Luton Rising
Our airport.
Our community.
Our planet.

February 2023

London Luton Airport Expansion

Planning Inspectorate Scheme Ref: TR020001

Volume 5 Environmental Statement and Related Documents

5.02 Appendix 7.1 Air Quality Methodology

Application Document Ref: TR020001/APP/5.02
APFP Regulation: 5(2)(a)

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

London Luton Airport Expansion Development Consent Order 202x

5.02 ENVIRONMENTAL STATEMENT APPENDIX 7.1 AIR QUALITY METHODOLOGY

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1 INTRODUCTION

1.1.1 Luton Rising (a trading name of London Luton Airport Limited (the 'Applicant')), is proposing to expand London Luton Airport (the airport) through an application for development consent for works that would allow growth from the current permitted capacity of 18 million passengers per annum (mppa) to accommodate 32 mppa (hereon referred to as the 'Proposed Development').

1.1.2 This document describes the methodology that has been used for the air quality and odour assessment as reported in **Chapter 7** of the Environmental Statement (ES) **[TR020001/APP/5.01]** submitted as part of the application for development consent.

1.1.3 This document provides details on:

a. the construction dust assessment methodology (**Section 2**);
b. the dispersion modelling methodology, including details of the receptors selected, the emissions calculated and the model parameters used (**Section 3**);
c. the significance criteria used (**Section 4**);
d. the odour assessment methodology (**Section 5**);
e. the health impact assessment methodology (**Section 6**); and
f. the assumptions and limitations (**Section 7**).

2 CONSTRUCTION DUST ASSESSMENT METHODOLOGY

2.1.1 There are five steps in the assessment process described in the Institute of Air Quality Management (IAQM) guidance (Ref. 1). These are summarised in **Inset 2.1** and a further description is provided in the following paragraphs.

Step 1: Need for assessment

2.1.2 The first step is the initial screening for the need for a detailed assessment. According to the IAQM guidance, an assessment is required where there are sensitive receptors within 350m of the site boundary (for ecological receptors that is 50m) and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from the site entrance(s).

Step 2: Assess the risk of dust impacts

2.1.3 This step is split into three sections as follows:

2A. Define the potential dust emission magnitude;

2B. Define the sensitivity of the area; and

2C. Define the risk of impacts.

2.1.4 Each of the dust-generating activities is given a dust emission magnitude depending on the scale and nature of the works (step 2A) based on the criteria shown in **Table 2.1**.

2.1.5 The sensitivity of the surrounding area is then determined (step 2B) for each dust effect from the above dust-generating activities, based on the proximity and number of receptors, their sensitivity to dust, the local PM_{10} background concentrations and any other site-specific factors. **Table 2.2** and **Table 2.3** show the criteria for defining the sensitivity of the area to different dust effects.

2.1.6 The overall risk of the impacts for each activity is then determined (step 2C) prior to the application of any mitigation measures (**Table 2.4**) and an overall risk for the site derived.

Table 2.1: Dust emission magnitude

Dust emission magnitude		
Small	**Medium**	**Large**
Demolition		
• total building volume <20,000m^3 • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10m above ground, demolition during wetter months	• total building volume 20,000m^3 to 50,000m^3 • potentially dusty construction material • demolition activities 10 20m above ground level	• total building volume >50,000m^3 • potentially dusty construction material (e.g. concrete) • on-site crushing and screening, demolition activities >20m above ground level
Earthworks		
• total site area <2,500m^2, soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • formation of bunds <4m in height • total material moved <20,000 tonnes • earthworks during wetter months	• total site area 2,500m^2 10,000m^2, moderately dusty soil type (e.g. silt) • 5-10 heavy earth moving vehicles active at any one time • formation of bunds 4m 8m in height • total material moved 20,000 to 100,000 tonnes	• total site area >10,000m^2 potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • >10 heavy earth moving vehicles active at any one time • formation of bunds >8m in height • total material moved >100,000 tonnes
Construction		
• total building volume <25,000 m^3 • construction material with low potential for	• total building volume 25,000m^3 100,000m^3	• total building volume >100,000m^3 • piling • on-site concrete batching

Dust emission magnitude		
Small	**Medium**	**Large**
dust release (e.g. metal cladding or timber)	• potentially dusty construction material (e.g. concrete) • piling • on-site concrete batching	• sandblasting
Trackout		
• <10 HDV (>3.5t) trips in any one day • surface material with low potential for dust release • unpaved road length <50m	• 10-50 HDV (>3.5t) trips in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50m – 100m;	• >50 HDV (>3.5t) trips in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100m

Table 2.2: Sensitivity of the area to dust soiling effects

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	<10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 2.3: Sensitivity of the area to human health impacts

Receptor sensitivity	Annual mean PM_{10}	Number of receptors	Distance from source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100		High	Medium	Low	
		1-10		Medium	Low		
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100		Medium	Low		
		1-10					
		>100	High	Medium	Low	Low	Low

Receptor sensitivity	Annual mean PM_{10}	Number of receptors	Distance from source (m)				
			<20	<50	<100	<200	<350
	24-28 µg/m3	10-100					
		1-10	Medium	Low			
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low				
		1-10					
Medium	>32 µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low			
	28-32 µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low				
	24-28µg/m^3	>10	Low	Low	Low	Low	Low
		1-10					
	<24µg/m^3	>10	Low	Low	Low	Low	Low
		1-10					
Low	-	>1	Low	Low	Low	Low	Low

Table 2.4: Risk of dust impacts

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Demolition			
High	High risk site	Medium risk site	Medium risk site
Medium	High risk site	Medium risk site	Low risk site
Low	Medium risk site	Low risk site	Negligible
Earthworks			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Construction			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Trackout			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Low risk site	Negligible

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Low	Low risk site	Low risk site	Negligible

Step 3: Determine the site-specific mitigation

2.1.7 Once each of the activities is assigned a risk rating, appropriate mitigation measures are identified. Where the risk is negligible, no mitigation measures are necessary.

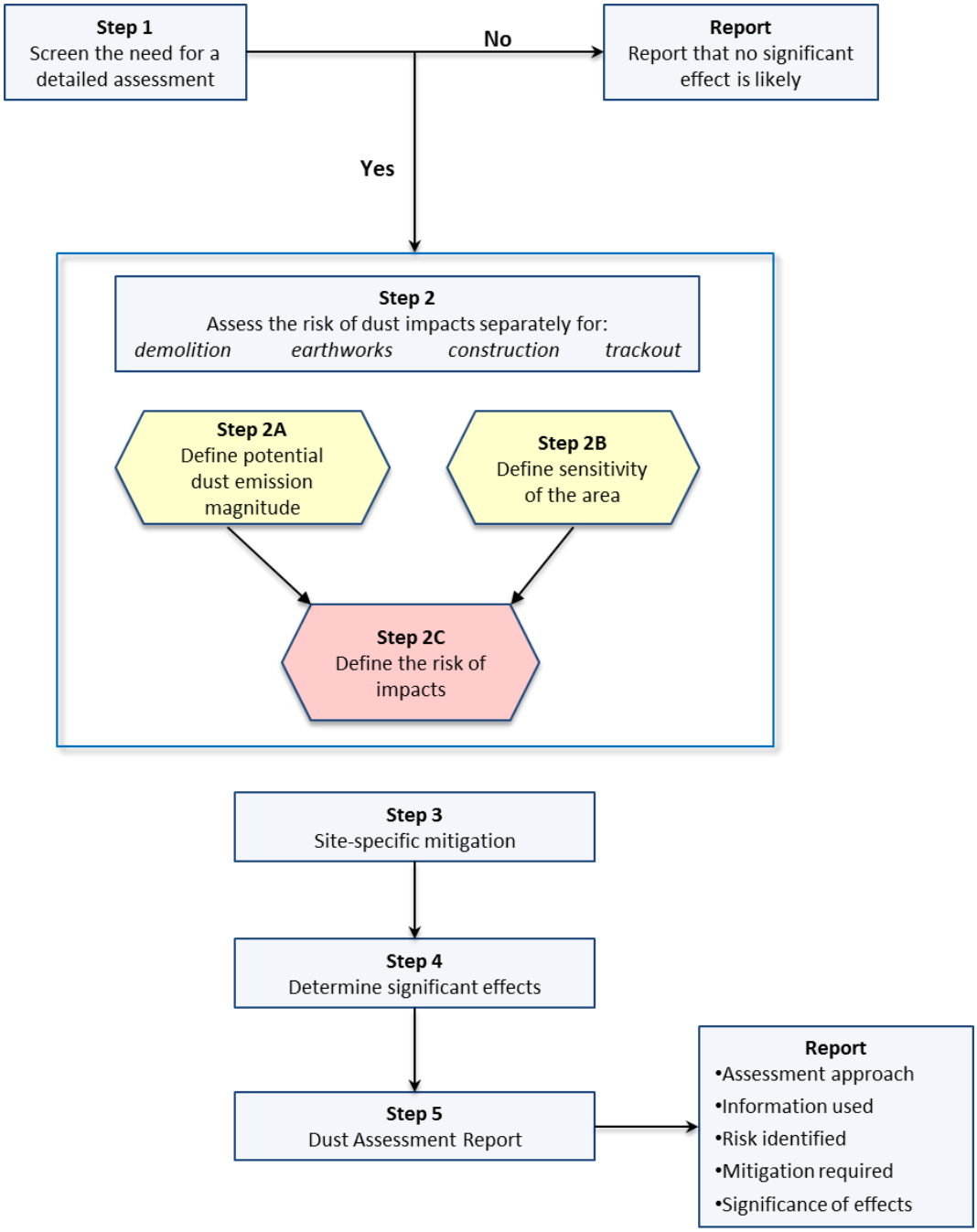
Step 4: Determine any significant residual effects

2.1.8 Once the risk of dust impacts has been determined and the appropriate dust mitigation measures identified, the final step is to determine whether there are any residual significant effects. The IAQM guidance (Ref. 1) notes that it is anticipated that with the implementation of effective site-specific mitigation measures, the environmental effect will not be significant in most cases.

Step 5: Prepare a dust assessment report

2.1.9 The last step of the assessment is the preparation of a Dust Assessment Report (provided as part of **Appendix 7.3** of the ES **[TR020001/APP/5.02]**).

Inset 2.1: IAQM dust assessment methodology (Ref. 1)



2.1.10 For this assessment, the risk of impacts from dust has been considered for each of the three assessment phases. The Proposed Development is split into three assessment phases (assessment Phase 1, 2a and 2b) as defined in **Chapter 5** of the ES **[TR020001/APP/5.01].** Each will require demolition, construction and earthworks, with associated trackout. The Proposed Development also includes requirement for highway intervention works adjacent to the airport and at the nearby M1 junction and Hitchin, which have also been assessed separately. The assessment was based on the construction information provided in the Construction Method Statement and Programme Report (provided as **Appendix 4.1** to this ES **[TR020001/APP/5.02]**).

3 MODELLING METHODOLOGY

3.1.1 This section sets out the method used to assess emissions and resulting concentrations from the airport sources and landside sources. This includes the assessment method for the operational phase impacts from growing airport capacity and the impacts from emissions associated with construction related traffic.

3.1.2 This section includes details of data sources used in the assessment; details of the sensitive receptor selection; and assessment scenarios.

3.2 Data sources

3.2.1 The following data sources have been used to inform the assessment:

a. monitoring data from Luton Borough Council (LBC) (Ref. 2), Central Bedfordshire Council (CBC) (Ref. 3), North Hertfordshire District Council (NHDC) (Ref. 4), London Luton Operations Limited (LLAOL) and the Applicant;
b. the UK Air Information Resource website (Ref. 5);
c. the National Atmospheric Emissions Inventory (NAEI) (Ref. 6);
d. aircraft fleet data and forecasts from aviation consultants (**Table 3.6**);
e. airside operational data from LLAOL (e.g. airside vehicles and fuel usage, and fuel usage for the fire training ground and the energy and heating combustion plant);
f. the International Civil Aviation Organization (ICAO) aircraft engine emissions databank (Ref. 7);
g. the ICAO airport air quality manual document no. 9889 (Ref. 8);
h. the Aviation Environmental Design Tool (AEDT) software (Ref. 9);
i. the Swedish Defence Research Agency (FOI) database for turboprop engine emissions (Ref. 10);
j. the Swiss Federal Office for Civil Association (FOCA) database for piston engines (Ref. 11);
k. the FOCA guidance on the determination of helicopter emissions (Ref. 12);
l. the European Environment Agency EMEP/EEA air pollutant emissions inventory guidebook (Ref. 13);
m. Ordnance Survey, AddressBase Plus data (Ref. 14); and
n. the Air Pollution Information System (APIS) website (Ref. 15).

3.3 Human receptors

3.3.1 Ordnance Survey (OS) AddressBase Plus data (Ref. 14) was used to assist in the identification of sensitive residential receptors in the study area. This geospatial dataset includes local authority and Royal Mail addresses and multi-

occupancy addresses. A total of 601 representative human receptors were selected for inclusion in the assessment, close to the airport and/or the affected road network (ARN) in the study area. Human receptors were modelled at a height of 1.5m. These are detailed in **Table 3.1**. Human receptors were chosen to capture the closest receptors along the ARN and at junctions, as well as around the airport. The receptor choices are considered to capture the most sensitive receptors.

3.3.2 Luton Hoo (receptor C1) and Someries Castle (receptor C2) have been identified as heritage receptors which could be sensitive to acid erosion from air pollutants. While there are no significant sources of acid emissions related to the Proposed Development receptors have been added at these locations to determine the change in air pollutant concentrations. The locations are also detailed in **Table 3.1**. Receptor IDs are preceded with letters which correspond to their type:

a. H = Residential properties (homes)
b. C = Cultural heritage (Luton Hoo and Someries Castle)
c. CH = Care Home
d. HC = Healthcare and hospital
e. N = Nursery
f. S = School

