Statutory Consultation 2022

Preliminary Environmental Information Report

Volume 3: Appendix 7.1

Air Quality Methodology

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1 CONSTRUCTION DUST ASSESSMENT METHODOLOGY

1.1.1 There are five steps in the assessment process described in the Institute of Air Quality Management (IAQM) guidance (Ref. 1.1). These are summarised in **Inset 1.1** and a further description is provided in the following paragraphs.

Step 1: Need for assessment

1.1.2 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

1.1.3 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.

1.1.4 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 1.1**.

1.1.5 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 PM10 background concentrations and any other site-specific factors. **Table 1.2** and **Table 1.3** show the criteria for defining the sensitivity of the area to different dust effects.

1.1.6 The overall risk of the impacts for each activity is then determined (step 2C) prior to the application of any mitigation measures (**Table 1.4**) and an overall risk for the site derived.

Table 1.1: 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)	• 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

Dust emission magnitude		
Small	**Medium**	**Large**
• demolition activities <10m above ground, demolition during wetter months		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 dust release (e.g. metal cladding or timber)	• total building volume 25,000m^3 100,000m^3 • potentially dusty construction material (e.g. concrete) • piling • on-site concrete batching	• total building volume >100,000m^3 • 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 1.2: 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 1.3: 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 $\mu g/m^3$	>100	High	High	High	Medium	Low
		10-100		High	Medium	Low	
		1-10		Medium	Low		
	28-32 $\mu g/m^3$	>100	High	High	Medium	Low	Low
		10-100		Medium	Low		
		1-10					
	24-28 µg/m3	>100	High	Medium	Low	Low	Low
		10-100					
		1-10	Medium	Low			
	<24 $\mu g/m^3$	>100	Medium	Low	Low	Low	Low
		10-100	Low				
		1-10					
Medium	>32 $\mu g/m^3$	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low			
	28-32 $\mu g/m^3$	>10	Medium	Low	Low	Low	Low
		1-10	Low				
	24-28$\mu g/m^3$	>10	Low	Low	Low	Low	Low
		1-10					
	<24$\mu g/m^3$	>10	Low	Low	Low	Low	Low
		1-10					
Low	-	>1	Low	Low	Low	Low	Low

Table 1.4: 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
Low	Low risk site	Low risk site	Negligible

Step 3: Determine the site-specific mitigation

1.1.7 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.

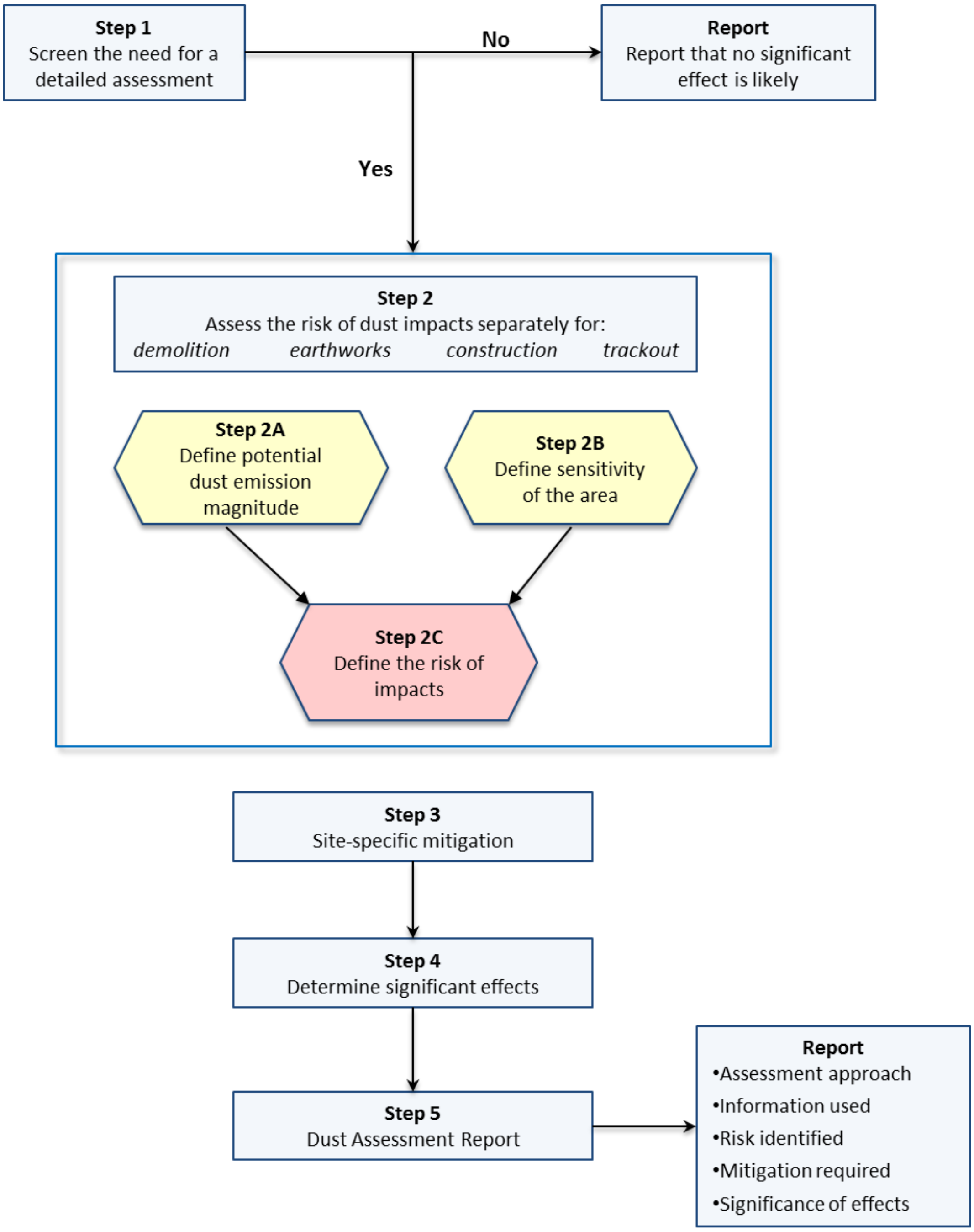
Step 4: Determine any significant residual effects

1.1.8 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. 1.1) 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

1.1.9 The last step of the assessment is the preparation of a Dust Assessment Report (**Appendix 7.3** of Volume 3 of the PEIR).

Inset 1.1: IAQM dust assessment methodology (Ref. 1.1)



1.1.10 For this assessment the risk of impacts from dust has been considered for each of the three assessment phases.

2 MODELLING METHODOLOGY

2.1.1 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.

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

2.2 Data sources

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

a. monitoring data from Luton Borough Council (LBC) (Ref. 2.2), Central Bedfordshire Council (CBC) (Ref. 2.3), North Hertfordshire District Council (NHDC) (Ref. 2.4), London Luton Operator Limited (LLAOL) and the Applicant;
b. the UK Air Information Resource website (Ref. 2.5);
c. the National Atmospheric Emissions Inventory (NAEI) (Ref. 2.6);
d. aircraft fleet data and forecasts from aviation consultants (**Table 2.5**);
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. 2.7);
g. the ICAO airport air quality manual document no. 9889 (Ref. 2.8);
h. the Aviation Environmental Design Tool (AEDT) software (Ref. 2.9);
i. the Swedish Defence Research Agency (FOI) database for turboprop engine emissions (Ref. 2.10);
j. the Swiss Federal Office for Civil Association (FOCA) database for piston engines (Ref. 2.11);
k. the FOCA guidance on the determination of helicopter emissions (Ref. 2.12);
l. the European Environment Agency EMEP/EEA air pollutant emissions inventory guidebook (Ref. 2.13);
m. Ordnance Survey, AddressBase Plus data (Ref. 2.14); and
n. the Air Pollution Information System (APIS) website (Ref. 2.15).

2.3 Human receptors

2.3.1 Ordnance Survey (OS) AddressBase Plus data (Ref. 2.14) 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 477 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 7.5**. Human receptors were chosen to capture the closest receptors along the ARN and at junctions, as well as around the airport and below the aircraft flightpath (the modelled flightpath up to an altitude of 457m). The receptor choices are considered to capture the most sensitive receptors.

2.3.2 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 2.1**.

Table 2.1: Sensitive human receptors

ID	Address	X	Y	Type	AQMA (Y/N)
1	Vanda Estate, London Road, Hitchin, SG4 7PJ	521101	223516	Residential	N
2	8 Luton Road, Luton, LU2 8PZ	512474	223309	Residential	N
3	New Mill End House, New Mill End, Luton, LU1 3TS	512121	218093	Residential	N
4	207B, Dunstable Road, Luton, LU1 1DD	508203	221972	Residential	N
5	135 Luton Road, Dunstable, LU5 4LW	503419	222179	Residential	N
6	The Lodge, Luton Road, Luton, LU1 4AF	506362	219797	Residential	N
7	29 Shelton Way, Luton, LU2 9AP	510181	223113	Residential	N
8	677 Dunstable Road, Luton, LU4 0DS	505347	222725	Residential	Y
9	5 Eaton Green Road, Luton, LU2 9HB	511300	221803	Residential	N
10	29 Olympic Court, Cannon Lane, Luton, LU2 8DA	510765	224330	Residential	N
11	30 Crawley Green Road, Luton, LU2 0QX	510051	221307	Residential	N
12	1 Gaddesden Lane, St. Albans, AL3 7AS	509763	211416	Residential	N
13	385 New Bedford Road, Luton, LU3 2AB	508504	224286	Residential	N
14	Baileys Farm, Hitchin, SG4 8NZ	515245	221709	Residential	N
15	32 Bank Close, Luton, LU4 9NX	505069	223686	Residential	Y
16	1 Hart Lane, Luton, LU2 0JF	510259	221614	Residential	N
17	28 Stevenage Road, Hitchin, SG4 9DL	518890	228295	Residential	Y

