport Planning
&
Highway Engineering
Concept | Consult | Construct
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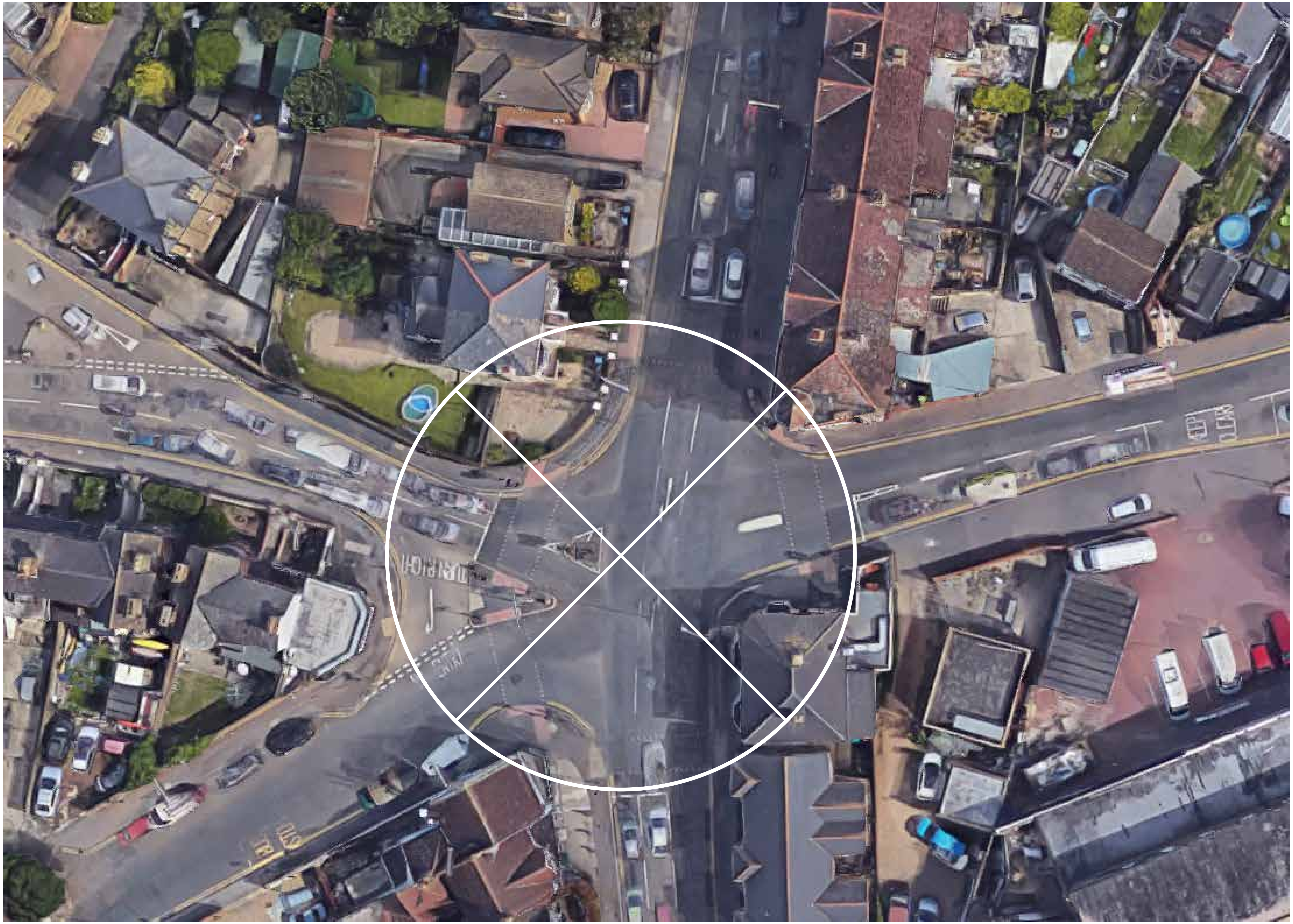
Client
RSP

Project
Manston Airport

Title
Location Plan

Date 24/04/2019	Status FINAL
Scale NTS	Original Size A3
Drawn AS	Checked AS

Job No.	Drawing No.	Rev.
0781	FIGURE 1	-



North

Notes:

1. Do not scale from this drawing.
2. All dimensions must be checked on site.

Rev.	Date	Initials	Amendments

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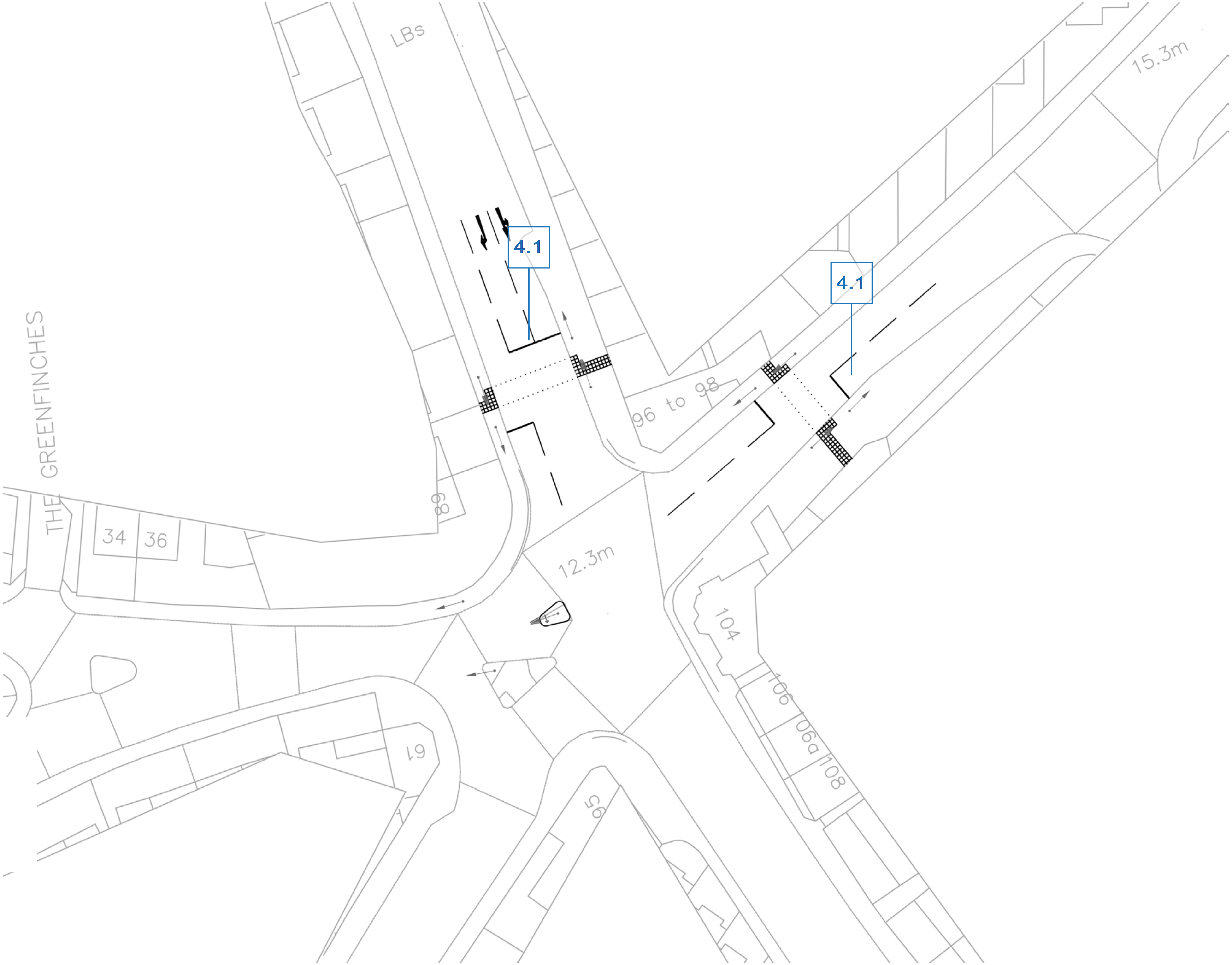
Client	RSP
Project	Manston Airport
Title	Aerial Photo
Date: 24/04/2019	Status: FINAL
Scale: NTS	Original Size: A3
Drawn: AS	Checked: AS

Job No.	Drawing No.	Rev.
0781	FIGURE 2	-



North

Notes:

1. Do not scale from this drawing.
2. All dimensions must be checked on site.

Source: Site Location & Access Design

Rev.	Date	Initials	Amendments

Badingham
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RSP

Project
Manston Airport

Title
Audit Plan

Date	Status
27/04/2019	FINAL

Scale	Original Size
NTS	A3

Drawn	Checked
AS	AS

Job No.	Drawing No.	Rev.
0781	FIGURE 3	-

APPENDIX 1

Road Safety Audit Brief

Project Summary	
Date:	11/04/2019
Document Reference:	
Prepared by:	Wood
On Behalf of:	RiverOak Strategic Partners
AUTHORISATION SHEET	
Project:	Manston Airport – Junction A254/B2052 Mitigation Proposal
Report title:	Manston Airport – Junction A254/B2052 Mitigation Proposal - RSA Stage 1
PREPARED BY:	
Name:	Pranav Yadav
Signed:	
Organisation:	Wood
Date:	11/04/2019
I APPROVE THE RSA BRIEF AND INSTRUCT THE RSA TO TAKE PLACE ON BEHALF OF THE OVERSEEING ORGANISATION:	
Name:	Tony Freudmann
Signed:	
Organisation:	RiverOak Strategic Partners
Date:	