Table 3.1: Sensitive human receptors

ID	Address	X	Y	Type	AQMA (Y/N)
H1	Vanda Estate, London Road, Hitchin, SG4 7PJ	521101	223516	Residential	N
H2	8 Luton Road, Luton, LU2 8PZ	512474	223309	Residential	N
H3	New Mill End House, New Mill End, Luton, LU1 3TS	512121	218093	Residential	N
H4	207B, Dunstable Road, Luton, LU1 1DD	508203	221972	Residential	N
H5	135 Luton Road, Dunstable, LU5 4LW	503419	222179	Residential	N
H6	The Lodge, Luton Road, Luton, LU1 4AF	506362	219797	Residential	N
H7	29 Shelton Way, Luton, LU2 9AP	510181	223113	Residential	N
H8	677 Dunstable Road, Luton, LU4 0DS	505347	222725	Residential	N
H9	5 Eaton Green Road, Luton, LU2 9HB	511300	221803	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H10	29 Olympic Court, Cannon Lane, Luton, LU2 8DA	510765	224330	Residential	N
H11	30 Crawley Green Road, Luton, LU2 0QX	510051	221307	Residential	N
H12	1 Gaddesden Lane, St. Albans, AL3 7AS	509763	211416	Residential	N
H13	385 New Bedford Road, Luton, LU3 2AB	508504	224286	Residential	N
H14	Baileys Farm, Hitchin, SG4 8NZ	515245	221709	Residential	N
H15	32 Bank Close, Luton, LU4 9NX	505069	223686	Residential	N
H16	1 Hart Lane, Luton, LU2 0JF	510259	221614	Residential	N
H17	28 Stevenage Road, Hitchin, SG4 9DL	518890	228295	Residential	Y
H18	15 Twyford Drive, Luton, LU2 9TB	511882	222519	Residential	N
H19	Lilley House, West Street, Luton, LU2 8LH	511943	226231	Residential	N
H20	31C, New Bedford Road, Luton, LU1 1SE	508875	221648	Residential	N
H21	127 Bradley Road, Luton, LU4 8SW	505621	222221	Residential	N
H22	346 Luton Road, Dunstable, LU5 4LG	504252	222482	Residential	N
H23	247 Turners Road North, Luton, LU2 9AH	510597	223133	Residential	N
H24	102 West Street, Dunstable, LU6 1NX	501513	221726	Residential	N
H25	21 Woodside Home Park, Luton, LU1 4LP	507479	219207	Residential	N
H26	6 Poynters Road, Luton, LU4 0LA	504319	222551	Residential	N
H27	45 Cutenhoe Road, Luton, LU1 3NB	509331	219875	Residential	N
H28	211 New Bedford Road, Luton, LU3 1LL	508709	223197	Residential	N
H29	1 Nicholls Farm Cottages, Lybury Lane, St. Albans, AL3 7JH	509312	212940	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H30	55 Eaton Green Road, Luton, LU2 9JE	511712	221999	Residential	N
H31	47 Windmill Road, Luton, LU1 3XL	509964	220936	Residential	N
H32	32 Laxton Close, Luton, LU2 8SJ	512454	222277	Residential	N
H33	1 Manley Highway Cottages, Pirton Road, Hitchin, SG5 2ES	516482	229071	Residential	N
H34	33A, Farley Hill, Luton, LU1 5EG	508838	220582	Residential	N
H35	55B, High Street North, Dunstable, LU6 1JF	501715	222051	Residential	N
H36	71 Seabrook, Luton, LU4 0EJ	505170	223384	Residential	N
H37	The Beeches, Hemel Hempstead Road, St. Albans, AL3 7AG	509661	210764	Residential	N
H38	98A, Dunstable Road, Luton, LU1 1EH	508341	221849	Residential	Y
H39	28 Barnston Close, Luton, LU2 9RZ	511878	222072	Residential	N
H40	St. Marys Rc Presbytery, Castle Street, Luton, LU1 3AG	509158	220900	Residential	Y
H41	West Winds, Lye Hill, Hitchin, SG4 8PP	514993	221607	Residential	N
H42	19 Felton Close, Luton, LU2 9TD	511842	222478	Residential	N
H43	49 Falconers Road, Luton, LU2 9ET	511017	221986	Residential	N
H44	Winch Hill House, Luton, LU2 8PB	513764	221610	Residential	N
H45	44 Crescent Road, Luton, LU2 0AH	509963	221350	Residential	N
H46	Inglenook, East Street, Luton, LU2 8LW	511852	226565	Residential	N
H47	36 Gibraltar Cottages, London Road, Luton, LU1 4LE	509592	217396	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H48	16 Broad Oak Court, Handcross Road, Luton, LU2 8JE	511508	223068	Residential	N
H49	Lynch Field, The Lynch, Dunstable, LU6 3QZ	504198	218305	Residential	N
H50	20B, Church Street, Dunstable, LU5 4RU	501974	221891	Residential	Y
H51	52 Chertsey Close, Luton, LU2 9JD	511610	221906	Residential	N
H52	132 Luton Road, Dunstable, LU5 4JW	503381	222201	Residential	N
H53	346 Ashcroft Road, Luton, LU2 9AF	511199	222512	Residential	N
H54	67 Ashcroft Road, Luton, LU2 9AX	510725	223595	Residential	N
H55	1 Hartop Court, Lalleford Road, Luton, LU2 9JF	511686	221988	Residential	N
H56	295 New Bedford Road, Luton, LU3 1NH	508634	223680	Residential	N
H57	1 Eaton Place, Luton, LU2 9LB	511778	222014	Residential	N
H58	Cuckoos Nest, 60 Crawley Green Road, Luton, LU2 0QW	510190	221448	Residential	N
H59	25 Buckingham Drive, Luton, LU2 9RA	511485	222505	Residential	N
H60	39 London Road, Dunstable, LU6 3DH	502710	221032	Residential	N
H61	Luton Lodge, Stockwood Park, Luton, LU1 4BH	508513	220238	Residential	N
H62	45 Upper Tilehouse Street, Hitchin, SG5 2EF	517998	229018	Residential	N
H63	82 Stockingstone Road, Luton, LU2 7NF	509712	222760	Residential	N
H64	98 Lullington Close, Luton, LU2 8QY	511145	223235	Residential	N
H65	62 Pirton Road, Hitchin, SG5 2BQ	517521	228933	Residential	N
H66	Wardown Park Lodge, New Bedford Road, Luton, LU3 1LP	508754	222913	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H67	10 Pirton Road, Hitchin, SG5 2BD	517863	228994	Residential	N
H68	402 Dunstable Road, Luton, LU4 8JU	507200	222487	Residential	N
H69	102 Leicester Road, Luton, LU4 8SJ	506027	222196	Residential	N
H70	1 Grange Cottages, Hitchin, SG5 3ES	515246	227605	Residential	N
H71	View Point, School Lane, Hitchin, SG5 3AZ	514160	227406	Residential	N
H72	180 Ashcroft Road, Luton, LU2 9AB	510616	223091	Residential	N
H73	Telford Place, 1 Telford Way, Luton, LU1 1HT	508784	221700	Residential	Y
H74	46 Bowbrookvale, Luton, LU2 8SY	512667	222285	Residential	N
H75	Common Farm, Luton Road, Luton,	502154	229910	Residential	N
H76	11 Luton Road, Luton, LU1 4AF	506446	219811	Residential	N
H77	9 Dower Court, London Road, Hitchin, SG4 9EX	518720	228334	Residential	Y
H78	71 Poynters Road, Dunstable, LU5 4SG	504035	222703	Residential	N
H79	Lodge Cottages, Lilley Bottom, Luton, LU2 8NH	512955	225471	Residential	N
H80	123 Dunstable Road, Luton, LU1 4AN	505724	219392	Residential	N
H81	284 Crawley Green Road, Luton, LU2 0SJ	510771	222155	Residential	N
H82	70 Castle Street, Luton, LU1 3AJ	509085	220740	Residential	N
H83	36 Tudor Court, Hitchin, SG5 2BE	517701	228804	Residential	N
H84	152 Hitchin Road, Luton, LU2 0ES	509733	221918	Residential	N
H85	29 Tameton Close, Luton, LU2 8UX	512464	222982	Residential	N
H86	54A-54B, New Bedford Road, Luton, LU1 1SH	508893	221661	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H87	Hamilton Court 45-47, Collingdon Street, Luton, LU1 1BQ	508697	221536	Residential	N
H88	6 Ashton Square, Dunstable, LU6 3SN	501890	221839	Residential	Y
H89	199 Barton Road, Luton, LU3 2BN	508176	225915	Residential	N
H90	47 Upper Tilehouse Street, Hitchin, SG5 2EF	517949	228988	Residential	N
H91	379 Ashcroft Road, Luton, LU2 9AF	511224	222536	Residential	N
H92	1 Harrowden Court, Harrowden Road, Luton, LU2 0SR	511031	221660	Residential	N
H93	29-31, Castle Street, Luton, LU1 3AG	509263	220929	Residential	Y
H94	132 Ashcroft Road, Luton, LU2 9AY	510637	223376	Residential	N
H95	5 Statham Close, Luton, LU3 4EJ	508010	226381	Residential	N
H96	2 Leyhill Drive, Luton, LU1 5QA	507979	219896	Residential	N
H97	2 Enderby Road, Luton, LU3 2HQ	508379	224942	Residential	N
H98	18 Luton Road, Dunstable, LU5 4JN	502795	222073	Residential	N
H99	94 Lime Avenue, Luton, LU4 0EF	505246	223300	Residential	N
H100	Stagenhoe Home Farm, Stagenhoe Park, Hitchin, SG4 8DA	519044	222874	Residential	N
H101	54 Gilderdale, Luton, LU4 9NB	504584	224514	Residential	Y
H102	Corner Farm, The Lynch, Dunstable, LU6 3QZ	504288	218277	Residential	N
H103	2 The Stables, Lilley Bottom Road, Luton, LU2 8NS	512048	226135	Residential	N
H104	19 Hawthorn Close, Hitchin, SG5 2BW	518114	228736	Residential	N
H105	67 New Bedford Road, Luton, LU3 1DH	508750	222066	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H106	11 Timworth Close, Luton, LU2 9SF	511576	222465	Residential	N
H107	1 Park Street Lodge, Luton Hoo Estate, Luton, LU1 3TG	510179	220080	Residential	N
H108	141 Luton Road, Dunstable, LU5 4LP	503452	222190	Residential	N
H109	7 Primrose Court, Chiltern Road, Dunstable, LU6 1HH	501180	221584	Residential	N
H110	17 Longfield Drive, Luton, LU4 8RF	505493	222468	Residential	N
H111	87 Dunstable Road, Luton, LU1 4AN	505898	219478	Residential	N
H112	117 London Road, Luton, LU1 3RH	509067	219796	Residential	N
H113	2 Fermor Crescent, Luton, LU2 9HT	511424	222460	Residential	N
H114	12 Felton Close, Luton, LU2 9TD	511870	222431	Residential	N
H115	86 Crawley Green Road, Luton, LU2 0QU	510271	221584	Residential	N
H116	255 Runley Road, Luton, LU1 1TY	506406	221574	Residential	N
H117	10 West Street, Dunstable, LU6 1SX	501831	221836	Residential	Y
H118	42 Woodford Road, Dunstable, LU5 4JS	503414	222491	Residential	N
H119	25 Felton Close, Luton, LU2 9TD	511858	222502	Residential	N
H120	37D, Chapel Street, Luton, LU1 5DA	509047	220906	Residential	N
H121	15C, Crawley Road, Luton, LU1 1HX	508740	221697	Residential	Y
H122	806 Dunstable Road, Luton, LU4 0HE	504886	222676	Residential	N
H123	300 Hitchin Road, Luton, LU2 0EU	509984	222328	Residential	N
H124	41 Abingdon Road, Luton,	505299	223086	Residential	N
H125	53 Eaton Valley Road, Luton, LU2 0SN	510930	221981	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H126	4 Lambert Close, Luton, LU2 8BQ	511119	224765	Residential	N
H127	25A, Hitchin Road, Luton, LU2 0EJ	509564	221706	Residential	N
H128	6 Colwell Rise, Luton, LU2 9UA	512427	222282	Residential	N
H129	152 Sharpenhoe Road, Bedford,	500039	234952	Residential	N
H130	9 St. Elmo Court, London Road, Hitchin, SG4 9ET	518767	228232	Residential	N
H131	123 Hartsfield Road, Luton, LU2 9DY	510924	222297	Residential	N
H132	Wobbley Bottom Farm, Pirton Road, Hitchin, SG5 2ES	516455	229047	Residential	N
H133	6 Poynters Road, Luton, LU4 0LA	504347	222535	Residential	N
H134	2 Homedell House, Roundwood Lane, Harpenden, AL5 3RA	512518	215355	Residential	N
H135	41 Woodford Road, Dunstable, LU5 4JS	503383	222485	Residential	N
H136	91 Ravenhill Way, Luton, LU4 0HD	504684	223876	Residential	N
H137	87 Eldon Road, Luton, LU4 0AY	505433	222383	Residential	N
H138	17 Mardle Close, Luton, LU1 4EZ	506182	218912	Residential	N
H139	2 Brays Court, Brays Road, Luton, LU2 9DG	510627	223184	Residential	N
H140	67 Stopsley Way, Luton, LU2 7UU	510239	223305	Residential	N
H141	9 Nayland Close, Luton, LU2 9SZ	512051	222302	Residential	N
H142	2 Park Street Lodge, Luton Hoo Estate, Luton, LU1 3TG	510198	220096	Residential	N
H143	5 Poynters Road, Dunstable, LU5 4SG	504261	222551	Residential	N
H144	4 Baylam Dell, Luton, LU2 9ST	512043	222162	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H145	65 Someries Arch, Luton, LU1 3TF	511105	220067	Residential	N
H146	22 Copperfields, Luton, LU4 0JX	505064	223518	Residential	N
H147	1 Stevenage Road, Hitchin, SG4 9DH	518683	228394	Residential	N
H148	24 Claverley Green, Luton, LU2 8TA	512211	222779	Residential	N
H149	Barton Hill Farm Cottage, Barton Hill Road, Luton, LU2 8NE	509667	228439	Residential	N
H150	135 Bradley Road, Luton, LU4 0AR	505523	222221	Residential	N
H151	24 East Street, Luton, LU2 8LW	511866	226592	Residential	N
H152	8 Sackville Road, Luton, LU1 5FQ	508954	220660	Residential	N
H153	333 New Bedford Road, Luton, LU3 2AB	508572	223991	Residential	N
H154	Church Road, Luton, LU1 4BJ	508159	218793	Residential	N
H155	69 Skimpot Lane, Luton, LU1 4AY	505182	222125	Residential	N
H156	45 Kynance Close, Luton, LU2 9DN	510229	223025	Residential	N
H157	58 Cutenhoe Road, Luton, LU1 3NE	509379	219872	Residential	N
H158	17 Windsor Street, Luton, LU1 5DT	508955	220733	Residential	N
H159	9 Friston Green, Luton, LU2 9SE	511678	222464	Residential	N
H160	7 Gosmore Road, Hitchin, SG4 9AN	518581	228248	Residential	N
H161	94 Crawley Green Road, Luton, LU2 0QT	510301	221620	Residential	N
H162	9 Nuns Close, Hitchin, SG5 1EP	518198	229182	Residential	N
H163	Priory View, Church Street, Dunstable, LU5 4FG	502381	222031	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H164	908A, Dunstable Road, Luton, LU4 0HJ	504440	222553	Residential	N
H165	35 Kenilworth Road, Luton, LU1 1DQ	508130	221699	Residential	N
H166	Index Court, Index Drive, Dunstable, LU6 3TZ	502654	221045	Residential	N
H167	20A, Katherine Drive, Dunstable, LU5 4NT	503377	222511	Residential	N
H168	White Lodge, Hitchin, SG4 8NW	517618	222464	Residential	N
H169	74 Ashcroft Road, Luton, LU2 9AU	510665	223646	Residential	N
H170	20 Old Park Road, Hitchin, SG5 2JR	518150	229158	Residential	N
H171	16 Nayland Close, Luton, LU2 9SZ	512097	222281	Residential	N
H172	61 Crawley Green Road, Luton, LU2 0AA	510158	221460	Residential	N
H173	5 Colwell Rise, Luton, LU2 9TJ	512390	222276	Residential	N
H174	The Beeches, Hemel Hempstead Road, St. Albans,	510306	206696	Residential	N
H175	255 Crawley Green Road, Luton, LU2 0QJ	510659	222084	Residential	N
H176	84 Park Street, Luton, LU1 3EU	509556	220947	Residential	N
H177	Offley Chase, Luton, LU2 8NJ	513353	224753	Residential	N
H178	Point Red, 146 Midland Road, Luton, LU2 0BL	509069	221710	Residential	N
H179	Moulton Court, Moulton Rise, Luton, LU2 0AL	509770	221539	Residential	N
H180	68 Stuart Place, Luton, LU1 5DL	508902	221125	Residential	Y
H181	773 Dunstable Road, Luton, LU4 0HL	504879	222644	Residential	N
H182	7 Alderton Close, Luton, LU2 9SA	511845	222423	Residential	N
H183	1 Turnpike Drive, Luton, LU3 3RA	508074	226436	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H184	Law Hall Farm, Law Hall Lane, Hitchin, SG4 8JJ	516458	222125	Residential	N
H185	80 Chalk Hill, Luton, LU2 8PY	512763	223631	Residential	N
H186	Hitchin Hill, Hitchin, SG4 9AJ	518613	228382	Residential	N
H187	29A, High Street South, Dunstable, LU6 3RZ	501969	221785	Residential	Y
H188	41 Upper Tilehouse Street, Hitchin, SG5 2EE	518130	229043	Residential	Y
H189	6 Wyndham Road, Luton, LU4 0EA	505341	222836	Residential	N
H190	41 Deep Denes, Luton, LU2 7SU	510280	222843	Residential	N
H191	Wesley House, 19 Chapel Street, Luton, LU1 2EG	509129	220992	Residential	Y
H192	277A, Dunstable Road, Luton, LU4 8BS	507618	222187	Residential	N
H193	128 Common Road, Dunstable, LU6 3RG	503318	218045	Residential	N
H194	510 Hitchin Road, Luton, LU2 7ST	510104	223082	Residential	N
H195	2 Pump Cottages, Hexton Road, Luton, LU2 8NB	510765	227627	Residential	N
H196	1 Pirton Road, Hitchin, SG5 2BD	517865	228947	Residential	N
H197	1C, Crescent Road, Luton, LU2 0AB	509542	221631	Residential	N
H198	66 Upper Tilehouse Street, Hitchin, SG5 2EE	518064	229059	Residential	N
H199	2 Crawley Green Road, Luton, LU1 3LP	509805	221157	Residential	N
H200	87 Langford Drive, Luton, LU2 9AL	510308	223436	Residential	N
H201	41 London Road, Luton, LU1 3UE	509019	220356	Residential	N
H202	45 Skimpot Lane, Luton, LU1 4AY	505029	222140	Residential	N
H203	6A, Church Street, Dunstable, LU5 4RU	501926	221867	Residential	Y
H204	8 Oving Close, Luton, LU2 9RN	511669	222503	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H205	Fitzroy Court, Vicarage Street, Luton, LU1 3FN	509672	221138	Residential	N
H206	159 Crawley Green Road, Luton, LU2 0QL	510443	221834	Residential	N
H207	Swedish Cottages, Barton Road, Luton, LU3 3PU	507689	227875	Residential	N
H208	5 Barn Owl Close, Luton, LU1 5QZ	507910	219832	Residential	N
H209	59 Hitchin Road, Luton, LU2 0EL	509618	221805	Residential	N
H210	11 Withy Close, Luton, LU4 9NZ	504826	223992	Residential	N
H211	Woodland Court, Hart Hill Drive, Luton, LU2 0AX	510078	221356	Residential	N
H212	Wards Farm, Hexton Road, Luton, LU2 8LU	511540	227150	Residential	N
H213	11 Wigmore Lane, Luton, LU2 8AA	510757	223636	Residential	N
H214	17 Offley Road, Hitchin, SG5 2AZ	517855	228897	Residential	N
H215	687 Dunstable Road, Luton, LU4 0DS	505304	222729	Residential	N
H216	311 Crawley Green Road, Luton, LU2 9AG	511416	222511	Residential	N
H217	6 Alderton Close, Luton, LU2 9SA	511882	222378	Residential	N
H218	15 Someries Hill, Luton, LU2 9DL	511471	223031	Residential	N
H219	449 Luton Road, Harpenden, AL5 3QE	511314	216129	Residential	N
H220	2 Manor Cottages, Hexton Road, Luton, LU2 8NA	511244	227580	Residential	N
H221	171 Manor Road, Luton, LU1 4HJ	506462	218999	Residential	N
H222	4 High Street North, Dunstable, LU6 1JU	501906	221882	Residential	Y
H223	1 Charles Street, Luton, LU2 0EB	509695	221904	Residential	N
H224	116 Barton Road, Luton, LU3 2BD	508336	225420	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H225	238 Stockingstone Road, Luton, LU2 7DG	509313	223219	Residential	N
H226	Park Cottage, Farley Hill, Luton, LU1 5NY	508257	220028	Residential	N
H227	29 Wigmore Lane, Luton, LU2 8AB	510884	223527	Residential	N
H228	119 Falconers Road, Luton, LU2 9ET	511097	221759	Residential	N
H229	40B, High Street North, Dunstable, LU6 1LA	501806	221976	Residential	N
H230	10 Cheslyn Close, Luton, LU2 8UA	512348	222906	Residential	N
H231	102 High Street North, Dunstable, LU6 1LN	501494	222327	Residential	N
H232	43-45, High Street North, Dunstable, LU6 1JE	501756	222000	Residential	Y
H233	Greenkeepers Bungalow, Stockwood Park, Luton, LU1 4BH	508551	219587	Residential	N
H234	3 Wigmore Lane, Luton, LU2 9TH	511814	222540	Residential	N
H235	15 Fermor Crescent, Luton, LU2 9HU	511232	222450	Residential	N
H236	Millfield House, Millfield Lane, Luton, LU1 4AR	505509	218706	Residential	N
H237	4 Linley Dell, Luton, LU2 8TJ	511948	222597	Residential	N
H238	1 Offley Road, Hitchin, SG5 2AZ	517908	228957	Residential	N
H239	99 Russett Way, Dunstable, LU5 4GD	502840	222079	Residential	N
H240	183 High Street, Luton, LU4 9LE	505236	223447	Residential	N
H241	430 Hitchin Road, Luton, LU2 7ST	510130	222813	Residential	N
H242	1 Oakley Road, Luton, LU4 9PT	506414	222652	Residential	N
H243	741 Dunstable Road, Luton, LU4 0HL	505046	222667	Residential	N
H244	124 Lalleford Road, Luton, LU2 9JJ	511495	222472	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H245	1 Mortgrove Cottages, Luton, LU2 8ND	510462	227993	Residential	N
H246	212 High Street South, Dunstable, LU6 3NX	502431	221288	Residential	N
H247	Belmullet House, 76 Stuart Street, Luton, LU1 2SW	508754	221296	Residential	Y
H248	3 Wigmore Lane, Luton, LU2 8AA	510713	223660	Residential	N
H249	The Meadows, Hemel Hempstead Road, St. Albans,	509280	207781	Residential	N
H250	70 Cutenhoe Road, Luton, LU1 3NF	509393	219895	Residential	N
H251	1 Ashcroft Road, Luton, LU2 9AU	510530	223827	Residential	N
H252	Hillcrest Bungalow, Dunstable Road, Luton, LU1 4AN	505301	219241	Residential	N
H253	Lynton, Upper Tilehouse Street, Hitchin, SG5 2EF	517919	229006	Residential	N
H254	Luton Rugby Club, Newlands Road, Luton, LU1 4BQ	508228	219336	Residential	N
H255	80 Dunstable Road, Luton, LU1 4AL	505978	219529	Residential	N
H256	82 Stokers Close, Dunstable, LU5 4EY	502552	221988	Residential	N
H257	899 Dunstable Road, Luton, LU4 0HR	504447	222521	Residential	N
H258	768 Dunstable Road, Luton, LU4 0DX	505262	222769	Residential	N
H259	Nadeem Plaza, 172 Dunstable Road, Luton, LU4 8FG	508155	222027	Residential	N
H260	1 Buckingham Drive, Luton, LU2 9RA	511565	222499	Residential	N
H261	Common Farm, Luton Road, Luton,	501019	232822	Residential	N
H262	Bentley Court, Moor Street, Luton, LU1 1EZ	508427	221723	Residential	Y
H263	66 Tameton Close, Luton, LU2 8UX	512443	222840	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H264	8A, Dunstable Road, Luton, LU1 1DY	508697	221371	Residential	Y
H265	54 Stevenage Road, Hitchin, SG4 9DR	518984	228278	Residential	Y
H266	Common Farm, Luton Road, Luton,	502248	229410	Residential	N
H267	279 Crawley Green Road, Luton, LU2 0QH	510820	222230	Residential	N
H268	35 Wyatt Court, Farley Fields, Luton, LU1 5FG	507732	219884	Residential	N
H269	14 The Ridgeway, Hitchin, SG5 2BT	517631	228739	Residential	N
H270	3 Tilehouse Street, Hitchin, SG5 2TS	518142	229001	Residential	N
H271	45 Cutenhoe Road, Luton, LU1 3NB	509343	219880	Residential	N
H272	50 Layham Drive, Luton, LU2 9SY	512076	222171	Residential	N
H273	11A, Raleigh Grove, Luton, LU4 8RE	505509	222388	Residential	N
H274	1A, Barnfield Avenue, Luton, LU2 7AS	508550	224369	Residential	N
H275	622 Dunstable Road, Luton, LU4 8SE	506044	222675	Residential	N
H276	Longmeadow Community Farm, Sundon Road, Luton, LU4 9UA	503773	226133	Residential	N
H277	5 Front Street, Luton, LU1 4BP	508010	218481	Residential	N
H278	8 Millstone Way, Harpenden, AL5 5FE	514222	215639	Residential	N
H279	BUPA St Marys Nursing Home, 19 Dunstable Road, Luton, LU1 1BE	508594	221429	Residential	Y
H280	36 Tilehouse Street, Hitchin, SG5 2DY	518160	229044	Residential	N
H281	7 Whitchurch Close, Luton, LU2 9RH	511659	222902	Residential	N
H282	6 Mortimer Close, Luton, LU1 5RR	506966	221006	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H283	11 Pinford Dell, Luton, LU2 9SD	511765	222464	Residential	N
H284	142 Luton Road, Dunstable, LU5 4LE	503449	222225	Residential	N
H285	2 London Road, Hitchin, SG4 9EX	518704	228263	Residential	N
H286	1 Skimpot Road, Luton, LU4 0JB	504393	222448	Residential	N
H287	Hillside, Luton Road, Luton, LU4 9UB	503574	226178	Residential	N
H288	2 Pondfarm Cottages, Hexton Road, Luton, LU2 8LX	511537	227204	Residential	N
H289	34 Ditchling Close, Luton, LU2 8JR	511403	223104	Residential	N
H290	18 Bank Close, Luton, LU4 9NX	505020	223749	Residential	N
H291	415 Hitchin Road, Luton, LU2 7SP	510083	222890	Residential	N
H292	133 High Street North, Dunstable, LU6 1JN	501484	222301	Residential	N
H293	16 The Mount, Luton, LU3 1BU	508864	221843	Residential	N
H294	131 Eaton Valley Road, Luton, LU2 0SN	511000	221682	Residential	N
H295	15 West Street, Dunstable, LU6 1SL	501818	221806	Residential	N
H296	5 Farley Green Cottages, Luton, LU1 4AA	507859	219777	Residential	N
H297	Manor Court, Luton Road, Luton, LU1 4AE	506613	219889	Residential	N
H298	19 Felton Close, Luton, LU2 9TD	511842	222478	Residential	N
H299	Dane Street Farm West, Dane Street, Luton, LU2 8PE	513306	220732	Residential	N
H300	13A, Layham Drive, Luton, LU2 9SY	511944	222350	Residential	N
H301	2A, Chertsey Close, Luton, LU2 9JD	511565	221886	Residential	N
H302	1 Lister Avenue, Hitchin, SG4 9ES	518794	228146	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H303	1C, Crescent Road, Luton, LU2 0AB	509544	221645	Residential	N
H304	192 Barton Road, Luton, LU3 3NH	508207	225964	Residential	N
H305	Union Chapel House, 43 Castle Street, Luton, LU1 3AR	509183	220902	Residential	Y
H306	13 Deep Denes, Luton, LU2 7SU	510147	223029	Residential	N
H307	1 The Green, Luton, LU1 4HF	506311	219742	Residential	N
H308	24 Rowington Close, Luton, LU2 9TZ	512361	222870	Residential	N
H309	3 Silver Lion Cottages, Luton, LU2 8NL	512153	225957	Residential	N
H310	Hill & Coles Farmhouse, London Road, St. Albans, AL3 8HA	508924	215546	Residential	N
H311	68 Cutenhoe Road, Luton, LU1 3NF	509393	219894	Residential	N
H312	Oak View, 1 Stockingstone Road, Luton, LU2 7FJ	510078	222699	Residential	N
H313	1 Ivy Cottages, Luton, LU2 8NX	513174	222466	Residential	N
H314	Kingsbury Court, Church Street, Dunstable, LU5 4ND	502109	221952	Residential	Y
H315	373 Barton Road, Luton, LU3 3NS	507908	226824	Residential	N
H316	138 Paynes Park, Hitchin, SG5 1AU	518202	229077	Residential	N
H317	561 Dunstable Road, Luton, LU4 8QW	505926	222628	Residential	N
H318	5 Brill Close, Luton, LU2 9RL	511765	222753	Residential	N
H319	Egan House, 2 Cardiff Road, Luton, LU1 1PP	508697	221303	Residential	Y
H320	Pirton Road, Hitchin, SG5 2EN	517314	228937	Residential	N
H321	91A, High Street North, Dunstable, LU6 1JJ	501594	222186	Residential	N
H322	3 Redding Lane, St. Albans, AL3 7QN	509092	214094	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H323	1 Woodford Road, Dunstable, LU5 4JS	503379	222312	Residential	N
H324	1 Leygreen Close, Luton, LU2 0SQ	510475	221830	Residential	N
H325	80 Ashcroft Road, Luton, LU2 9AX	510680	223622	Residential	N
H327	313 Ashcroft Road, Luton, LU2 9AA	511002	222779	Residential	N
H328	30 Farley Hill, Luton, LU1 5HQ	508758	220544	Residential	N
H329	1 Kiln Way, Dunstable, LU5 4GY	504425	222185	Residential	N
H330	Hyde Mill Farm, Lower Luton Road, Luton, LU2 9PX	513260	217006	Residential	N
H331	12 Beckbury Close, Luton, LU2 8UB	512406	222943	Residential	N
H332	694 Dunstable Road, Luton, LU4 8SE	505643	222741	Residential	N
H333	911A, Dunstable Road, Luton, LU4 0HR	504408	222503	Residential	N
H334	3D, Hazelbury Crescent, Luton, LU1 1DF	508383	221629	Residential	N
H335	105 High Street South, Dunstable, LU6 3SQ	502210	221568	Residential	N
H336	22 Ashcroft Road, Luton, LU2 9AU	510484	223810	Residential	N
H337	22A, Katherine Drive, Dunstable, LU5 4NT	503390	222525	Residential	N
H338	38C, West Street, Dunstable, LU6 1TA	501733	221790	Residential	N
H339	221 High Street South, Dunstable, LU6 3HY	502442	221312	Residential	N
H340	1 Gardner Court, London Road, Luton, LU1 3SJ	509058	219779	Residential	N
H341	5 Brandreth Avenue, Dunstable, LU5 4JP	503371	222262	Residential	N
H342	290 Ashcroft Road, Luton, LU2 9AE	511020	222729	Residential	N
H343	Common Farm, Luton Road, Luton,	502147	229892	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H344	102 Luton Road, Dunstable, LU5 4JW	503266	222163	Residential	N
H345	30 Crawley Green Road, Luton, LU2 0QX	510051	221307	Residential	N
H346	St. Aidans, Gosmore Road, Hitchin, SG4 9EZ	518631	228289	Residential	N
H347	18 Keeble Close, Luton, LU2 9RT	512149	222233	Residential	N
H348	45 Cutenhoe Road, Luton, LU1 3NB	509332	219875	Residential	N
H349	Unity House, 111 Stuart Street, Luton, LU1 5FW	508749	221257	Residential	Y
H350	18 Bramley Court, Luton Road, Dunstable, LU5 4GA	502735	222147	Residential	N
H351	2H, Farley Hill, Luton, LU1 5ER	508906	220679	Residential	N
H352	58 Upper Tilehouse Street, Hitchin, SG5 2EE	518013	229040	Residential	N
H353	17 Chertsey Close, Luton, LU2 9JD	511487	221862	Residential	N
H354	8 Woodford Road, Dunstable, LU5 4JS	503404	222298	Residential	N
H355	211 Ashcroft Road, Luton, LU2 9AA	510642	223113	Residential	N
H356	16 Polegate, Luton, LU2 8AJ	511854	222537	Residential	N
H357	6 Barn Owl Close, Luton, LU1 5QZ	507893	219830	Residential	N
H358	Crouchmore Farm, Luton, LU2 8PS	513538	222890	Residential	N
H359	190 Farley Hill, Luton, LU1 5NU	508122	219982	Residential	N
H360	19 Saywell Road, Luton, LU2 0QG	510614	222524	Residential	N
H361	White Horse Tea Green, Stony Lane, Luton, LU2 8PS	513636	223212	Residential	N
H362	52 Chertsey Close, Luton, LU2 9JD	511610	221906	Residential	N
H363	Green Acres, Luton, LU2 8NZ	513595	222328	Residential	N
H364	West End Farm, School Lane, Hitchin, SG5 3DA	514060	227467	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H365	15 Windmill Road, Luton, LU1 3XL	509846	221103	Residential	N
H366	14 Tameton Close, Luton, LU2 8UX	512400	222900	Residential	N
H367	2 Warren Lodge, Luton Hoo Estate, Luton, LU1 3TW	511810	218628	Residential	N
H368	30A, Stuart Street, Luton, LU1 2SW	508900	221170	Residential	Y
H369	265 Luton Road, Dunstable, LU5 4LR	503915	222339	Residential	N
H370	Felt House, Laporte Way, Luton, LU4 8FN	507189	222030	Residential	N
H371	The Beeches, Hemel Hempstead Road, St. Albans,	510721	206051	Residential	Y
H372	16 Traherne Close, Hitchin, SG4 9DS	518984	228310	Residential	N
H373	70 Castle Street, Luton, LU1 3AJ	509085	220740	Residential	N
H374	3 Wimborne Road, Luton, LU1 1PD	508109	221661	Residential	N
H375	7 Wyatt Court, Farley Fields, Luton, LU1 5FG	507792	219854	Residential	N
H376	711 Dunstable Road, Luton, LU4 0DT	505202	222709	Residential	N
H377	4 Felton Close, Luton, LU2 9TD	511906	222405	Residential	N
H378	6 Pinford Dell, Luton, LU2 9SD	511823	222442	Residential	N
H379	4 Hedges Way, Luton, LU4 9FD	504799	224115	Residential	N
H380	5 Reston Path, Luton, LU2 9UU	512177	222729	Residential	N
H381	83 Dunstable Road, Luton, LU1 4AL	505937	219486	Residential	N
H382	406 Hitchin Road, Luton, LU2 7ST	510149	222759	Residential	N
H383	1 Keeble Close, Luton, LU2 9RT	512125	222202	Residential	N
H384	Wenlock Court, Manor Road, Luton, LU1 3FT	509663	220967	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H385	27 Wratten Road East, Hitchin, SG5 2AS	518131	228910	Residential	N
H386	117 Poynters Road, Dunstable, LU5 4SQ	503866	222821	Residential	N
H388	41 Stevenage Road, Hitchin, SG4 9DW	519233	228231	Residential	N
H389	39 Old Park Road, Hitchin, SG5 2JX	518091	229311	Residential	N
H390	Windmill Cottage, Lilley Bottom, Hitchin, SG4 8LW	514690	223852	Residential	N
H391	4 Coverly Court, Falconers Road, Luton, LU2 9BF	510982	222260	Residential	N
H392	7 Primrose Court, Chiltern Road, Dunstable, LU6 1HH	501180	221584	Residential	N
H393	18 Colwell Rise, Luton, LU2 9UA	512387	222361	Residential	N
H394	Homelea, Lybury Lane, St. Albans, AL3 7JJ	509555	213170	Residential	N
H395	1 Wyndham Road, Luton, LU4 0EA	505303	222809	Residential	N
H396	1A, Manor Road, Luton, LU1 4EE	506304	219719	Residential	N
H397	120 Mancroft Road, Luton, LU1 4EN	506110	218890	Residential	N
H398	Hill Rise, Luton Road, Hitchin, SG5 3DR	513386	226883	Residential	N
H399	657A, Dunstable Road, Luton, LU4 8QR	505447	222712	Residential	N
H400	Ashridge, Luton, LU1 4LJ	508603	218071	Residential	N
H401	178 Poynters Road, Luton, LU4 0LB	503879	222852	Residential	N
H402	Lawn Cottage, Newlands Road, Luton, LU1 4BQ	508210	219401	Residential	N
H403	161 Stevenage Road, Hitchin, SG4 9DX	519188	228277	Residential	N
H404	69 Old Park Road, Hitchin, SG5 2JT	518135	229245	Residential	N
H405	194 High Street South, Dunstable, LU6 3HS	502346	221382	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H406	Oakwood, Darley Hall, Luton, LU2 8PP	514207	222535	Residential	N
H407	67 Dovehouse Hill, Luton, LU2 9ES	511041	222350	Residential	N
H408	1 Falconers Road, Luton, LU2 9ET	510946	222208	Residential	N
H409	640A, Hitchin Road, Luton, LU2 7UG	510447	223835	Residential	N
H410	8 Rowington Close, Luton, LU2 9TZ	512473	222792	Residential	N
H411	Flat 3, High Street North, Dunstable, LU6 1HX	501855	221880	Residential	Y
H412	431 Hitchin Road, Luton, LU2 7SP	510060	222962	Residential	N
H413	43 Bull Wood Cottages, London Road, Luton, LU1 4LA	509336	219036	Residential	N
H414	3 Armitage Gardens, Luton, LU4 8RD	505547	222306	Residential	N
H415	Wandon End Farm, Luton, LU2 8NX	513309	222448	Residential	N
H416	114 Manor Road, Luton, LU1 4HH	506503	219019	Residential	N
H417	132 Kestrel Way, Luton, LU4 0UR	504436	224245	Residential	N
H418	7 Brook Street, Luton, LU3 1DS	508749	221970	Residential	N
H419	373A, Hitchin Road, Luton, LU2 7SP	510122	222750	Residential	N
H420	1 Polegate, Luton, LU2 8AJ	511800	222640	Residential	N
H421	9 Coles Lane, Harpenden, AL5 3DW	509158	216123	Residential	N
H422	97 Luton Road, Dunstable, LU5 4LW	503254	222131	Residential	N
H424	Telford Place, 1 Telford Way, Luton, LU1 1HT	508784	221700	Residential	Y
H425	Chapel Street Student Halls, 21 Chapel Street, Luton, LU1 2SE	509081	220959	Residential	Y