ID	Address	X	Y	Type	AQMA (Y/N)
18	15 Twyford Drive, Luton, LU2 9TB	511882	222519	Residential	N
19	Lilley House, West Street, Luton, LU2 8LH	511943	226231	Residential	N
20	31C, New Bedford Road, Luton, LU1 1SE	508875	221648	Residential	N
21	127 Bradley Road, Luton, LU4 8SW	505621	222221	Residential	Y
22	346 Luton Road, Dunstable, LU5 4LG	504252	222482	Residential	N
23	247 Turners Road North, Luton, LU2 9AH	510597	223133	Residential	N
24	102 West Street, Dunstable, LU6 1NX	501513	221726	Residential	N
25	21 Woodside Home Park, Luton, LU1 4LP	507479	219207	Residential	N
26	6 Poynters Road, Luton, LU4 0LA	504319	222551	Residential	N
27	45 Cutenhoe Road, Luton, LU1 3NB	509331	219875	Residential	N
28	211 New Bedford Road, Luton, LU3 1LL	508709	223197	Residential	N
29	1 Nicholls Farm Cottages, Lybury Lane, St. Albans, AL3 7JH	509312	212940	Residential	N
30	55 Eaton Green Road, Luton, LU2 9JE	511712	221999	Residential	N
31	47 Windmill Road, Luton, LU1 3XL	509964	220936	Residential	N
32	32 Laxton Close, Luton, LU2 8SJ	512454	222277	Residential	N
33	1 Manley Highway Cottages, Pirton Road, Hitchin, SG5 2ES	516482	229071	Residential	N
34	33A, Farley Hill, Luton, LU1 5EG	508838	220582	Residential	N
35	55B, High Street North, Dunstable, LU6 1JF	501715	222051	Residential	N
36	71 Seabrook, Luton, LU4 0EJ	505170	223384	Residential	Y

ID	Address	X	Y	Type	AQMA (Y/N)
37	The Beeches, Hemel Hempstead Road, St. Albans, AL3 7AG	509661	210764	Residential	N
38	98A, Dunstable Road, Luton, LU1 1EH	508341	221849	Residential	Y
39	28 Barnston Close, Luton, LU2 9RZ	511878	222072	Residential	N
40	St. Marys Rc Presbytery, Castle Street, Luton, LU1 3AG	509158	220900	Residential	Y
41	West Winds, Lye Hill, Hitchin, SG4 8PP	514993	221607	Residential	N
42	19 Felton Close, Luton, LU2 9TD	511842	222478	Residential	N
43	49 Falconers Road, Luton, LU2 9ET	511017	221986	Residential	N
44	Winch Hill House, Luton, LU2 8PB	513764	221610	Residential	N
45	44 Crescent Road, Luton, LU2 0AH	509963	221350	Residential	N
46	Inglenook, East Street, Luton, LU2 8LW	511852	226565	Residential	N
47	36 Gibraltar Cottages, London Road, Luton, LU1 4LE	509592	217396	Residential	N
48	16 Broad Oak Court, Handcross Road, Luton, LU2 8JE	511508	223068	Residential	N
49	Lynch Field, The Lynch, Dunstable, LU6 3QZ	504198	218305	Residential	N
50	20B, Church Street, Dunstable, LU5 4RU	501974	221891	Residential	Y
51	52 Chertsey Close, Luton, LU2 9JD	511610	221906	Residential	N
52	132 Luton Road, Dunstable, LU5 4JW	503381	222201	Residential	N
53	346 Ashcroft Road, Luton, LU2 9AF	511199	222512	Residential	N
54	67 Ashcroft Road, Luton, LU2 9AX	510725	223595	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
55	1 Hartop Court, Lalleford Road, Luton, LU2 9JF	511686	221988	Residential	N
56	295 New Bedford Road, Luton, LU3 1NH	508634	223680	Residential	N
57	1 Eaton Place, Luton, LU2 9LB	511778	222014	Residential	N
58	Cuckoos Nest, 60 Crawley Green Road, Luton, LU2 0QW	510190	221448	Residential	N
59	25 Buckingham Drive, Luton, LU2 9RA	511485	222505	Residential	N
60	39 London Road, Dunstable, LU6 3DH	502710	221032	Residential	N
61	Luton Lodge, Stockwood Park, Luton, LU1 4BH	508513	220238	Residential	N
62	45 Upper Tilehouse Street, Hitchin, SG5 2EF	517998	229018	Residential	N
63	82 Stockingstone Road, Luton, LU2 7NF	509712	222760	Residential	N
64	98 Lullington Close, Luton, LU2 8QY	511145	223235	Residential	N
65	62 Pirton Road, Hitchin, SG5 2BQ	517521	228933	Residential	N
66	Wardown Park Lodge, New Bedford Road, Luton, LU3 1LP	508754	222913	Residential	N
67	10 Pirton Road, Hitchin, SG5 2BD	517863	228994	Residential	N
68	402 Dunstable Road, Luton, LU4 8JU	507200	222487	Residential	N
69	102 Leicester Road, Luton, LU4 8SJ	506027	222196	Residential	N
70	1 Grange Cottages, Hitchin, SG5 3ES	515246	227605	Residential	N
71	View Point, School Lane, Hitchin, SG5 3AZ	514160	227406	Residential	N
72	180 Ashcroft Road, Luton, LU2 9AB	510616	223091	Residential	N
73	Telford Place, 1 Telford Way, Luton, LU1 1HT	508784	221700	Residential	Y

ID	Address	X	Y	Type	AQMA (Y/N)
74	46 Bowbrookvale, Luton, LU2 8SY	512667	222285	Residential	N
75	Common Farm, Luton Road, Luton,	502154	229910	Residential	N
76	11 Luton Road, Luton, LU1 4AF	506446	219811	Residential	N
77	9 Dower Court, London Road, Hitchin, SG4 9EX	518720	228334	Residential	Y
78	71 Poynters Road, Dunstable, LU5 4SG	504035	222703	Residential	N
79	Lodge Cottages, Lilley Bottom, Luton, LU2 8NH	512955	225471	Residential	N
80	123 Dunstable Road, Luton, LU1 4AN	505724	219392	Residential	N
81	284 Crawley Green Road, Luton, LU2 0SJ	510771	222155	Residential	N
82	70 Castle Street, Luton, LU1 3AJ	509085	220740	Residential	N
83	36 Tudor Court, Hitchin, SG5 2BE	517701	228804	Residential	N
84	152 Hitchin Road, Luton, LU2 0ES	509733	221918	Residential	N
85	29 Tameton Close, Luton, LU2 8UX	512464	222982	Residential	N
86	54A-54B, New Bedford Road, Luton, LU1 1SH	508893	221661	Residential	N
87	Hamilton Court 45-47, Collingdon Street, Luton, LU1 1BQ	508697	221536	Residential	N
88	6 Ashton Square, Dunstable, LU6 3SN	501890	221839	Residential	Y
89	199 Barton Road, Luton, LU3 2BN	508176	225915	Residential	N
90	47 Upper Tilehouse Street, Hitchin, SG5 2EF	517949	228988	Residential	N
91	379 Ashcroft Road, Luton, LU2 9AF	511224	222536	Residential	N
92	1 Harrowden Court, Harrowden Road, Luton, LU2 0SR	511031	221660	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
93	29-31, Castle Street, Luton, LU1 3AG	509263	220929	Residential	Y
94	132 Ashcroft Road, Luton, LU2 9AY	510637	223376	Residential	N
95	5 Statham Close, Luton, LU3 4EJ	508010	226381	Residential	N
96	2 Leyhill Drive, Luton, LU1 5QA	507979	219896	Residential	N
97	2 Enderby Road, Luton, LU3 2HQ	508379	224942	Residential	N
98	18 Luton Road, Dunstable, LU5 4JN	502795	222073	Residential	N
99	94 Lime Avenue, Luton, LU4 0EF	505246	223300	Residential	Y
100	Stagenhoe Home Farm, Stagenhoe Park, Hitchin, SG4 8DA	519044	222874	Residential	N
101	54 Gilderdale, Luton, LU4 9NB	504584	224514	Residential	Y
102	Corner Farm, The Lynch, Dunstable, LU6 3QZ	504288	218277	Residential	N
103	2 The Stables, Lilley Bottom Road, Luton, LU2 8NS	512048	226135	Residential	N
104	19 Hawthorn Close, Hitchin, SG5 2BW	518114	228736	Residential	N
105	67 New Bedford Road, Luton, LU3 1DH	508750	222066	Residential	N
106	11 Timworth Close, Luton, LU2 9SF	511576	222465	Residential	N
107	1 Park Street Lodge, Luton Hoo Estate, Luton, LU1 3TG	510179	220080	Residential	N
108	141 Luton Road, Dunstable, LU5 4LP	503452	222190	Residential	N
109	7 Primrose Court, Chiltern Road, Dunstable, LU6 1HH	501180	221584	Residential	N
110	17 Longfield Drive, Luton, LU4 8RF	505493	222468	Residential	Y
111	87 Dunstable Road, Luton, LU1 4AN	505898	219478	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
112	117 London Road, Luton, LU1 3RH	509067	219796	Residential	N
113	2 Fermor Crescent, Luton, LU2 9HT	511424	222460	Residential	N
114	12 Felton Close, Luton, LU2 9TD	511870	222431	Residential	N
115	86 Crawley Green Road, Luton, LU2 0QU	510271	221584	Residential	N
116	255 Runley Road, Luton, LU1 1TY	506406	221574	Residential	N
117	10 West Street, Dunstable, LU6 1SX	501831	221836	Residential	Y
118	42 Woodford Road, Dunstable, LU5 4JS	503414	222491	Residential	N
119	25 Felton Close, Luton, LU2 9TD	511858	222502	Residential	N
120	37D, Chapel Street, Luton, LU1 5DA	509047	220906	Residential	N
121	15C, Crawley Road, Luton, LU1 1HX	508740	221697	Residential	Y
122	806 Dunstable Road, Luton, LU4 0HE	504886	222676	Residential	N
123	300 Hitchin Road, Luton, LU2 0EU	509984	222328	Residential	N
124	41 Abingdon Road, Luton,	505299	223086	Residential	Y
125	53 Eaton Valley Road, Luton, LU2 0SN	510930	221981	Residential	N
126	4 Lambert Close, Luton, LU2 8BQ	511119	224765	Residential	N
127	25A, Hitchin Road, Luton, LU2 0EJ	509564	221706	Residential	N
128	6 Colwell Rise, Luton, LU2 9UA	512427	222282	Residential	N
129	152 Sharpenhoe Road, Bedford,	500039	234952	Residential	N
130	9 St. Elmo Court, London Road, Hitchin, SG4 9ET	518767	228232	Residential	N
131	123 Hartsfield Road, Luton, LU2 9DY	510924	222297	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
132	Wobbley Bottom Farm, Pirton Road, Hitchin, SG5 2ES	516455	229047	Residential	N
133	6 Poynters Road, Luton, LU4 0LA	504347	222535	Residential	N
134	2 Homedell House, Roundwood Lane, Harpenden, AL5 3RA	512518	215355	Residential	N
135	41 Woodford Road, Dunstable, LU5 4JS	503383	222485	Residential	N
136	91 Ravenhill Way, Luton, LU4 0HD	504684	223876	Residential	N
137	87 Eldon Road, Luton, LU4 0AY	505433	222383	Residential	Y
138	17 Mardle Close, Luton, LU1 4EZ	506182	218912	Residential	N
139	2 Brays Court, Brays Road, Luton, LU2 9DG	510627	223184	Residential	N
140	67 Stopsley Way, Luton, LU2 7UU	510239	223305	Residential	N
141	9 Nayland Close, Luton, LU2 9SZ	512051	222302	Residential	N
142	2 Park Street Lodge, Luton Hoo Estate, Luton, LU1 3TG	510198	220096	Residential	N
143	5 Poynters Road, Dunstable, LU5 4SG	504261	222551	Residential	N
144	4 Baylam Dell, Luton, LU2 9ST	512043	222162	Residential	N
145	65 Someries Arch, Luton, LU1 3TF	511105	220067	Residential	N
146	22 Copperfields, Luton, LU4 0JX	505064	223518	Residential	Y
147	1 Stevenage Road, Hitchin, SG4 9DH	518683	228394	Residential	N
148	24 Claverley Green, Luton, LU2 8TA	512211	222779	Residential	N
149	Barton Hill Farm Cottage, Barton Hill Road, Luton, LU2 8NE	509667	228439	Residential	N
150	135 Bradley Road, Luton, LU4 0AR	505523	222221	Residential	Y