General Details				
Highway Scheme Name & Road Number	Manston Airport – A254/B2052 Mitigation Proposal – College Road (east), Ramsgate Road (south), College Road (west), Beatrice Road, Ramsgate Road (north)			
Type of Scheme *e.g. new road scheme, smart motorway, junction improvement, traffic signs and road markings improvement, traffic calming, etc.*				
New Roundabout Junction with the B2190				
RSA Stage *Tick as appropriate ✓*	1 √	2	3	4
	Interim			
Overseeing Organisation Details	**Design Organisation Details**			
16 Charles II Street London SW1Y 4NW	Wood Glyn Price Associate Director Canon Court, Abbey Lawn, Abbey Forgate, Shrewsbury, SY2 5DE, UK			
Police Contact Details (RSA3 Only)	**Maintaining Agent Contact Details**			
N/A	N/A			
RSA Team Membership				
A.R.J. Setter (Team Leader) D. F. Rogers (Team Member)	BA (Hons) MSc CMILT MCIHT AMICE MSoRSA Highways England Certificate of Competence & Compliant with EU Directive 2008/96/EC Badingham Limited JP, CEng BEng (Hons) MICE MSoRSA FIHE Ashburn Consultants			
Terms of Reference *Make reference to relevant DMRB documents and other guidance where appropriate.*				
DMRB – TD 50/04 – The Geometric Layout of Signal-controlled Junctions and Signalised Roundabout				

Scheme Details
Scheme Description/Objective
General *Define the extents of the RSA, include a brief scheme description, the scheme objectives, a start date for construction if known and a completion date. In addition, for stage 4 RSAs, confirm when all related traffic management has been removed.*
The proposal is for a scheme to improve the existing College Road/Ramsgate Road/Beatrice Road signalised junction. The existing stop line located on College Road (east) will be moved away from the junction to accommodate a new stop line on the exit lane. A new stop line will be provided on the exit arm of Ramsgate Road (north). It has not been decided when this junction will be constructed as this is part of ongoing discussions with KCC. Complete should take between 3-6 months.
Design Standards Applied to the Scheme Design *For example, DMRB.*
DMRB has been applied to the design of the proposed roundabout. DMRB TD 50/04 – The Geometric Layout of Signal-controlled Junctions and Signalised Roundabout
Design Speeds *Provide details of applied and/or existing design speeds.*
40MPH
Speed Limits *State whether mandatory or advisory, available speed data.*
The existing speed limit around the junction is 30mph.
Existing Traffic Flows/Queues *To include current automatic traffic counter (ATC) data, up-to-date turning count and queue information etc.*
The traffic flow of the junction will be provided from the MCC taken at this junction.
Forecast Traffic Flows *Where available and relevant, provide future traffic flow data including vehicle proportions.*
Future Traffic flows at the junction for the AM and PM Peak will be provided in a matrix format.
Pedestrian, Cyclist & Equestrian Desire Lines *Include details of pedestrian, cyclist and equestrian movements in the vicinity of the scheme and, when applicable the relevant walking, cycling and horse-riding assessment and review reports HD 42/17 [Ref 7.1].*
The existing pedestrian crossings located on College Road (east) and Ramsgate Road (north) will be relocated slightly back from the junction.
Environmental Constraints *Include all environmental constraints within the scheme extents, for example sites of special scientific interest (SSSI), conservation areas, listed properties etc.*
No environmental constrains have been observed.

Locality
Description of Locality *Include all environmental constraints within the scheme extents, e.g. (SSSI), conservation areas, listed properties etc.*
Junction is located southwest of the Margate and surrounded by residential properties.
General Description *Include road network, road type, relevant land uses etc.*
College Road (east) is a two-way single carriageway. Ramsgate Road (south) is a two-way single carriageway with two lane entry approach. College Road (west) is a one-way (exit only) single carriageway with on-street parking. Beatrice Road is a one-way (entry only) single carriageway with on-street parking along the south side of the road. Ramsgate Road (north) is a two-way single carriageway. There is a dedicated right turn lane with giveaway from Beatrice Road to College Road (west). Most of the corners of the junction is secured by guardrails. Footway and pedestrian crossing facilities are available at the junction.
Relevant Factors Which May Affect Road Safety *Factors known to the Design Organisation and considered as part of the design. This should also include anything that would not be immediately obvious to the RSA Team – such as school crossing patrols and large events, for example.*
Total eight accidents have been recorded at the junction. These are accidents 30 (additional year), 89 (additional year), 206,247,283,300,313, 322, 429, 475, 476, 485. Three of the eight accidents were serious. One of the serious accidents involved a pedestrian who stepped into the path of a moving vehicle to cross the road and collided with the vehicle. Two of the serious accidents occurred due to careless driving. One of the slight accidents involved a pedestrian who stepped into the path of a moving vehicle and collided with the vehicle. A motorbike and pedal cycle were also involved into different slight accidents which were cause by carelessness. Most of the accident occurred due to careless driving or movement within the junction. The details of these accidents will be provided with this brief.

Analysis

Collision Data Analysis
Stages 1,2, and 3 provide a summary of road traffic collision data covering both the extent of the scheme and the adjoining sections of highway. As a minimum, the most recent 36 month of data. At Stage 4, provide 12 months of post-opening validated road traffic collision data. Raw data should be provided as an appendix.

Accident data for the junction will be provided with this brief.

Departures from Standards
Include status details, i.e. approved/pending/rejected, and any design strategy records produced for improvements to existing trunk roads and motorways.

N/A

Previous Road Safety Audit Stage Reports, Road Safety Audit Response Reports & Evidence of Agreed Actions
Attach previous reports to the RSA Brief, or provide an explanation where these are not available.

N/A

Strategic Decisions
Includes items outside the scope of this RSA, which will not change irrespective of the RSA, for example route choice, junction type, approved departures from standard.

N/A

List of Included Documents and Drawings
For example: previous RSA reports; Design Responses; Departures; Road Traffic Collision Data; Walking, Cycling and Horse-Riding Assessment and Reviews. This could include any relevant operational data such as damage-only collision data or incident logs.
This list could be included as an attachment to the RSA Brief or a hyperlink to a shared electronic location where the RSA Brief information has been collated.

Documents

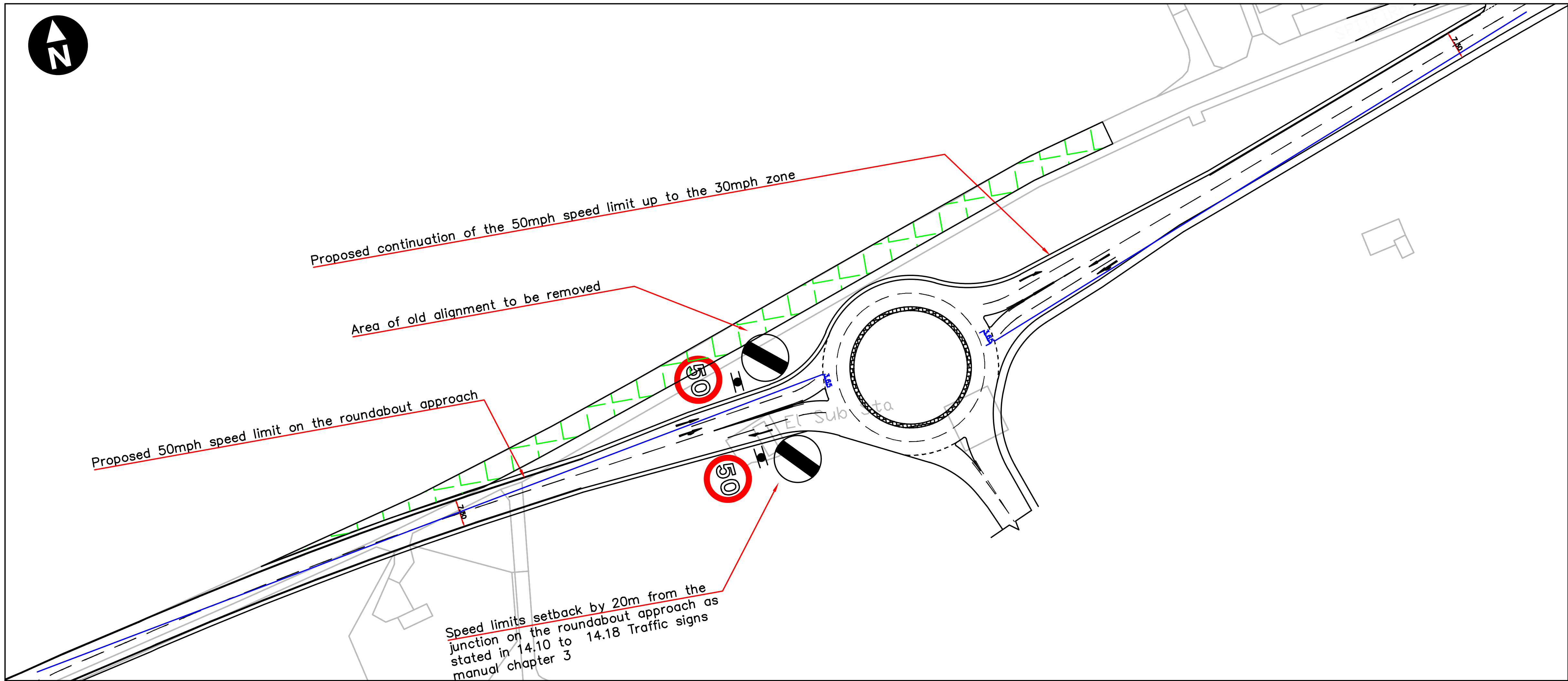
Reference/Revision	Title	Date
RSA – A254/B2052 – MCC results		11.04.2019
RSA – A254/B2052 – future Year Traffic Flows (2039)		11.04.2019
RSA – A254/B2052 – Accident Data		11.04.2019
RSA – A254/B2052 – LINSIG output		11.04.2019