ID	Address	X	Y	Type	AQMA (Y/N)
H426	385 New Bedford Road, Luton, LU3 2AB	508504	224286	Residential	N
H427	306 Crawley Green Road, Luton, LU2 0SL	510859	222214	Residential	N
H428	St. Ninians Court, Villa Road, Luton, LU2 7NU	508940	221745	Residential	N
H429	Lower Harpendon Road, Luton, LU1 3PL	510798	220150	Residential	N
H430	42 Ashcroft Road, Luton, LU2 9AU	510564	223749	Residential	N
H431	2A, Chertsey Close, Luton, LU2 9JD	511565	221886	Residential	N
H432	Lilley Bottom Farm, Lilley Bottom, Luton, LU2 8NH	513414	225090	Residential	N
H433	7 Stevenage Road, Hitchin, SG4 9DH	518709	228372	Residential	N
H434	17 Mardle Close, Luton, LU1 4EZ	506179	218911	Residential	N
H435	725 Barton Road, Luton, LU3 3PX	507446	228523	Residential	N
H436	158A, Dunstable Road, Luton, LU1 1EW	508219	221987	Residential	N
H437	North Lodge, Putteridge Park, Luton, LU2 8LF	511511	225285	Residential	N
H438	16 Darley Road, Hitchin, SG4 8PD	514679	222723	Residential	N
H439	10 Heaton Dell, Luton, LU2 9TP	512374	222343	Residential	N
H440	97 Crawley Green Road, Luton, LU2 0JU	510223	221575	Residential	N
H441	Oakfield House, Luton Road, Luton, LU1 4AD	507177	219965	Residential	N
H442	69 Hartsfield Road, Luton, LU2 9DX	510694	222532	Residential	N
H443	7 Bagshawe Court, Farley Fields, Luton, LU1 5FJ	507705	219923	Residential	N
H444	12 Priory Court, Church Street, Dunstable, LU5 4NA	502277	221945	Residential	N
H445	61 Eldon Road, Luton, LU4 0AY	505388	222500	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H446	26 Hitchin Road, Luton, LU2 0ER	509581	221711	Residential	N
H447	486 Hitchin Road, Luton, LU2 7ST	510076	222979	Residential	N
H448	42 Bull Wood Cottages, London Road, Luton, LU1 4LA	509339	219030	Residential	N
H449	5A, Castle Street, Luton, LU1 3AA	509232	221084	Residential	N
H450	4 Queensway Parade, Dunstable, LU5 4DW	501787	222055	Residential	N
H451	2 Woodford Road, Dunstable, LU5 4JS	503398	222267	Residential	N
H452	The Dower House, Stagenhoe Park, Hitchin, SG4 8BZ	518680	222734	Residential	N
H453	113 West Street, Dunstable, LU6 1SG	501485	221687	Residential	N
H454	London Road Gate Luton Hoo, London Road, Luton, LU1 4LE	509489	217660	Residential	N
H455	124 Common Road, Dunstable, LU6 3RG	503357	218022	Residential	N
H456	415 Luton Road, Harpenden, AL5 3QE	511431	216062	Residential	N
H457	52 Old Bedford Road, Luton, LU2 7QB	508808	221960	Residential	N
H458	218 Luton Road, Dunstable, LU5 4LF	503758	222324	Residential	N
H459	7A, Guildford Street, Luton, LU1 2NQ	509401	221413	Residential	N
H460	295 Hitchin Road, Luton, LU2 7SL	510030	222543	Residential	N
H461	659 Hitchin Road, Luton, LU2 7UP	510500	224004	Residential	N
H462	40 High Street South, Dunstable, LU6 3HA	501942	221786	Residential	Y
H463	1A, Carisbrooke Road, Luton, LU4 8HD	506320	222297	Residential	N
H464	50 Layham Drive, Luton, LU2 9SY	512076	222171	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
H465	1 The Green, Luton, LU2 8PS	513632	223158	Residential	N
H466	Sun Cottage, Darley Hall, Luton, LU2 8PP	514126	222483	Residential	N
H468	370A, Hitchin Road, Luton, LU2 7SR	510106	222674	Residential	N
H469	131 Dunstable Road, Luton, LU1 1BW	508366	221768	Residential	Y
H470	5A, Cardiff Road, Luton, LU1 1PP	508719	221280	Residential	Y
H471	786 Dunstable Road, Luton, LU4 0HE	505003	222694	Residential	N
H472	Bottom Lodge, Luton, LU2 9PS	512928	217265	Residential	N
H473	Endee Lodge, Gosmore Road, Hitchin, SG4 9AN	518565	228322	Residential	N
H474	The Beeches, Hemel Hempstead Road, St. Albans,	511043	205716	Residential	N
H475	Lodge Farm, Hitchin, SG4 8LL	514755	224260	Residential	N
H476	29 Ashcroft Road, Luton, LU2 9AU	510588	223764	Residential	N
H477	85 Kingsway, Luton, LU1 1TS	507276	221937	Residential	N
C1	Luton Hoo, The Luton Drive, Hyde, Luton, East of England, England, LU1 3TQ	510414	218661	Cultural Heritage	N
C2	Someries Castle, Airport Way, Luton, East of England, England, LU2 9GP, United Kingdom	511944	220209	Cultural Heritage	N
CH1	St Monica's Day Centre (for older people)	507831	223176	Care Home	N
CH2	Dukeminster Court	502436	222074	Care Home	N
CH3	Tudor House	501592	221767	Care Home	N
CH4	Beech Closure Resource Centre	503152	220365	Care Home	N
CH5	Milford Lodge Care Home	518558	228435	Care Home	N
CH6	Woodside Nursing Home and Residential Home	508155	218799	Care Home	N
CH7	Foxholes Care Home	517239	229001	Care Home	N

ID	Address	X	Y	Type	AQMA (Y/N)
CH8	Stockwood House Care Home	509146	219761	Care Home	N
CH9	Oakley Care Home	506197	223020	Care Home	N
CH10	Oakley Care Home	506193	223030	Care Home	N
CH11	Victoriana	508672	222402	Care Home	N
CH12	Ambassador House Care Homes	508619	222152	Care Home	N
CH13	Collinson Care Home	506113	222688	Care Home	N
CH14	Mulberry House	508329	225450	Care Home	N
CH15	Ridgeway Lodge Care Homes	503195	222463	Care Home	N
CH16	St Marys Care Home - Bupa	508596	221435	Care Home	Y
CH17	Ashwood Place	519061	228415	Care Home	N
CH18	Field House Care Home - Bupa	513212	214870	Care Home	N
CH19	The Beeches	509689	221661	Care Home	N
CH20	Advanced Housing and Support	509154	220048	Care Home	N
CH21	Ashton Lodge	501577	222407	Care Home	N
CH22	Chiltern view Care Home	501262	221630	Care Home	N
CH23	Friars Lodge	502288	221842	Care Home	N
CH24	Trefoil House Care	508277	225241	Care Home	N
CH25	Widecombe Nursing Home	508071	225506	Care Home	N
CH26	Rowles House	508439	224925	Care Home	N
CH27	The Bethesda Home	512428	215408	Care Home	N
CH28	Hope Lodge	508526	220283	Care Home	N
CH29	Belle Vue	508723	222509	Care Home	N
CH30	Moorland Care Home	508880	221919	Care Home	N
CH31	Westbourne care home	518011	229464	Care Home	N
CH32	Caddington Grove Care Home	503220	220546	Care Home	N
CH33	Beech Closure Resource Centre	503103	220400	Care Home	N
CH34	Milford Lodge	518558	228435	Care Home	N
HC1	Luton Treatment Centre	508503	221346	Healthcare	N
HC2	Chalk Hills Healthcare	501058	222679	Healthcare	N
HC3	MHA Elmside	518208	229416	Healthcare	N

ID	Address	X	Y	Type	AQMA (Y/N)
HC4	Luton and Dunstable University Hospital	505032	222770	Hospital	N
HC5	Luton and Dunstable University Hospital	505075	222832	Hospital	N
HC6	Luton and Dunstable University Hospital	505172	222878	Hospital	N
N1	Chaple Street Nursery School	508901	220716	Nursery	N
N2	The Mall Nursery and Creche	509359	221306	Nursery	N
N3	Bright Horizons Bramingham Day	507581	225600	Nursery	N
N4	Grasmere Nursery School	507964	225579	Nursery	N
N5	Grasmere Nursery School	508000	225561	Nursery	N
N6	Training Depot Day Nursery	508749	222008	Nursery	N
N7	Little Buttons	512740	223522	Nursery	N
N8	Little Buttons	512772	223547	Nursery	N
N9	Wenlock VA Church of England Junior School	510571	221651	Nursery	N
N10	Wenlock VA Church of England Junior School	510536	221637	Nursery	N
N11*	Prospect House Day Nursery	511263	221472	Nursery	N
N12	Hart Hill Nursery School and Childens Centre	510045	221602	Nursery	N
N13	Masiyanday Daycare	509258	221395	Nursery	N
N14	Hillborough Infant School	508526	220537	Nursery	N
N15	Hillborough Infant School	508520	220520	Nursery	N
N16	Kinder City Nursery	510092	222556	Nursery	N
N17	Bright Horizons Harpenden Luton Road	512942	214975	Nursery	N
N18	Tots Academy	505279	223524	Nursery	N
N19	Little Peoples Nursery	508226	225090	Nursery	N
N20	Leagrave Primary School	505180	223635	Nursery	N
N21	Hart Hill Nursery School and Children's Centre	510045	221602	Nursery	N
S1	Rabia Girls School	507425	222139	School	N
S2	Gainsford House	517298	229054	School	N
S3	River Bank Primary School	508576	222936	School	N
S4	Foxdell Junior School	506217	221843	School	N

ID	Address	X	Y	Type	AQMA (Y/N)
S5	Bury Park Educational Institute	508380	221808	School	Y
S6	Ashton St Peters Church of England VA Primary School	501362	221727	School	N
S7	Dunstable Icknield Lower School	501578	221632	School	N
S8	Challney High School for Boys	505559	222932	School	N
S9	Icknield High School	508291	224370	School	N
S10	St Charalambos Greek Community School	507902	222142	School	N
S11	Mehria School	507911	222176	School	N
S12	Windmill Hill School	509621	221842	School	N
S13	Barnfield College	508662	224231	School	N
S14	Barnfield College	507881	225883	School	N
S15	Kalamullah Akademy	508330	221993	School	N
S16	Chiltern Academy	510175	220571	School	N
S17	Someries Infant and Junior School	511369	223007	School	N
S18	Someries Infant and Junior School	511330	223055	School	N
S19	Cockernhoe Primary School	512427	223440	School	N
S20	Whitehill Junior School	519259	228415	School	N
S21	Lady Zia Wernher School	510555	223200	School	N
S22	Bramingham Primary School	507628	225959	School	N
S23	Maidenhall Community Pre School	507373	222503	School	N
S24	Stopsley Primary School	510346	223741	School	N
S25	Queen Elizabeth School	511343	222621	School	N
S26	Richmond Hill School East	512133	222615	School	N
S27	Rambridge Primary School	510638	222969	School	N
S28	Someries Infant and Junior School	511321	223008	School	N
S29	Oakwood Primary School	509168	220122	School	N
S30	Hillborough Junior School	508539	220518	School	N
S31	Hillborough Junior School	508491	220552	School	N
S32	University of Bedforshire	509440	221098	School	N

ID	Address	X	Y	Type	AQMA (Y/N)
S33	University of Bedforshire	509464	221123	School	N
S34	University of Bedforshire	509488	221154	School	N
S35	University of Bedforshire	509441	221157	School	N
S36	University of Bedforshire	509422	221107	School	N
S37	University of Bedforshire	509429	221177	School	N
S38	Sacred Heart Primary School	510445	223320	School	N
S39	Tennyson Road Primary School	509139	220300	School	N
S40	University of Bedforshire	509531	221028	School	N
S41	University of Bedforshire	509524	221095	School	N
S42	University of Bedforshire	509563	221109	School	N
S43	University of Bedforshire	509514	221118	School	N
S44	University of Bedforshire	509552	221098	School	N
S45	University of Bedforshire	509555	221070	School	N
S46	Priory Academy	502286	221696	School	N
S47	St Georges School	502320	221786	School	N
S48	Warden Hill Infant School	508241	225188	School	N
S49	Warden Hill Infant School	508209	225132	School	N
S50	Warden Hill Infant School	508255	225147	School	N
S51	Dallow Primary School	508290	221551	School	N
S52	Leagrave Primary School	505255	223646	School	N
S53	Stockwood Park Academy	507713	220174	School	N
S54	Downside Pimary School	506325	222452	School	N
S55	Downside Infant School	506326	222467	School	N
S56	Icknield Primary School	507791	224307	School	N
S57	Samuel Lucas Junior Mixed and Infant School	517969	229373	School	N
S58	St Margaret of Scotland Catholic Primary School	507528	220316	School	N
S59	Beech Hill Community Primary School	507914	222043	School	N
S60	Wigmore Primary School	511982	222544	School	N
S61	St Christophers Academy	503882	222540	School	N
S62	Hexton JMI School	510448	230361	School	N
S63	Chiltern School	503182	220456	School	N
S64	Arnold Academy	508675	230603	School	N

ID	Address	X	Y	Type	AQMA (Y/N)
S65	Challney High School for Girls	505484	223233	School	N
Notes: * Prospect House Day Nursery is included in the demolition schedule to 27mppa (Assessment Phase 2a) and therefore receptor N11 will not be present in Assessment Phases 2a and 2b.					

3.4 Compliance receptors

3.4.1 Where the ARN overlaps with Defra PCM links, receptors have been selected and used to determine the risk of delaying compliance with the air quality standards.

Table 3.2: Compliance receptors

ID	Description	X	Y
PCM1	A505 (Luton Rd) qualifying feature	501328	222497
PCM2	A505 (Luton Rd) 4m	501331	222499
PCM3	A505 (Luton Rd) qualifying feature	501701	222096
PCM4	A505 (Luton Rd) 4m	501704	222098
PCM5	Church St qualifying feature	502321	221975
PCM6	Church St 4m	502321	221978
PCM7	A505 (Luton Rd) qualifying feature	503057	222107
PCM8	A505 (Luton Rd) 4m	503056	222110
PCM9	Skimpot Rd qualifying feature	504422	222347
PCM10	Skimpot Rd 4m	504425	222348
PCM11	A505 (Dunstable Rd) qualifying feature	504487	222547
PCM12	A505 (Dunstable Rd) 4m	504488	222544
PCM13	M1 qualifying feature	505445	222676
PCM14	M1 4m	505443	222676
PCM15	M1 qualifying feature	505423	222446
PCM16	M1 4m	505426	222447

ID	Description	X	Y
PCM17	A505 (Dunstable Rd) qualifying feature	505966	222664
PCM18	A505 (Dunstable Rd) 4m	505965	222668
PCM19	A505 (Dunstable Rd) qualifying feature	506753	222644
PCM20	A505 (Dunstable Rd) 4m	506753	222648
PCM21	A505 (Stuart St) qualifying feature	508777	221271
PCM22	A505 (Stuart St) 4m	508780	221273
PCM23	A505 (Park Viaduct) qualifying feature	509328	220904
PCM24	A505 (Park Viaduct) 4m	509327	220902
PCM25	A505 (Windmill Rd) qualifying feature	509972	220917
PCM26	A505 (Windmill Rd) 4m	509975	220919
PCM27	Airport Way qualifying feature	511317	220864
PCM28	Airport Way 4m	511314	220867
PCM29	A505 (New Airport Way) qualifying feature	511040	220617
PCM30	A505 (New Airport Way) 4m	511034	220616
PCM31	Airport Approach Rd qualifying feature	511775	221053
PCM32	Airport Approach Rd 4m	511775	221049
PCM33	Vauxhall Way qualifying feature	511009	220814
PCM34	Vauxhall Way 4m	511013	220814
PCM35	A505 (Vauxhall Way) qualifying feature	510972	222007
PCM36	A505 (Vauxhall Way) 4m	510976	222008

ID	Description	X	Y
PCM37	A505 (Vauxhall Way) qualifying feature	510641	222520
PCM38	A505 (Vauxhall Way) 4m	510638	222517
PCM39	A5228 (Hitchin Rd) qualifying feature	510080	222959
PCM40	A5228 (Hitchin Rd) 4m	510084	222960
PCM41	A505 (Stopsley Way) qualifying feature	510245	223302
PCM42	A505 (Stopsley Way) 4m	510244	223303
PCM43	A5528 (Stockingstone Rd) qualifying feature	509865	222732
PCM44	A5528 (Stockingstone Rd) 4m	509865	222736
PCM45	A6 (New Bedford Rd) qualifying feature	508736	223033
PCM46	A6 (New Bedford Rd) 4m	508732	223033
PCM47	A6 (New Bedford Rd) qualifying feature	508633	223801
PCM48	A6 (New Bedford Rd) 4m	508629	223800
PCM49	A6 (Barton Rd) qualifying feature	508033	226507
PCM50	A6 (Barton Rd) 4m	508037	226508
PCM51	Hatters Way qualifying feature	507927	221749
PCM52	Hatters Way 4m	507927	221748
PCM53	M1 qualifying feature	505248	223403
PCM54	M1 4m	505247	223403
PCM55	A1081 (Luton Rd) qualifying feature	512401	215508

ID	Description	X	Y
PCM56	A1081 (Luton Rd) 4m	512398	215506
PCM57	A602 (Stevenage Rd) qualifying feature	518801	228325
PCM58	A602 (Stevenage Rd) 4m	518800	228321
PCM59	A602 (Park Way) qualifying feature	518578	228358
PCM60	A602 (Park Way) 4m	518578	228353
PCM61	A505 (Upper Tilehouse St) qualifying feature	518045	229047
PCM62	A505 (Upper Tilehouse St) 4m	518044	229051
PCM63	A505 (Old Park Rd) qualifying feature	518072	229386
PCM64	A505 (Old Park Rd) 4m	518076	229388
PCM65	Hatters Way qualifying feature	505768	222157
PCM66	Hatters Way 4m	505768	222159

3.5 Ecological receptors

3.5.1 Sensitive ecological receptors are defined as those sites whose features have been designated as sensitive to air pollutants, either directly or indirectly. High levels of NOx can adversely affect vegetation, including leaf or needle damage and reduce plant growth. Deposition of pollutants derived from NOx emissions contribute to acidification and/or eutrophication of sensitive habitats leading to loss of biodiversity (Ref. 15). The likelihood of such effects occurring is determined by pollutant thresholds known as 'critical loads' which are defined by the United Nations Economic Commission for Europe (UNECE) (referenced on the APIS website (Ref. 15)) as:

> "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*."

3.5.2 It is important to distinguish between a critical load and the air quality standard (or critical level) for NOx. The critical load relates to the quantity of pollutant (in this case nitrogen) deposited from air to the ground, whereas the critical level is the gaseous concentration of a pollutant in the air. Critical loads are defined by

APIS and are specific to a particular ecological receptor site or the particular habitats in them.

3.5.3 To assess the impacts on ecosystems the study area was reviewed to identify Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI), Local Nature Reserves (LNR) Ancient Woodland (AW) within 200m of the ARN and 5km from the airport. Non-designated sites including Local Wildlife Sites (LWS), County Wildlife Sites (CWS), District Wildlife Sites (DWS) and Ancient Veteran Trees were also identified within 200m of the ARN and 2km from the airport. A total of 129 ecological sites were selected for inclusion in the assessment and these are detailed in **Table 3.3**. All ecological receptor locations were modelled at a height of 0m. Transects across ecological receptors were also assessed, for those receptors where effects could not be screened out at the boundary of the site, using the criteria in **Section 4**. These transects are included at the bottom of **Table 3.3**. Ecological receptor IDs are preceded with the letter “E” which correspond to their type (“Ecological”).

Table 3.3: Sensitive ecological receptors

ID	Site Name	X	Y	Designation
E1	Furzen Wood AW	514029	224409	AW
E2	Stubbocks Wood AW	513881	223694	AW
E3	Watkin's Wood AW	515367	222217	AW
E4	Lord's Wood AW	515275	222502	AW
E5	Winchill Wood AW/Winch Hill Wood LWS	513484	221317	LWS
E6	Sewetts Wood AW	515059	220724	AW
E7	Withstocks Wood AW	513488	220245	AW
E8	Slaughters Wood AW	511660	223067	AW
E9	George Wood AW	511500	219367	AW
E10	Hardingdell Woods AW	512479	219388	AW
E11	Horsleys Wood AW	513129	219337	AW
E12	Birch Wood AW	511523	218382	AW
E13	Kidney/Bulls Wood AW	509952	219779	AW
E14	Appspond Wood LWS	511129	205365	LWS
E15	Potters Crouch Plantation LWS	510897	205566	LWS
E16	Westwick Hall LWS	510286	206708	LWS
E17	Bury Wood (near Redbourn) LWS	509509	212134	LWS
E18	Nicky Way Dismantled Railway LWS	509685	211014	LWS
E19	Nicholl's Great Wood and Rabbitfield Spring LWS	509314	212679	LWS

ID	Site Name	X	Y	Designation
E20	St Agnell's Farm LWS	509169	213669	LWS
E21	Fir Tree Spring LWS	510573	216353	LWS
E22	Kinsbourne Green Grassland LWS	511410	216048	LWS
E23	Heavens Wood & Chalk Wood LWS	508899	217505	LWS
E24	Road Verge near Pepperstock LWS	509445	217581	LWS
E25	The Nicky Line LWS	512828	215101	LWS
E26	Batford Springs and Meadow LWS	514773	215035	LWS
E27	River Lea Pastures, N. of Harpenden LWS	513714	216178	LWS
E28	East Hyde Riverside LWS	512663	217435	LWS
E29	Luton Hoo Park LWS	510705	220219	LWS
E30	Church Cemetery, Luton LWS	509982	221268	LWS
E31	Dairybon Scarp LWS	511145	220982	LWS
E32	Vauxhall Way LWS	511103	221700	LWS
E33	Hitchin Road Spinney LWS	509798	222014	LWS
E34	People's Park LWS	509568	222377	LWS
E35	River Lea LWS	508839	221787	LWS
E36	The Chase LWS	510120	223166	LWS
E37	Slaughters Wood and Green Lane LWS	511898	222555	LWS
E38	Wigmore Park LWS	513026	222209	LWS
E39	Burnt Wood LWS	513639	221031	LWS
E40	Limekiiln Wood LWS	513999	220696	LWS
E41	Diamondend Springs, Limekiln Wood, Pondcroft LWS	514342	220896	LWS
E42	Sloughs Wood LWS	514347	220656	LWS
E43	Laysbury Dells LWS	515025	220335	LWS
E44	Sellbarns Dell LWS	514830	220793	LWS
E45	Hurst Wood LWS, Sewetts Wood AW	515154	220653	AW
E46	Whiteway Bottom Copse	515997	220830	LWS
E47	Long Lane	516253	221239	LWS
E48	Chilten Green LWS	513445	219557	LWS
E49	Kidney and Bull Woods LWS	509301	219128	LWS
E50	Stockwood Park LWS	509161	219259	LWS
E51	Stockwood Park LWS	509037	219713	LWS
E52	Kingswaldenbury Icehouse	516208	222884	LWS

ID	Site Name	X	Y	Designation
E53	Wandon End Park LWS	511722	223491	LWS
E54	Dunstable to Luton disused railway LWS	502542	222017	LWS
E55	Blows Down LWS	504542	222102	LWS
E56	The Linces LWS	505809	221914	LWS
E57	Dallow Lane LWS	505940	221919	LWS
E58	Hatters Way LWS	505664	222150	LWS
E59	Foxdell LWS	506303	221626	LWS
E60	Dallow Downs and Winsdon Hill SSSI	506930	220991	SSSI
E61	Castle Croft and Bluebell Woods LWS	507447	220324	LWS
E62	Riverside Walk LWS	508798	223198	LWS
E63	Honeygate and Crick Hills LWS	509405	223090	LWS
E64	Stockingstone Hill LWS	509391	223087	LWS
E65	Croda Colloids LWS, River Lea LWS	508735	222829	LWS
E66	Icknield School LWS	508094	224333	LWS
E67	Cowslip Meadows SSSI	508450	224643	SSSI
E68	Fallowfield LWS	508486	223934	LWS
E69	Bramingham and Icknield Corridor LWS	508137	225943	LWS
E70	Wardswood Lane	511612	226669	LWS
E71	Smithcombe, Sharpenhoe and Sundon Hills SSSI	507509	229106	SSSI
E72	Barton Quarry LWS	507540	229098	LWS
E73	Barton scrubby grasslands LWS	509571	230270	LWS
E74	Ravensburgh Castle, Hexton Manor Estate LWS	510172	230292	LWS
E75	Hexton Chalk Pit LWS	510635	230011	LWS
E76	Hexton Chalk Pit Road Verge LWS	510625	229981	LWS
E77	Offley Chalk Banks, Offley Park LWS & Old Road Plantation/New Plantation LWS	514678	227454	LWS
E78	The Willows (Hitchin) LWS	517520	228586	LWS
E79	Priory Park Icehouse LWS	518263	228491	LWS
E80	Folly Alder Swamp LWS	519444	228116	LWS
E81	Kingshoe Wood LWS	500467	233875	LWS

ID	Site Name	X	Y	Designation
E82	Hill's Plantation LWS	500884	233027	LWS
E83	Hipsey Spinney LWS	503135	228235	LWS
E84	Sundon Chalk Pits LWS	503533	227415	LWS
E85	River Flit LWS	503574	226526	LWS
E86	Ancient Veteran Tree	513300	214840	AVT
E87	Ancient Veteran Tree	514810	214910	AVT
E88	Ancient Veteran Tree	508460	218190	AVT
E89	Ancient Veteran Tree	505500	219190	AVT
E90	Ancient Veteran Tree	506390	219820	AVT
E91	Ancient Veteran Tree	501340	221520	AVT
E92	Ancient Veteran Tree	502030	221840	AVT
E93	Ancient Veteran Tree	508604	230459	AVT
E94	Ancient Veteran Tree	512500	219990	AVT
E95	Ancient Veteran Tree	516190	222900	AVT
E96	Ancient Veteran Tree	516190	222910	AVT
E97	Ancient Veteran Tree	516180	222910	AVT
E98	Ancient Veteran Tree	516170	222910	AVT
E99	Ancient Veteran Tree	516170	222920	AVT
E100	Ancient Veteran Tree	516100	222930	AVT
E101	Ancient Veteran Tree	516010	222960	AVT
E102	Ancient Veteran Tree	515898	223300	AVT
E103	Ancient Veteran Tree	516260	223070	AVT
E104	Ancient Veteran Tree	516400	223200	AVT
E105	Ancient Veteran Tree	516400	223100	AVT
E106	Ancient Veteran Tree	516400	223050	AVT
E107	Ancient Veteran Tree	516280	223080	AVT
E108	Batford Springs LNR	514626	215194	LNR
E109	Galley and Warden Hills CWS, SSSI	508098	226535	SSSI
E110	River Flit CWS	502727	229124	CWS
E111	River Lea CWS, River Lea DWS, Lewsey Park DWS	504999	223648	CWS, DWS
E112	Dallow Downs CWS, Winsdon Hill SSSI	508107	221141	CWS, SSSI
E113	Featherbed Lane Copse by Serge Hill LWS	511236	204540	LWS
E114	Luton Hoo Park LWS, River Lea CWS	510412	220209	CWS

ID	Site Name	X	Y	Designation
E115	Stockwood Park CWS, Ancient Veteran Tree	508481	218976	CWS, AVT
E116	Gread Brangingham Park LWS	508017	226509	LWS
E117	Galley and Warden Hills CWS, SSSI	508997	225140	CWS, SSSI
E118	River Lea, Riverside Walk LWS	508632	223930	LWS
E119	Dairybon Scarp LWS	511023	220729	LWS
E120	Wigmore Park LWS	512358	221881	LWS
E121	Wigmore Park LWS	513360	221283	LWS
E122	Wain Wood SSSI	517744	225182	SSSI
E123	Chalton Scrub and Grassland CWS	503734	226506	CWS
E124	Great Hayes Wood DWS	511186	224873	DWS
E125	Dog Kennel Down CWS	502118	223021	CWS
E126	Hay Wood and Stopsley Common DWS	510451	224381	DWS
E127	Hexton Manor Icehouse	510814	230319	LWS
E128	Luton Parkway Verges DWS	510614	220334	DWS
E129	Icknield Way below Telegraph Hill	510878	228242	LWS
E5.1	Winchill Wood AW/Winch Hill Wood LWS	513481	221327	LWS
E5.2	Winchill Wood AW/Winch Hill Wood LWS	513478	221336	LWS
E5.3	Winchill Wood AW/Winch Hill Wood LWS	513476	221346	LWS
E5.4	Winchill Wood AW/Winch Hill Wood LWS	513473	221356	LWS
E5.5	Winchill Wood AW/Winch Hill Wood LWS	513471	221365	LWS
E5.6	Winchill Wood AW/Winch Hill Wood LWS	513468	221375	LWS
E5.7	Winchill Wood AW/Winch Hill Wood LWS	513466	221385	LWS
E5.8	Winchill Wood AW/Winch Hill Wood LWS	513463	221394	LWS
E5.9	Winchill Wood AW/Winch Hill Wood LWS	513461	221404	LWS
E5.10	Winchill Wood AW/Winch Hill Wood LWS	513458	221414	LWS
E5.11	Winchill Wood AW/Winch Hill Wood LWS	513455	221423	LWS