ID	Address	X	Y	Type	AQMA (Y/N)
151	24 East Street, Luton, LU2 8LW	511866	226592	Residential	N
152	8 Sackville Road, Luton, LU1 5FQ	508954	220660	Residential	N
153	333 New Bedford Road, Luton, LU3 2AB	508572	223991	Residential	N
154	Church Road, Luton, LU1 4BJ	508159	218793	Residential	N
155	69 Skimpot Lane, Luton, LU1 4AY	505182	222125	Residential	N
156	45 Kynance Close, Luton, LU2 9DN	510229	223025	Residential	N
157	58 Cutenhoe Road, Luton, LU1 3NE	509379	219872	Residential	N
158	17 Windsor Street, Luton, LU1 5DT	508955	220733	Residential	N
159	9 Friston Green, Luton, LU2 9SE	511678	222464	Residential	N
160	7 Gosmore Road, Hitchin, SG4 9AN	518581	228248	Residential	N
161	94 Crawley Green Road, Luton, LU2 0QT	510301	221620	Residential	N
162	9 Nuns Close, Hitchin, SG5 1EP	518198	229182	Residential	N
163	Priory View, Church Street, Dunstable, LU5 4FG	502381	222031	Residential	N
164	908A, Dunstable Road, Luton, LU4 0HJ	504440	222553	Residential	N
165	35 Kenilworth Road, Luton, LU1 1DQ	508130	221699	Residential	N
166	Index Court, Index Drive, Dunstable, LU6 3TZ	502654	221045	Residential	N
167	20A, Katherine Drive, Dunstable, LU5 4NT	503377	222511	Residential	N
168	White Lodge, Hitchin, SG4 8NW	517618	222464	Residential	N
169	74 Ashcroft Road, Luton, LU2 9AU	510665	223646	Residential	N
170	20 Old Park Road, Hitchin, SG5 2JR	518150	229158	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
171	16 Nayland Close, Luton, LU2 9SZ	512097	222281	Residential	N
172	61 Crawley Green Road, Luton, LU2 0AA	510158	221460	Residential	N
173	5 Colwell Rise, Luton, LU2 9TJ	512390	222276	Residential	N
174	The Beeches, Hemel Hempstead Road, St. Albans,	510306	206696	Residential	N
175	255 Crawley Green Road, Luton, LU2 0QJ	510659	222084	Residential	N
176	84 Park Street, Luton, LU1 3EU	509556	220947	Residential	N
177	Offley Chase, Luton, LU2 8NJ	513353	224753	Residential	N
178	Point Red, 146 Midland Road, Luton, LU2 0BL	509069	221710	Residential	N
179	Moulton Court, Moulton Rise, Luton, LU2 0AL	509770	221539	Residential	N
180	68 Stuart Place, Luton, LU1 5DL	508902	221125	Residential	Y
181	773 Dunstable Road, Luton, LU4 0HL	504879	222644	Residential	N
182	7 Alderton Close, Luton, LU2 9SA	511845	222423	Residential	N
183	1 Turnpike Drive, Luton, LU3 3RA	508074	226436	Residential	N
184	Law Hall Farm, Law Hall Lane, Hitchin, SG4 8JJ	516458	222125	Residential	N
185	80 Chalk Hill, Luton, LU2 8PY	512763	223631	Residential	N
186	Hitchin Hill, Hitchin, SG4 9AJ	518613	228382	Residential	N
187	29A, High Street South, Dunstable, LU6 3RZ	501969	221785	Residential	Y
188	41 Upper Tilehouse Street, Hitchin, SG5 2EE	518130	229043	Residential	Y
189	6 Wyndham Road, Luton, LU4 0EA	505341	222836	Residential	Y
190	41 Deep Denes, Luton, LU2 7SU	510280	222843	Residential	N
191	Wesley House, 19 Chapel Street, Luton, LU1 2EG	509129	220992	Residential	Y