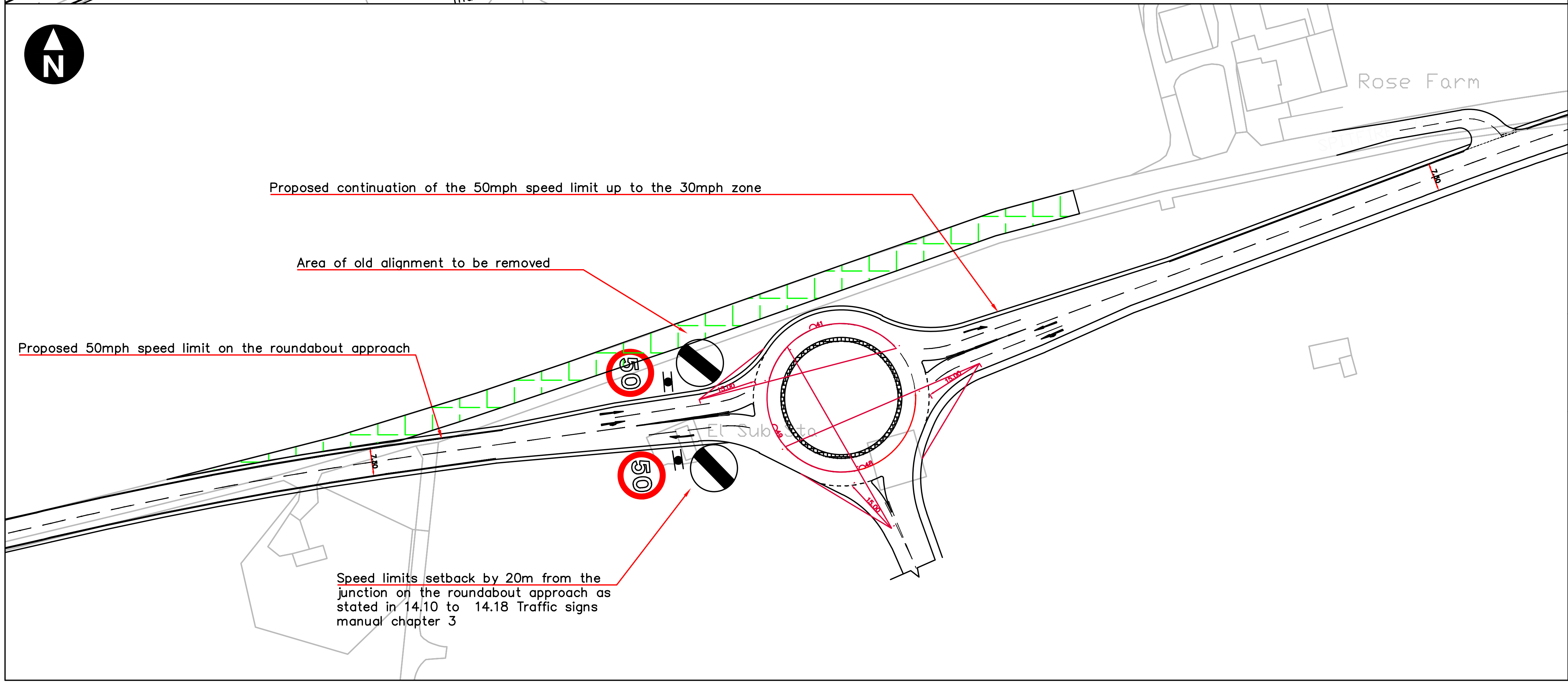
Drawings

Reference/Revision	Title	Date
RSA – A254/B2052 – Site Location and Access design		11.04.2019
RSA – A254/B2052 – Cad file		11.04.2019

Checklist			
Tick all that are included and provide reasons for those that are not included. ✓			
Site Location plan		Scale Layout Plans	
Departures and Relaxations from Standards		Construction/Typical Details	
Previous RSA Reports		Previous RSA Response Reports & Evidence of Agreed Actions	
Collision Data and Collision Data Analysis		Road Traffic Collision Plot	
Traffic Signal Staging		Traffic Counts	
Speed Surveys		Pedestrian, Cyclist, Horse-Riding Desire Lines & Volumes	
Walking, Cycling and Horse-Riding Assessment & Reviews		Items Outside the Scope of the RSA/Strategic Decisions	
Other Factors that may Impact Upon Road Safety		Design Speeds/Speed Limits	
Design Standards Used		Adjacent Land Uses	

Appendix TR.4.44





Key

- Existing based on Ordnance Survey Map
- Proposed Kerbline
- Proposed road marking
- Proposed location of speed limit signage
- Old Spitfire Way alignment to be removed
- Forward visibility on approach at the give way line - 160m (westbound) and 215m (eastbound)
- Forward visibility at entry (exceeding 40m along centre line)

0 m 50 m

Scale 1:1250 @ A3

Client

RSP

Manston Airport DCO

Appendix TR 4.44
Proposed cargo facility access design

June 2019

wood.