ID	Site Name	X	Y	Designation
E10.1	Hardingdell and Fernell's Woods CWS	512478	219378	CWS
E10.2	Hardingdell and Fernell's Woods CWS	512476	219368	CWS
E10.3	Hardingdell and Fernell's Woods CWS	512475	219358	CWS
E10.4	Hardingdell and Fernell's Woods CWS	512473	219349	CWS
E10.5	Hardingdell and Fernell's Woods CWS	512472	219339	CWS
E10.6	Hardingdell and Fernell's Woods CWS	512470	219329	CWS
E10.7	Hardingdell and Fernell's Woods CWS	512469	219319	CWS
E10.8	Hardingdell and Fernell's Woods CWS	512467	219309	CWS
E10.9	Hardingdell and Fernell's Woods CWS	512466	219299	CWS
E10.10	Hardingdell and Fernell's Woods CWS	512464	219289	CWS
E10.11	Hardingdell and Fernell's Woods CWS	512463	219279	CWS
E10.12	Hardingdell and Fernell's Woods CWS	512461	219269	CWS
E10.13	Hardingdell and Fernell's Woods CWS	512460	219260	CWS
E10.14	Hardingdell and Fernell's Woods CWS	512458	219250	CWS
E10.15	Hardingdell and Fernell's Woods CWS	512457	219240	CWS
E10.16	Hardingdell and Fernell's Woods CWS	512455	219230	CWS
E10.17	Hardingdell and Fernell's Woods CWS	512454	219220	CWS
E10.18	Hardingdell and Fernell's Woods CWS	512452	219210	CWS
E10.19	Hardingdell and Fernell's Woods CWS	512451	219200	CWS
E10.20	Hardingdell and Fernell's Woods CWS	512449	219190	CWS
E13.1	Kidney/Bulls Wood AW	509961	219775	AW

ID	Site Name	X	Y	Designation
E13.2	Kidney/Bulls Wood AW	509970	219771	AW
E13.3	Kidney/Bulls Wood AW	509980	219767	AW
E13.4	Kidney/Bulls Wood AW	509989	219762	AW
E13.5	Kidney/Bulls Wood AW	509998	219758	AW
E13.6	Kidney/Bulls Wood AW	510007	219754	AW
E13.7	Kidney/Bulls Wood AW	510016	219750	AW
E13.8	Kidney/Bulls Wood AW	510025	219745	AW
E13.9	Kidney/Bulls Wood AW	510034	219741	AW
E13.10	Kidney/Bulls Wood AW	510043	219737	AW
E13.11	Kidney/Bulls Wood AW	510052	219733	AW
E13.12	Kidney/Bulls Wood AW	510061	219728	AW
E13.13	Kidney/Bulls Wood AW	510070	219724	AW
E13.14	Kidney/Bulls Wood AW	510079	219720	AW
E13.15	Kidney/Bulls Wood AW	510088	219716	AW
E13.16	Kidney/Bulls Wood AW	510097	219712	AW
E13.17	Kidney/Bulls Wood AW	510106	219707	AW
E13.18	Kidney/Bulls Wood AW	510115	219703	AW
E13.19	Kidney/Bulls Wood AW	510125	219699	AW
E13.20	Kidney/Bulls Wood AW	510134	219695	AW
E29.1	Luton Hoo Park CWS	510711	220211	CWS
E29.2	Luton Hoo Park CWS	510717	220203	CWS
E29.3	Luton Hoo Park CWS	510723	220195	CWS
E29.4	Luton Hoo Park CWS	510729	220187	CWS
E29.5	Luton Hoo Park CWS	510734	220179	CWS
E29.6	Luton Hoo Park CWS	510740	220171	CWS
E29.7	Luton Hoo Park CWS	510746	220163	CWS
E29.8	Luton Hoo Park CWS	510752	220155	CWS
E29.9	Luton Hoo Park CWS	510758	220146	CWS
E29.10	Luton Hoo Park CWS	510764	220138	CWS
E29.11	Luton Hoo Park CWS	510769	220130	CWS
E29.12	Luton Hoo Park CWS	510775	220122	CWS
E29.13	Luton Hoo Park CWS	510781	220114	CWS
E29.14	Luton Hoo Park CWS	510787	220106	CWS
E29.15	Luton Hoo Park CWS	510793	220098	CWS
E29.16	Luton Hoo Park CWS	510799	220090	CWS
E29.17	Luton Hoo Park CWS	510804	220081	CWS

ID	Site Name	X	Y	Designation
E29.18	Luton Hoo Park CWS	510810	220073	CWS
E29.19	Luton Hoo Park CWS	510816	220065	CWS
E29.20	Luton Hoo Park CWS	510822	220057	CWS
E30.1	Church Cemetery, Luton	509988	221260	LWS
E30.2	Church Cemetery, Luton	509994	221252	LWS
E30.3	Church Cemetery, Luton	510000	221243	LWS
E30.4	Church Cemetery, Luton	510006	221235	LWS
E30.5	Church Cemetery, Luton	510011	221227	LWS
E30.6	Church Cemetery, Luton	510017	221219	LWS
E30.7	Church Cemetery, Luton	510023	221211	LWS
E30.8	Church Cemetery, Luton	510029	221203	LWS
E30.9	Church Cemetery, Luton	510035	221195	LWS
E30.10	Church Cemetery, Luton	510041	221187	LWS
E30.11	Church Cemetery, Luton	510046	221178	LWS
E30.12	Church Cemetery, Luton	510052	221170	LWS
E30.13	Church Cemetery, Luton	510058	221162	LWS
E30.14	Church Cemetery, Luton	510064	221154	LWS
E30.15	Church Cemetery, Luton	510070	221146	LWS
E30.16	Church Cemetery, Luton	510075	221138	LWS
E30.17	Church Cemetery, Luton	510081	221130	LWS
E30.18	Church Cemetery, Luton	510087	221121	LWS
E30.19	Church Cemetery, Luton	510093	221113	LWS
E30.20	Church Cemetery, Luton	510099	221105	LWS
E31.1	Dairybon Scarp DWS	511155	220982	DWS
E31.2	Dairybon Scarp DWS	511165	220981	DWS
E32.1	Vauxhall Way DWS	511104	221710	DWS
E37.1	Slaughters Wood and Green lane CWS	511896	222564	CWS
E37.2	Slaughters Wood and Green lane CWS	511895	222574	CWS
E37.3	Slaughters Wood and Green lane CWS	511894	222584	CWS
E37.4	Slaughters Wood and Green lane CWS	511893	222594	CWS
E37.5	Slaughters Wood and Green lane CWS	511892	222604	CWS

ID	Site Name	X	Y	Designation
E37.6	Slaughters Wood and Green lane CWS	511890	222614	CWS
E37.7	Slaughters Wood and Green lane CWS	511889	222624	CWS
E37.8	Slaughters Wood and Green lane CWS	511888	222634	CWS
E37.9	Slaughters Wood and Green lane CWS	511887	222644	CWS
E37.10	Slaughters Wood and Green lane CWS	511886	222654	CWS
E37.11	Slaughters Wood and Green lane CWS	511884	222664	CWS
E37.12	Slaughters Wood and Green lane CWS	511883	222674	CWS
E37.13	Slaughters Wood and Green lane CWS	511882	222684	CWS
E37.14	Slaughters Wood and Green lane CWS	511881	222694	CWS
E37.15	Slaughters Wood and Green lane CWS	511880	222703	CWS
E37.16	Slaughters Wood and Green lane CWS	511878	222713	CWS
E37.17	Slaughters Wood and Green lane CWS	511877	222723	CWS
E37.18	Slaughters Wood and Green lane CWS	511876	222733	CWS
E37.19	Slaughters Wood and Green lane CWS	511875	222743	CWS
E37.20	Slaughters Wood and Green lane CWS	511874	222753	CWS
E38.1	Wigmore Park CWS	513019	222201	CWS
E38.2	Wigmore Park CWS	513013	222194	CWS
E38.3	Wigmore Park CWS	513006	222186	CWS
E38.4	Wigmore Park CWS	512999	222179	CWS
E38.5	Wigmore Park CWS	512993	222171	CWS
E38.6	Wigmore Park CWS	512986	222164	CWS
E38.7	Wigmore Park CWS	512979	222156	CWS
E38.8	Wigmore Park CWS	512973	222149	CWS
E38.9	Wigmore Park CWS	512966	222141	CWS
E38.10	Wigmore Park CWS	512960	222134	CWS

ID	Site Name	X	Y	Designation
E38.11	Wigmore Park CWS	512953	222126	CWS
E38.12	Wigmore Park CWS	512946	222119	CWS
E38.13	Wigmore Park CWS	512940	222111	CWS
E38.14	Wigmore Park CWS	512933	222104	CWS
E38.15	Wigmore Park CWS	512927	222096	CWS
E38.16	Wigmore Park CWS	512920	222089	CWS
E38.17	Wigmore Park CWS	512913	222081	CWS
E38.18	Wigmore Park CWS	512907	222074	CWS
E38.19	Wigmore Park CWS	512900	222066	CWS
E38.20	Wigmore Park CWS	512894	222059	CWS
E39.1	Burnt Wood LWS	513642	221021	LWS
E39.2	Burnt Wood LWS	513645	221012	LWS
E39.3	Burnt Wood LWS	513648	221002	LWS
E39.4	Burnt Wood LWS	513650	220993	LWS
E39.5	Burnt Wood LWS	513653	220983	LWS
E39.6	Burnt Wood LWS	513656	220973	LWS
E39.7	Burnt Wood LWS	513659	220964	LWS
E39.8	Burnt Wood LWS	513662	220954	LWS
E39.9	Burnt Wood LWS	513665	220945	LWS
E39.10	Burnt Wood LWS	513668	220935	LWS
E39.11	Burnt Wood LWS	513671	220926	LWS
E39.12	Burnt Wood LWS	513674	220916	LWS
E39.13	Burnt Wood LWS	513677	220906	LWS
E39.14	Burnt Wood LWS	513680	220897	LWS
E39.15	Burnt Wood LWS	513683	220887	LWS
E39.16	Burnt Wood LWS	513685	220878	LWS
E39.17	Burnt Wood LWS	513688	220868	LWS
E39.18	Burnt Wood LWS	513691	220859	LWS
E48.1	Chiltern Green CWS	513448	219547	CWS
E48.2	Chiltern Green CWS	513451	219538	CWS
E48.3	Chiltern Green CWS	513454	219528	CWS
E48.4	Chiltern Green CWS	513457	219519	CWS
E48.5	Chiltern Green CWS	513460	219509	CWS
E48.6	Chiltern Green CWS	513463	219500	CWS
E48.7	Chiltern Green CWS	513466	219490	CWS
E48.8	Chiltern Green CWS	513469	219481	CWS

ID	Site Name	X	Y	Designation
E48.9	Chiltern Green CWS	513472	219471	CWS
E48.10	Chiltern Green CWS	513475	219462	CWS
E48.11	Chiltern Green CWS	513478	219452	CWS
E48.12	Chiltern Green CWS	513481	219442	CWS
E48.13	Chiltern Green CWS	513484	219433	CWS
E48.14	Chiltern Green CWS	513487	219423	CWS
E48.15	Chiltern Green CWS	513490	219414	CWS
E48.16	Chiltern Green CWS	513493	219404	CWS
E48.17	Chiltern Green CWS	513496	219395	CWS
E48.18	Chiltern Green CWS	513499	219385	CWS
E48.19	Chiltern Green CWS	513502	219376	CWS
E48.20	Chiltern Green CWS	513505	219366	CWS
E49.1	Kidney and Bull Woods CWS	509296	219136	CWS
E49.2	Kidney and Bull Woods CWS	509291	219145	CWS
E49.3	Kidney and Bull Woods CWS	509286	219153	CWS
E49.4	Kidney and Bull Woods CWS	509281	219162	CWS
E49.5	Kidney and Bull Woods CWS	509275	219170	CWS
E49.6	Kidney and Bull Woods CWS	509270	219179	CWS
E49.7	Kidney and Bull Woods CWS	509265	219188	CWS
E49.8	Kidney and Bull Woods CWS	509260	219196	CWS
E49.9	Kidney and Bull Woods CWS	509255	219205	CWS
E49.10	Kidney and Bull Woods CWS	509249	219213	CWS
E49.11	Kidney and Bull Woods CWS	509244	219222	CWS
E49.12	Kidney and Bull Woods CWS	509239	219230	CWS
E49.13	Kidney and Bull Woods CWS	509234	219239	CWS
E49.14	Kidney and Bull Woods CWS	509228	219247	CWS
E49.15	Kidney and Bull Woods CWS	509223	219256	CWS
E49.16	Kidney and Bull Woods CWS	509218	219264	CWS
E49.17	Kidney and Bull Woods CWS	509213	219273	CWS
E49.18	Kidney and Bull Woods CWS	509208	219281	CWS
E49.19	Kidney and Bull Woods CWS	509202	219290	CWS
E49.20	Kidney and Bull Woods CWS	509197	219299	CWS
E62.1	Riverside Walk CWS	508797	223208	CWS
E62.2	Riverside Walk CWS	508796	223218	CWS
E62.3	Riverside Walk CWS	508796	223228	CWS
E62.4	Riverside Walk CWS	508795	223238	CWS

ID	Site Name	X	Y	Designation
E62.5	Riverside Walk CWS	508794	223248	CWS
E62.6	Riverside Walk CWS	508794	223258	CWS
E62.7	Riverside Walk CWS	508793	223268	CWS
E62.8	Riverside Walk CWS	508793	223278	CWS
E62.9	Riverside Walk CWS	508792	223288	CWS
E62.10	Riverside Walk CWS	508791	223298	CWS
E62.11	Riverside Walk CWS	508791	223308	CWS
E62.12	Riverside Walk CWS	508790	223318	CWS
E62.13	Riverside Walk CWS	508790	223328	CWS
E62.14	Riverside Walk CWS	508789	223338	CWS
E62.15	Riverside Walk CWS	508788	223347	CWS
E62.16	Riverside Walk CWS	508788	223357	CWS
E62.17	Riverside Walk CWS	508787	223367	CWS
E62.18	Riverside Walk CWS	508786	223377	CWS
E62.19	Riverside Walk CWS	508786	223387	CWS
E62.20	Riverside Walk CWS	508785	223397	CWS
E63.1	Honeygate and Crick Hills CWS	509415	223090	CWS
E63.2	Honeygate and Crick Hills CWS	509425	223091	CWS
E63.3	Honeygate and Crick Hills CWS	509435	223092	CWS
E63.4	Honeygate and Crick Hills CWS	509445	223093	CWS
E63.5	Honeygate and Crick Hills CWS	509455	223094	CWS
E63.6	Honeygate and Crick Hills CWS	509465	223094	CWS
E64.1	Stockingstone Hill DWS	509381	223087	DWS
E64.2	Stockingstone Hill DWS	509371	223086	DWS
E65.1	Croda Colloids CWS, River Lea CWS	508726	222830	CWS
E65.2	Croda Colloids CWS, River Lea CWS	508716	222831	CWS
E65.3	Croda Colloids CWS, River Lea CWS	508706	222832	CWS
E65.4	Croda Colloids CWS, River Lea CWS	508696	222833	CWS
E65.5	Croda Colloids CWS, River Lea CWS	508686	222834	CWS
E65.6	Croda Colloids CWS, River Lea CWS	508676	222834	CWS
E65.7	Croda Colloids CWS, River Lea CWS	508666	222835	CWS

ID	Site Name	X	Y	Designation
E114.1	Luton Hoo Park CWS, River Lea CWS	510412	220199	CWS
E114.2	Luton Hoo Park CWS, River Lea CWS	510412	220189	CWS
E114.3	Luton Hoo Park CWS, River Lea CWS	510411	220179	CWS
E114.4	Luton Hoo Park CWS, River Lea CWS	510411	220169	CWS
E114.5	Luton Hoo Park CWS, River Lea CWS	510411	220159	CWS
E114.6	Luton Hoo Park CWS, River Lea CWS	510411	220149	CWS
E114.7	Luton Hoo Park CWS, River Lea CWS	510411	220139	CWS
E114.8	Luton Hoo Park CWS, River Lea CWS	510411	220129	CWS
E114.9	Luton Hoo Park CWS, River Lea CWS	510411	220119	CWS
E114.10	Luton Hoo Park CWS, River Lea CWS	510411	220109	CWS
E119.1	Dairybon Scarp LWS	511032	220734	LWS
E119.2	Dairybon Scarp LWS	511041	220738	LWS
E119.3	Dairybon Scarp LWS	511050	220743	LWS
E119.4	Dairybon Scarp LWS	511059	220747	LWS
E119.5	Dairybon Scarp LWS	511068	220752	LWS
E119.6	Dairybon Scarp LWS	511077	220756	LWS
E120.1	Wigmore Park CWS	512363	221872	CWS
E120.2	Wigmore Park CWS	512368	221864	CWS
E120.3	Wigmore Park CWS	512373	221855	CWS
E120.4	Wigmore Park CWS	512378	221846	CWS
E120.5	Wigmore Park CWS	512383	221838	CWS
E120.6	Wigmore Park CWS	512388	221829	CWS
E120.7	Wigmore Park CWS	512393	221820	CWS
E120.8	Wigmore Park CWS	512398	221812	CWS
E120.9	Wigmore Park CWS	512403	221803	CWS
E120.10	Wigmore Park CWS	512408	221794	CWS
E120.11	Wigmore Park CWS	512413	221786	CWS
E120.12	Wigmore Park CWS	512418	221777	CWS

ID	Site Name	X	Y	Designation
E120.13	Wigmore Park CWS	512423	221768	CWS
E120.14	Wigmore Park CWS	512428	221760	CWS
E120.15	Wigmore Park CWS	512433	221751	CWS
E120.16	Wigmore Park CWS	512438	221742	CWS
E120.17	Wigmore Park CWS	512443	221734	CWS
E120.18	Wigmore Park CWS	512448	221725	CWS
E120.19	Wigmore Park CWS	512453	221716	CWS
E120.20	Wigmore Park CWS	512458	221708	CWS
E121.1	Wigmore Park CWS	513357	221293	CWS
E121.2	Wigmore Park CWS	513354	221302	CWS
E121.3	Wigmore Park CWS	513350	221311	CWS
E121.4	Wigmore Park CWS	513347	221321	CWS
E121.5	Wigmore Park CWS	513344	221330	CWS
E121.6	Wigmore Park CWS	513340	221340	CWS
E121.7	Wigmore Park CWS	513337	221349	CWS
E121.8	Wigmore Park CWS	513334	221359	CWS
E121.9	Wigmore Park CWS	513331	221368	CWS
E121.10	Wigmore Park CWS	513327	221377	CWS
E121.11	Wigmore Park CWS	513324	221387	CWS
E121.12	Wigmore Park CWS	513321	221396	CWS
E121.13	Wigmore Park CWS	513317	221406	CWS
E121.14	Wigmore Park CWS	513314	221415	CWS
E121.15	Wigmore Park CWS	513311	221425	CWS
E121.16	Wigmore Park CWS	513307	221434	CWS
E121.17	Wigmore Park CWS	513304	221443	CWS
E121.18	Wigmore Park CWS	513301	221453	CWS
E121.19	Wigmore Park CWS	513297	221462	CWS
E121.20	Wigmore Park CWS	513294	221472	CWS
E123.1	Chalton Scrub and Grassland CWS	503744	226510	CWS
E123.2	Chalton Scrub and Grassland CWS	503753	226513	CWS
E123.3	Chalton Scrub and Grassland CWS	503763	226516	CWS
E123.4	Chalton Scrub and Grassland CWS	503772	226519	CWS
E123.5	Chalton Scrub and Grassland CWS	503782	226522	CWS
E124.1	Great Hayes Wood DWS	511192	224865	DWS
E124.2	Great Hayes Wood DWS	511198	224857	DWS
E124.3	Great Hayes Wood DWS	511204	224849	DWS

ID	Site Name	X	Y	Designation
E124.4	Great Hayes Wood DWS	511211	224841	DWS
E124.5	Great Hayes Wood DWS	511217	224833	DWS
E124.6	Great Hayes Wood DWS	511223	224825	DWS
E124.7	Great Hayes Wood DWS	511229	224817	DWS
E124.8	Great Hayes Wood DWS	511235	224810	DWS
E124.9	Great Hayes Wood DWS	511241	224802	DWS
E124.10	Great Hayes Wood DWS	511247	224794	DWS
E124.11	Great Hayes Wood DWS	511253	224786	DWS
E124.12	Great Hayes Wood DWS	511259	224778	DWS
E124.13	Great Hayes Wood DWS	511265	224770	DWS
E124.14	Great Hayes Wood DWS	511271	224762	DWS
E124.15	Great Hayes Wood DWS	511277	224754	DWS
E124.16	Great Hayes Wood DWS	511283	224746	DWS
E124.17	Great Hayes Wood DWS	511289	224738	DWS
E124.18	Great Hayes Wood DWS	511295	224730	DWS
E124.19	Great Hayes Wood DWS	511301	224722	DWS
E124.20	Great Hayes Wood DWS	511307	224714	DWS
E125.1	Dog Kennel Down CWS	502110	223028	CWS
E125.2	Dog Kennel Down CWS	502103	223035	CWS
E125.3	Dog Kennel Down CWS	502096	223041	CWS
E125.4	Dog Kennel Down CWS	502088	223048	CWS
E125.5	Dog Kennel Down CWS	502081	223055	CWS
E125.6	Dog Kennel Down CWS	502074	223062	CWS
E125.7	Dog Kennel Down CWS	502066	223069	CWS
E125.8	Dog Kennel Down CWS	502059	223075	CWS
E125.9	Dog Kennel Down CWS	502052	223082	CWS
E125.10	Dog Kennel Down CWS	502044	223089	CWS
E125.11	Dog Kennel Down CWS	502037	223096	CWS
E125.12	Dog Kennel Down CWS	502030	223103	CWS
E125.13	Dog Kennel Down CWS	502022	223109	CWS
E125.14	Dog Kennel Down CWS	502015	223116	CWS
E125.15	Dog Kennel Down CWS	502008	223123	CWS
E125.16	Dog Kennel Down CWS	502000	223130	CWS
E125.17	Dog Kennel Down CWS	501993	223137	CWS
E125.18	Dog Kennel Down CWS	501986	223143	CWS
E125.19	Dog Kennel Down CWS	501978	223150	CWS

ID	Site Name	X	Y	Designation
E125.20	Dog Kennel Down CWS	501971	223157	CWS
E127.1	Hexton Manor Icehouse	510824	230321	LWS
E127.2	Hexton Manor Icehouse	510834	230323	LWS
E127.3	Hexton Manor Icehouse	510844	230326	LWS
E128.1	Luton Parkway Verges DWS	510618	220325	DWS
E128.2	Luton Parkway Verges DWS	510623	220316	DWS
E128.3	Luton Parkway Verges DWS	510628	220307	DWS
E128.4	Luton Parkway Verges DWS	510632	220299	DWS
E128.5	Luton Parkway Verges DWS	510637	220290	DWS
E128.6	Luton Parkway Verges DWS	510642	220281	DWS
E129.1	Icknield Way below Telegraph Hill	510886	228246	LWS
E129.2	Icknield Way below Telegraph Hill	510895	228251	LWS
E129.3	Icknield Way below Telegraph Hill	510904	228255	LWS
E129.4	Icknield Way below Telegraph Hill	510913	228260	LWS
E129.5	Icknield Way below Telegraph Hill	510922	228265	LWS
E129.6	Icknield Way below Telegraph Hill	510931	228269	LWS
E129.7	Icknield Way below Telegraph Hill	510940	228274	LWS
E129.8	Icknield Way below Telegraph Hill	510948	228279	LWS
E129.9	Icknield Way below Telegraph Hill	510957	228283	LWS
E129.10	Icknield Way below Telegraph Hill	510966	228288	LWS
E129.11	Icknield Way below Telegraph Hill	510975	228292	LWS
E129.12	Icknield Way below Telegraph Hill	510984	228297	LWS
E129.13	Icknield Way below Telegraph Hill	510993	228302	LWS

Nitrogen deposition

3.5.4 Data for the sensitive ecological sites identified were obtained from the APIS website (Ref. 15). Full details of the assumptions used for nutrient nitrogen and acidity critical loads, and background nitrogen and acid deposition rates by ecological site are summarised in **Table 3.4**.