ID	Address	X	Y	Type	AQMA (Y/N)
192	277A, Dunstable Road, Luton, LU4 8BS	507618	222187	Residential	N
193	128 Common Road, Dunstable, LU6 3RG	503318	218045	Residential	N
194	510 Hitchin Road, Luton, LU2 7ST	510104	223082	Residential	N
195	2 Pump Cottages, Hexton Road, Luton, LU2 8NB	510765	227627	Residential	N
196	1 Pirton Road, Hitchin, SG5 2BD	517865	228947	Residential	N
197	1C, Crescent Road, Luton, LU2 0AB	509542	221631	Residential	N
198	66 Upper Tilehouse Street, Hitchin, SG5 2EE	518064	229059	Residential	N
199	2 Crawley Green Road, Luton, LU1 3LP	509805	221157	Residential	N
200	87 Langford Drive, Luton, LU2 9AL	510308	223436	Residential	N
201	41 London Road, Luton, LU1 3UE	509019	220356	Residential	N
202	45 Skimpot Lane, Luton, LU1 4AY	505029	222140	Residential	N
203	6A, Church Street, Dunstable, LU5 4RU	501926	221867	Residential	Y
204	8 Oving Close, Luton, LU2 9RN	511669	222503	Residential	N
205	Fitzroy Court, Vicarage Street, Luton, LU1 3FN	509672	221138	Residential	N
206	159 Crawley Green Road, Luton, LU2 0QL	510443	221834	Residential	N
207	Swedish Cottages, Barton Road, Luton, LU3 3PU	507689	227875	Residential	N
208	5 Barn Owl Close, Luton, LU1 5QZ	507910	219832	Residential	N
209	59 Hitchin Road, Luton, LU2 0EL	509618	221805	Residential	N
210	11 Withy Close, Luton, LU4 9NZ	504826	223992	Residential	Y
211	Woodland Court, Hart Hill Drive, Luton, LU2 0AX	510078	221356	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
212	Wards Farm, Hexton Road, Luton, LU2 8LU	511540	227150	Residential	N
213	11 Wigmore Lane, Luton, LU2 8AA	510757	223636	Residential	N
214	17 Offley Road, Hitchin, SG5 2AZ	517855	228897	Residential	N
215	687 Dunstable Road, Luton, LU4 0DS	505304	222729	Residential	Y
216	311 Crawley Green Road, Luton, LU2 9AG	511416	222511	Residential	N
217	6 Alderton Close, Luton, LU2 9SA	511882	222378	Residential	N
218	15 Someries Hill, Luton, LU2 9DL	511471	223031	Residential	N
219	449 Luton Road, Harpenden, AL5 3QE	511314	216129	Residential	N
220	2 Manor Cottages, Hexton Road, Luton, LU2 8NA	511244	227580	Residential	N
221	171 Manor Road, Luton, LU1 4HJ	506462	218999	Residential	N
222	4 High Street North, Dunstable, LU6 1JU	501906	221882	Residential	Y
223	1 Charles Street, Luton, LU2 0EB	509695	221904	Residential	N
224	116 Barton Road, Luton, LU3 2BD	508336	225420	Residential	N
225	238 Stockingstone Road, Luton, LU2 7DG	509313	223219	Residential	N
226	Park Cottage, Farley Hill, Luton, LU1 5NY	508257	220028	Residential	N
227	29 Wigmore Lane, Luton, LU2 8AB	510884	223527	Residential	N
228	119 Falconers Road, Luton, LU2 9ET	511097	221759	Residential	N
229	40B, High Street North, Dunstable, LU6 1LA	501806	221976	Residential	N
230	10 Cheslyn Close, Luton, LU2 8UA	512348	222906	Residential	N
231	102 High Street North, Dunstable, LU6 1LN	501494	222327	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
232	43-45, High Street North, Dunstable, LU6 1JE	501756	222000	Residential	Y
233	Greenkeepers Bungalow, Stockwood Park, Luton, LU1 4BH	508551	219587	Residential	N
234	3 Wigmore Lane, Luton, LU2 9TH	511814	222540	Residential	N
235	15 Fermor Crescent, Luton, LU2 9HU	511232	222450	Residential	N
236	Millfield House, Millfield Lane, Luton, LU1 4AR	505509	218706	Residential	N
237	4 Linley Dell, Luton, LU2 8TJ	511948	222597	Residential	N
238	1 Offley Road, Hitchin, SG5 2AZ	517908	228957	Residential	N
239	99 Russett Way, Dunstable, LU5 4GD	502840	222079	Residential	N
240	183 High Street, Luton, LU4 9LE	505236	223447	Residential	Y
241	430 Hitchin Road, Luton, LU2 7ST	510130	222813	Residential	N
242	1 Oakley Road, Luton, LU4 9PT	506414	222652	Residential	N
243	741 Dunstable Road, Luton, LU4 0HL	505046	222667	Residential	N
244	124 Lalleford Road, Luton, LU2 9JJ	511495	222472	Residential	N
245	1 Mortgrove Cottages, Luton, LU2 8ND	510462	227993	Residential	N
246	212 High Street South, Dunstable, LU6 3NX	502431	221288	Residential	N
247	Belmullet House, 76 Stuart Street, Luton, LU1 2SW	508754	221296	Residential	Y
248	3 Wigmore Lane, Luton, LU2 8AA	510713	223660	Residential	N
249	The Meadows, Hemel Hempstead Road, St. Albans,	509280	207781	Residential	N
250	70 Cutenhoe Road, Luton, LU1 3NF	509393	219895	Residential	N
251	1 Ashcroft Road, Luton, LU2 9AU	510530	223827	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
252	Hillcrest Bungalow, Dunstable Road, Luton, LU1 4AN	505301	219241	Residential	N
253	Lynton, Upper Tilehouse Street, Hitchin, SG5 2EF	517919	229006	Residential	N
254	Luton Rugby Club, Newlands Road, Luton, LU1 4BQ	508228	219336	Residential	N
255	80 Dunstable Road, Luton, LU1 4AL	505978	219529	Residential	N
256	82 Stokers Close, Dunstable, LU5 4EY	502552	221988	Residential	N
257	899 Dunstable Road, Luton, LU4 0HR	504447	222521	Residential	N
258	768 Dunstable Road, Luton, LU4 0DX	505262	222769	Residential	Y
259	Nadeem Plaza, 172 Dunstable Road, Luton, LU4 8FG	508155	222027	Residential	N
260	1 Buckingham Drive, Luton, LU2 9RA	511565	222499	Residential	N
261	Common Farm, Luton Road, Luton,	501019	232822	Residential	N
262	Bentley Court, Moor Street, Luton, LU1 1EZ	508427	221723	Residential	Y
263	66 Tameton Close, Luton, LU2 8UX	512443	222840	Residential	N
264	8A, Dunstable Road, Luton, LU1 1DY	508697	221371	Residential	Y
265	54 Stevenage Road, Hitchin, SG4 9DR	518984	228278	Residential	Y
266	Common Farm, Luton Road, Luton,	502248	229410	Residential	N
267	279 Crawley Green Road, Luton, LU2 0QH	510820	222230	Residential	N
268	35 Wyatt Court, Farley Fields, Luton, LU1 5FG	507732	219884	Residential	N
269	14 The Ridgeway, Hitchin, SG5 2BT	517631	228739	Residential	N
270	3 Tilehouse Street, Hitchin, SG5 2TS	518142	229001	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
271	45 Cutenhoe Road, Luton, LU1 3NB	509343	219880	Residential	N
272	50 Layham Drive, Luton, LU2 9SY	512076	222171	Residential	N
273	11A, Raleigh Grove, Luton, LU4 8RE	505509	222388	Residential	N
274	1A, Barnfield Avenue, Luton, LU2 7AS	508550	224369	Residential	N
275	622 Dunstable Road, Luton, LU4 8SE	506044	222675	Residential	N
276	Longmeadow Community Farm, Sundon Road, Luton, LU4 9UA	503773	226133	Residential	N
277	5 Front Street, Luton, LU1 4BP	508010	218481	Residential	N
278	8 Millstone Way, Harpenden, AL5 5FE	514222	215639	Residential	N
279	BUPA St Marys Nursing Home, 19 Dunstable Road, Luton, LU1 1BE	508594	221429	Residential	Y
280	36 Tilehouse Street, Hitchin, SG5 2DY	518160	229044	Residential	N
281	7 Whitchurch Close, Luton, LU2 9RH	511659	222902	Residential	N
282	6 Mortimer Close, Luton, LU1 5RR	506966	221006	Residential	N
283	11 Pinford Dell, Luton, LU2 9SD	511765	222464	Residential	N
284	142 Luton Road, Dunstable, LU5 4LE	503449	222225	Residential	N
285	2 London Road, Hitchin, SG4 9EX	518704	228263	Residential	N
286	1 Skimpot Road, Luton, LU4 0JB	504393	222448	Residential	N
287	Hillside, Luton Road, Luton, LU4 9UB	503574	226178	Residential	N
288	2 Pondfarm Cottages, Hexton Road, Luton, LU2 8LX	511537	227204	Residential	N
289	34 Ditchling Close, Luton, LU2 8JR	511403	223104	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
290	18 Bank Close, Luton, LU4 9NX	505020	223749	Residential	Y
291	415 Hitchin Road, Luton, LU2 7SP	510083	222890	Residential	N
292	133 High Street North, Dunstable, LU6 1JN	501484	222301	Residential	N
293	16 The Mount, Luton, LU3 1BU	508864	221843	Residential	N
294	131 Eaton Valley Road, Luton, LU2 0SN	511000	221682	Residential	N
295	15 West Street, Dunstable, LU6 1SL	501818	221806	Residential	N
296	5 Farley Green Cottages, Luton, LU1 4AA	507859	219777	Residential	N
297	Manor Court, Luton Road, Luton, LU1 4AE	506613	219889	Residential	N
298	19 Felton Close, Luton, LU2 9TD	511842	222478	Residential	N
299	Dane Street Farm West, Dane Street, Luton, LU2 8PE	513306	220732	Residential	N
300	13A, Layham Drive, Luton, LU2 9SY	511944	222350	Residential	N
301	2A, Chertsey Close, Luton, LU2 9JD	511565	221886	Residential	N
302	1 Lister Avenue, Hitchin, SG4 9ES	518794	228146	Residential	N
303	1C, Crescent Road, Luton, LU2 0AB	509544	221645	Residential	N
304	192 Barton Road, Luton, LU3 3NH	508207	225964	Residential	N
305	Union Chapel House, 43 Castle Street, Luton, LU1 3AR	509183	220902	Residential	Y
306	13 Deep Denes, Luton, LU2 7SU	510147	223029	Residential	N
307	1 The Green, Luton, LU1 4HF	506311	219742	Residential	N
308	24 Rowington Close, Luton, LU2 9TZ	512361	222870	Residential	N
309	3 Silver Lion Cottages, Luton, LU2 8NL	512153	225957	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
310	Hill and Coles Farmhouse, London Road, St. Albans, AL3 8HA	508924	215546	Residential	N
311	68 Cutenhoe Road, Luton, LU1 3NF	509393	219894	Residential	N
312	Oak View, 1 Stockingstone Road, Luton, LU2 7FJ	510078	222699	Residential	N
313	1 Ivy Cottages, Luton, LU2 8NX	513174	222466	Residential	N
314	Kingsbury Court, Church Street, Dunstable, LU5 4ND	502109	221952	Residential	Y
315	373 Barton Road, Luton, LU3 3NS	507908	226824	Residential	N
316	138 Paynes Park, Hitchin, SG5 1AU	518202	229077	Residential	N
317	561 Dunstable Road, Luton, LU4 8QW	505926	222628	Residential	N
318	5 Brill Close, Luton, LU2 9RL	511765	222753	Residential	N
319	Egan House, 2 Cardiff Road, Luton, LU1 1PP	508697	221303	Residential	Y
320	Pirton Road, Hitchin, SG5 2EN	517314	228937	Residential	N
321	91A, High Street North, Dunstable, LU6 1JJ	501594	222186	Residential	N
322	3 Redding Lane, St. Albans, AL3 7QN	509092	214094	Residential	N
323	1 Woodford Road, Dunstable, LU5 4JS	503379	222312	Residential	N
324	1 Leygreen Close, Luton, LU2 0SQ	510475	221830	Residential	N
325	80 Ashcroft Road, Luton, LU2 9AX	510680	223622	Residential	N
326	Leagrave Primary School, Strangers Way, Luton, LU4 9ND	505193	223654	School	N
327	313 Ashcroft Road, Luton, LU2 9AA	511002	222779	Residential	N
328	30 Farley Hill, Luton, LU1 5HQ	508758	220544	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
329	1 Kiln Way, Dunstable, LU5 4GY	504425	222185	Residential	N
330	Hyde Mill Farm, Lower Luton Road, Luton, LU2 9PX	513260	217006	Residential	N
331	12 Beckbury Close, Luton, LU2 8UB	512406	222943	Residential	N
332	694 Dunstable Road, Luton, LU4 8SE	505643	222741	Residential	N
333	911A, Dunstable Road, Luton, LU4 0HR	504408	222503	Residential	N
334	3D, Hazelbury Crescent, Luton, LU1 1DF	508383	221629	Residential	N
335	105 High Street South, Dunstable, LU6 3SQ	502210	221568	Residential	N
336	22 Ashcroft Road, Luton, LU2 9AU	510484	223810	Residential	N
337	22A, Katherine Drive, Dunstable, LU5 4NT	503390	222525	Residential	N
338	38C, West Street, Dunstable, LU6 1TA	501733	221790	Residential	N
339	221 High Street South, Dunstable, LU6 3HY	502442	221312	Residential	N
340	1 Gardner Court, London Road, Luton, LU1 3SJ	509058	219779	Residential	N
341	5 Brandreth Avenue, Dunstable, LU5 4JP	503371	222262	Residential	N
342	290 Ashcroft Road, Luton, LU2 9AE	511020	222729	Residential	N
343	Common Farm, Luton Road, Luton,	502147	229892	Residential	N
344	102 Luton Road, Dunstable, LU5 4JW	503266	222163	Residential	N
345	30 Crawley Green Road, Luton, LU2 0QX	510051	221307	Residential	N
346	St. Aidans, Gosmore Road, Hitchin, SG4 9EZ	518631	228289	Residential	N
347	18 Keeble Close, Luton, LU2 9RT	512149	222233	Residential	N
348	45 Cutenhoe Road, Luton, LU1 3NB	509332	219875	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
349	Unity House, 111 Stuart Street, Luton, LU1 5FW	508749	221257	Residential	Y
350	18 Bramley Court, Luton Road, Dunstable, LU5 4GA	502735	222147	Residential	N
351	2H, Farley Hill, Luton, LU1 5ER	508906	220679	Residential	N
352	58 Upper Tilehouse Street, Hitchin, SG5 2EE	518013	229040	Residential	N
353	17 Chertsey Close, Luton, LU2 9JD	511487	221862	Residential	N
354	8 Woodford Road, Dunstable, LU5 4JS	503404	222298	Residential	N
355	211 Ashcroft Road, Luton, LU2 9AA	510642	223113	Residential	N
356	16 Polegate, Luton, LU2 8AJ	511854	222537	Residential	N
357	6 Barn Owl Close, Luton, LU1 5QZ	507893	219830	Residential	N
358	Crouchmore Farm, Luton, LU2 8PS	513538	222890	Residential	N
359	190 Farley Hill, Luton, LU1 5NU	508122	219982	Residential	N
360	19 Saywell Road, Luton, LU2 0QG	510614	222524	Residential	N
361	White Horse Tea Green, Stony Lane, Luton, LU2 8PS	513636	223212	Residential	N
362	52 Chertsey Close, Luton, LU2 9JD	511610	221906	Residential	N
363	Green Acres, Luton, LU2 8NZ	513595	222328	Residential	N
364	West End Farm, School Lane, Hitchin, SG5 3DA	514060	227467	Residential	N
365	15 Windmill Road, Luton, LU1 3XL	509846	221103	Residential	N
366	14 Tameton Close, Luton, LU2 8UX	512400	222900	Residential	N
367	2 Warren Lodge, Luton Hoo Estate, Luton, LU1 3TW	511810	218628	Residential	N
368	30A, Stuart Street, Luton, LU1 2SW	508900	221170	Residential	Y
369	265 Luton Road, Dunstable, LU5 4LR	503915	222339	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
370	Felt House, Laporte Way, Luton, LU4 8FN	507189	222030	Residential	N
371	The Beeches, Hemel Hempstead Road, St. Albans,	510721	206051	Residential	Y
372	16 Traherne Close, Hitchin, SG4 9DS	518984	228310	Residential	N
373	70 Castle Street, Luton, LU1 3AJ	509085	220740	Residential	N
374	3 Wimborne Road, Luton, LU1 1PD	508109	221661	Residential	N
375	7 Wyatt Court, Farley Fields, Luton, LU1 5FG	507792	219854	Residential	N
376	711 Dunstable Road, Luton, LU4 0DT	505202	222709	Residential	N
377	4 Felton Close, Luton, LU2 9TD	511906	222405	Residential	N
378	6 Pinford Dell, Luton, LU2 9SD	511823	222442	Residential	N
379	4 Hedges Way, Luton, LU4 9FD	504799	224115	Residential	N
380	5 Reston Path, Luton, LU2 9UU	512177	222729	Residential	N
381	83 Dunstable Road, Luton, LU1 4AL	505937	219486	Residential	N
382	406 Hitchin Road, Luton, LU2 7ST	510149	222759	Residential	N
383	1 Keeble Close, Luton, LU2 9RT	512125	222202	Residential	N
384	Wenlock Court, Manor Road, Luton, LU1 3FT	509663	220967	Residential	N
385	27 Wratten Road East, Hitchin, SG5 2AS	518131	228910	Residential	N
386	117 Poynters Road, Dunstable, LU5 4SQ	503866	222821	Residential	N
387	Challney High School for Boys, Stoneygate Rd, Luton, LU4 9TJ	505543	222942	School	N
388	41 Stevenage Road, Hitchin, SG4 9DW	519233	228231	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
389	39 Old Park Road, Hitchin, SG5 2JX	518091	229311	Residential	N
390	Windmill Cottage, Lilley Bottom, Hitchin, SG4 8LW	514690	223852	Residential	N
391	4 Coverly Court, Falconers Road, Luton, LU2 9BF	510982	222260	Residential	N
392	7 Primrose Court, Chiltern Road, Dunstable, LU6 1HH	501180	221584	Residential	N
393	18 Colwell Rise, Luton, LU2 9UA	512387	222361	Residential	N
394	Homelea, Lybury Lane, St. Albans, AL3 7JJ	509555	213170	Residential	N
395	1 Wyndham Road, Luton, LU4 0EA	505303	222809	Residential	Y
396	1A, Manor Road, Luton, LU1 4EE	506304	219719	Residential	N
397	120 Mancroft Road, Luton, LU1 4EN	506110	218890	Residential	N
398	Hill Rise, Luton Road, Hitchin, SG5 3DR	513386	226883	Residential	N
399	657A, Dunstable Road, Luton, LU4 8QR	505447	222712	Residential	Y
400	Ashridge, Luton, LU1 4LJ	508603	218071	Residential	N
401	178 Poynters Road, Luton, LU4 0LB	503879	222852	Residential	N
402	Lawn Cottage, Newlands Road, Luton, LU1 4BQ	508210	219401	Residential	N
403	161 Stevenage Road, Hitchin, SG4 9DX	519188	228277	Residential	N
404	69 Old Park Road, Hitchin, SG5 2JT	518135	229245	Residential	N
405	194 High Street South, Dunstable, LU6 3HS	502346	221382	Residential	N
406	Oakwood, Darley Hall, Luton, LU2 8PP	514207	222535	Residential	N
407	67 Dovehouse Hill, Luton, LU2 9ES	511041	222350	Residential	N
408	1 Falconers Road, Luton, LU2 9ET	510946	222208	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
409	640A, Hitchin Road, Luton, LU2 7UG	510447	223835	Residential	N
410	8 Rowington Close, Luton, LU2 9TZ	512473	222792	Residential	N
411	Flat 3, High Street North, Dunstable, LU6 1HX	501855	221880	Residential	Y
412	431 Hitchin Road, Luton, LU2 7SP	510060	222962	Residential	N
413	43 Bull Wood Cottages, London Road, Luton, LU1 4LA	509336	219036	Residential	N
414	3 Armitage Gardens, Luton, LU4 8RD	505547	222306	Residential	Y
415	Wandon End Farm, Luton, LU2 8NX	513309	222448	Residential	N
416	114 Manor Road, Luton, LU1 4HH	506503	219019	Residential	N
417	132 Kestrel Way, Luton, LU4 0UR	504436	224245	Residential	N
418	7 Brook Street, Luton, LU3 1DS	508749	221970	Residential	N
419	373A, Hitchin Road, Luton, LU2 7SP	510122	222750	Residential	N
420	1 Polegate, Luton, LU2 8AJ	511800	222640	Residential	N
421	9 Coles Lane, Harpenden, AL5 3DW	509158	216123	Residential	N
422	97 Luton Road, Dunstable, LU5 4LW	503254	222131	Residential	N
423	Dallow Primary School, Dallow Rd, Luton, LU1 1LZ	508300	221590	School	N
424	Telford Place, 1 Telford Way, Luton, LU1 1HT	508784	221700	Residential	Y
425	Chapel Street Student Halls, 21 Chapel Street, Luton, LU1 2SE	509081	220959	Residential	Y
426	385 New Bedford Road, Luton, LU3 2AB	508504	224286	Residential	N
427	306 Crawley Green Road, Luton, LU2 0SL	510859	222214	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
428	St. Ninians Court, Villa Road, Luton, LU2 7NU	508940	221745	Residential	N
429	Lower Harpendon Road, Luton, LU1 3PL	510798	220150	Residential	N
430	42 Ashcroft Road, Luton, LU2 9AU	510564	223749	Residential	N
431	2A, Chertsey Close, Luton, LU2 9JD	511565	221886	Residential	N
432	Lilley Bottom Farm, Lilley Bottom, Luton, LU2 8NH	513414	225090	Residential	N
433	7 Stevenage Road, Hitchin, SG4 9DH	518709	228372	Residential	N
434	17 Mardle Close, Luton, LU1 4EZ	506179	218911	Residential	N
435	725 Barton Road, Luton, LU3 3PX	507446	228523	Residential	N
436	158A, Dunstable Road, Luton, LU1 1EW	508219	221987	Residential	N
437	North Lodge, Putteridge Park, Luton, LU2 8LF	511511	225285	Residential	N
438	16 Darley Road, Hitchin, SG4 8PD	514679	222723	Residential	N
439	10 Heaton Dell, Luton, LU2 9TP	512374	222343	Residential	N
440	97 Crawley Green Road, Luton, LU2 0JU	510223	221575	Residential	N
441	Oakfield House, Luton Road, Luton, LU1 4AD	507177	219965	Residential	N
442	69 Hartsfield Road, Luton, LU2 9DX	510694	222532	Residential	N
443	7 Bagshawe Court, Farley Fields, Luton, LU1 5FJ	507705	219923	Residential	N
444	12 Priory Court, Church Street, Dunstable, LU5 4NA	502277	221945	Residential	N
445	61 Eldon Road, Luton, LU4 0AY	505388	222500	Residential	Y
446	26 Hitchin Road, Luton, LU2 0ER	509581	221711	Residential	N
447	486 Hitchin Road, Luton, LU2 7ST	510076	222979	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
448	42 Bull Wood Cottages, London Road, Luton, LU1 4LA	509339	219030	Residential	N
449	5A, Castle Street, Luton, LU1 3AA	509232	221084	Residential	N
450	4 Queensway Parade, Dunstable, LU5 4DW	501787	222055	Residential	N
451	2 Woodford Road, Dunstable, LU5 4JS	503398	222267	Residential	N
452	The Dower House, Stagenhoe Park, Hitchin, SG4 8BZ	518680	222734	Residential	N
453	113 West Street, Dunstable, LU6 1SG	501485	221687	Residential	N
454	London Road Gate Luton Hoo, London Road, Luton, LU1 4LE	509489	217660	Residential	N
455	124 Common Road, Dunstable, LU6 3RG	503357	218022	Residential	N
456	415 Luton Road, Harpenden, AL5 3QE	511431	216062	Residential	N
457	52 Old Bedford Road, Luton, LU2 7QB	508808	221960	Residential	N
458	218 Luton Road, Dunstable, LU5 4LF	503758	222324	Residential	N
459	7A, Guildford Street, Luton, LU1 2NQ	509401	221413	Residential	N
460	295 Hitchin Road, Luton, LU2 7SL	510030	222543	Residential	N
461	659 Hitchin Road, Luton, LU2 7UP	510500	224004	Residential	N
462	40 High Street South, Dunstable, LU6 3HA	501942	221786	Residential	Y
463	1A, Carisbrooke Road, Luton, LU4 8HD	506320	222297	Residential	N
464	50 Layham Drive, Luton, LU2 9SY	512076	222171	Residential	N
465	1 The Green, Luton, LU2 8PS	513632	223158	Residential	N
466	Sun Cottage, Darley Hall, Luton, LU2 8PP	514126	222483	Residential	N