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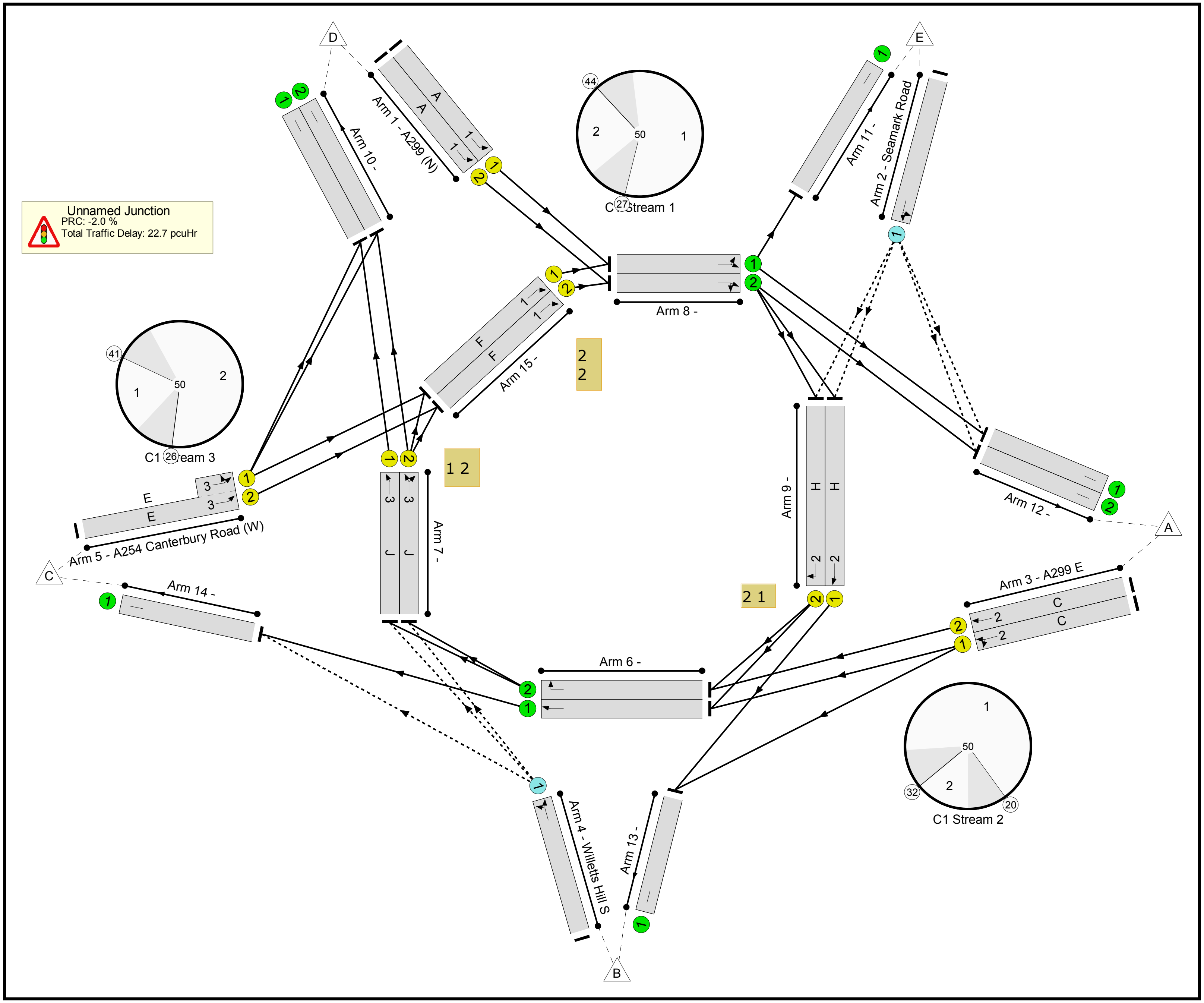
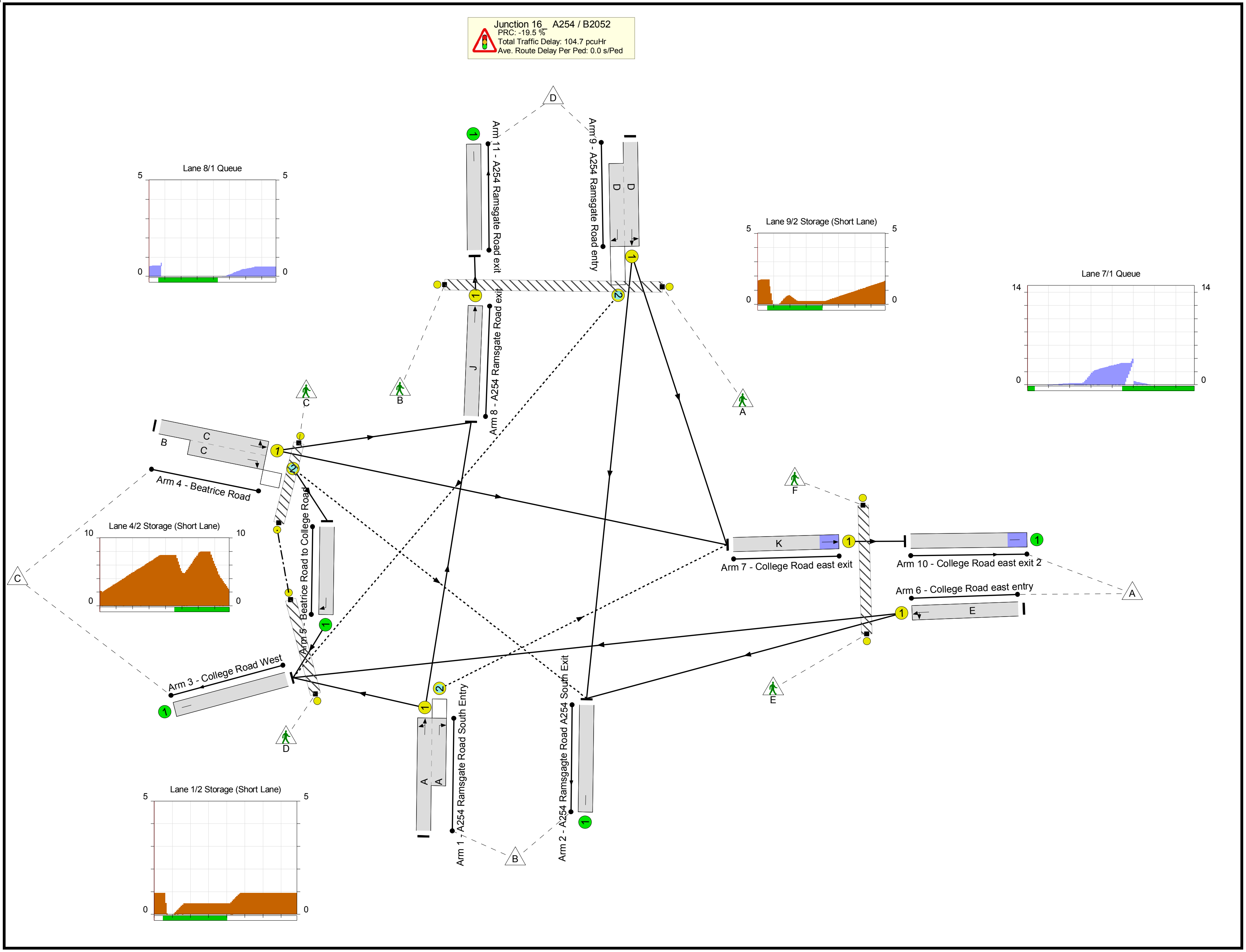
Appendix TR.4.45