Table 3.4: Sensitive ecological receptor nitrogen deposition details

Designated site	Habitat	Nutrient nitrogen	
		Minimum empirical critical load (kg N/ha/yr)	Average background nitrogen deposition (kg N/ha/yr)
Furzen Wood AW	Forest	10	34.16
Stubbocks Wood AW	Forest	10	34.16
Watkin's Wood AW	Forest	10	34.02
Lord's Wood AW	Forest	10	34.02
Winchill Wood AW/Winch Hill Wood LWS	Forest	10	34.16
Sewetts Wood AW	Forest	10	34.02
Withstocks Wood AW	Forest	10	34.16
Slaughters Wood AW	Forest	10	34.16
George Wood AW	Forest	10	33.6
Hardingdell Woods AW	Forest	10	33.6
Horsleys Wood AW	Forest	10	33.6
Birch Wood AW	Forest	10	33.6
Kidney/Bulls Wood AW	Forest	10	35.98
Appspond Wood LWS	Forest	10	35
Potters Crouch Plantation LWS	Forest	10	35
Westwick Hall LWS	Forest	10	20.16
Bury Wood (near Redbourn) LWS	Forest	10	36.4
Nicky Way Dismantled Railway LWS	Forest	10	36.4
Nicholl's Great Wood and Rabbitfield Spring LWS	Forest	10	36.4
St Agnell's Farm LWS	Forest	10	21.56
Fir Tree Spring LWS	Forest	10	33.6
Kinsbourne Green Grassland LWS	Grassland	20	19.32

Designated site	Habitat	Nutrient nitrogen	
		Minimum empirical critical load (kg N/ha/yr)	Average background nitrogen deposition (kg N/ha/yr)
Heavens Wood & Chalk Wood LWS	Forest	10	35.98
Road Verge near Pepperstock LWS	Forest	10	35.98
The Nicky Line LWS	Forest	10	19.32
Batford Springs and Meadow LWS	Forest	10	19.32
River Lea Pastures, N. of Harpenden LWS	Grassland	20	19.32
East Hyde Riverside LWS	Grassland	10	19.32
Luton Hoo Park LWS	Forest	10	34.16
Church Cemetery, Luton LWS	Grassland	20	19.88
Dairybon Scarp LWS	Grassland	10	19.88
Vauxhall Way LWS	Forest	10	19.88
Hitchin Road Spinney LWS	Forest	10	35.70
People's Park LWS	Grassland	15	20.86
River Lea LWS	Grassland	10	20.86
The Chase LWS	Forest	10	34.16
Slaughters Wood and Green Lane LWS	Forest	10	34.16
Wigmore Park LWS	Forest	10	34.16
Burnt Wood LWS	Forest	10	34.16
Limekiiln Wood LWS	Forest	10	34.16
Diamondend Springs, Limekiln Wood, Pondcroft LWS	Forest	10	34.16
Sloughs Wood LWS	Forest	10	34.16
Laysbury Dells LWS	Forest	10	34.02
Sellbarns Dell LWS	Forest	10	34.16

Designated site	Habitat	Nutrient nitrogen	
		Minimum empirical critical load (kg N/ha/yr)	Average background nitrogen deposition (kg N/ha/yr)
Hurst Wood LWS, Sewetts Wood AW	Forest	10	34.02
Whiteway Bottom Copse	Forest	10	34.02
Long Lane	Forest	10	34.02
Chilten Green LWS	Forest	10	19.32
Kidney and Bull Woods LWS	Forest	10	35.98
Stockwood Park LWS	Forest	10	35.98
Stockwood Park LWS	Forest	10	35.98
Kingswaldenbury Icehouse	Grassland	20	19.46
Wandon End Park LWS	Forest	10	34.16
Dunstable to Luton disused railway LWS	Grassland	5	19.04
Blows Down LWS	Grassland	15	19.04
The Linces LWS	Grassland	15	20.86
Dallow Lane LWS	Forest	10	35.70
Hatters Way LWS	Grassland	15	20.86
Foxdell LWS	Grassland	15	20.86
Dallow Downs and Winsdon Hill SSSI	Forest	10	35.70
Castle Croft and Bluebell Woods LWS	Forest	10	35.70
Riverside Walk LWS	Forest	10	20.86
Honeygate and Crick Hills LWS	Forest	10	20.86
Stockingstone Hill LWS	Grassland	20	20.86
Croda Colloids LWS, River Lea LWS	Grassland	20	20.86
Icknield School LWS	Grassland	20	20.86
Cowslip Meadows SSSI	Grassland	10	20.86

Designated site	Habitat	Nutrient nitrogen	
		Minimum empirical critical load (kg N/ha/yr)	Average background nitrogen deposition (kg N/ha/yr)
Fallowfield LWS	Grassland	20	20.86
Bramingham and Icknield Corridor LWS	Forest	10	33.46
Wardswood Lane	Forest	10	33.74
Smithcombe, Sharpenhoe and Sundon Hills SSSI	Forest	10	33.46
Barton Quarry LWS	Grassland	15	19.32
Barton scrubby grasslands LWS	Grassland	15	17.64
Ravensburgh Castle, Hexton Manor Estate LWS	Forest	10	30.52
Hexton Chalk Pit LWS	Forest	10	30.52
Hexton Chalk Pit Road Verge LWS	Forest	10	33.74
Offley Chalk Banks, Offley Park LWS & Old Road Plantation/New Plantation LWS	Forest	10	33.74
The Willows (Hitchin) LWS	Grassland	10	18.34
Priory Park Icehouse LWS	Forest	10	32.06
Folly Alder Swamp LWS	Forest	10	32.06
Kingshoe Wood LWS	Forest	10	31.08
Hill's Plantation LWS	Forest	10	17.50
Hipsey Spinney LWS	Forest	10	32.76
Sundon Chalk Pits LWS	Grassland	15	18.76
River Flit LWS	Forest	10	18.76
Ancient Veteran Tree	Forest	10	34.72
Ancient Veteran Tree	Forest	10	34.72
Ancient Veteran Tree	Forest	10	35.98
Ancient Veteran Tree	Forest	10	35.98

Designated site	Habitat	Nutrient nitrogen	
		Minimum empirical critical load (kg N/ha/yr)	Average background nitrogen deposition (kg N/ha/yr)
Ancient Veteran Tree	Forest	10	35.98
Ancient Veteran Tree	Forest	10	32.76
Ancient Veteran Tree	Forest	10	32.76
Ancient Veteran Tree	Forest	10	31.36
Ancient Veteran Tree	Forest	10	33.60
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	5	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	10	34.02
Ancient Veteran Tree	Forest	5	34.02
Batford Springs LNR	Forest	10	33.60
Galley and Warden Hills CWS, SSSI	Grassland	15	19.32
River Flit CWS	Forest	10	18.76
River Lea CWS, River Lea DWS, Lewsey Park DWS	Grassland	15	18.76

Designated site	Habitat	Nutrient nitrogen	
		Minimum empirical critical load (kg N/ha/yr)	Average background nitrogen deposition (kg N/ha/yr)
Dallow Downs CWS, Winsdon Hill SSSI	Forest	10	20.86
Featherbed Lane Copse by Serge Hill LWS	Forest	10	20.02
Luton Hoo Park LWS, River Lea CWS	Forest	10	34.16
Stockwood Park CWS, Ancient Veteran Tree	Forest	10	35.98
Gread Brangingham Park LWS	Forest	10	33.46
Galley and Warden Hills CWS, SSSI	Forest	10	33.46
River Lea, Riverside Walk LWS	Grassland	10	20.86
Dairybon Scarp LWS	Forest	10	34.16
Wigmore Park LWS	Grassland	15	19.88
Wigmore Park LWS	Forest	10	19.88
Wain Wood SSSI	Forest	10	32.06
Chalton Scrub and Grassland CWS	Grassland	15	17.08
Great Hayes Wood DWS	Forest	10	33.74
Dog Kennel Down CWS	Grassland	15	19.88
Hay Wood and Stopsley Common DWS	Forest	10	18.76
Hexton Manor Icehouse	Forest	10	34.16
Luton Parkway Verges DWS	Grassland	15	34.16
Icknield Way below Telegraph Hill	Forest	10	19.04

3.6 Assessment scenarios

3.6.1 As the airport expands in phases, impacts to air quality will change with the airport growth. Typically, for air quality, impacts will be greatest in the opening year of a scheme as technology improvements reduce emissions from vehicles and other sources. The scenarios assessed in the ES for the Core Planning Case are as follows.

a. Baseline (2019), there were 18 million passengers per annum (mppa).
b. Assessment Phase 1: 2027 with and without scheme (21.5 mppa). The impacts from the first stage of growth are assessed in this scenario. Impacts are likely to be greatest during this scenario as older vehicles and airplanes are still in operation. On the roads the existing fleet will still have a high proportion of pre-euro 6/VI vehicles. The scenario will include peak construction vehicles in assessment Phase 1.
c. Assessment Phase 2a: 2039 with and without scheme (27 mppa). The impacts from the second stage of growth are assessed. With traffic being the most likely source to result in an impact to air quality it is considered this is a suitable assessment year as vehicle emissions are expected to improve year on year. The scenario will include peak construction vehicles in assessment Phase 2a.
d. Assessment Phase 2b: 2043 with and without scheme (32 mppa). The impacts for the full application extent are assessed. With traffic being the most likely source to result in an impact to air quality, it is considered this is a suitable assessment year as vehicle emissions are expected to improve year on year. The scenario will include peak construction vehicles in assessment Phase 2b as a conservative scenario.

3.6.2 It is considered the years assessed in the ES will capture the greatest possible air quality impacts, because it assesses early phases when vehicle fleets will still have higher proportions of pre-euro 6/VI vehicles (compared to later years), and capture later phases where the capacity increases and therefore the traffic generated by the Proposed Development would be expected to increase. If no impacts are predicted in these years, there is a low risk of impacts occurring in other years.

Sensitivity test scenarios

3.6.3 The ‘19 mppa Application’, ‘A321Neo acoustic performance’ and ‘Next generation aircraft’ sensitivity scenarios described in **Chapter 5** of this ES **[TR020001/APP/5.01]** are qualitatively assessed for air quality and summarised in **Chapter 7** of this ES **[TR020001/APP/5.01]**. A quantitative assessment of the following has been undertaken and the conclusions are summarised in **Chapter 7** of the ES and the results are detailed in **Appendix 7.4** of this ES **[TR020001/APP/5.02]**:

a. Faster Growth
    i. Assessment Phase 1: 21.5mppa (2026)
    ii. Assessment Phase 2a: 27mppa (2038)

iii. Assessment Phase 2b: 32mppa (2042)

b. Slower Growth

i. Assessment Phase 1: 21.5mppa (2030)

ii. Assessment Phase 2a: 27mppa (2046)

iii. Assessment Phase 2b: 32mppa (2049)

c. M1 sensitivity (2043)

3.6.4 The following air quality specific modelling sensitivity testing have also been undertaken, referred to as modelling sensitivity analysis:

a. Modelling the 2027 core assessment scenario (worst case phase in terms of total predicted concentrations) with terrain to understand the sensitivity of the results to including the effects of terrain in the study area on the dispersion of emissions;

b. Using the Defra NOx to NO_2 conversion tool to compare results to the Clapp and Jenkin approach detailed in **Section 3.8**; and

c. Modelling all core assessment scenarios with traffic data split into periods (AM peak, inter-peak, PM peak, off-peak periods) to understand how it effects results compared to using AADT traffic data representing a day.

3.7 Emission inventory methodology

Sources of emissions

3.7.1 To compile the emissions required for input to the dispersion modelling an emissions inventory of NOx, primary NO_2 (pNO_2, refers to the proportion of NOx that is emitted as NO_2), fine particulate matter (PM_{10}) and very fine particulate matter ($PM_{2.5}$) was compiled for the following pollution sources:

a. aircraft main engines in the landing and take-off (LTO) cycle;

b. aircraft auxiliary power units (APUs), while in use on the ground;

c. ground support equipment (GSE), namely airside vehicles which handle aircraft turn-arounds, load and unload baggage and cargo, and conduct inspections and essential maintenance of airfield infrastructure, particularly the runway which is in constant use;

d. other airport sources, including car parks, airport energy and heating plant, ground power units (GPUs) and the fire training ground;

e. road vehicles using the local and strategic highway network around the airport; and

f. all other sources not related to the Proposed Development, considered to be background sources (e.g. industrial emissions, emissions from domestic heating, and minor roads).

3.7.2 The following sections provide the detailed information used to gather the emissions for each of the sources.

Aircraft emissions during LTO cycle

3.7.3 The ICAO Airport Air Quality Manual (Ref. 8) defines the LTO cycle as the emissions associated with aircraft operations up to a height of 915m (3,000ft). Emissions from aircraft were calculated using fleet data provided by LLAOL, consisting of annual aircraft movements recorded in 2019. The fleet data was used to build the emissions inventory for all modes of the LTO cycle: taxiing; hold; take-off roll; initial climb; climb out; approach; and landing.

3.7.4 Aircraft emissions were calculated up to a height of 915m. However, the ICAO manual (Ref. 8) and Department for Transport guidance (Ref. 16) states that 305m (1,000ft) is the typical altitude for ground-level NO_2 impacts from aircraft emissions. Therefore, the dispersion modelling assessment has been undertaken up to a height of 457m (1,500ft), which is taken as a slightly conservative (pessimistic) cut-off of the emissions.

3.7.5 Emissions were calculated for the engines for each aircraft type. The method of this calculation is provided in this section.

3.7.6 The detailed fleet data for 2019 was further used to derive the runway utilisation, which is presented in **Table 3.5** (excluding helicopter operations). The runway can operate in an easterly direction (07 operation) or a westerly direction (25 operation) and this is dependent on wind conditions. The names ’07 operation’ and ’25 operation’ are called that to reflect the baring angle of the runway 70˚ for easterly direction and 250˚ for the westerly direction. Typically, when there is a westerly to south westerly wind (prevailing wind), the runway will operate in the 25 direction. An hourly profile for each hour of the year (an hour by hour parameter applied for each hour of the year i.e. 8,760 factors for one year of meteorological data) was derived from the detailed 2019 data and used to model all the aircraft departures and arrivals and represent the operations in different directions.

Table 3.5: Runway use

Runway direction (bearing)	Air Transport Movements (ATMs)	% of total
07 operation (70°)	41,814	30%
25 operation (250°)	99,088	70%

Fixed Wing Aircraft

3.7.7 The detailed aircraft movement data provided by the aviation consultants was used to identify the main types of aircraft that used the airport in 2019. Forecast aircraft movement data was also provided by the aviation consultants (**Table 3.6**). These were merged into modelling categories (MCATs) of similar aircraft types, relating to short/long haul and narrow/wide body aircraft, and number and type of engines. Information on the commercial aircraft engines were provided by the aviation consultants and supplemented by an in-house aircraft fleet database and online resources.

3.7.8 For each MCAT, information on the climb and approach profiles were obtained from AEDT software (Ref. 9). This was used to derive speeds and time in mode for take-off, initial climb, climb out and approach.

3.7.9 From the annual aircraft movements recorded at the airport in 2019, 14 fixed wing aircraft modelling categories (MCATs) were defined for the assessment. **Table 3.7** presents the MCATs and the aircraft type in each. Emissions were calculated for the engines for each aircraft type in each MCAT.

3.7.10 Turbofan engine emission factors of NOx and fuel consumption rates were taken from the ICAO aircraft engine emissions databank (Ref. 7).

3.7.11 Emissions of pNO_2 were derived using the fractions described in the Project for Sustainable Development of Heathrow (PSDH) methodology (Ref. 17). These were 4.5% pNO_2 at 100% thrust, 5.3% at 85% thrust, 15% at 30% thrust and 37.5% at 7% thrust. For intermediate thrust settings, the pNO_2 fractions were derived linearly.

3.7.12 For piston engines, pollutant emission and fuel flow indices were taken from the FOCA database (Ref. 11) and for turboprop engines from the FOI confidential database (Ref. 10).

3.7.13 Emissions of PM_{10} were derived from the smoke number, fuel flow and hydrocarbon emission indices following the methodology described in the ICAO Airport Air Quality Manual (Ref. 8).

3.7.14 In relation to $PM_{2.5}$ emissions, the EMEP/EEA guidebook (Ref. 13) states that "*it is reasonable to assume that for aircraft, the particulate matter emissions can be considered as* $PM_{2.5}$". Therefore, it was assumed that all particulate matter emissions from aircraft engines were in the $PM_{2.5}$ fraction.

3.7.15 Emissions (E) for each MCAT and each LTO mode were calculated using the following equation:

$$E\,[g] = EI * FF * TIM * number\ of\ engines * ATMs$$

3.7.16 Where EI is the emission factor in g/kg, FF is the fuel flow in kg/s and TIM is the time-in-mode in seconds.

Table 3.6: Aircraft ATM forecasts

Aircraft	2027 ATMs		2039 ATMs		2043 ATMs	
	DM	DS	DM	DS	DM	DS
Commercial Aircraft						
Airbus A319	0	0	0	0	0	0
Airbus A320	22,110	25,880	0	0	0	0
Airbus A320Neo	39,480	46,210	60,790	71,400	60,790	75,640
Airbus A321	530	620	0	0	0	0
Airbus A321LR	0	0	0	630	0	630
Airbus A321neo	24,740	28,960	26,710	43,840	26,710	54,210

Aircraft	2027 ATMs		2039 ATMs		2043 ATMs	
	DM	DS	DM	DS	DM	DS
Airbus A350-900	0	0	0	630	0	630
Boeing 737-400	0	0	0	0	0	0
Boeing 737-800W	9,990	11,710	3,130	3,130	1,890	1,890
Boeing 737-900W	530	620	0	0	0	0
Boeing 737-Max10	0	0	0	2,510	0	5,040
Boeing 737-Max8	8,420	9,860	14,540	19,420	15,780	23,950
Boeing 737-Max9	0	0	630	630	630	630
Boeing-787-10	0	0	0	1,250	0	1,890
Boeing-787-8	0	0	0	1,880	0	4,410
Boeing-787-9	0	0	0	630	0	1,260
Dash-8-Q400	0	0	0	5,010	0	4,410
Embraer E190-E2	0	0	0	0	0	2,520
Freight Aircraft						
Airbus A300-600F	1,100	1,100	0	0	0	0
Airbus A330-200F	150	150	400	400	400	400
Airbus A330-300F	0	0	850	850	850	850
Boeing-737-800F	0	0	1,050	1,050	1,050	1,050
Boeing-737-400F	270	270	0	0	0	0
Boeing-757-200F	780	780	0	0	0	0
Business and General Aviation Aircraft						
Airbus A319CJ	150	150	0	0	0	0
Airbus A319Neo CJ	200	200	350	350	350	350
Agusta 109 Helicopter	600	600	600	600	600	600
Beechcraft King Air 350	550	550	550	550	550	550
Boeing-737-BBJ7	150	150	0	0	0	0
Boeing-737-BBJ Max7	200	200	350	350	350	350
Bombardier Global Express 6000	4,300	4,300	4,300	4,300	4,300	4,300
Canadair Challenger 605	4,050	4,050	4,050	4,050	4,050	4,050
Cessna 680 Sovereign	7,450	7,450	7,450	7,450	7,450	7,450

Aircraft	2027 ATMs		2039 ATMs		2043 ATMs	
	DM	DS	DM	DS	DM	DS
Dassault Falcon FA8X	3,100	3,100	3,100	3,100	3,100	3,100
Embraer Legacy 650E	2,000	2,000	2,000	2,000	2,000	2,000
Embraer Phenom 300E	950	950	950	950	950	950
Gulfstream 400	2,550	2,550	2,550	2,550	2,550	2,550
Gulfstream 650	3,750	3,750	3,750	3,750	3,750	3,750
Totals	138,100	156,160	138,100	183,260	138,100	209,410

Table 3.7: Aircraft MCATs

MCAT	Description	Representative aircraft type	
		Baseline (2019)	Future (2027-2043)
1	Piston engine aircraft	Diamond DA-40/2 Twin Star (DA42)	-
2	Small business jets (turbofan engines)	Canadair Global Express (GLEX)	Cessna 680 Sovereign (C680)
3	Turboprop aircraft	Beechraft King Air 200 (BE20)	Bombardier Dash 8 - Q400 (DH8D)
4	Narrow body, short to medium range aircraft	Boeing 737-800 (B738)	
5	Narrow body, short to medium range aircraft	Airbus A320 (A320)	
6	Narrow body, short to medium range aircraft	Airbus A321 (A321)	
7	Narrow body, medium to long range aircraft	Boeing 757-200 (B752)	
8	Wide body, medium to long range aircraft	Airbus A300-600 (A306) (2027) / Airbus A330-300 (2039 & 2043)	
9	Wide body, medium to long range aircraft	Boeing 787-8 (B788)	
10	Regional jets, short to medium range aircraft	Embraer ERJ-135 (E135)	Embraer E190-E2 (E290)

MCAT	Description	Representative aircraft type	
		Baseline (2019)	Future (2027-2043)
11	Regional jets, short to medium range aircraft (4x engines)	BAE (HS) 146-200 (B462)	-
12	Narrow body, short to medium range aircraft	Airbus A320Neo (A20N)	
13	Narrow body, short to medium range aircraft	Airbus A321Neo (A21N)	
14	Narrow body, short to medium range aircraft	-	Boeing 737-MAX 8 (B38M)
Notes: The representative aircraft considers the proportion of ATMs it contributes to the MCAT and how representative the aircraft is likely to be in terms of dispersion from the engine exhausts.			

3.7.17 For the final approach of the arriving aircraft, emissions were calculated from 457m to the ground. Emissions were calculated using a 30% thrust for final approach. For the dispersion model, only emissions from the final approach were included, since emissions above 457m (i.e. upper approach) would have a negligible impact on ground level concentrations. Approach profiles for individual aircraft types were obtained from AEDT (Ref. 9) software, which was used to derive the travelling speed, distance and time-in-mode. **Table 3.8** presents the final approach parameters included in the model for the representative aircraft in each MCAT.

Table 3.8: Final approach model parameters

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
1	Speeds not required. These MCATs are piston and turboprop engines modelled as volume sources following ADMS guidance (Ref. 18).		8,724	211
2 (Baseline)			8,602	218
2 (Future)			8,724	167
3 (Baseline)			8,724	301
4	73.1	71.1	8,101	108
5	66.2	65.4	8,573	130
6	69.3	68.8	8,573	125
7	68.3	65.7	8,724	129
8	66.6	65.9	8,573	129
9	71.8	70.7	8,573	120
10	70.1	63.9	8,724	130

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
11	84.0	59.7	8,724	133
12	66.2	65.4	8,573	130
13	69.3	68.8	8,573	125
14	69.6	68.1	8,573	124

3.7.18 For the landing phase (landing roll on the runway), emissions were calculated using a 7% thrust which was assumed to take into account use of reverse thrust. Emissions were modelled at ground level and times in mode were taken from the AEDT software (Ref. 9) for the representative aircraft in each MCAT, ranging from four to 26 seconds.

3.7.19 Brake and tyre wear during landing were represented in the model as volume sources (**Figure 7.5** of this ES **[TR020001/APP/5.03]**). PM_{10} emission rates were calculated following the PSDH methodology as amended in the 2005/6 emissions inventory for Gatwick Airport (Ref. 19). Brake and tyre wear were calculated using the following equations:

*Brake wear = 2.5 * 10-7 * MRW [kg PM_{10} per LTO]*

*Tyre wear = 10% * (2.23 * 10-6 * MRW – 0.0879) [kg PM_{10} per LTO]*

3.7.20 Where MRW is the maximum ramp weight. It was assumed that $PM_{2.5}$ emissions were 40% of brake wear and 70% of tyre wear PM_{10} emissions, following methodology in the 2005/6 emission inventory for Gatwick Airport (Ref. 19).

3.7.21 For the taxiing in and out of the arriving and departing aircraft, emissions were calculated using a 7% thrust for the engines, which is the ICAO default. Emissions were distributed spatially along the taxiways based on the 2019 fleet data, stand locations and usage. Times in mode were taken from the detailed 2017 movements and the average values were 367 seconds for taxi in and 816 seconds for taxi out.

3.7.22 For departing aircraft, hold emissions were calculated using a 7% thrust for the engines, which is the ICAO default, and an average time in mode of 205 seconds. The time-in-mode for hold emissions was calculated as the difference between the Eurocontrol (Ref. 20) taxi-out time and the observed taxi-out time from the detailed fleet data at the airport. Emissions were distributed spatially at the holding positions on the airfield.

3.7.23 For the take-off phase, emissions were calculated using an 85% thrust for the engines and modelled along the runway. The 85% thrust for take-off is different from the ICAO default of 100% but is the value used in recent airport emissions inventories of major UK airports. AEDT provided details of profiles for individual aircraft types. **Table 3.9** presents the take-off parameters included in the model for the lead aircraft in each MCAT.

Table 3.9: Take-off model parameters

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
1	Speeds not required. These MCATs are piston and turboprop engines modelled as volume sources following ADMS guidance (Ref. 18).		400	24
2 (Baseline)			1,503	73
2 (Future)			811	24
3 (Baseline)			392	15
4	0.0	89.3	2,173	45
5	0.0	80.2	1,761	40
6	0.0	87.6	2,114	45
7	0.0	90.4	2,099	45
8	0.0	88.9	1,979	36
9	0.0	89.9	2,162	45
10	0.0	67.3	1,114	28
11	0.0	72.9	1,253	32
12	0.0	80.2	1,761	40
13	0.0	87.6	2,114	45
14	0.0	87.0	2,071	45

3.7.24 For the climb phase of the arriving aircraft, emissions were calculated for the initial climb from the ground up to 457m. Emissions were calculated using an 85% thrust for initial climb, consistent with the take-off thrust, as recommended by the PSDH methodology. For the dispersion model, only emissions from the initial climb were included, since emissions above 475m (i.e. climb out) would have a negligible impact on ground level concentrations. AEDT provided details of climb profiles for individual aircraft types. **Table 3.10** presents the initial climb parameters included in the model for the representative aircraft in each MCAT.

Table 3.10: Initial climb model parameters

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
1	Speeds not required. These MCATs are piston and turboprop engines modelled as volume sources following ADMS guidance (Ref. 18).		6,967	143
2 (Baseline)			3,972	70
2 (Future)			2,684	40
3 (Baseline)			2,360	50
4	89.3	106.6	3,754	36
5	80.2	110.3	4,719	47
6	87.6	115.5	4,962	48
7	90.4	108.0	4,396	42

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
8	88.9	110.2	3,989	37
9	89.9	108.1	5,129	48
10	67.3	80.7	3,624	46
11	72.9	88.2	7,125	87
12	80.2	110.3	4,719	47
13	87.6	115.5	4,962	48
14	87.0	113.0	5,832	55

3.7.25 **Figure 7.6** to **Figure 7.26** of this ES **[TR020001/APP/5.03]** present the modelled LTO sources for all combinations of 07 and 25 arrival and departure operations. Since the lengths of final approach, landing, take-off and initial climb varied by MCAT, the figures present the largest lengths for these modes.

Helicopters

3.7.26 The detailed aircraft movement data provided by the aviation consultants was used to identify the main types of helicopters that used the airport in 2019. Helicopters were modelled in a similar way to the fixed wing aircraft. Emissions were calculated for each operating mode (i.e. idle before departure, take-off and climb, and idle after arrival) and then added together to derive the total LTO cycle emissions.

3.7.27 Helicopters were modelled using information from the annual aircraft movements recorded at the airport in 2019. There is a total of 578 helicopter movements at the airport in 2019 and 600 movements are forecast in all future scenarios.

3.7.28 Emissions were calculated for an Agusta A109 helicopter, which was the most frequent in 2019, using the FOCA guidance (Ref. 12) and modelled in the middle of the runway. The Agusta A109 was also forecast as the only helicopter in the future years. **Table 3.11** presents the power setting, shaft horsepower and time used for each mode to calculate the emissions. **Table 3.12** presents the fuel flow (in kg/s) and NOx and PM_{10} emission indices (in g/kg) for each LTO mode of the helicopters. The FOCA guidance does not include emissions of pNO_2. It was therefore assumed that pNO_2 emissions were 37.5% of NOx as a worst case, taken from the PSDH methodology for fixed wing aircraft at 7% thrust. A monthly profile was used to apportion movements across the year as shown in **Inset 3.1**, based on the 2019 data.

3.7.29 Emissions were assigned spatially to the middle of the runway and were represented in the model as a volume source up to a height of 50m.

Table 3.11: Helicopter parameters for emission calculations

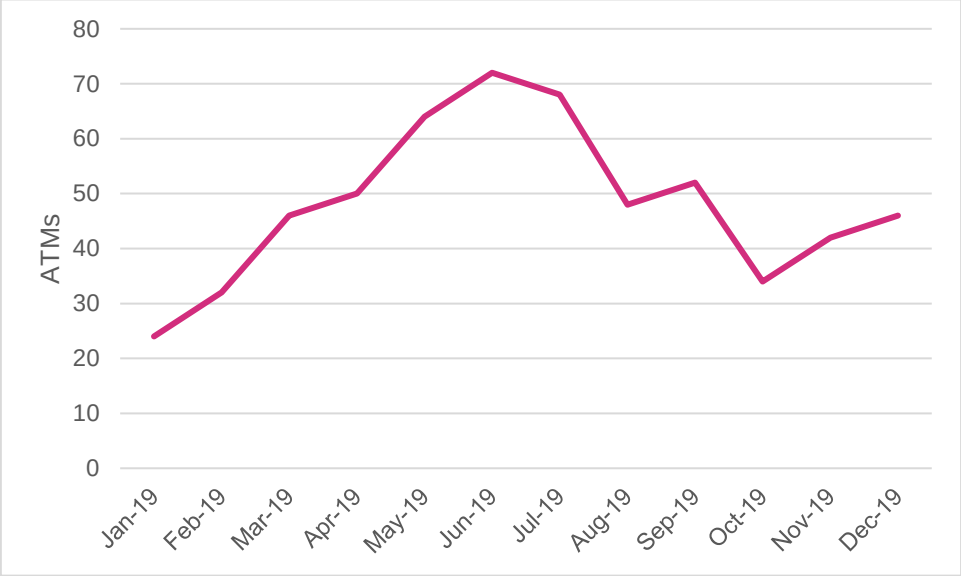
Mode	Power	Shaft horsepower	Time (min)
Idle	7%	46	5

Mode	Power	Shaft horsepower	Time (min)
Take-off and climb	78%	507	3
Approach	38%	247	5.5

Table 3.12: Helicopter emission indices and fuel flow

Mode	Fuel flow (kg/s)	NOx (g/kg)	PM_{10} (g/kg)
Idle	0.01	1.85	0.12
Take Off	0.04	7.25	0.21
Approach	0.03	4.82	0.16

Inset 3.1: Monthly profile for helicopter use



Auxiliary power units (APUs)

3.7.30 The APUs were assumed to run for three minutes on average for each LTO cycle before connecting to power. This was based on information from LLAOL. The same time in mode (TIM) was assumed for the baseline and future scenarios.