ID	Address	X	Y	Type	AQMA (Y/N)
467	Someries Infant and Junior Schools, Wigmore Ln, Luton, LU2 8AH	511376	223029	School	N
468	370A, Hitchin Road, Luton, LU2 7SR	510106	222674	Residential	N
469	131 Dunstable Road, Luton, LU1 1BW	508366	221768	Residential	Y
470	5A, Cardiff Road, Luton, LU1 1PP	508719	221280	Residential	Y
471	786 Dunstable Road, Luton, LU4 0HE	505003	222694	Residential	N
472	Bottom Lodge, Luton, LU2 9PS	512928	217265	Residential	N
473	Endee Lodge, Gosmore Road, Hitchin, SG4 9AN	518565	228322	Residential	N
474	The Beeches, Hemel Hempstead Road, St. Albans,	511043	205716	Residential	N
475	Lodge Farm, Hitchin, SG4 8LL	514755	224260	Residential	N
476	29 Ashcroft Road, Luton, LU2 9AU	510588	223764	Residential	N
477	85 Kingsway, Luton, LU1 1TS	507276	221937	Residential	N
C1	Luton Hoo, The Luton Drive, Hyde, Luton, LU1 3TQ	510414	218661	Cultural Heritage	N
C2	Someries Castle, Someries, Luton, LU2 9GP	511944	220209	Cultural Heritage	N