Full Input Data And Results

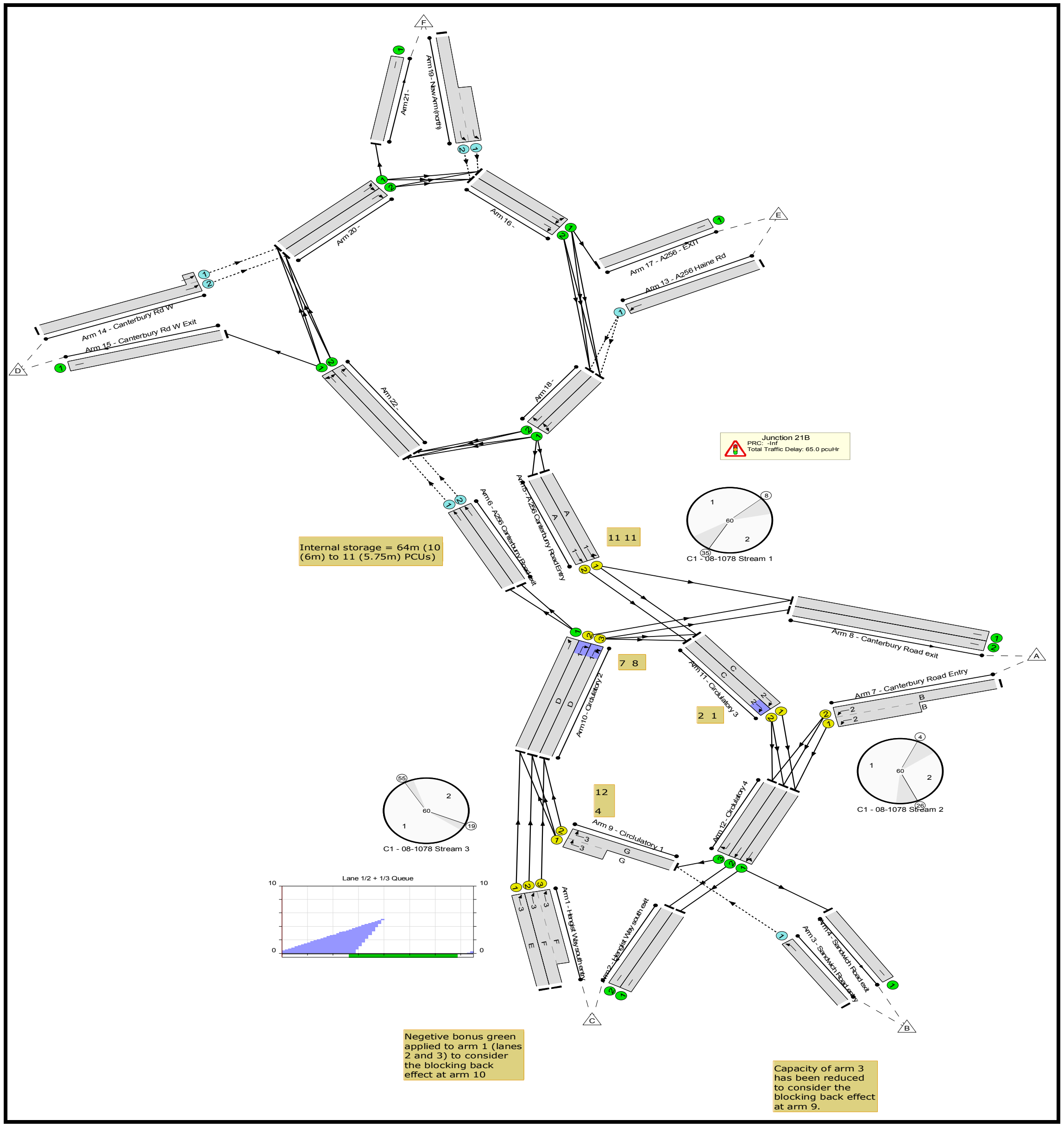


Full Input Data And Results

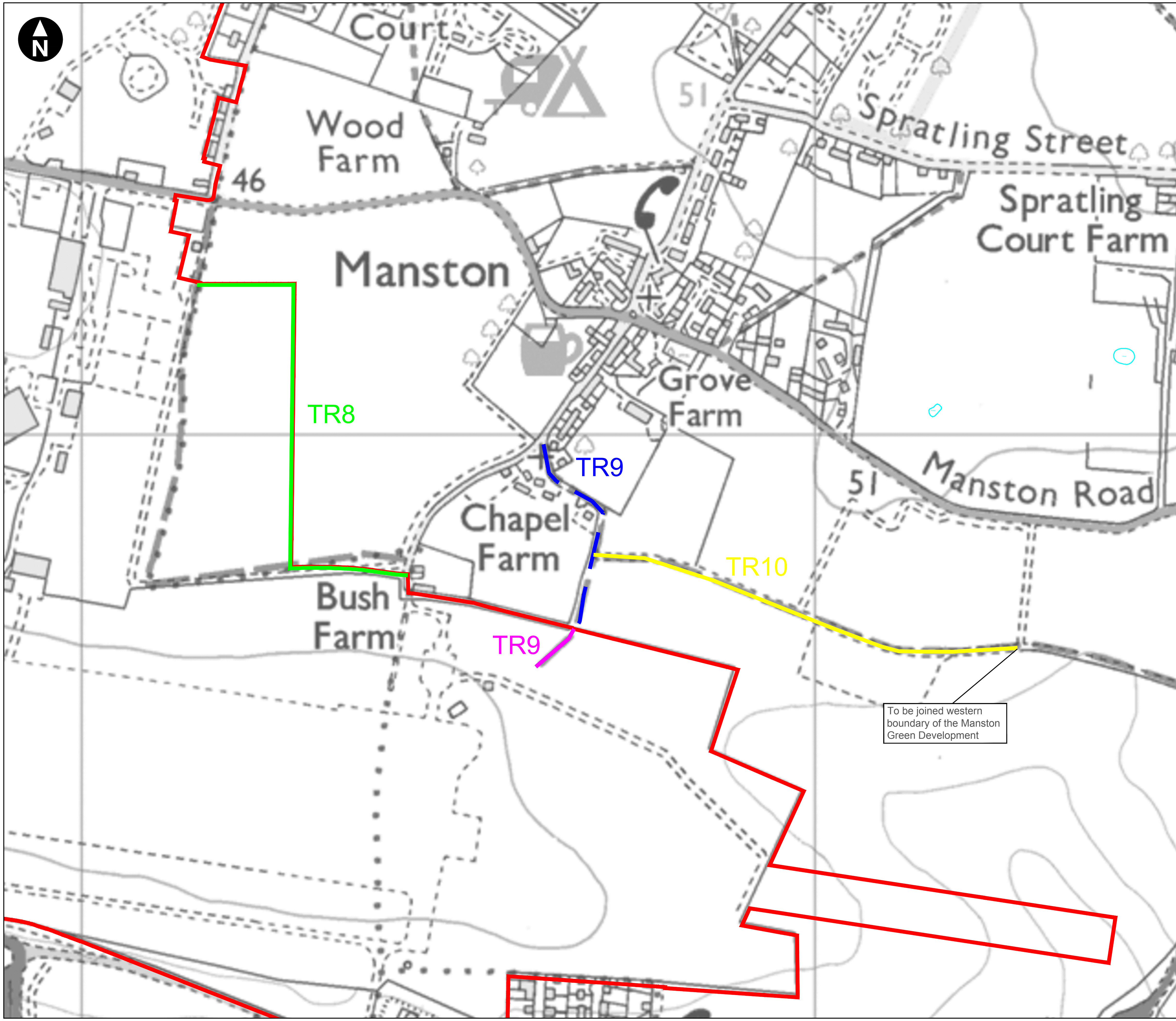


Full Input Data And Results

Network Layout Diagram



Appendix TR.4.48



Key

- Order limits
- TR8 - to be diverted, widened to 3m and upgraded with suitable paved surface
- TR9 - no upgrade required as existing provision is suitable
- TR9 - element of TR9 within red line boundary to be extinguished
- TR10 - to be widened to 3m and upgraded with suitable paved surface

0 m 300 m

Scale 1:5000 @ A3

Client

RSP

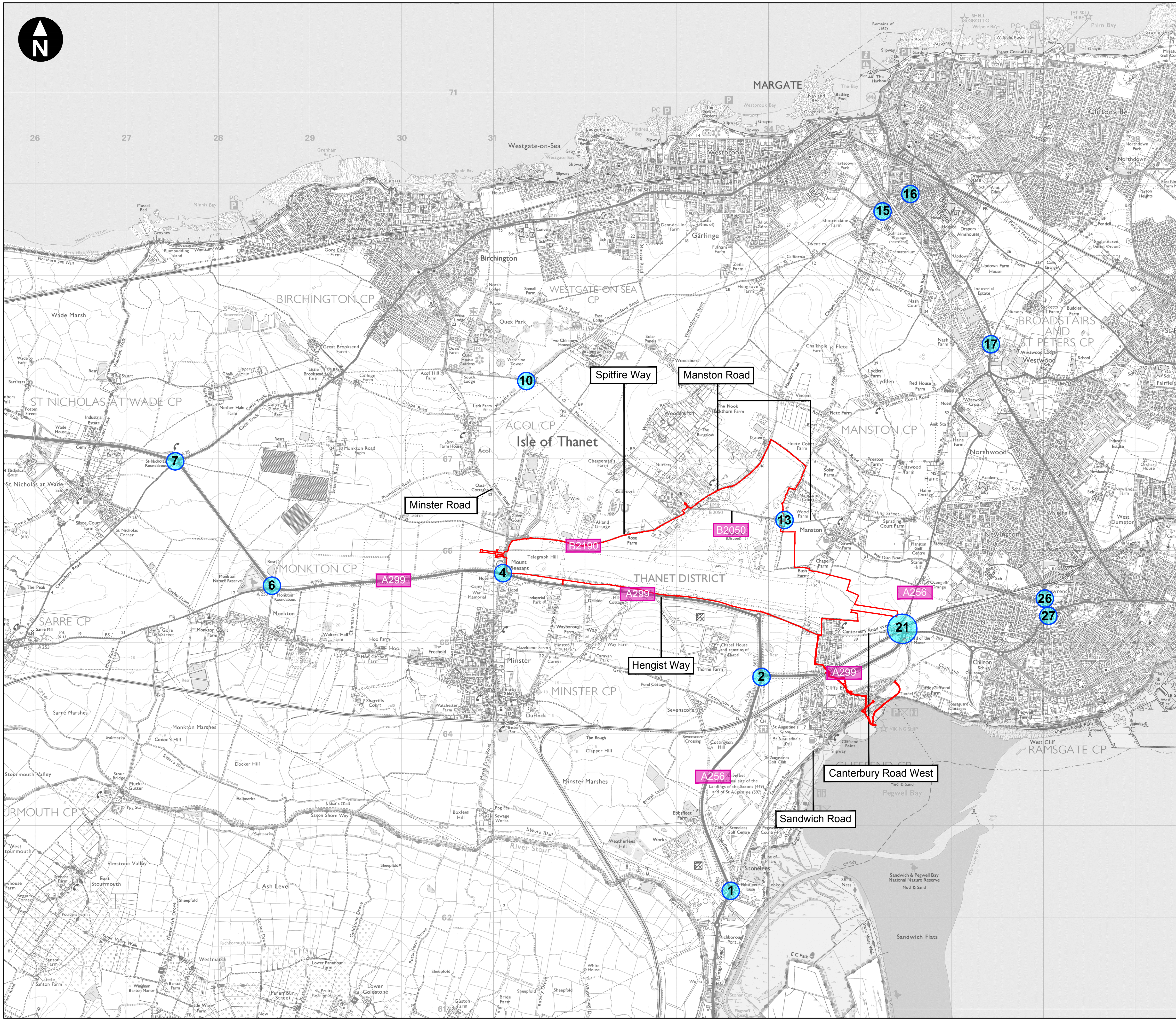
Manston Airport DCO

Schedule Five - Public Rights of Way

June 2019

wood.

R:\Projects\40820 STH Manston Airport Post Application\D Design\Drawings\AutoCAD\40820-Lon217.dwg Originator: PRANAV.YADAV



Key

Order limits

1 Off site junction

1 A256/Sandwich Road
2 A256/A299/Cottingham Link Road
4 A299/B2190 (Minster Road)/B2190 (Tothill Street)
6 A253 (Canterbury Road)/A299/Willetts Hill/Seamark Road
7 A299/A28 (Canterbury Road)/ Potten Street Road
10 B2050 (Manston Road)/Shottendane Road/Margate Hill
13 B2050 (Manston Road)/Manston Court Road
15 B2052 Hartsdown Road/B2052 (Tivoli Road)/B2052 (College Road)/Nash Road/Empire Terrace/ManstonRoad (Coffin Corner)
16 A254 (Ramsgate Road)/B2052 (College Road)/B2052 (Beatrice Road)
17 A254 (Margate road)/A254 (Ramsgate Road)/Star Lane/Poorhole Lane
21 A299/A256/Sandwich Rd/Canterbury Rd E/Haine Road
26 B2050 (Manston Road)/B2014 (Newington Road)
27 B2014 (Newington Road)/A255 (High Street)

0 m 1000 m 2000 m

Scale 1:40000 @ A3

Client

RSP

Manston Airport DCO

Schedule 10 - Off Site Junctions

June 2019

wood.