3.7.31 The auxiliary power units (APUs) used on each aircraft operating in the baseline and future scenarios were determined. Emission rates of NOx and PM_{10} were obtained from an in-house database supplemented by standard emissions for generalised aircraft types from the ICAO airport air quality manual.

3.7.32 The emissions from APUs were calculated for each aircraft. Where information was not available on the type of APU for an aircraft, default emissions were taken from the ICAO manual. **Table 3.13** presents the APU types and emission factors used for each aircraft. It was assumed that pNO_2 emissions were 10% of NOx, taken from the EMIT software (Ref. 21). Emissions were factored for each hour of the year using the profile created from the aircraft movements.

3.7.33 **Figure 7.27** of this ES **[TR020001/APP/5.03]** presents the modelled sources for the APUs at the stands. The APUs were modelled as volume.

3.7.34 Emissions were distributed spatially around the airport at the stands in line with stand usage and the temporal variation was modelled using the ATM profile for 2019.

Table 3.13: APU emission factors for lead aircraft

MCAT	Code	APU	NOx (kg/hour)	PM_{10} (kg/hour)
1	DA42	No APU	-	-
2 (baseline)	GLEX	RE220	0.45	0.07
2 (future)	C680	RE100CX	0.45	0.07
3 (baseline)	BE20	No APU	-	-
3 (future)	DH8D	APS 1000/T-62T-46C12	0.46	0.07
4	B738	Allied Signal AS 131-9	0.77	0.09
5	A320	GTCP 36-300	1.01	0.06
6	A321	GTCP 36-300	1.01	0.06
7	B752	Garrett GTCP 331-200A/ Garrett GTCP 331-200ER	1.16	0.11
8 (2027)	A306	TSCP 700-5	1.73	0.11
8 (2039, 2043)	A333	GTCP331-350	2.03	<0.01
9	B788	Hamilton Sundstrand APS5000	1.04	0.06
10 (baseline)	E135	ICAO default for "Business/Regional Jet (<100 seats)"	0.45	0.07
10 (future)	E290	APS2300	0.51	0.16
11	B462	GTCP36/APS1000	1.01	0.06
12	A20N	GTCP 36-300	1.01	0.06
13	A21N	GTCP 36-300	1.01	0.06
14	B38M	Honeywell 131-9	0.77	0.09

Aircraft engine testing

3.7.35 Engine testing occurs at the Engine Run Up Bay (ERUB) shown in **Figure 7.28** of this ES **[TR020001/APP/5.03]**. A total of 313 tests during 2017 were recorded. As a conservative assumption the total number of tests was assumed to increase in line with the growth in ATMs to 2019. The aircraft types for these tests were not available. Therefore, the tests were distributed between the MCATs based on the ATM distribution.

3.7.36 In the future scenarios, as a conservative assumption, the total number of tests was assumed to increase in line with the growth in ATMs. **Table 3.14** show the

figures used and **Figure 7.29** of this ES **[TR020001/APP/5.03]** provides the locations.

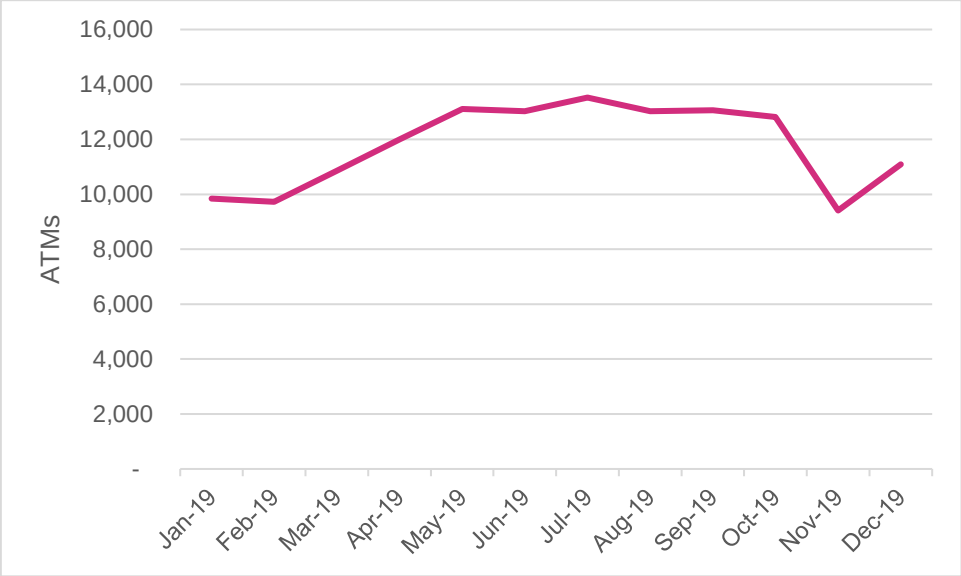
3.7.37 The emissions were calculated using the same approach as for the aircraft in the LTO cycle. The average test cycle assumed was 10mins at 100% thrust and 25mins at 7% (idle) thrust.

3.7.38 Engine testing was assumed to be spread temporally for each hour of the year using the profile created from the aircraft movements. A monthly profile was applied to the emissions based on the 2019 ATM distribution as shown in **Inset 3.2**. The engine tests were included in the model as volume sources with a height of 5m.

Table 3.14: Number of aircraft engine runs at the ERUB

MCAT	2019	2027 DM	2027 DS	2039 DM	2039 DS	2043 DM	2043 DS
Total	327	319	361	319	424	319	484

Inset 3.2: Monthly profile of engine testing



Fire training ground

3.7.39 The fire training ground is currently located to the east of the airport as shown in **Figure 7.28** of this ES **[TR020001/APP/5.03]**. The training ground is operated by LLAOL's fire services, using liquefied petroleum gas (LPG) and wood as the combustion fuels. Emission factors were taken from the NAEI (Ref. 6) and converted for use in the assessment (**Table 3.15**). It was assumed that pNO_2 emissions were 5% of NOx emissions following NAEI guidance. The fuel use from the operation of this facility in 2019 was provided by LLAOL and is presented in **Table 3.15**.

3.7.40 LLAOL provided information on the typical operating times of the fire training ground. Typically, they would operate between 10:00-12:30 for day-time exercises and between 20:00-22:00 for night exercises. LLAOL also provides

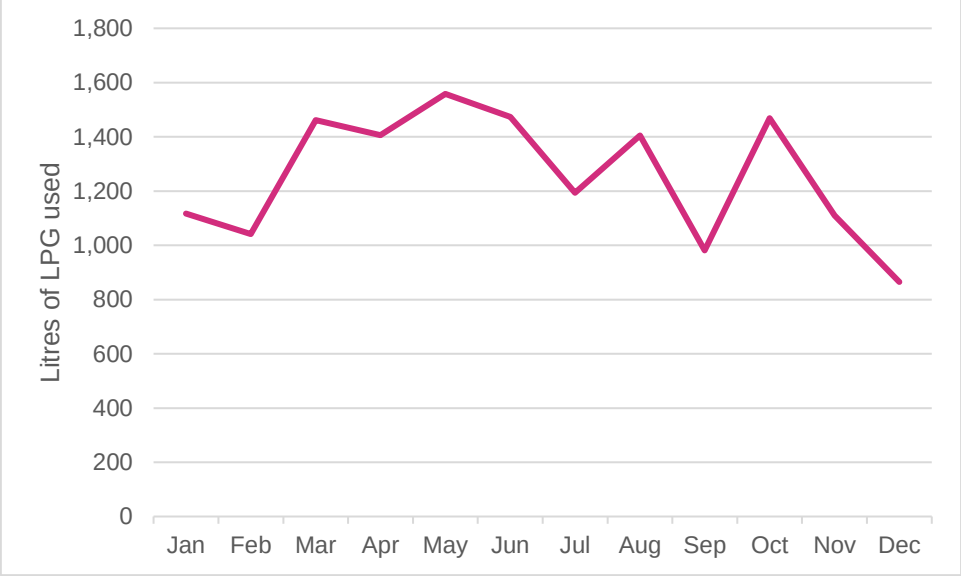
the fuel used per month. This information was used to derive a monthly use profile for the fire training ground. This was reflected in the modelling using a monthly (**Inset 3.3**) and diurnal profile. The fire training ground was included in the model as a volume source with a height of 10m.

3.7.41 LLAOL confirmed that the frequency of operations is expected to remain the same in future years and therefore the methodology for the future scenarios were the same, assuming the same amount of fuel use. The only difference is the proposed new location for the fire training ground to the south of the runway, shown in **Figure 7.29** of this ES **[TR020001/APP/5.03]**.

Table 3.15: Fuel consumption at the fire training ground and emission factors used

Fuel type	Fuel consumption	Emission factor	
		NOx	PM_{10}
LPG	12,792 litres	1.85×10^{-3} kg/litre	1.95×10^{-5} kg/litre
Wood	4,500 kg	2.25×10^{-3} kg/kg	2.42×10^{-3} kg/kg

Inset 3.3: Monthly profile for the LPG used at the fire training ground



Ground Support Equipment (GSE)

3.7.42 GSE at the airport includes a range of different vehicles, such as belt-loaders, tugs, towers, hydraulic lift platforms and de-icing units. Data for airside vehicles at the airport was provided by LLAOL (2019 Airside Vehicle Permit and Fuel Purchases spreadsheet, April 2019), consisting of a record of all permitted vehicles for airside access and a record of total fuel purchased by airside vehicles in 2019, which was all diesel. While fuel purchased on the airfield may be used off-site, it was assumed that this would be balanced by the vehicles on-site which purchase fuel off-site.

3.7.43 For the emissions calculations, GSE was split into road vehicles and non-road mobile machinery (NRMM). From the record of fuel purchases, it was derived that 58% of the fuel was issued for road vehicles and 42% for NRMM. The road vehicles were further split into passenger cars, light commercial vehicles (less than 3,500kg) and heavy-duty vehicles (more than 3,500kg). The composition of the euro classes of the road vehicles were estimated using the registration dates and information available from the DVLA. It was assumed that all NRMM on the airport comply with Euro Stage IIIA emission standards. The GSE composition and fuel use is provided in **Table 3.16**.

3.7.44 Emissions of NOx and PM_{10} were taken from the EMEP/EEA air pollutant emissions inventory for NRMM and road vehicle GSE and are provided in **Table 3.17**. Light commercial vehicles were selected to be light duty vehicles N1(II) in the EMEP/EEA database, while heavy duty vehicles were selected to be rigid "14-20 tonnes", because the majority of the heavy-duty vehicles were 19 tonnes. For the NRMM, the fraction NOx that was pNO_2 was assumed to be the same as the fraction for Euro 3 diesel car or LGV, 27% (taken from the NAEI). For road vehicle GSE, the pNO_2 fractions were taken from NAEI for each type of vehicle and Euro standard.

3.7.45 Fuel consumption for road vehicles were also taken from EMEP/EEA assuming an average speed of 20mph (32kph). This assumption was based on the LLAOL operating instructions (Ref. 22), which states the maximum speed limit of 20mph.

3.7.46 For the future scenarios, the same methodology was used to calculate the future emissions. However, the fuel used was increased in line with the ATM growth, but the same fleet compositions in terms of vehicle and Euro types were used as in 2019. This provided a conservative (pessimistic) assumption on GSE emissions as it is likely that the future fleet will have newer vehicles (later Euro class or electric) which would have lower or zero emissions, following the commitments in the Outline Operational Air Quality Plan (**Appendix 7.5** of this ES **[TR020001/APP/5.02]**.

3.7.47 GSE emissions were distributed spatially on the aprons of the airport near stands, based on the stand usage for 2019. Emissions were factored for each hour of the year using a profile created from the aircraft movements. The location of modelled GSE is shown in **Figure 7.29** of this ES **[TR020001/APP/5.03]**.

Table 3.16: GSE fleet fuel use from 2019

GSE type	Euro Class/Stage	Diesel (litres)
Passenger cars	1	3,664
	2	10,994
	3	5,501
	4	13,569
	5	6,217

Light commercial	2	412
	3	10,117
	4	35,075
	5	28,667
	6	22,239
Heavy duty	III	18,215
	IV	2,436
	V	20,111
	VI	189,701
NRMM	IIIA	284,152
Total		**675,797**

Table 3.17: Emission factors for GSE

Vehicle	Emission factor	
	NOx	PM_{10}
NRMM (g/tonnes)		
Stage IIIA	15,653	950
Road vehicles (g/km)		
Car (Euro 1)	0.66	0.06
Car (Euro 2)	0.73	0.05
Car (Euro 3)	0.76	0.03
Car (Euro 4)	0.61	0.03
Car (Euro 5)	0.65	<0.01
LGV (Euro 2)	1.25	0.08
LGV (Euro 3)	1.05	0.06
LGV (Euro 4)	0.85	0.03
LGV (Euro 5)	1.18	<0.01
LGV (Euro 6)	0.95	<0.01
HGV (Euro III)	6.41	0.16
HGV (Euro IV)	4.22	0.03
HGV (Euro V)	6.04	0.04
HGV (Euro VI)	0.49	<0.01

Ground Power Units (GPUs)

3.7.48 Fixed electrical ground power (FEGP) was not available at stands in 2019. Therefore, GPUs were used at the airport to provide power to an aircraft while at stand. Data for the hourly usage of GPUs was provided by LLAOL for 2018 (confirmed via email correspondence, May 2019). It was assumed that they

were used for the same amount of time in 2019. The GPUs were used for a total of 171,148 hours in 2018.

3.7.49 LLAOL also provided the make and model of the GPUs which were diesel-fuelled Guinault GA100 units (via email correspondence, May 2019). The Cummins QSB4.5 engine, compliant with Euro Stage IIIA, was the engine option assumed for these GPUs. This engine was used to calculate the emissions, using EMEP/EEA factors for Stage IIIA NRMMs. The emissions used are shown in **Table 3.18**. The fraction NOx that was pNO_2 was assumed to be the same as the fraction for a Euro 3 diesel car, 16% (taken from the NAEI).

3.7.50 GPUs were spatially distributed at the airport on the aprons near the stands. Emissions were factored for each hour of the year using a profile created from the aircraft movements.

3.7.51 In the future scenarios, the emissions have been assumed to increase in line with the ATM growth. However, in the 2039 and 2043 DS scenarios, the new Terminal 2 (T2) is proposed to have FEGP at all stands, removing the need for GPUs at these stands. Therefore, the GPU emissions assumed for the DS future scenarios are conservative.

Table 3.18: Emission factors for GPUs

Emission standard	NOx (g/tonnes)	PM_{10} (g/tonne)
Stage IIIA	15,653	950

Energy and Heating Combustion Plant

3.7.52 Details of the energy and heating plant were provided by LLAOL (via email correspondence, May 2019) and are presented in **Table 3.19** and the locations are shown in **Figure 7.30** of this ES **[TR020001/APP/5.03]**. The natural gas-fired boilers and heater take their fuel from gas feeds which serve specific buildings. The monthly gas usage data from these gas feeds were provided by LLAOL. **Inset 3.4** shows the monthly total gas consumption. Data for the diesel (gas oil) purchased for 2019, which is purchased as and when needed and stored on-site, was also provided by LLAOL. The diesel data did not provide enough detail to inform the profile of usage. Therefore, the monthly total natural gas consumption profile was applied to all the energy and heating plant.

3.7.53 The fuel serving specific buildings were apportioned to the relevant plant (located at the same building), in proportion to their thermal input. Emissions were calculated using factors from EMEP/EEA specific to natural gas plant and fuel oil plant of sizes between 50kW to 1MW and plant above 1MW (thermal input). It was assumed that pNO_2 emissions were 5% of NOx emissions following NAEI.

3.7.54 The energy and heating plant were represented in the model as area sources above the rooftops of their respective buildings.

3.7.55 For the future scenarios, it was assumed that the fuel used by the existing terminal building would increase in line with passenger growth. In scenarios 2039 and 2043 DS, T2 was added as an area source and emission were apportioned to the T1 and T2 sources proportionate to the passenger split. However, this is assumed to be conservative because the T2 will not have gas or oil fuelled heating, the proposed engineered servicing of the terminal building will be designed to meet exacting standards with regards to energy conservation and sustainable principles, including meeting 'BREEAM excellent' criteria. For example, photovoltaic panels would be installed on the roof, as well as ground or air source heating and cooling systems under the Proposed Development to deliver a source of sustainable energy.

3.7.56 The model input parameters for the boiler and generator locations are provided in **Table 3.20**.

Table 3.19: Details of the heating and energy plant in 2019

Plant type	Location	Thermal input (kW)	Fuel type
Boiler 1	T1 (Old Terminal Building)	1,050	Natural gas
Boiler 2	T1 (Old Terminal Building)	1,050	Natural gas
Boiler 3	T1 (New Terminal Building)	1,050	Natural gas
Boiler 4	T1 (New Terminal Building)	1,050	Natural gas
Boiler 5	T1 (New Terminal Building)	1,100	Natural gas
Boiler 6	Fire Station	80	Gas Oil
Boiler 7	Fire Station	80	Gas Oil
Boiler 8	Fire Station	80	Gas Oil
Boiler 9	Building 94	120	Natural gas
Boiler 10	Building 94	120	Natural gas
Boiler 11	Cargo Centre	31	Natural gas
Heater	Hangar 24	349	Natural gas
Generator 1	Switch house 1	400	Gas oil
Generator 2	Switch house 2	400	Gas oil
Generator 3	Switch house 4	160	Gas oil
Generator 4	Switch house 4	160	Gas oil
Generator 5	Air Traffic Control Tower	250	Gas oil
Generator 6	T1 (New Terminal Building 1A)	1,500	Gas oil

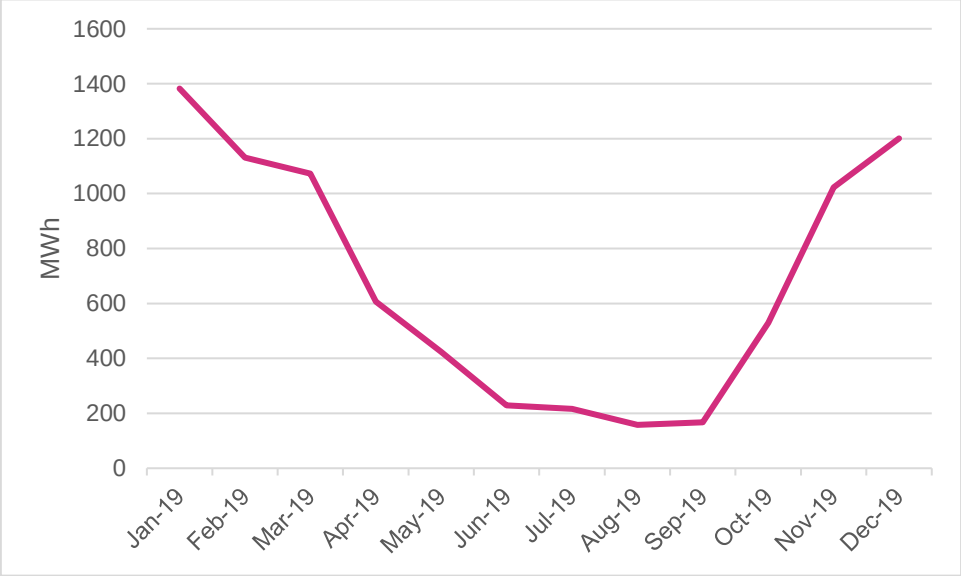
Plant type	Location	Thermal input (kW)	Fuel type
Generator 7	T1 (New Terminal Building 2B)	1,500	Gas oil
Generator 8	T1 (New Terminal Building)	2,000	Gas oil
Generator 9	T1 (Old Terminal Building)	1,010	Gas oil
Generator 10	T1 (Old Terminal Building)	1,600	Gas oil
Generator 11	Airfield Portable generator	420	Gas oil
Generator 12	Mobile unit	40	Gas oil
Generator 13	Mobile unit	40	Gas oil
Generator 14	Mobile unit	33	Gas oil
Generator 15	Mobile unit	10	Gas oil
Notes: The heater is a Combat (0100 PGP ECA) heater, as provided by LLAOL. Generators 11 to 15 are mobile generators. However, LLAOL have proposed usual locations for use in the assessment (via email correspondence, May 2019).			

Table 3.20: Model input parameters of boilers and generators

Sources	OS coordinates of centroid (X, Y)	Height of area source (m)
Boiler 1	511838, 221463	12.0
Boiler 2	511838, 221463	12.0
Boiler 3	511891, 221488	30.0
Boiler 4	511891, 221488	30.0
Boiler 5	511891, 221488	30.0
Boiler 6	511911, 220950	3.4
Boiler 7	511911, 220950	3.4
Boiler 8	511911, 220950	3.4
Boiler 9	511359, 221462	2.5
Boiler 10	511359, 221462	2.5
Boiler 11	511976, 221901	7.0
Heater	511529, 221604	12.0
Generator 1	511925, 220925	2.8
Generator 2	513078, 220853	3.0
Generator 3	512922, 221256	2.3
Generator 4	512922, 221256	2.3

Sources	OS coordinates of centroid (X, Y)	Height of area source (m)
Generator 5	511911, 221172	3.0
Generator 6	511891, 221488	30.0
Generator 7	511891, 221488	30.0
Generator 8	511992, 221372	3.0
Generator 9	511811, 221446	7.0
Generator 10	511819, 221299	11.0
Generator 11*	-	-
Generator 12	511536, 221251	2.0
Generator 13	511359, 221462	2.0
Generator 14	511529, 221604	1.8
Generator 15	511529, 221604	2.8
Notes: Generator 11 location not available as generator is shared between switch houses.		

Inset 3.4: Gas consumption (MWh) for boilers (2019)



Traffic Data

3.7.57 Operational traffic data has been provided for the air quality assessment by the surface access team. Annual average daily traffic (AADT) has been provided and traffic data representing the average conditions occurring in four specific time periods (morning peak, inter-peak, afternoon peak and off-peak) – traffic period data. For the time periods in **Table 3.21** the following data parameters were provided:

a. traffic flow, defined as vehicles/hour;

b. percentage heavy duty vehicles (HDV); and

c. vehicle speeds, in kilometres per hour (kph).

Table 3.21: Traffic time periods

Traffic period	Time period
AM peak (AM)	3 hours (07.00 – 10.00)
Inter-peak (IP)	6 hours (10.00 – 16.00)
PM peak (PM)	3 hours (16.00 – 19.00)
Off peak (OP)	12 hours (19.00 – 07.00)

3.7.58 A modelling sensitivity analysis has been undertaken with the traffic period data.

3.7.59 Modelled speeds were reduced to 20kph at junctions following the LAQM guidance (Ref. 23).

3.7.60 Emissions from traffic data were calculated using the emission factors provided in the latest version of the Department for Environment, Food and Rural Affairs (Defra) Emissions Factor Toolkit (EFT) (Ref. 24).

3.7.61 The GIS software, ArcMap, was used to assist in inputting the road link information into the air quality model. The modelled roads are shown in **Figure 7.1** of this ES **[TR020001/APP/5.03]**.

3.7.62 Two sets of traffic data for each assessment Phase were provided. One which considered the Local Transport Plans of relevant authorities (LTP traffic data) and a set which used Web-based Transport Analysis Guidance (WebTAG) from Department for Transport (webTAG traffic data). The results have been reported in **Appendix 7.3** of this ES **[TR020001/APP/5.02]**.

Construction Traffic

3.7.63 Construction traffic data for the construction period was provided by the Construction Method Statement and Programme Report provided as **Appendix 4.1** of the ES **[TR020001/APP/5.02]**. Assessment Phase 1 construction traffic is predicted to occur from 2025 to 2027; assessment Phase 2a from 2033 to 2036; and assessment Phase 2b from 2037 to 2041.

3.7.64 The year with peak construction traffic movements for each assessment phase have been used in the assessment. For example, the data shows that 2035 is the year when peak construction traffic movements are predicted to occur across all stages, considering both the operatives (construction-related workers) and construction-related delivery vehicle movements. This would occur in assessment Phase 2a, for which peak operational traffic data from the surface access team is available for 2039. Therefore, to predict the change in concentrations, a scenario has been assessed by adding the 2035 construction traffic to the 2039 do something (with Proposed Development) operational traffic data. Emissions for the construction vehicle movements have been calculated using emission factors for the year of the peak construction traffic from the latest version of the Defra EFT. This combines the peak construction traffic with the peak operational traffic within the assessment phase, which is considered to create a worst-case scenario, in terms of total volumes of traffic and emissions.

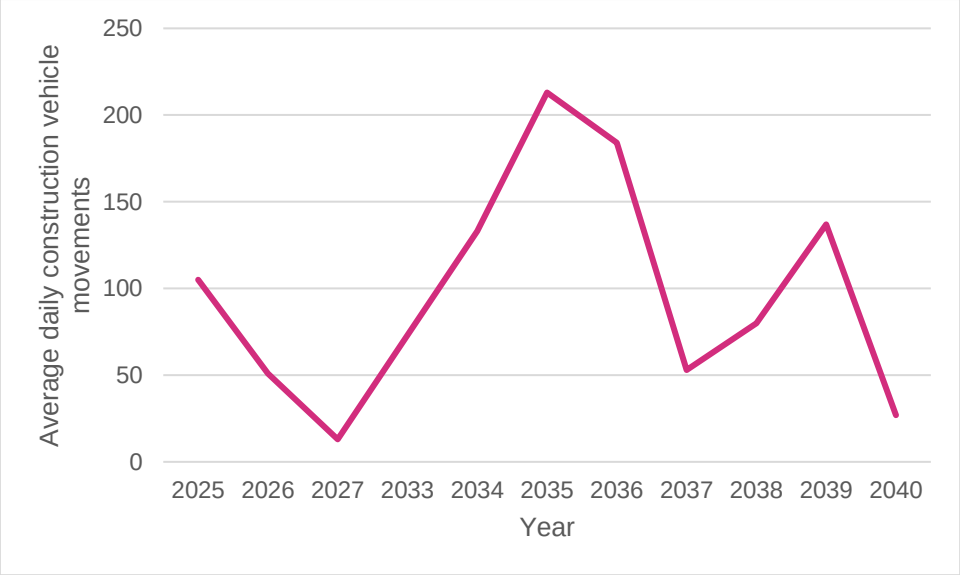
3.7.65 Working hours will be from 08:00 to 18:00 on weekdays (excluding bank holidays) and from 08:00 to 13:00 on Saturdays. This has been included in the modelling.

3.7.66 A summary of the construction traffic data assessed in provided in **Table 3.22**. The total average daily traffic flow predicted as a result of the construction phase is shown in **Inset 3.5**.