2.4 Ecological receptors

2.4.1 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. 2.15). 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) 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*."

2.4.2 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.

2.4.3 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) and Veteran Trees within 200m of the ARN. A total of 36 ecological sites were selected for inclusion in the assessment and these are detailed in **Table 2.2**. 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 3**. These transects are included at the bottom of **Table 2.2**.

Table 2.2: Sensitive ecological receptors

ID	Site Name	X	Y	Designation
E1	Batford Springs	514627	215193	Local nature reserve
E2	Galley and Warden Hills	508093	226537	Site of Special Scientific Interest
E3	Galley and Warden Hills	508666	225556	Site of Special Scientific Interest
E4	Cowslip Meadow	508451	224649	Site of Special Scientific Interest
E5	Kingshoe Wood	500132	234283	Ancient Woodland
E6	Kingshoe Wood	500149	234097	Ancient Woodland
E7	Kingshoe Wood	500264	234030	Ancient Woodland
E8	Hipsey Spinney	503135	228235	Ancient Woodland
E9	Crab Apple (Coppice)	505500	219190	Veteran Trees
E10	Common Yew (Maiden)	506390	219820	Veteran Trees
E11	Dallow Downs and Winsdon Hill	506443	221510	Site of Special Scientific Interest
E12	Dallow Downs and Winsdon Hill	506930	220991	Site of Special Scientific Interest
E13	Badgerdell Wood	506410	221192	Ancient Woodland
E14	Field Maple	508760	218780	Veteran Trees
E15	Common Yew (Maiden)	507980	218470	Veteran Trees
E16	Kidney/Bulls Woods	509344	218684	Ancient Woodland
E17	Kidney/Bulls Woods	509169	219340	Ancient Woodland
E18	Chalk Wood	508884	217518	Ancient Woodland
E19	Rabbitfield Spring	509321	212679	Ancient Woodland

ID	Site Name	X	Y	Designation
E20	Bury Wood	509514	212147	Ancient Woodland
E21	Aspond Wood	511130	205363	Ancient Woodland
E22	Kidney/Bulls Woods	509946	219768	Ancient Woodland
E23	George Woods	511496	219366	Ancient Woodland
E24	Cricket Bat willow (Maiden)	514645	215025	Veteran Trees
E25	Stubbocks Wood	513883	223694	Ancient Woodland
E26	Furzen Wood	513998	224433	Ancient Woodland
E27	Slaughters Wood	511925	222846	Ancient Woodland
E28	Burnwell Spinneys	511022	227640	Ancient Woodland
E29	Smithcombe, Sharpenhoe and Sundon Hills	507467	229027	Site of Special Scientific Interest
E30	Church Wood	510337	230332	Ancient Woodland
E31	The Butts	510644	230072	Ancient Woodland
E32	Black mulberry	508604	230459	Ancient Trees
E33	Hitch/Hearnfield Wood	519470	222838	Ancient Woodland
E34	Pedunculate Oak	518230	222740	Ancient Trees
E35	Sweet Chestnut	518469	222544	Ancient Trees
E36	Winchill Wood	513685	221298	Ancient Woodland
E18_0	Chalk Wood Transect start	508884	217518	Ancient Woodland
E18_10	Chalk Wood Transect 10m	508894	217519	Ancient Woodland
E18_20	Chalk Wood Transect 20m	508904	217519	Ancient Woodland
E18_30	Chalk Wood Transect 30m	508914	217520	Ancient Woodland
E18_40	Chalk Wood Transect 40m	508924	217521	Ancient Woodland
E18_50	Chalk Wood Transect 50m	508934	217522	Ancient Woodland
E18_80	Chalk Wood Transect 80m	508964	217525	Ancient Woodland
E18_100	Chalk Wood Transect 100m	508984	217527	Ancient Woodland
E18_200	Chalk Wood Transect 200m	509084	217536	Ancient Woodland

ID	Site Name	X	Y	Designation
E22_T1_0	Kidney/Bulls Woods Transect start	509946	219768	Ancient Woodland
E22_T1_10	Kidney/Bulls Woods Transect 10m	509955	219765	Ancient Woodland
E22_T1_20	Kidney/Bulls Woods Transect 20m	509965	219762	Ancient Woodland
E22_T1_30	Kidney/Bulls Woods Transect 30m	509974	219759	Ancient Woodland
E22_T1_40	Kidney/Bulls Woods Transect 40m	509984	219756	Ancient Woodland
E22_T1_50	Kidney/Bulls Woods Transect 50m	509993	219752	Ancient Woodland
E22_T1_80	Kidney/Bulls Woods Transect 80m	510022	219743	Ancient Woodland
E22_T1_100	Kidney/Bulls Woods Transect 100m	510041	219736	Ancient Woodland
E22_T1_200	Kidney/Bulls Woods Transect 200m	510135	219704	Ancient Woodland
E22_T2_0	Kidney/Bulls Woods Transect 2 start	509390	219139	Ancient Woodland
E22_T2_10	Kidney/Bulls Woods Transect 2 10m	509395	219130	Ancient Woodland
E22_T2_20	Kidney/Bulls Woods Transect 2 20m	509400	219121	Ancient Woodland
E22_T2_30	Kidney/Bulls Woods Transect 2 30m	509405	219113	Ancient Woodland
E22_T2_40	Kidney/Bulls Woods Transect 2 40m	509410	219104	Ancient Woodland
E22_T2_50	Kidney/Bulls Woods Transect 2 50m	509415	219095	Ancient Woodland
E22_T2_80	Kidney/Bulls Woods Transect 2 80m	509430	219069	Ancient Woodland
E22_T2_100	Kidney/Bulls Woods Transect 2 100m	509440	219052	Ancient Woodland
E22_T2_200	Kidney/Bulls Woods Transect 2 200m	509489	218965	Ancient Woodland
E23_0	George Woods Transect start	511496	219366	Ancient Woodland
E23_10	George Woods Transect 10m	511504	219371	Ancient Woodland