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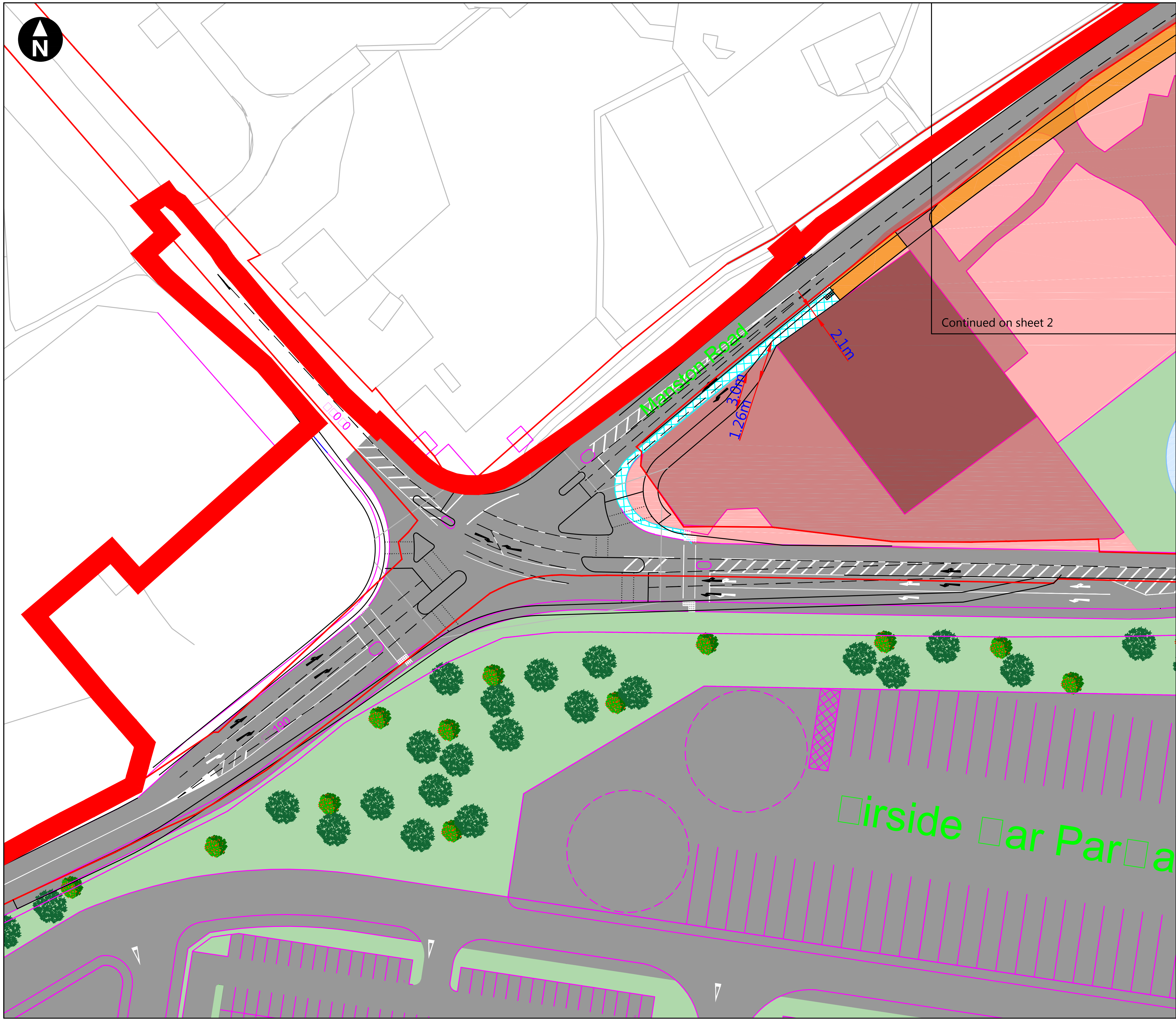


Key

- Red Line Boundary
- Existing based on Ordnance Survey map
- Proposed Scheme
- Intervisibility area
- Highway boundary
- Manston - Haine Link Land for safeguarding

0 m 40 m

Scale 1:750 @ A3

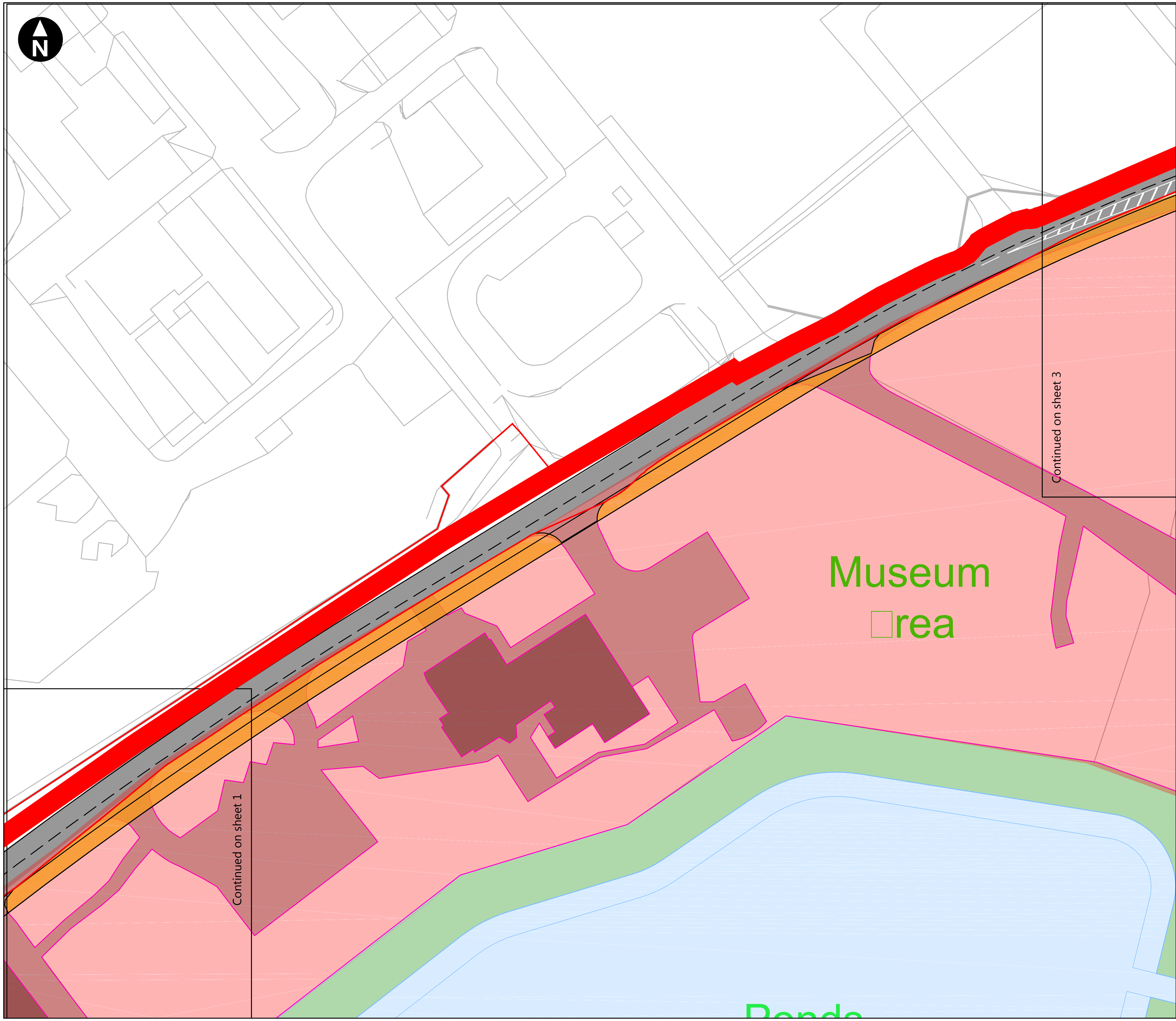
Manston Airport DCO

Schedule 8 - Manston - Haine Link
Land for Safeguarding
Sheet 1

June 2019

wood.

R:\Projects\40820 STH Manston Airport Post Application\D Design\Drawings\AutoCAD\40820-Lon224.dwg Originator: ADAM.GUY



Key

Red Line Boundary

Existing based on Ordnance Survey map

Proposed Scheme

Highway boundary

Manston - Haine Link Land for safeguarding

0 m 40 m

Scale 1:750 @ A3

Manston Airport DCO

Schedule 8 - Manston - Haine Link Land for Safeguarding Sheet 2

June 2019

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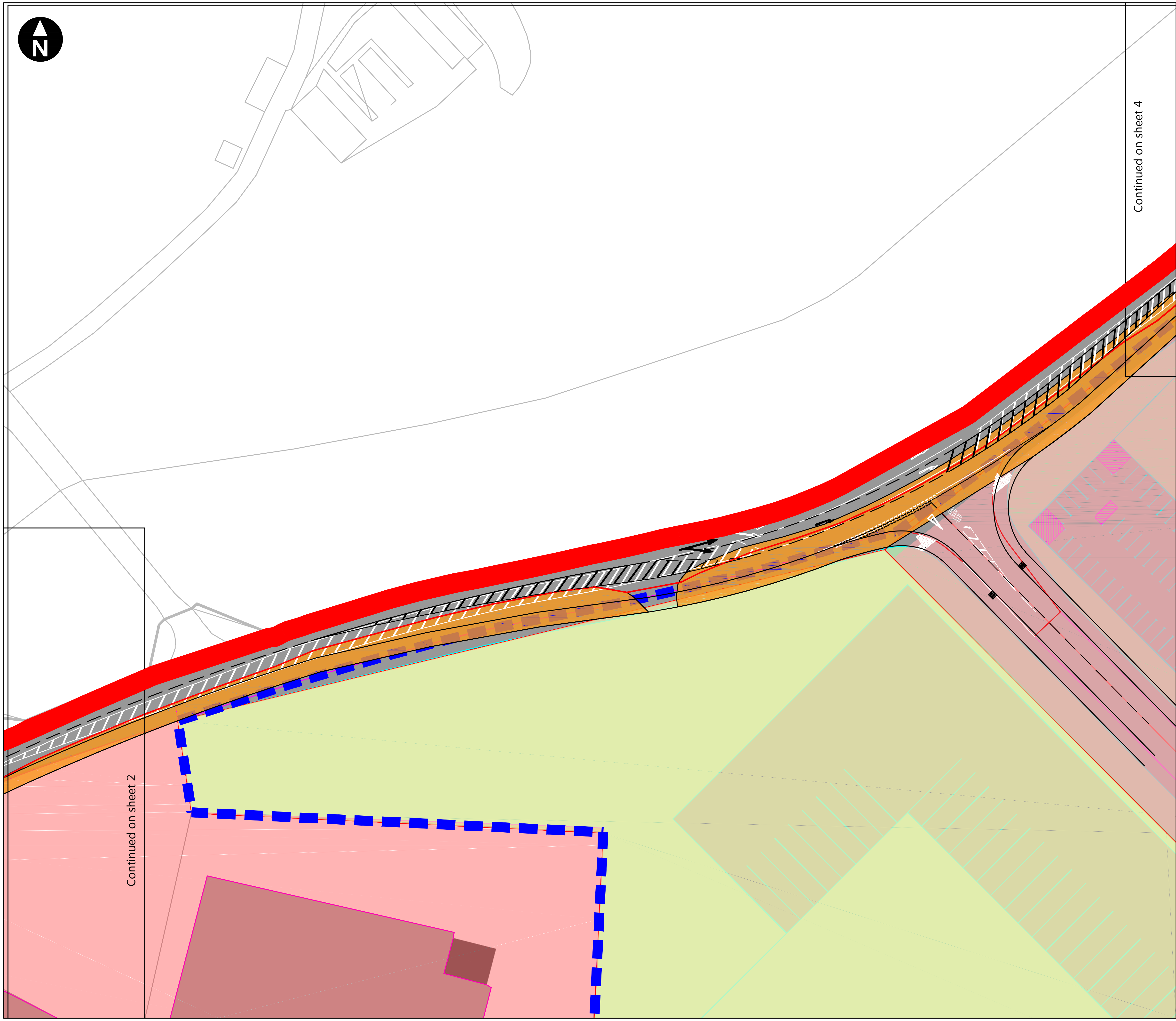