Table 3.22: Summary of total construction traffic assessed

Assessment scenario	Peak construction year	AADT	HDV%
Phase 1 (2027 DS)	2025	105	83.0
Phase 2a (2039 DS)	2035	213	73.0
Phase 2b (2043 DS)	2040	137	73.0

Inset 3.5: Construction traffic movements



3.7.67 The primary access route taken by construction traffic is assumed to use Percival Way or the Airport Access Road (AAR) when it is available. The route taken by all deliveries and operatives is assumed to come directly from the M1 (split 50 percent north and south of Junction 10 of the M1) and travel on the A1081 to the airport. This route was assumed for all construction traffic. The full route is shown in **Figure 7.31** of this ES **[TR020001/APP/5.03]**.

Ammonia Emission

3.7.68 National Highways have developed a tool to account for the additional contribution of ammonia (NH_3) emissions from vehicles to deposited nitrogen (Ref. 25). This has been used to determine the nitrogen deposition at designated ecological sites assessed.

Car Parks

3.7.69 Information on the number of spaces per car park (existing and future) were provided by the design team. Information provided by LLAOL (email, May 2019) set out the number of movements for the existing car parks. Future movements were calculated on the same use per space ratio as calculated for the existing car parks.

3.7.70 Emissions were calculated in accordance with the Cambridge Environmental Research Consultants (CERC) note on modelling car parks (Ref. 26).

3.7.71 Emission factors for vehicles were taken from the latest Defra's EFT, while cold start emissions were taken from the NAEI. The percentage of pNO_2 emissions was also taken from the NAEI, for the relevant years. A speed of 5kph was assumed in all car parks.

3.7.72 The car parks are represented in the model as areas for surface car parks and volumes for multi-storey car parks. **Table 3.23** shows the details of the car parks modelled, spaces and movements for each modelled year. The locations of the areas and volumes representing the car parks is shown in **Figure 7.33** to **Figure 7.36** of this ES **[TR020001/APP/5.03]**.

Table 3.23: Modelled car parks

ID	Name	Spaces				Daily movements			
		2019 and DM	2027	2039	2043	2019 and DM	2027	2039	2043
1	Long stay existing	4,205	-	0	0	839	-	-	-
2	Car Hire existing 1	650	-	-	-	270	-	-	-
3	TUI existing	500	500	-	-	577	577	-	-
4	Staff overflow	320	310	-	-	133	310	-	-
5	MSCP 1 existing	1,699	-	-	-	1,960	-	-	-
6	Mid stay existing	2,350	-	-	-	978	-	-	-
7	EasyJet	850	-	-	-	981	-	-	-
8	Vauxhall 1	1,050	-	-	-	210	-	-	-
9	Vauxhall 2	570	-	-	-	114	-	-	-
10	Existing small 1	310	310	310	310	358	358	358	358
11	Existing small 2	370	370	370	370	426	426	426	426
12	Existing small 3	195	195	195	195	225	225	225	225

ID	Name	Spaces				Daily movements			
		2019 and DM	2027	2039	2043	2019 and DM	2027	2039	2043
13	Existing small 4	148	148	148	148	171	171	171	171
14	Existing small 5	109	109	109	109	126	126	126	126
15	ATC/staff	130	130	130	130	150	150	150	150
16	Existing small 6	168	168	168	168	194	194	194	194
P1	MSCP (tiered)	-	-	1,084	1,108	-	-	1,250	1,279
P2	Surface parking (trailer)	-	-	488	499	-	-	563	575
P3	Block parking (mid-stay)	-	1,858	1,842	1,884	-	773	766	784
P4	MSCP	-	4,058	4,024	4,117	-	4,682	4,643	4,749
P5	Deck surface parking	-	2,677	1,300	1,330	-	3,089	1,500	1,535
P6	Block parking	-	1,366	1,755	-	-	1,576	2,025	-
P7	Surface parking	-	3,376	1,333	-	-	3,895	1,538	-
P8	Surface parking	-	-	650	-	-	-	750	-
P9	Deck and surface parking	-	2,060	1,300	1,330	-	2,376	1,500	1,535
P10	Surface parking	-	-	1,246	3,508	-	-	1,438	4,047
P11	Block parking	-	-	2,926	5,930	-	-	3,375	6,842
P12	MSCP	-	-	-	2,394	-	-	-	2,762
P13	Surface parking	-	929	921	942	-	1,072	1,063	1,087

NRMM and Concrete Batching Plant

3.7.73 Information on the Non-Road Mobile Machinery (NRMM) equipment predicted to be used was provided in the Construction Method Statement and Programme Report provided as **Appendix 4.1** of the ES **[TR020001/APP/5.02]**. **Table 3.24** provides a summary of the NRMM usage through the stages. The NRMM were assumed to operate for 8 hours for each day, which is considered conservative, as not all plant would be expected to be operating throughout the day. The NRMM were assumed to meet Euro Stage V emission standards, which is

considered a conservative assumption for future construction. The emission rates were identified based on Euro Stage V standards and the power output predicted for the type of NRMM. The emissions calculated from the number of machine days (operating days) were spread across the construction years for each phase. The percentage pNO_2 emissions was assumed to be the same as for a Euro 5 diesel car (16%), taken from the NAEI.

3.7.74 The Construction Method Statement and Programme Report indicates that a concrete batching plant would be considered. To provide a conservative assessment, it was assumed that a concrete batching plant would operate throughout the different construction phases for 22 working days per month, 8 hours per day, following the information in the Construction Method Statement and Programme Report. The concrete batching plant was assumed to be powered by a 500kW diesel generator. The technical specification of Cummins 500kW diesel engine (QSX15-G8) was used as an assumption for the generator powering the concrete batching plant, as a generic generator for that size. The emission for the Cummins diesel engine were used to estimate emissions.

3.7.75 The emissions were assumed to be spread across the work areas around the Proposed Development. **Figure 7.37** of this ES **[TR020001/APP/5.03]** shows the area sources used in the modelling to represent the work areas.

Table 3.24: Summary of NRMM equipment predicted

NRMM Vehicle Type	Fuel Type	Power Output (kW)	Total Number of Machine Days on Site (per assessment phase)		
			Phase 1	Phase 2a	Phase 2b
360-hydraulic excavators (40T)	diesel	235	400	5,356	2,582
360-hydraulic excavators (20T)	diesel	234	5,038	13,659	12,429
360-hydraulic long reach excavators	diesel	234	258	1,162	516
Crusher	diesel	315	0	387	0
Rigid Heavy Goods Vehicles (HGV)	diesel	239	10,338	35,040	24,860
All terrain articulated dumper (40T)	diesel	350	9,701	21,555	20,463

NRMM Vehicle Type	Fuel Type	Power Output (kW)	Total Number of Machine Days on Site (per assessment phase)		
			Phase 1	Phase 2a	Phase 2b
Dumper (9T)	diesel	55	9,701	21,555	10,576
GPS Bulldozer	diesel	126	2,075	5,043	4,901
Soil stabiliser	diesel	126	329	968	903
Roller	diesel	95	2,264	4,871	4,600
Compressors	diesel	95	6,064	18,758	15,398
Concrete Paving Machine	diesel	140	589	516	989
Asphalt paving machine	diesel	140	1,776	2,860	2,449
Roller	diesel	95	520	774	516
Telehandler Forklift	diesel	129	5,118	14,928	10,492
Tower Cranes	electric		520	4,950	1,808
Mobile Truck Mounted concrete pump	diesel	129	1,040	7,444	3,616
Concrete mixer truck	diesel	125	5,560	15,378	13,504
Mobile Cranes (100T)	diesel	370	1,103	7,444	4,777
General waste skips	diesel	238	9,251	33,157	21,075
Vans	diesel	142	4,520	11,700	9,718
Cars	petrol	142	8,652	19,892	17,112
Access equipment (cherry pickers / MEWPs)	diesel	53	2,600	34,124	15,500

3.8 Model setup and verification

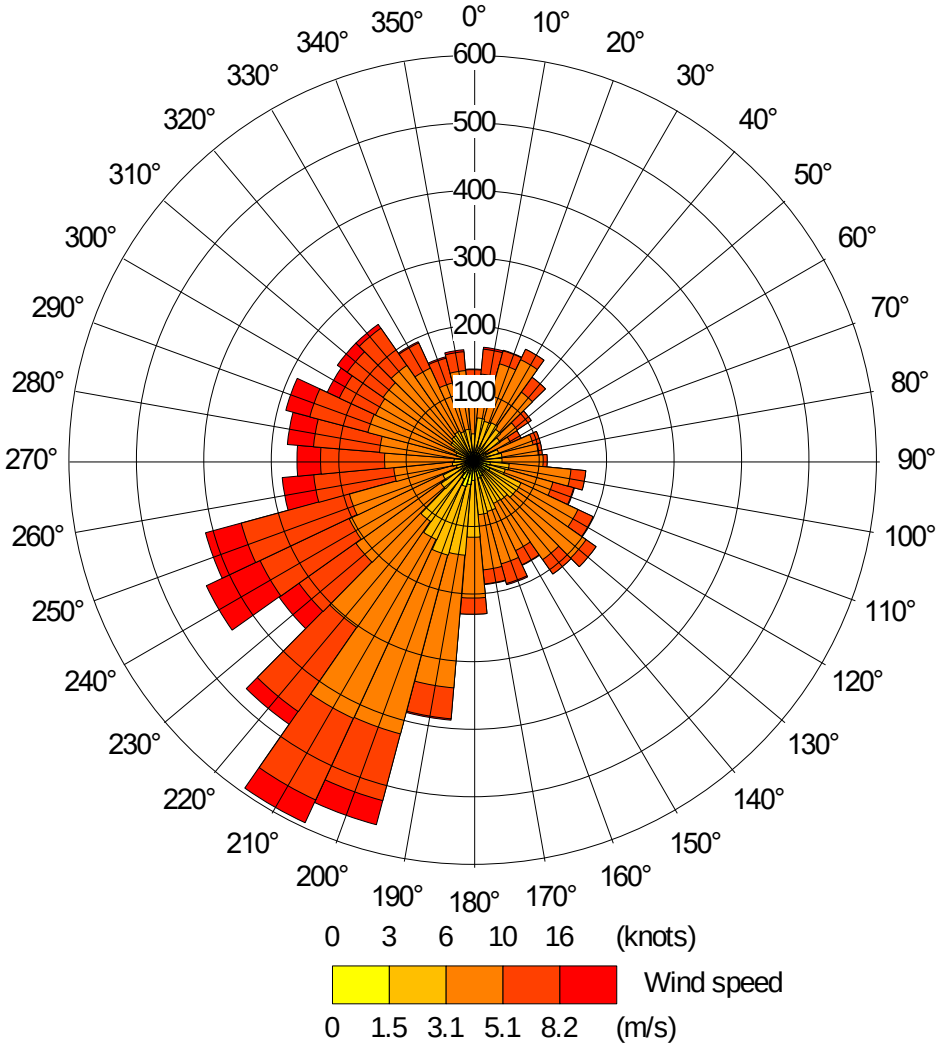
Meteorological Data

3.8.1 The effect of meteorological conditions on dispersion is accounted for in the dispersion model. The meteorological data site considered to be most representative of conditions across the study area was the data recorded at the airport. Data from this site was obtained (Ref. 27) in model-ready format for one year (2019).

3.8.2 Most dispersion models of roads do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. Defra LAQM TG(22) guidance states that the meteorological data file is tested in a dispersion model and the relevant output log file checked to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. The guidance recommends that meteorological data should only be used if the percentage of usable hours is greater than 75% and preferably greater than 90%.

3.8.3 The meteorological data selected from the Application Site includes more than 95% of usable data. This is above the 90% threshold and this data therefore meets the requirement of the Defra guidance. The wind rose shown in **Inset 3.6** identifies the predominant wind direction as south-westerly.

Inset 3.6: The airport 2019 wind rose



Other Parameters

3.8.4 The extent of mechanical turbulence (and hence mixing) in the atmosphere is affected by the surface/ground over which the air is passing. Typical surface roughness values range from 0.0001m (for water or sandy deserts) to 1.5m (for cities, forests and industrial areas). In this assessment, a surface roughness of 1m was applied to the study area and 1m to the meteorological site at the airport.

3.8.5 Another model parameter is the minimum Monin-Obukhov length, which describes the minimum level of turbulence in the atmosphere, which is limited due to the urban heat island effect. Typical values range from 1m to 10m for rural and sparsely populated areas. In urban area, where traffic and buildings cause the generation and/or retention of more heat, these values are higher. In this assessment, a minimum length of 30m was used to represent an urban area. These values are considered suitable for the assessment area.

NOx to NO_2 Conversion

3.8.6 The model predicts roadside NOx concentrations, which comprise principally nitric oxide (NO) and primary NO_2 (i.e. NO_2 that is emitted directly from the aircraft or vehicle exhaust). The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO_2 (known as secondary NO_2). Since only NO_2 has been associated with effects on human health, the air quality standards for the protection of human health are based on NO_2 rather than NOx or NO. Thus, a suitable NOx to NO_2 conversion needs to be applied to the modelled NOx concentrations.

3.8.7 The method taken for this conversion in the assessment follows the approach described by Clapp and Jenkin (Ref. 28), which takes account of the proportion of primary NO_2 in the balance between NO and NO_2 and derives total NO_2 concentrations as a function of distance from major sources. The method requires a value for the regional background oxidant, which was taken to be 33.5ppb in 2008 and was projected to increase by +0.1ppb/year for future years, i.e. 34.6ppb in 2019.

3.8.8 Defra provide a NOx to NO_2 calculator which is used primarily for the conversion of modelled road NOx emission to NO_2. The Clapp and Jenkin approach allows different percentages of pNO_2 to be assumed depending on the source type, which is considered appropriate for this assessment which includes many other sources than just roads. However, as mentioned in **Section 3.6**, a modelling sensitivity test was undertaken using the Defra calculator for comparison and the results are provided in **Appendix 7.4** of this ES **[TR020001/APP/5.02]**.

Terrain

3.8.9 Terrain effects may play a role in the dispersion of pollutants in this geographic area. The Application Site is located on a plateau southeast of Luton town centre. However, the ADMS model is not able to model aircraft jet sources with complex terrain. Terrain data has been obtained from the Ordinance Survey (OS) and shown in **Figure 7.38 [TR020001/APP/5.03]**. Although complex terrain has not been included, large scale terrain effects are captured by the meteorological data used.

Model Verification

3.8.10 A comparison of modelled and measured NO_2 concentrations has been undertaken. This process is known as model verification. Verification has been undertaken for the base year, using the in LAQM TG(22) (Ref. 23). Additional receptor points have been included in the baseline modelling to represent the location of diffusion tube sites within 200m of the ARN to provide information for the verification exercise.

3.8.11 The objectives of the model verification are to evaluate model performance, determine whether model adjustment is required, and to provide confidence in the assessment.

3.8.12 LAQM TG(22) suggests that if modelled annual mean NO_2 concentrations are within ±25% and preferably within ±10% of the monitored concentration and there is no systematic under or over prediction, then model adjustment is not considered necessary to further improve modelled results.

3.8.13 Modelled and monitored results may not compare well at some locations for several reasons including:

a. uncertainties in estimated traffic flow and speed data;
b. model setup (including street canyons, road widths, receptor locations);
c. model limitations (treatment of roughness and meteorological data);
d. uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data); and
e. uncertainty in emissions/emission factors.

3.8.14 The above factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable.

3.8.15 Some monitoring locations are not suitable for model verification purposes as there may be specific local influences or they may be located too close to the road, in which case LAQM TG(22) advises they should not be used. Therefore, each site was examined and it was considered whether it was suitable for use in the verification study. The criteria used to determine the suitability of the monitoring data for inclusion into the verification process is outlined below:

a. monitoring location was required to be within 200m of a road in the study area;
b. monitoring data influenced by major road emissions sources which were missing from the traffic model, and hence could not be included in the dispersion model was excluded; and
c. monitoring data from sites where the exact location could not be accurately identified or validated was excluded.

3.8.16 Some locations were then removed from the verification. For those monitoring sites not used, the justification for their removal is provided in **Appendix 7.2** of this ES **[TR020001/APP/5.02]**.

3.8.17 The outcome of the model verification exercise is reported in **Appendix 7.2** of this ES **[TR020001/APP/5.02]**.

4 SIGNIFICANCE CRITERIA

4.1 Assessment of impacts at human receptors

4.1.1 For the assessment of long-term impacts and significance at sensitive human receptors, the approach described in the EPUK/IAQM guidance (Ref. 29) is used. This is best practice for undertaking air quality assessments.

4.1.2 Impact descriptors are determined based on the magnitude of incremental change in pollutant concentrations as a proportion of the relevant assessment

level; in this instance the air quality standards. The change is then examined in relation to the predicted total pollutant concentrations in the assessment year and its relationship with the relevant air quality standard (**Table 4.1**).

Table 4.1: EPUK/IAQM impact descriptors

% Change in concentrations relative to air quality standard		Predicted concentration relative to air quality standard				
		Very High	High	Medium	Low	Very low
		>110%	103-109%	95-102%	76-94%	<75%
High	>10%	Substantial	Substantial	Substantial	Moderate	Moderate
Medium	6-10%	Substantial	Substantial	Moderate	Moderate	Slight
Low	2-5%	Substantial	Moderate	Moderate	Slight	Negligible
Very low	1%	Moderate	Moderate	Slight	Negligible	Negligible

4.1.3 Slight and substantial impacts from the EPUK/IAQM guidance are considered equivalent to 'minor' and 'major' respectively for this assessment. The resulting impact descriptors at each of the assessed receptors are then used in combination with other considerations, to make a professional judgement on the overall significance of effects from the Proposed Development. In the assessment, '**substantial'** or '**moderate'** impacts are usually judged to result in **significant effects** in the absence of additional factors, and '**slight** or '**negligible'** impacts usually result in effects which are **not significant**.

4.1.4 The impact descriptors at each of the assessed receptors can then be used as a starting point to make a judgement on the overall significance of effect of a proposed development, however other influences would also need to be considered, such as:

a. the existing and future air quality in the absence of the development;
b. the extent of current and future population exposure to the impacts; and
c. the influence and validity of any assumptions adopted when undertaking the prediction of impacts.

4.1.5 Professional judgement should be used to determine the overall significance of effect of the Proposed Development, however in circumstances where the Proposed Development can be judged in isolation, it is likely that a '**moderate'** or '**substantial'** impact will give rise to a **significant** effect and a '**negligible'** or '**slight'** impact will result in an effect which is **not significant**.

4.1.6 With regards to the short term NO_2 standard, LAQM TG(22) discusses the relationship between annual mean and hourly mean NO_2 concentrations. It is considered that where annual mean NO_2 concentrations are lower than 60µg/m^3, it is unlikely that the hourly mean NO_2 standard will be exceeded.

4.2 Assessment of impacts at ecological receptors

4.2.1 For the assessment of impacts and significance at the local sensitive ecological receptors identified within 2km of the Proposed Development and 200m of the ARN, the methodology for this assessment follows the IAQM and Natural

England guidance documents (Ref. 30) (Ref. 31). Information on sensitive habitats for the designated sites has been taken from the APIS website (Ref. 15) in consultation with the Project ecologists.

4.2.2 Annual mean NOx concentrations were predicted and compared against the long-term air quality standard (30 µg/m^3).

4.2.3 For ecological sites, where NOx concentrations are predicted to be below the air quality standard, no significant effects would be anticipated. For those sites where NOx concentrations are predicted to be above the air quality standard, then a judgment of significance, by an ecologist, can be made once an assessment of nitrogen deposition has been undertaken for the site.

4.2.4 A further assessment has therefore been undertaken for ecological receptors to predict the change in nitrogen deposition as a result of the Proposed Development for those receptors at which NOx concentrations are above the air quality standard of 30 µg/m^3.

4.2.5 Ammonia emissions from road traffic can also affect the nitrogen deposition at ecological sites. There is no guidance currently on the assessment of ammonia emissions and there are no government assessment tools. National Highways have developed a tool to account for the additional contribution of ammonia (NH_3) emissions from vehicles to deposited nitrogen (Ref. 25). This has been used to determine the nitrogen deposition contribution from road vehicle ammonia emissions at designated ecological sites assessed. Ammonia is only emitted from road vehicles as a by-product of the diesel engine gas treatment; it is not emitted from aircraft engines.

4.2.6 For an assessment of nitrogen deposition, NOx has first been converted to NO_2 using the Clapp and Jenkin approach (Ref. 28), and then the nitrogen deposition rate has been calculated as follows:

a. NO_2 concentrations (µg/m^3) were multiplied by the relevant deposition velocity (0.0015 m/s for grassland and 0.003 m/s for forest habitats);
b. the resulting value (µg NO_2/m^2/s) was converted to kg N/ha/yr using a factor of 96 (i.e. converting from NO_2 to nitrogen using the molecular mass); and
c. the nitrogen contribution calculated from road vehicle ammonia emissions (using the National Highways tool) was also added to get the total nitrogen deposition.

4.2.7 Where the long-term process contribution (PC) (the predicted change in concentrations of nitrogen deposition due to the Proposed Development) is predicted to be less than one per cent of the long-term environmental standard (this is the critical load in the case of assessing nitrogen deposition for ecological sites) then no significant effects would be anticipated (Ref. 30) (Ref. 31).

4.2.8 These calculations were carried out for the baseline and future year assessment scenarios at sensitive receptor locations at the designated ecological sites in the study area. The resulting change in nitrogen

deposition due to the Proposed Development was compared against the lower critical level for each ecological site as a precautionary measure.

4.2.9 Sulphur emissions from road vehicles, aircraft engines and other airport sources would not significantly affect the acidity at the ecological sites, therefore acidity has not been assessed with regards to sulphur. The short-term guideline for 24-hour NOx concentrations has also not been assessed since the long-term critical loads are the key determinants of impact on the ecological sites.

5 ODOUR IMPACT METHODOLOGY

5.1.1 Odour is a mix of volatile chemical compounds (or a single compound) that triggers a reaction in the nose. As the nose is very sensitive it often only requires very low concentrations to trigger this reaction. Any odour, whether considered to be pleasant or unpleasant, can result in a loss of amenity for occupiers of property if it is unwanted. However, as noted in the Defra Odour Guidance for Local Authorities (Ref. 32) when exposed to odour that are perceived to be unwanted these cause occupants of the area to have a "negative appraisal" of their environment. They cope with this stress in several ways, for instance, by changing behaviour, complaining or seeking distractions from the odour source.

5.1.2 Several factors determine whether an odour is perceived by an individual as unpleasant, the Defra guidance notes the following as important:

a. offensiveness of the odour;
b. intensity of the odour;
c. duration of exposure;
d. frequency of exposure; and
e. tolerance and expectation of the exposed subjects.

5.1.3 Odour concentrations are reported as European Odour Units per cubic metre (ou_E/m^3). One ou_E/m^3 is the concentration at which 50% of an odour sampling panel can detect the odour. To measure the odour concentration, a sample is presented to an "odour panel" at various dilutions until only 50% of the panel can detect the odour. If the odour sample has had to be diluted by a factor of 10 then the original sample is considered to have an odour concentration of 10 ou_E/m^3.

5.1.4 There is no relevant guidance for assessment of odours in an internal environment, however, the IAQM guidance on Odours (Ref. 33) does recommend that where detailed modelling is not possible a semi-quantitative assessment is carried out using different assessment methods such as using the Source, Pathway, Receptor (SPR) model and sniff testing. As such this assessment uses both approaches and complaints data has been used to inform the assessment along with feedback received during consultation.

5.2 Source pathway receptor assessment

5.2.1 The SPR approach examines each of the three factors for each potential odour source and receptor and then determines the risk of adverse odour impacts. This approach is largely for planning purposes where a new odorous process is proposed near to sensitive receptors (or vice versa). It is considered relevant to this assessment to review the potential change in odour as a result of the Proposed Development.

5.2.2 The IAQM guidance (Ref. 33) suggests that the following factors are considered for the SPR as shown in **Table 5.1**. This approach has been used for the assessment of baseline and future operations at the airport.

Table 5.1: Risk Factors for SPR Approach

Source Odour Potential	Pathway Effectiveness	Receptor
Factors affecting the source odour potential include: • The magnitude of the odour release; • How inherently odorous the materials are; • The unpleasantness (or offensiveness) of the odour.	Factors affecting the odour flux to the receptor are: • Distance from source to receptor; • Frequency of winds from the source to receptor (not relevant for internal odour sources); • The effectiveness of any mitigation/control to reduce the odour flux to the receptor; • Topography and terrain.	Some receptors are more sensitive, this is largely determined by the expectations for the area.

5.2.3 This assessment is not a prediction of what will actually occur during the operational life of the Proposed Development but the potential for occurrences. Furthermore, an occurrence does not mean that any of the receptors will experience an effect or that this will give rise to a complaint.

5.2.4 Typically, the greatest potential for adverse odour to occur is during periods of stable atmospheric conditions with calm or low wind speeds, generally when wind speeds are less than 3m/s. This reduces dilution and mixing of odours with ambient air and results in higher odour concentrations at receptor locations. In addition, as noted during sniff testing gusty conditions with wind blowing across the airport was noted as having potential to result in distinct odour from the airport being detected. Therefore, the percentage of time when high wind speeds over 9m/s occur has also been accounted for in the pathway effectiveness.

5.2.5 There are no prescribed distance criteria in relation to odour emissions. Therefore, the following distance spans, based on distance from the potential odour to receptors have been used to define the effectiveness of the pathway:

a. Receptors within 200m of the source.

b. Receptors 200m – 500m from the source.

c. Receptors 500m – 1km from the source.

5.2.6 The percentage that the wind is blowing from the airport towards the receptor, with a speed of less than 3m/s and more than 9m/s, has been calculated. A 45˚ range of wind directions centred on the identified receptor has been used to ensure that a spatial extent of the airport was captured and takes into account the uncertainty of the measured wind directions and the plume width from the source.

5.2.7 This calculation used five years of meteorological data from London Luton Airport. From this calculation and the distance between the source and nearest identified receptor, the pathway effectiveness has been calculated.

5.2.8 **Table 5.2** and **Table 5.3** present the matrices extracted from the IAQM guidance (Ref. 33), which show the interaction between the source potential, odour pathway and sensitivity of receptors to derive the magnitude of risk of odour exposure. This has been used to determine the significance of any odour affects sensitive receptors.

Qualitative odour assessment

5.2.9 The initial step in the assessment is to estimate the odour generating potential of the activity, considering the magnitude of the release, how inherently odorous it is, and the relative unpleasantness of the emission. The “pathway effectiveness” is then determined, by considering the distance from the source, the frequency of exposure considering prevailing winds where appropriate, the likely effectiveness of dispersion and terrain between the emission point and receptor location.

Table 5.2: Risk of Odour Exposure at a Specific Receptor Location

Pathway Effectiveness	Source Odour Potential		
	Small	Medium	Large
Highly Effective	Low Risk	Medium Risk	High Risk
Moderately Effective	Negligible Risk	Low Risk	Medium Risk
Ineffective	Negligible Risk	Negligible Risk	Low Risk

5.2.10 Finally, a judgement on the significance of the effect on receptors is then made. The matrix in **Table 5.3** describes the general relationship between the risk of odour exposure (impact) experienced by a receptor for a given sensitivity and the magnitude of adverse effect that is likely to result.

Table 5.3: Likely Magnitude of Odour Effect at a Specific Receptor Location

Risk of Odour Exposure	Receptor Sensitivity		
	Low	Medium	High
High	Slight adverse	Moderate adverse	Substantial adverse
Medium	Negligible	Slight adverse	Moderate adverse

Low	Negligible	Negligible	Slight adverse
Negligible	Negligible	Negligible	Negligible

5.2.11 If the overall effect is described as **moderate or substantial**, the effect is considered to be **significant**.