ID	Site Name	X	Y	Designation
E23_20	George Woods Transect 20m	511513	219376	Ancient Woodland
E23_30	George Woods Transect 30m	511522	219381	Ancient Woodland
E23_40	George Woods Transect 40m	511530	219386	Ancient Woodland
E23_50	George Woods Transect 50m	511539	219391	Ancient Woodland
E23_80	George Woods Transect 80m	511565	219406	Ancient Woodland
E23_100	George Woods Transect 100m	511582	219416	Ancient Woodland
E23_200	George Woods Transect 200m	511669	219465	Ancient Woodland
E25_0	Stubbocks Wood Transect start	513883	223694	Ancient Woodland
E25_10	Stubbocks Wood Transect 10m	513877	223702	Ancient Woodland
E25_20	Stubbocks Wood Transect 20m	513871	223710	Ancient Woodland
E25_30	Stubbocks Wood Transect 30m	513866	223719	Ancient Woodland
E25_40	Stubbocks Wood Transect 40m	513860	223727	Ancient Woodland
E25_50	Stubbocks Wood Transect 50m	513854	223735	Ancient Woodland
E25_80	Stubbocks Wood Transect 80m	513836	223759	Ancient Woodland
E25_100	Stubbocks Wood Transect 100m	513824	223775	Ancient Woodland
E25_200	Stubbocks Wood Transect 200m	513766	223856	Ancient Woodland
E26_0	Furzen Wood Transect start	513998	224433	Ancient Woodland
E26_10	Furzen Wood Transect 10m	514001	224443	Ancient Woodland
E26_20	Furzen Wood Transect 20m	514004	224452	Ancient Woodland
E26_30	Furzen Wood Transect 30m	514007	224462	Ancient Woodland

ID	Site Name	X	Y	Designation
E26_40	Furzen Wood Transect 40m	514010	224471	Ancient Woodland
E26_50	Furzen Wood Transect 50m	514013	224481	Ancient Woodland
E26_80	Furzen Wood Transect 80m	514022	224509	Ancient Woodland
E26_100	Furzen Wood Transect 100m	514029	224528	Ancient Woodland
E26_200	Furzen Wood Transect 200m	514060	224623	Ancient Woodland
E27_0	Slaughters Wood Transect start	511925	222846	Ancient Woodland
E27_10	Slaughters Wood Transect 10m	511919	222855	Ancient Woodland
E27_20	Slaughters Wood Transect 20m	511914	222863	Ancient Woodland
E27_30	Slaughters Wood Transect 30m	511908	222872	Ancient Woodland
E27_40	Slaughters Wood Transect 40m	511903	222880	Ancient Woodland
E27_50	Slaughters Wood Transect 50m	511898	222889	Ancient Woodland
E27_80	Slaughters Wood Transect 80m	511882	222914	Ancient Woodland
E27_100	Slaughters Wood Transect 100m	511871	222931	Ancient Woodland
E27_200	Slaughters Wood Transect 200m	511817	223015	Ancient Woodland
E28_0	Burnwell Spinneys Transect start	510768	227679	Ancient Woodland
E28_10	Burnwell Spinneys Transect 10m	510778	227681	Ancient Woodland
E28_20	Burnwell Spinneys Transect 20m	510788	227683	Ancient Woodland
E28_30	Burnwell Spinneys Transect 30m	510797	227685	Ancient Woodland
E28_40	Burnwell Spinneys Transect 40m	510807	227687	Ancient Woodland
E28_50	Burnwell Spinneys Transect 50m	510817	227689	Ancient Woodland

ID	Site Name	X	Y	Designation
E28_80	Burnwell Spinneys Transect 80m	510846	227695	Ancient Woodland
E28_100	Burnwell Spinneys Transect 100m	510866	227698	Ancient Woodland
E28_200	Burnwell Spinneys Transect 200m	510964	227718	Ancient Woodland
E36_T1_0	Winchill Wood Transect start	513685	221298	Ancient Woodland
E36_T1_10	Winchill Wood Transect 10m	513682	221307	Ancient Woodland
E36_T1_20	Winchill Wood Transect 20m	513680	221317	Ancient Woodland
E36_T1_30	Winchill Wood Transect 30m	513677	221327	Ancient Woodland
E36_T1_40	Winchill Wood Transect 40m	513674	221336	Ancient Woodland
E36_T1_50	Winchill Wood Transect 50m	513671	221346	Ancient Woodland
E36_T1_80	Winchill Wood Transect 80m	513662	221374	Ancient Woodland
E36_T1_100	Winchill Wood Transect 100m	513656	221394	Ancient Woodland
E36_T1_200	Winchill Wood Transect 200m	513627	221489	Ancient Woodland
E36_T2_0	Winchill Wood Transect 2 start	513466	221316	Ancient Woodland
E36_T2_10	Winchill Wood Transect 2 10m	513472	221324	Ancient Woodland
E36_T2_20	Winchill Wood Transect 2 20m	513479	221331	Ancient Woodland
E36_T2_30	Winchill Wood Transect 2 30m	513485	221339	Ancient Woodland
E36_T2_40	Winchill Wood Transect 2 40m	513491	221346	Ancient Woodland
E36_T2_50	Winchill Wood Transect 2 50m	513498	221354	Ancient Woodland
E36_T2_80	Winchill Wood Transect 2 80m	513517	221377	Ancient Woodland
E36_T2_100	Winchill Wood Transect 2 100m	513530	221392	Ancient Woodland

ID	Site Name	X	Y	Designation
E36_T2_200	Winchill Wood Transect 2 200m	513595	221469	Ancient Woodland

Nitrogen and acid deposition

2.4.4 Data for Cowslip Meadow SSSI were obtained from the APIS website (Ref. 2.15). The habitat is characterised as grassland and the most sensitive feature has a minimum nutrient nitrogen critical load of 20kg N/ha/yr. The minimum background nitrogen deposition rate at this site is 21.7kg N/ha/yr as a three-year average (2017-2019). The minimum acidity critical load for nitrogen for the most sensitive feature at this site is 0.9keq/ha/yr and maximum is 4.9keq/ha/yr. The minimum background acid deposition rate for nitrogen is 1.6keq/ha/hr as a three-year average (2017-2019). The minimum acidity critical load for sulphur for the most sensitive feature at this site is 4.0keq/ha/yr and the minimum background acid deposition rate for sulphur is 0.2keq/ha/hr as a three-year average (2017-2019).

2.4.5 Data for Dallow Downs and Winsdon Hill SSSI were obtained from the APIS website (Ref. 2.15). The habitat is characterised as grassland and the most sensitive feature has a minimum nutrient nitrogen critical load of 15kg N/ha/yr. The minimum background nitrogen deposition rate at this site is 21.7kg N/ha/yr as a three-year average (2017-2019). The minimum acidity critical load for nitrogen for the most sensitive feature at this site is 0.9keq/ha/yr and maximum is 4.9keq/ha/yr. The minimum background acid deposition rate for nitrogen is 1.6keq/ha/hr as a three-year average (2017-2019). The minimum acidity critical load for sulphur for the most sensitive feature at this site is 4.0keq/ha/yr and the minimum background acid deposition rate for sulphur is 0.2keq/ha/hr as a three-year average (2017-2019).

2.4.6 Data for Galley and Warden Hills SSSI were obtained from the APIS website (Ref. 2.15). The habitat is characterised as grassland and the most sensitive feature has a minimum nutrient nitrogen critical load of 15kg N/ha/yr. The minimum background nitrogen deposition rate at this site is 19.5kg N/ha/yr as a three-year average (2017-2019). The minimum acidity critical load for nitrogen for the most sensitive feature at this site is 0.9keq/ha/yr and maximum is 4.9keq/ha/yr. The minimum background acid deposition rate for nitrogen is 1.4keq/ha/hr as a three-year average (2017-2019). The minimum acidity critical load for sulphur for the most sensitive feature at this site is 4.0keq/ha/yr and the minimum background acid deposition rate for sulphur is 0.2keq/ha/hr as a three-year average (2017-2019).

2.4.7 Data for Smithcombe, Sharpenhoe and Sundon Hills SSSI were obtained from the APIS website (Ref. 2.15). The habitat is characterised as grassland and the most sensitive feature has minimum nutrient nitrogen critical load of 15kg N/ha/yr. The minimum background nitrogen deposition rate at this site is 19.5kg N/ha/yr as a three-year average (2017-2019). The minimum acidity critical load for nitrogen for the most sensitive feature at this site is 0.9keq/ha/yr and maximum is 4.9keq/ha/yr. The minimum background acid deposition rate for nitrogen is 1.4keq/ha/hr as a three-year average (2017-2019). The minimum acidity critical load for sulphur for the most sensitive feature at this site is 4.0keq/ha/yr and the minimum background acid deposition rate for sulphur is 0.2keq/ha/hr as a three-year average (2017-2019).

2.4.8 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 2.3**.