Manston Airport DCO

Schedule 8 -Manston - Haine Link
Land for Safeguarding
Sheet 3

June 2019

wood.

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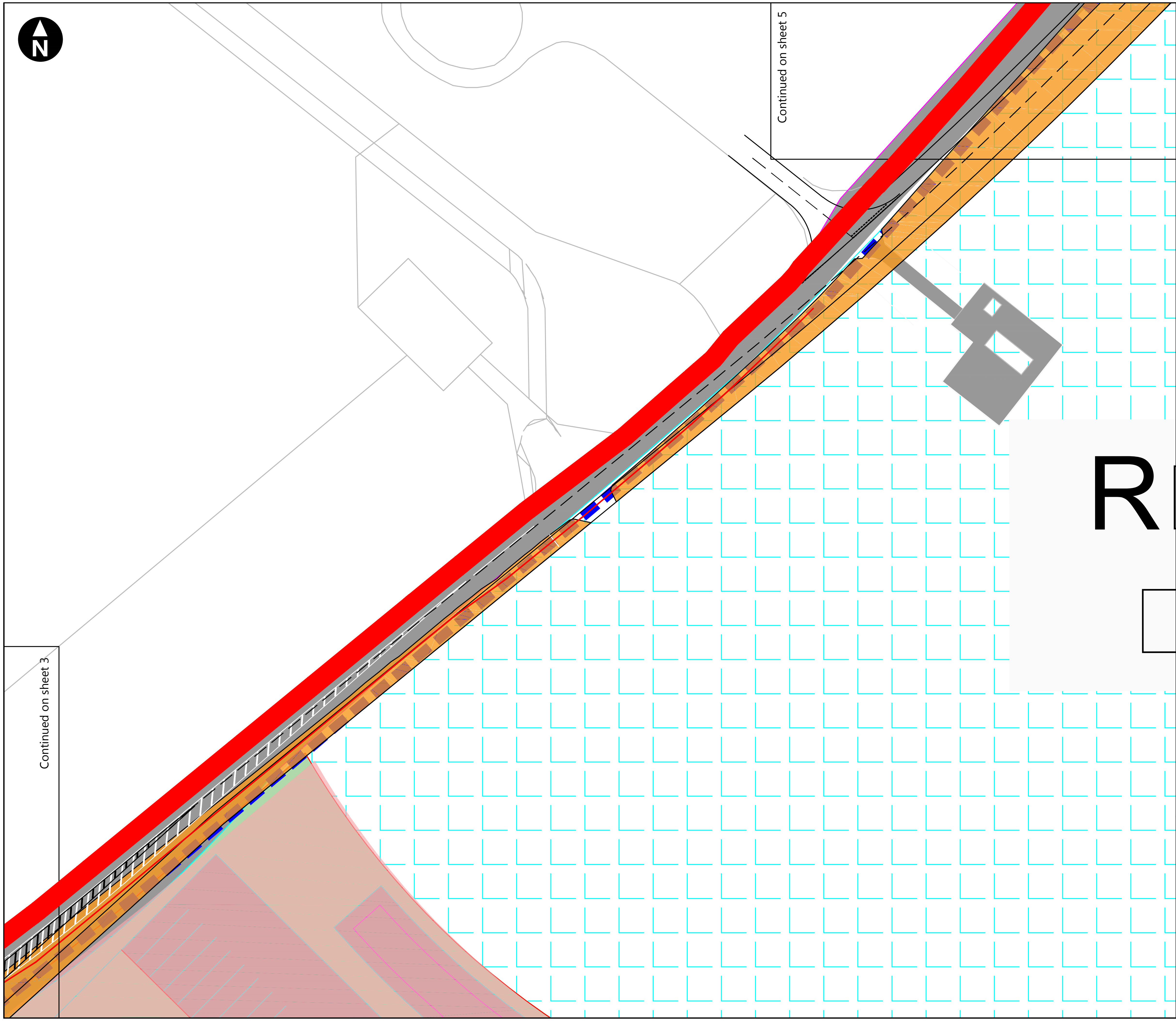

Continued on sheet 5

Continued on sheet 3

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Key

- Red Line Boundary
- Existing based on Ordnance Survey map
- Proposed Scheme
- Highway boundary
- Manston - Haine Link Land for safeguarding
- Northern Grass Area boundary

0 m 40 m

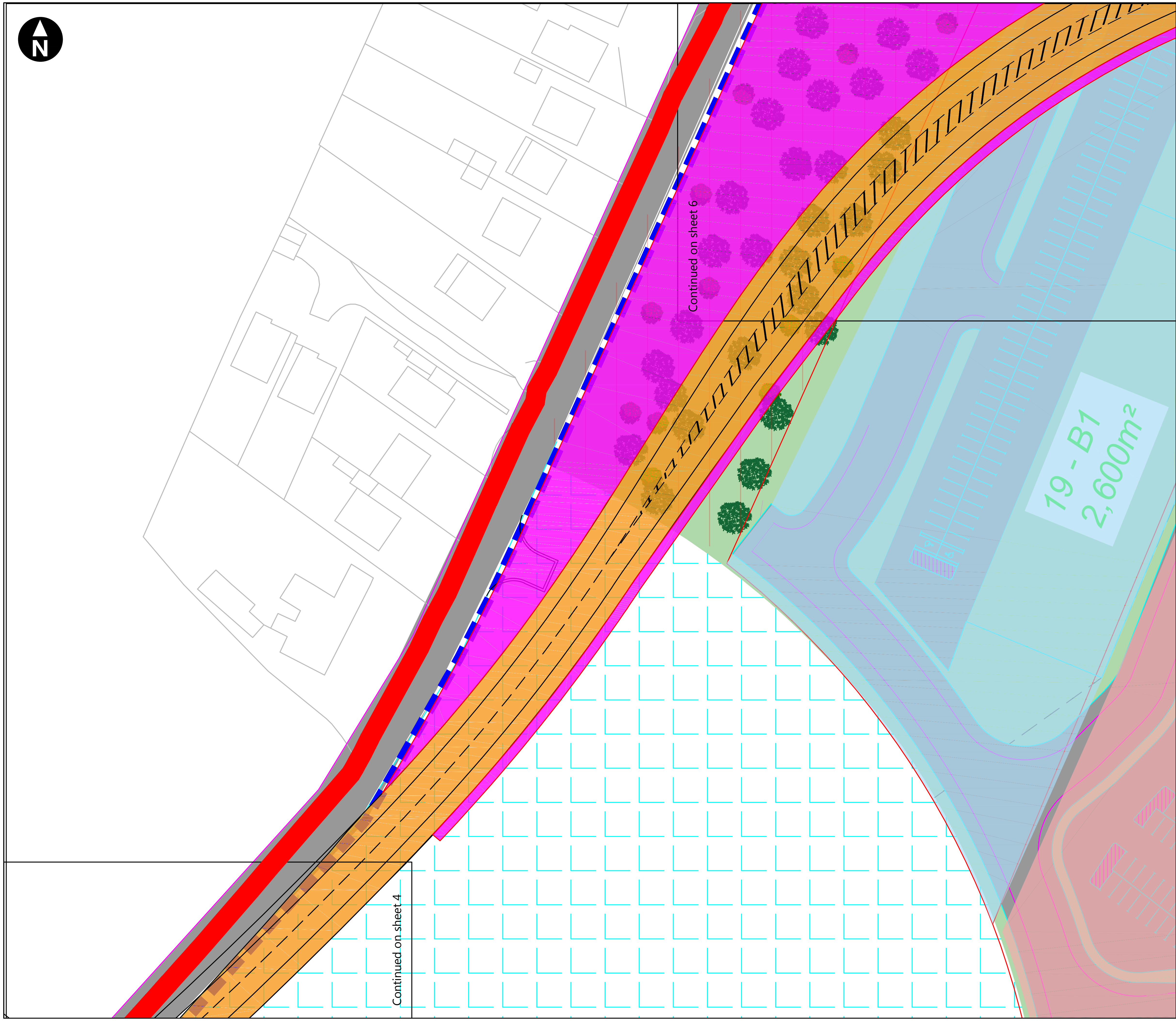
Scale 1:750 @ A3

Manston Airport DCO

Schedule 8 -Manston - Haine Link
Land for Safeguarding
Sheet 4

June 2019

wood.