5.2.12 This does not mean that the potential odour activities are unacceptable, rather it is an indication that careful consideration should be given to the consequences of the emissions and the scope for mitigation measures that should be brought forward.

5.2.13 Where the overall effect is judged to be **slight adverse or negligible**, this would be considered to be **not significant**.

5.3 Sniff testing

5.3.1 It is difficult to quantify odour objectively if it is due to a mixture of substances. For this reason, “sniff testing”, or “field odour surveying” is the most common form of odour monitoring.

5.3.2 The magnitude of the effect is determined by scale of exposure (FIDO), and the sensitivity of receptor (Location). These factors are described by the Institute of Air Quality Management (IAQM) Guidance on the assessment of odour for planning (Ref. 33) as:

a. *‘Frequency – how often an individual is exposed to odour;*
b. *Intensity – the individual’s perception of the strength of the odour;*
c. *Duration – the overall duration that individuals are exposed to an odour over time;*
d. *Odour unpleasantness – odour unpleasantness describes the character of an odour as it relates to the ‘hedonic tone’ (which may be pleasant, neutral or unpleasant) at a given odour concentration/intensity. This can be measured in the laboratory as the hedonic tone, and when measured by the standard method and expressed on a standard nine-point scale it is termed the hedonic score; and*
e. *Location – the type of land use and nature of human activities in the vicinity of an odour source. Tolerance and expectation of the receptor. The ‘Location’ factor can be considered to encompass the receptor characteristics, receptor sensitivity, and socio-economic factors.’*

5.3.3 In Europe, Australia and New Zealand, the subjective sniff test is widely used, in which the assessor allocates the intensity of the environmental odour against a numerical scale linked to a qualitative description such as “not perceptible”, “weak”, “strong” etc. There is currently no UK national standard method for subjective sniff test.

5.3.4 The IAQM guidance on the assessment of odour for planning (Ref. 33) outlines the odour intensity and offensiveness scale used for the sniff test surveys undertaken as part of this assessment as shown in **Table 5.4**.

Table 5.4: Odour intensity and offensiveness descriptors

Intensity scale		Offensiveness	
Score	**Intensity**	**Score**	**Perceived hedonic tone**
0	No odour	+4	Very pleasant
1	Very faint odour	+3	Pleasant
2	Faint odour	+2	Moderately pleasant
3	Distinct odour	+1	Mildly pleasant
4	Strong odour	0	Neutral / no odour
5	Very strong odour	-1	Mildly unpleasant
6	Extremely strong odour	-2	Moderately unpleasant
		-3	Unpleasant
		-4	Very unpleasant

5.3.5 The main principles of the sensory assessment are described in the sub-sections below.

Step 1 - Conduct sniff testing

5.3.6 The described sniff test technique was used to gather information on odour intensity, character, unpleasantness, frequency, and duration at the test locations of interest according to the procedure outlined by IAQM (Ref. 33).

5.3.7 The sensory test was carried out at each test location over a standard observation time, typically five minutes. Testing started from locations affected by the least-intense odours, to avoid olfactory fatigue. For each test location, the start time of the observation period and the attributes of the odour over the observation period were recorded as follows:

a. The assessor breathes normally, inhaling ambient air samples through the nose at regular intervals (i.e., every 10 seconds, to give 30 samples over typically a five-minute observation period). However, where the odour levels are either constant or intense then the odour assessor should avoid olfactory fatigue / desensitisation by alternating each sample sniff of ambient air with a sniff of odour-free air;

b. For each sample, the odour intensity, measured using the German method of Verein Deutscher Ingenieure standards (VDI scale, 0-6), is recorded (**Table 5.4**);

c. At the end of the observation period at the test location, the odour unpleasantness is noted down by classifying it as unpleasant, neutral (neither pleasant nor unpleasant) or pleasant. This assumes that at least some of the 30 samples were of intensity ‘3’ or more (“i.e., the odour is at least “barely recognisable”);

d. The odour descriptor should also note odours can be objectively described using standardised categories and reference vocabulary. It is

useful to provide odour assessors with standard descriptor terms, which are organised with similar terms in categories and groups either as a list or as an “odour wheel”;

e. Next the pervasiveness / extent of the odour at this test location is assessed. This can be calculated as the percentage odour time, tI$\geqslant$4, which is the number of samples where odour was recognisable divided by the total number of samples (i.e. 30). Note that “recognisable odour” is where the odour strength exceeds the recognition threshold and is definitely recognisable by the assessor, i.e., the assessor is capable of definitely identifying its quality/character, which corresponds to VDI intensity of four or more; and

f. The average odour intensity, I-mean, over the test period is calculated and the maximum intensity observed is noted.

5.3.8 The above procedure was then repeated at the next test location, remembering that the character of an odour mixture can change over distance, as the particular components may become diluted below their individual detection thresholds at different distances.

5.3.9 Sniff testing was undertaken on fourteen separate dates (from July 2021 to September 2022). Weather forecasts were consulted prior to the surveys to ensure sniff tests were carried out under appropriate weather conditions; for instance, wind directions, wind speed, amount of rainfall prior to the surveys and temperatures were considered to avoid periods of high wind speeds or heavy rainfall.

5.3.10 In accordance with the EA's H4 Guidance (Ref. 34) the assessors did not have a poor sense of smell, suffer from olfactory fatigue or have a cold, sinusitis or sore throat prior to the assessment. In addition, the assessors avoided strongly scented toiletries such as perfume/aftershave and refrained from consuming food or drinks (except water) for at least half an hour before undertaking each survey.

5.3.11 Wind speed and direction were observed by the assessors throughout the survey periods and recorded. This allows subsequent analysis and identification of potential sources of emissions to be undertaken. The following additional information at each monitoring location was recorded:

a. location of test;

b. weather conditions, such as cloud cover, wind speed and wind direction;

c. temperature;

d. the character of the odour, including the intensity and a description of the odour;

e. whether any odour was constant or intermittent;

f. receptor sensitivity;

g. the likely source of the odour;

h. any other comments or observations; and

i. identification of any external activities, such as agricultural practices, that could be either the source, a contributor to, or a confounding factor in a particular odour event.

Sniff test locations

5.3.12 All field odour survey forms completed during the survey are contained in **Appendix 7.2** of this ES **[TR020001/APP/5.02]**. **Table 5.5** presents the sniff test locations. Locations were selected at publicly accessible locations around the airport. The sniff test locations are presented in **Figure 7.39 [TR020001/APP/5.03]**.

Table 5.5: Sniff testing locations

Location ID	Location description	OS Grid reference	
		X	Y
1	Near ASDA Superstore car park	511962	222457
2	Wigmore Valley Park	512466	222138
3	Near Someries Castle	511966	220217
4	Winch Hill	513773	221752
5	Vauxhall Way	511057	221386
6	Luton Parkway Station Exit (North)	510552	220660

Step 2 - Estimate odour exposure at the test location

5.3.13 The results have been interpreted to assess the odour impact at the time and place of sampling. Odours may occur frequently in short bursts (known as 'acute' exposures), or for longer periods ('chronic' exposures). **Table 5.6** shows how the intensity, frequency and duration can be considered together. The relative unpleasantness of an odour is highly subjective. As what may be odorous for one person may not be deemed as odorous by another person.

Table 5.6: Matrix to Assess the Odour Exposure (Neutral and Unpleasant Odours) at Time and Place of Sampling

Average Intensity (Imean)	Percentage Odour Time (TI≥4) During Test				
	≤10%	11-20%	21-30%	31-40%	≥41%
6	Large	Very Large	Very Large	Very Large	Very Large
5	Medium	Large	Large	Very Large	Very Large
4	Small	Medium	Medium	Large	Large
3	Small	Medium	Medium	Medium	Medium
2	Small	Small	Medium	Medium	Medium
1	Small	Small	Small	N/A	N/A
Notes: Imean is rounded to the nearest whole number					

Average Intensity (Imean)	Percentage Odour Time (TI≥4) During Test				
	≤10%	11-20%	21-30%	31-40%	≥41%
The following over riding considerations affect the scoring of the odour annoyance impact: if I-mean = 0, then the odour effect can for practical purposes be considered negligible; and if I-mean = 1 but tI≥4 = 0%, then the odour effect can for practical purposes be considered negligible.					

Step 3 - Bring together the results to judge odour effect

5.3.14 **Table 5.7** provides guidance on how to consider the overall odour exposure (impact) in conjunction with the sensitivity of receptors (see **Table 5.8**), in order to gauge the effect.

Table 5.7: Matrix to Assess the Odour Effect at Individual Receptors

Overall Odour Exposure	Receptor Sensitivity		
	Low	Medium	High
Very Large	Substantial adverse	Substantial adverse	Substantial adverse
Large	Moderate adverse	Moderate adverse	Substantial adverse
Medium	Slight adverse	Slight adverse	Moderate adverse
Small	Negligible	Negligible	Slight adverse

5.3.15 The frequency of an odour episode occurring is thought to be as important as the magnitude of the individual odours. The real challenge is to combine the resulting probability of impact with the sensitivity of the receptor to gauge the effect that is taking place.

5.3.16 It is expected that certain meteorological conditions with greater wind speeds would allow for more rapid dispersal of odour emissions from the source, whilst periods of lower wind speeds could give rise to a stronger odour intensity / exposure. This variation is not captured by the single sniff test at each location. This has been considered when interpreting the results. **Table 5.8** is sourced from the IAQM odour guidance (Ref. 33), and it describes the factors influencing sensitivity of receptors to odours. In this case, there are likely to be people present continuously or regularly for extended periods as part of normal use of the space. Residential dwellings are locations where enjoyment of a high level of amenity would be expected and can therefore be considered highly sensitive to odour impacts.

Table 5.8: Receptor Sensitivity to Odours

Receptor Sensitivity	Description of Sensitivity
High Sensitivity Receptor	Surrounding land where: Users can reasonably expect enjoyment of a high level of amenity; and

Receptor Sensitivity	Description of Sensitivity
	People would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Examples may include residential dwellings, hospitals, schools/education and tourist/cultural.
Medium Sensitivity Receptor	Surrounding land where: Users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or People wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low Sensitivity Receptor	Surrounding land where: The enjoyment of amenity would not reasonably be expected; or There is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples may include industrial use, farms, footpaths and roads.

6 HEALTH IMPACT ASSESSMENT METHODOLOGY

6.1.1 The air quality modelling methodology detailed in this document has been used to determine the change in pollutant concentrations at all relevant human receptor locations in the study area. These results are used to calculate a total population-weighted average concentrations (PWAC) for each scenario, which is used in the health assessment reported in **Chapter 13** of the ES **[TR020001/APP/5.01]**. The details of the health assessment methodology, with regards to the air quality related effects, is detailed in **Appendix 13.4** of this ES **[TR020001/APP/5.02]**. The PWAC results are considered in the health assessment in **Chapter 13** of this ES **[TR020001/APP/5.01]**.

7 ASSUMPTIONS AND LIMITATIONS

Table 7.1: Summary of assumptions and limitations

Source	Assumptions and limitations
Fixed wing aircraft	Emissions of pNO_2 were derived using the fractions described in the Project for the Sustainable Development of Heathrow (PSDH) (Ref. 17) air quality methodology; these were 4.5% pNO_2 at 100% thrust, 5.3% at 85% thrust, 15% at 30% thrust and 37.5% at 7% thrust. For intermediate thrust settings, the pNO_2 fractions were derived linearly.
Fixed wing aircraft	Emissions of PM_{10} were derived from the smoke number, fuel flow and hydrocarbon emission indices following the methodology described in the International Civil Aviation Organization (ICAO) airport air quality manual (Ref. 8). For turboprop engines, smoke number indices are not available in the FOI database, therefore, it was assumed that PM_{10} emissions were the same as those for Cessna Citation Mustang (engine PW615F) in the small business jet modelling category 2 (MCAT 2). The Cessna Citation Mustang is considered to the competitor of the Beechcraft King Air 200.
Fixed wing aircraft	The proportion of PM_{10} assumed to be $PM_{2.5}$ was: Brake wear: 40% Tyre wear: 70% Other aircraft sources: 100%
Fixed wing aircraft	The thrust settings for the LTO modes were assumed to be the following: Upper approach 15%, recommended by PSDH methodology; Final approach 30%, recommended by ICAO; Landing 7%, recommended by LLAOL; Taxiing and hold 7%, recommended by ICAO; Take-off 85%, different to ICAO of 100%, but is the value used in recent airport emissions inventories of major UK airports; Initial climb 85%, recommended by ICAO; and Climb out 78%, recommended by the PSDH methodology.
Fixed wing aircraft	The speeds, ground distance and times in mode for the LTO cycle were taken from the Aviation Environmental Design Tool (AEDT) software (produced by the Federal Aviation Administration (FAA)).
Fixed wing aircraft	AEDT parameters for landing were adjusted to reflect reality: The ground distance was adjusted to reach runway exits. However, time in mode (TIM) was not changed. Final speeds were changed from 0m/s to 7.7m/s to

Source	Assumptions and limitations
	represent the taxi speed it would reach when exiting the runway.
Fixed wing aircraft	AEDT parameters for take-off were also adjusted to reflect reality: Ground distances were shortened if they extended beyond the end of the runway. However, the TIM or speeds were not changed.
Fixed wing aircraft	AEDT parameters for the BE20 aircraft were used a proxy for the B350 aircraft.
Fixed wing aircraft	Hold was calculated as the difference between the Eurocontrol stated taxi out time and the observed time.
Fixed wing aircraft	Average taxi times were assumed to be the same in the future as the times calculated in the baseline. This is considered worst-case because the future designs are expected to reduce taxi distances and times. However, this data is unavailable for the future scenarios.
Fixed wing aircraft	Brake and tyre wear was calculated using methodology from the 2005/6 emissions inventory for Gatwick Airport and used the same following $PM_{2.5}$ fractions of PM_{10}: 40% of PM_{10} from brake wear; and 70% from tyre wear.
APUs	An in-house database of APU emissions was used. The information in the database has been built using various sources including AEDT software, Zurich Airport study (Ref. 35), IATA HKIA study (Ref. 36), EMIT and the ICAO manual.
APUs	Where information was not available on the type of APU for an aircraft ICAO default emissions for APUs were used. This was assumed for aircraft with a maximum take-off weight (MTOW) of more than 10,000kg.
APUs	Aircraft with a maximum take-off weight (MTOW) of less than 10,000kg, and information was not available on the type of APU, were assumed not to have an APU.
APUs	The APUs were assumed to run for three minutes on average for each LTO cycle before connecting to power, which would be from a GPU in the baseline. This was based on anecdotal information from LLAOL. The TIM was assumed for the baseline and future scenarios.
APUs	The pNO_2 fraction is 10% of the NOx emissions following EMIT software.
APUs	The APU emissions were represented as volume sources at the end of the stand aprons with a height of 8m. This is assumed to represent where the APU exhausts are expected to be located on aircraft.

Source	Assumptions and limitations
APUs	Less data was available for PM emission factors than Nox emission factors. Therefore, the ratio of Nox and known PM emissions for similar APUs in terms of Nox emissions were used to assume the missing PM emissions.
APUs	The spatial and temporal distribution was assumed to follow the stand usage and ATMs profiles, respectively.
Engine testing	The average test cycle was assumed to be 10 minutes at 100% thrust and 25 at 7% (idle) thrust, following the methodology in the Environmental Statement prepared for a planning application in 2012 (reference 12/01400/FUL) (Ref. 37) – "*Full planning application for dualling of airport way/airport approach road and associated junction improvements, extensions and alterations to the terminal buildings, erection of new departures/arrivals pier and walkway, erection of a pedestrian link building from the short-stay car park to the terminal, extensions and alterations to the mid-term and long-term car parks, construction of a new parallel taxiway, extensions to the existing taxiway parallel to the runway, extensions to existing aircraft parking aprons, improvements to ancillary infrastructure including access and drainage, and demolition of existing structures and enabling works. Outline planning application for the construction of a multi-storey car park and pedestrian link building (all matters reserved).*"
Engine testing	Detailed information on the aircraft type using the ERUB in 2019 was not available. As a conservative assumption, the total number of tests was assumed to increase in line with growth in ATMs. Therefore, the total of 313 tests in 2017 were factored up based on total ATMs to 2019 and distributed between the MCATs based on their ATM distribution.
Engine testing	Engine testing was assumed to be spread temporally for each hour of the year using the profile created from the aircraft movements. A monthly profile was also applied which was based on the 2019 ATM monthly profile.
Engine testing	Engine tests were included in the model as volume sources with a height of 5m.
Fire training ground	The proposed new fire training ground location was assumed to be operating in assessment Phase 2b (2043).
Fire training ground	NAEI emissions factors were considered more appropriate because they were more fuel specific to LPG and wood than the EMEP/EEA factors.
Fire training ground	The pNO_2 fraction is 5% of the NOx emissions, taken from the NAEI.

Source	Assumptions and limitations
Fire training ground	Future operations and fuel use is assumed to be the same as 2019, as confirmed by LLAOL.
Fire training ground	Fire training grounds were included in the model as volume sources with a height of 10m.
GSE	It was assumed that all NRMM were Euro Stage IIIA compliant in baseline and future scenarios, based on estimates using the registration dates and information available from the DVLA.
GSE	Light commercial vehicles were assumed to be light duty vehicles N1(II) in the EMEP/EEA emission factor database.
GSE	Heavy duty vehicles were selected to be rigid “14-20 tonnes”, because the majority of the heavy duty vehicles were 19 tonnes.
GSE	The vehicle fleet mix in terms of Euro class and vehicle type, calculated for the baseline was assumed to be the same in the future. This is conservative as the Outline Operational Air Quality Plan (**Appendix 7.5** of the ES **[TR020001/APP/5.02]**) provides commitments around airside vehicles.
GSE	The pNO_2 fraction for NRMM Stage IIIA was assumed to be the same as a Euro 3 diesel car or LGV, which is 27% of the NOx emissions. This is taken from the NAEI. For the road vehicles, specific pNO_2 fractions were taken from the NAEI for each vehicle and Euro type.
GSE	A speed of 20mph was assumed for all vehicles airside for the emission and fuel calculations. This is based on the LLAOL Operations Safety Instruction (OSI) 003-19 which states a maximum speed limit of 20mph for airside vehicles (Ref. 22).
GSE	2019 fuel used was increased in line with the ATM growth for the future scenarios. However, the same fleet compositions in terms of vehicle and Euro types were used as in 2017.
GPUs	The Cummins QSB4.5 engine was assumed for the emission calculations of the GPUs. This engine is identified as an option of the manufacturer's website (Guinault) for the particular model (GA100), Other engine options are compliant to Stage 4 and 5. The QSB4.5 is Euro Stage IIIA compliant and maximum fuel efficiency (in terms of kWh output) occurs at 1,300 RPM. At this speed fuel consumption is given at 214 g/kWh.
GPUs	The EMEP/EEA emission factor for Stage IIIA compliant NRMM was used to calculate the emissions.

Source	Assumptions and limitations
GPUs	The pNO_2 fraction is 14% of the NOx emissions, taken from the NAEI for a Euro 3 LGV or bus.
GPUs	To estimate the number of ATMs at T2 stands in 2039 and 2043 DS scenario, the average ATM usage at similar sized stands in the 2019 scenario were calculated. These numbers were then applied to the new T2 stands. The numbers at all stands were then increased proportionally to get to the total ATMs forecast for 2039 and 2043 DS. These numbers then informed the GPU emissions.
GPUs	For all the future scenarios, the GPU emissions were increased in line with the ATM growth. However, in the 2039 and 2043 DS scenarios, the new Terminal 2 (T2) is proposed to have FEGP at all stands. Therefore, the GPU emissions assumed for the DS future scenarios are conservative.
Energy and heating plant	The total monthly natural gas consumption data was used to create the temporal profile used in the model for all energy and heating plant sources in the baseline and future scenarios. The profile was assumed to be representative of the typical usage.
Energy and heating plant	The fuel data was specific to the buildings the fuel served. Fuel was apportioned to the various plant serving a specific building. This was done proportionately based on their thermal input capacity.
Energy and heating plant	The specific parameters of the boilers and generators were not available and therefore emissions factors from EMEP/EEA specific to fuel type and thermal input capacity were used to calculate the emissions.
Energy and heating plant	The pNO_2 fraction is 5% of the NOx emissions, taken from the NAEI.
Energy and heating plant	The specific parameters for the energy and heating plant exhaust points were not available, therefore emissions were represented in the mode as area sources above the rooftops of their respective buildings.
Energy and heating plant	Forecast fuel usage was not available. For the future scenarios, it was assumed that the fuel used by the existing terminal building would increase in line with passenger growth. In scenario 2039 and 2043 DS, T2 was added as an area source and emissions were apportioned to the T1 and T2 sources proportionate to the passenger split (T1 will have 18 mppa and T2 will have 14 mppa). However, this is assumed to be conservative because the T2 proposed engineered servicing of the terminal building will be designed to meet exacting standards with regards to energy conservation and sustainable principles, including meeting

Source	Assumptions and limitations
	'BREEAM excellent' criteria and will not have any gas combustion. For example, photovoltaic panels would be installed on the roof, as well as ground source heating and cooling systems under the terminal to deliver a source of sustainable energy (**Appendix 12.1** in the ES **[TR020001/APP/5.02]**).
Road traffic	Emissions for 'England (not London)' have been used in the EFT.
Road traffic	The future year emission factors have been used from the Defra EFT (i.e. the 2027, 2039 and 2043 factors).
Road traffic	Ammonia emissions from road traffic have been calculated using the National Highways tool.
Road traffic	2.7.59 Modelled speeds were reduced to 20kph at junctions following the LAQM guidance.
Road traffic	pNO_2 percentages of NOx for road traffic were taken from NAEI predictions for the future years.
Construction traffic	The year with peak construction traffic movements for each assessment phase have been used in the assessment (i.e. 2025 for assessment Phase 1; 2035 for assessment Phase 2a; and 2040 for assessment Phase 2b) Therefore, for example, 2025 construction traffic was added to 2027 operational traffic data. This is assumed to represent a combined worst-case scenario.
Construction traffic	The route taken by all deliveries and operatives is assumed to come directly from the M1 (split 50 percent north and south of Junction 10 of the M1) and travel up the A1081 and Percival Way or the AAR when it is available.
Car parks	Speed is assumed to be 5kph for all vehicles.
Car parks	Vauxhall car park spaces estimated from number on google earth. Vauxhall spaces assumed to have same turnover as long stay as it appears to be used for stacking or very low staff numbers.
Car parks	Future MSCPs were assumed to have the same trip ratio as the existing MSCP 1 - each space is used 1.15 times per day.
Car parks	The future mid stay parking was assumed to have the same trip ration as the existing mid stay – each space is used 0.42 times per day.
Car parks	All other future car parks were assumed to have the same trip ratio as the existing MSCP 1 – each space is used 1.15 times per day.
Car parks	TUI existing assumed to have same turn over as MSCP as it is for staff.

Source	Assumptions and limitations
Car parks	Car hire 1 and staff overflow assumed to have same turn over as mid-stay.
Car parks	EasyJet assumed to have same turn over as MSCP as it is for staff.
Car parks	ATC/staff assumed to have same turn over as MSCP as it is for staff.
Car parks	All small existing sites assumed to have same turn over as MSCP as it is for staff. The total spaces provided by surface transport was 1,385 in 2027, 1,455 in 2039 and 2,255 in 2043 - the number of spaces was apportioned by area of each car park.
NRMM	NRMM were assumed to operate for 8 hours for each day, which is considered conservative, as not all plant would be expected to be operating throughout the day.
NRMM	NRMM were assumed to meet Euro Stage V emission standards, which is considered a conservative assumption for future construction.
NRMM	The percentage pNO_2 emissions was assumed to be the same as for a Euro 5 diesel car (16%), taken from the NAEI.
NRMM	The emissions were assumed to be spread across the work areas around the Proposed Development
Concrete batching plant	It was assumed that a concrete batching plant would operate throughout the different construction phases for 22 working days per month, 8 hours per day
Concrete batching plant	The concrete batching plant was assumed to be powered by a 500kW diesel generator. The technical specification of Cummins 500kW diesel engine (QSX15-G8) was used as an assumption for the generator powering the concrete batching plant, as a generic generator for that size
Concrete batching plant	The emissions were assumed to be spread across the work areas around the Proposed Development

GLOSSARY AND ABBREVIATIONS

Term	Definition
AADT	Annual Average Daily Traffic
AAR	Airport Access Road
ADMS	Atmospheric Dispersion Modelling System
AEDT	Aviation Environmental Design Tool
APIS	Air Pollution Information System
APU	Auxiliary Power Units
AQMA	Air Quality Management Area
ARN	Affected Road Network
ASR	Annual Status Report (related to air quality)
ATC	Air Traffic Control
ATM	Air Transport Movements
AW	Ancient Woodland
BREEAM	Building Research Establishment's Environmental Assessment Method
CBC	Central Bedfordshire Council
Defra	Department for Environment Food and Rural Affairs
DM	Do-Minimum
DS	Do Something = an assessment scenario describing the conditions with the Proposed Development in place
EFT	Emissions factor toolkit
EMEP/EEA	European Monitoring and Evaluation Programme/European Environment Agency
EPUK	Environmental Protection UK
ERUB	Engine Run Up Bay
ES	Environmental Statement
FAA	Federal Aviation Administration
FEGP	Fixed electrical ground power
FIDOR	Frequency, Intensity, Duration, Offensiveness and Receptor Sensitivity
FOCA	Swiss Federal Office of Civil Aviation
FOI	Swedish Defence Research Agency
GIS	Geographic Information System
GPU	Ground Power Units
GSE	Ground Support Equipment

Term	Definition
HDV	Heavy duty vehicle (goods vehicles and buses >3.5t gross vehicle weight)
HGV	Heavy Goods Vehicle
IATA	International Air Transport Association
IAQM	Institute of Air Quality Management
ICAO	International Civil Aviation Organisation
LAQM	Local Air Quality Management
LBC	Luton Borough Council
LGV	Large goods vehicle
LLAOL	London Luton Airport Operations Limited, the current operators of London Luton Airport
LNR	Local Nature Reserve
LPG	Liquefied petroleum gas
LTO	Landing and Take-off
LTP	Local Transport Plans
MCATs	Modelling categories
mppa	Million passengers per annum
MRW	Maximum ramp weight for aircraft
MSCP	Multi-storey car park
MTOW	Maximum take-off weight
MWh	Mega Watt hour
NAEI	National Atmospheric Emissions Inventory
NHDC	North Hertfordshire District Council
NO	Nitric oxide
NOx	Oxides of Nitrogen
NO_2	Nitrogen Dioxide
NRMM	non-road mobile machinery
OS	Ordnance Survey
ou_E/m^3	European Odour Units per cubic metre
PC	Process contribution. Contribution as a result of the Proposed Development.
PEIR	Preliminary Environmental Information Report
PM_{10}	Particulate Matter 10 micrometers or smaller in diameter
$PM_{2.5}$	Particulate Matter 2.5 micrometers or smaller in diameter
pNO_2	Primary NO_2
ppb	parts per billion
PSDH	Project for Sustainable Development of Heathrow
SAC	Special Areas of Conservation
SPA	Special Protection Areas
SPR	Source, pathway, receptor
SSSI	Site of Special Scientific Interest
TIM	Time in mode. The mode being part of the LTO cycle.
UNECE	United Nations Economic Commission for Europe
WebTAG	Web-based Transport Analysis Guidance

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