Key

- Red Line Boundary
- Existing based on Ordnance Survey map
- Proposed Scheme
- Highway boundary
- Manston - Haine Link Land for safeguarding
- Northern Grass Area boundary

0 m 40 m

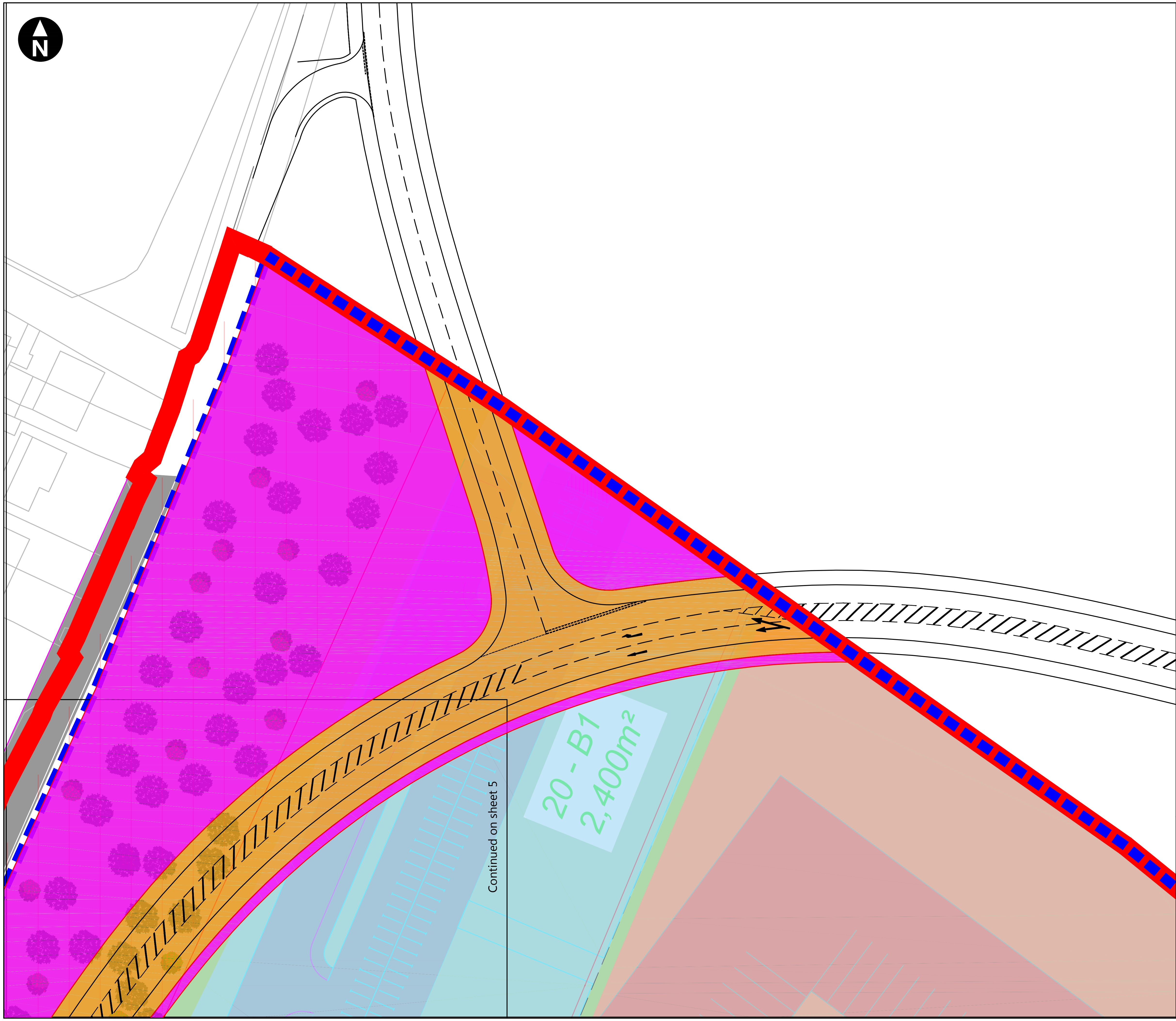
Scale 1:750 @ A3

Manston Airport DCO

Schedule 8 - Manston - Haine Link Land for Safeguarding Sheet 5

June 2019

wood.



Continued on sheet 5

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Key

Red Line Boundary

Existing based on Ordnance Survey map

Proposed Scheme

Highway boundary

Manston - Haine Link Land for safeguarding

Northern Grass Area boundary

0 m 40 m

Scale 1:750 @ A3

Manston Airport DCO

Schedule 8 -Manston - Haine Link Land for Safeguarding Sheet 6

June 2019

wood.

Appendix TR.4.54

wood.

Technical Note:
Appendix TR4.54 – TR10 Upgrade Costing – Methodology

1. Introduction

This Technical Note (TN) has been prepared to set out the methodology used to calculate the cost of £90,000 for upgrading PRoW TR10 set out in revised draft Section 106 Agreement [REP8-006] at Schedule 5.

1.1 Calculation Methodology

KCC Calculations

1.1.1 Ongoing discussion with KCC Public Rights of Way Denise Roffey officer regards improvements to PRoW as a result of the proposed development were undertaken in April 2019 and this resulted in a telephone conversation on the 9th of April 2019 where the specific issues regards upgrading TR10 were discussed.

1.1.2 Later on the 9th of April 2019 Denise Roffey sent an email to Wood setting out costs that had been calculated by KCC for the upgrading of TR10. This email is included as Appendix 1 to this TN.

1.1.3 The email set out the following methodology;

- The total cost of surfacing bridleway TR10 with compacted type one (passing 37.5mm sieve) to 100mm depth with 15mm thickness of 4mm to dust limestone fines would be £130,140.00 this is calculated in the following way:
- Length of bridleway (964 m) X width of bridleway (3 m) X cost of surface (£45 per metre) = £130,140.00

1.1.4 The length of bridleway, 946m, includes for all TR10 from the paved section of TR10 on High Street through to where it meets the A256 Haine Road.

Wood Calculations

1.1.5 In considering the costs of upgrading TR10, the calculations undertaken by Wood to inform the Section 106 were based on those set out above by KCC but for a shorter distance. In the future year, Manston Green Development, a consented development, will be provided and it is anticipated that the section of TR10 through the Manston Green development will be provided by that development.

1.1.6 The distance remaining between TR10 on the paved section of High Street though to the edge of the Manston Green development is measured as 666m. As such the following calculation was undertaken;

- Length of bridleway (666 m) X width of bridleway (3 m) X cost of surface (£45 per metre) = £89,910.00

1.1.7 This number was rounded up by £90 to the £90,000 figure set out in the Revised Section 106 agreement.

Issued by

Glyn Price

[redacted]

....

Approved by

Bev Coupe

[redacted]

....

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Management systems

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From: Denise.Roffey@kent.gov.uk <Denise.Roffey@kent.gov.uk>
Sent: 11 April 2019 14:56
To: Price, Glyn <glyn.price@woodplc.com>
Subject: RE: PRoW - Manston Airport

Hi Glyn

The total cost of surfacing bridleway TR10 with compacted type one (passing 37.5mm sieve) to 100mm depth with 15mm thickness of 4mm to dust limestone fines would be £130,140.00 this is calculated in the following way:

Length of bridleway (964 m) X width of bridleway (3 m) X cost of surface (£45 per metre) = £130,140.00

Please note, I have not included the section of bridleway that already has an acceptable hard surface.

I hope this helps?

Many thanks
Denise

Denise Roffey | Countryside Access Improvement Plan Officer | Public Rights Of Way & Access Service | Growth Environment & Transport |Environment Planning & Enforcement | Countryside & Community Development | Kent County Council | Invicta House | Sessions Square | Maidstone | Kent | ME14 1XX | Tel: 03000 418253

From: Price, Glyn <glyn.price@woodplc.com>
Sent: 09 April 2019 11:49
To: Roffey, Denise - GT EPE <Denise.Roffey@kent.gov.uk>
Cc: Coupe, Bev <bev.coupe@woodplc.com>
Subject: PRoW - Manston Airport

Denise

Thanks for the call earlier this morning regards TR10 and assisting us to give a response to the inspectors question.

As part of the conversation you mentioned costs for upgrading TR10 which it would be useful to have some approximate figures or anything more formal (that you have) on this. I know you referred to 140k, do you have some background evidence/caculations informing that?

Would be useful to have this to hand going forward.

Kind regards

Glyn Price
Associate Director (Planning Transport & Design)
Canon Court, Abbey Lawn, Abbey Forgate, Shrewsbury, SY2 5DE, UK

Direct: +44 (0)1743 264114
VOIP: #7914114
Email: Glyn.Price@woodplc.com

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wood.