Table 2.3: Sensitive ecological receptors

Designated site	Designation	Habitat	Nutrient nitrogen	
			Average background nitrogen deposition (kg N/ha/yr)	Minimum empirical critical load (kg N/ha/yr)
Aspond Wood	AW	Forest	31.4	10
Badgerdell Wood	AW	Forest	36.8	10
Batford Springs	LNR	Grassland	33.6	10
Black mulberry	Ancient Trees	Forest	36.4	10
Burnwell Spinneys	AW	Forest	32.5	10
Bury Wood	AW	Forest	35.8	10
Chalk Wood	AW	Forest	34.6	10
Church Wood	AW	Forest	32.1	10
Common Yew (Maiden)	Veteran Trees	Forest	34.6	10
Cowslip Meadow SSSI	SSSI	Grassland	21.7	20
Crab Apple (Coppice)	Veteran Trees	Forest	34.6	10
Cricket Bat willow (Maiden)	Veteran Trees	Forest	33.6	10
Dallow Downs and Winsdon Hill SSSI	SSSI	Grassland	21.7	15
Field Maple	Veteran Trees	Forest	34.6	10
Furzen Wood	AW	Forest	34	10
Galley and Warden Hills SSSI	SSSI	Grassland	19.5	15
George Woods	AW	Forest	33.6	10

Designated site	Designation	Habitat	Nutrient nitrogen	
			Average background nitrogen deposition (kg N/ha/yr)	Minimum empirical critical load (kg N/ha/yr)
Hipsey Spinney	AW	Forest	36.1	10
Hitch/Hearnfield Wood	AW	Forest	31.4	10
Kidney/Bulls Woods	AW	Forest	34.6	10
Kingshoe Wood	AW	Forest	34.3	10
Pedunculate Oak	Ancient Trees	Forest	31.4	10
Rabbitfield Spring	AW	Forest	35.8	10
Slaughters Wood	AW	Forest	34	10
Smithcombe, Sharpenhoe and Sundon Hills SSSI	SSSI	Grassland	19.5	15
Stubbocks Wood	AW	Forest	34	10
Sweet Chestnut	Ancient Trees	Forest	31.4	10
The Butts	AW	Forest	32.1	10
Winchill Wood	AW	Forest	34	10

2.5 Assessment scenarios

2.5.1 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 PEIR for the Core Planning Case are as follows.

a. Baseline (2019), there were 18 million passengers per annum (mppa).
b. 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 Phase 1.
c. 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 Phase 2a.
d. 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 Phase 2b.

2.5.2 It is considered the years assessed in the PEIR 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 year), 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.

2.5.3 The Faster and Slower growth scenarios detailed in **Chapter 5** in Volume 2 of the PEIR is qualitatively assessed for air quality and summarised in **Chapter 7** in Volume 2 of the PEIR. A quantitative assessment of the operational year of 2027 for the Faster growth scenario was undertaken and the conclusions are summarised in **Chapter 7** in Volume 2 of the PEIR and the results are detailed in **Appendix 7.3** in Volume 3 of the PEIR.

2.6 Emission inventory methodology

Sources of emissions

2.6.1 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).

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

Aircraft emissions during LTO cycle

2.6.3 The ICAO Airport Air Quality Manual (Ref. 2.8) 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.

2.6.4 Aircraft emissions were calculated up to a height of 915m. However, the ICAO manual (Ref. 2.8) and Department for Transport guidance (Ref. 2.16) 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.

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

2.6.6 The detailed fleet data for 2019 was further used to derive the runway utilisation, which is presented in **Table 2.4** (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. 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 2.4: Runway use

Runway direction (bearing)	Air Transport Movements (ATMs)	% of total
07 operation (70°)	41,814	29.7%
25 operation (250°)	99,088	70.3%

Fixed Wing Aircraft

2.6.7 The detailed aircraft movement data provided by the aviation consultants was used to identify the main types of aircraft and helicopters that used the airport in 2019. Forecast aircraft movement data was also provided by the aviation consultants (**Table 2.5**). 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.

2.6.8 For each MCAT, information on the climb and approach profiles were obtained from AEDT software (Ref. 2.9). This was used to derive speeds and time in mode for take-off, initial climb, climb out and approach.

2.6.9 From the annual aircraft movements recorded at the airport in 2019, 14 fixed wing aircraft modelling categories (MCATs) were defined for the assessment. **Table 2.6** presents the MCATs and the aircraft type in each. **Table 2.7** presents the MCAT proportions of the fleet. Emissions were calculated for the engines for each aircraft type in each MCAT.

2.6.10 Turbofan engine emission factors of NOx and fuel consumption rates were taken from the ICAO aircraft engine emissions databank (Ref. 2.7).

2.6.11 Emissions of pNO_2 were derived using the fractions described in the Project for Sustainable Development of Heathrow (PSDH) methodology (Ref. 2.17). 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.

2.6.12 For piston engines, pollutant emission and fuel flow indices were taken from the FOCA database (Ref. 2.11) and for turboprop engines from the FOI confidential database (Ref. 2.10).

2.6.13 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. 2.8).

2.6.14 In relation to $PM_{2.5}$ emissions, the EMEP/EEA guidebook (Ref. 2.13) 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.

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

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

2.6.16 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 2.5: Aircraft ATM forecasts

Aircraft	2027 ATMs		2039 ATMs		2043 ATMs	
	DM	DS	DM	DS	DM	DS
Commercial Aircraft						
Airbus A319	150	150	0	0	0	0
Airbus A320	18,420	21,570	0	0	0	0
Airbus A320Neo	43,690	51,140	60,790	71,400	60,790	75,640
Airbus A321	11,050	12,940	0	0	0	0
Airbus A321neo	14,210	16,640	26,710	44,470	26,710	54,840
Airbus A350-900	0	0	0	630	0	630
Boeing 737-400	570	570	0	0	0	0
Boeing 737-800	12,110	14,170	4,280	4,280	4,250	3,040
Boeing 737-900W	530	620	0	0	0	0
Boeing 737-Max10	0	0	0	2,510	0	5,040
Boeing 737-Max8	5,790	6,780	14,540	19,420	14,570	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	1,150	1,150	0	0	0	0
Airbus A330-200F	0	0	1,150	1,150	1,150	1,150
Boeing-757-200F	580	580	0	0	0	0
Business and General Aviation Aircraft						
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

Aircraft	2027 ATMs		2039 ATMs		2043 ATMs	
	DM	DS	DM	DS	DM	DS
Cessna 680 Sovereign	7,450	7,450	7,450	7,450	7,450	7,450
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 2.6: 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)	
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)
HELI	Helicopters	Agusta 109 Helicopter	
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.			

Table 2.7: MCAT fleet composition (ATMs)

MCAT	2019	2027 DM	2027 DS	2039 DM	2039 DS	2043 DM	2043 DS
1	32	-	-	-	-	-	-
2	24,896	28,150	28,150	28,150	28,150	28,150	28,150
3	832	550	550	550	5,560	550	4,960
4	18,394	13,360	15,510	4,280	4,280	4,250	3,040
5	65,748	18,570	21,720	-	-	-	-
6	18,922	11,050	12,940	-	-	-	-
7	1,414	580	580	-	-	-	-
8	1,914	1,150	1,150	1,150	1,150	1,150	1,150
9	40	-	-	-	3,760	-	7,560
10	1,162	-	-	-	-	-	2,520
11	102	-	-	-	-	-	-
12	6,013	43,890	51,340	61,140	71,750	61,140	75,990
13	1,434	14,210	16,640	26,710	45,100	26,710	55,470
14	-	5,990	6,980	15,520	22,910	15,550	29,970
HELI	578	600	600	600	600	600	600
Total	141,481	137,500	155,560	137,500	182,660	137,500	208,810

2.6.17 For the approach of the arriving aircraft, emissions were calculated in two segments: upper approach from 915m (3,000ft) to 457m (1,500ft) and final approach from 457m to the ground. Emissions were calculated using a 15%

thrust for upper approach and 30% thrust for final approach. For the dispersion model, only emissions from the final approach were included, since emissions above 457m would have a negligible impact on ground level concentrations. Approach profiles for individual aircraft types were obtained from AEDT (Ref. 2.9) software, which were used to derive the travelling speed, distance and time-in-mode. **Table 2.8** presents the final approach parameters included in the model for the representative aircraft in each MCAT.

Table 2.8: Final approach model parameters

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
1	46.9	37.1	8,724	211
2 (Baseline)	41.1	0.0	8,602	218
2 (Future)	55.4	49.7	8,724	167
3 (Baseline)	33.6	27.7	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
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

2.6.18 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. 2.9) for the representative aircraft in each MCAT, ranging from four to 26 seconds.

2.6.19 Brake and tyre wear during landing were represented in the model as volume sources (**Figure 7.5**). PM_{10} emission rates were calculated following the PSDH methodology as amended in the 2005/6 emissions inventory for Gatwick Airport (Ref. 2.18). 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]*

2.6.20 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. 2.18).

2.6.21 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.

2.6.22 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. 2.19) 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.

2.6.23 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 2.9** presents the take-off parameters included in the model for the lead aircraft in each MCAT.

Table 2.9: Take-off model parameters

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
1	0.0	32.5	400	24
2 (Baseline)	0.0	40.9	1,503	73
2 (Future)	0.0	61.1	811	24
3 (Baseline)	0.0	41.7	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

2.6.24 For the climb phase of the arriving aircraft, emissions were calculated in two segments: initial climb from the ground up to 457m and climb out from 457m to 915m. Emissions were calculated using an 85% thrust for initial climb, consistent with the take-off thrust, and 78% thrust for climb out, as recommended by the PSDH methodology. For the dispersion model, only emissions from the initial climb were included, since emissions above 475m would have a negligible impact on ground level concentrations. AEDT provided details of climb profiles for individual aircraft types. **Table 2.10** presents the initial climb parameters included in the model for the representative aircraft in each MCAT.

Table 2.10: Initial climb model parameters

MCAT	Initial speed (m/s)	Final speed (m/s)	Ground distance (m)	Time (s)
1	32.5	55.9	6,967	143
2 (Baseline)	40.9	61.1	3,972	70
2 (Future)	61.1	67.5	2,684	40
3 (Baseline)	41.7	48.0	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
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

2.6.25 **Figure 7.6** to **Figure 7.26** 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

2.6.26 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.

2.6.27 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.

2.6.28 Emissions were calculated for an Agusta A109 helicopter, which was the most frequent in 2019, using the FOCA guidance (Ref. 2.12) and modelled in the middle of the runway. The Agusta A109 was also forecast as the only helicopter in the future years. **Table 2.11** presents the power setting, shaft horsepower and time used for each mode to calculate the emissions. **Table 2.12** 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 (using the .fac file) was used to apportion movements across the year as shown in **Inset 2.1**, based on the 2019 data.

2.6.29 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.

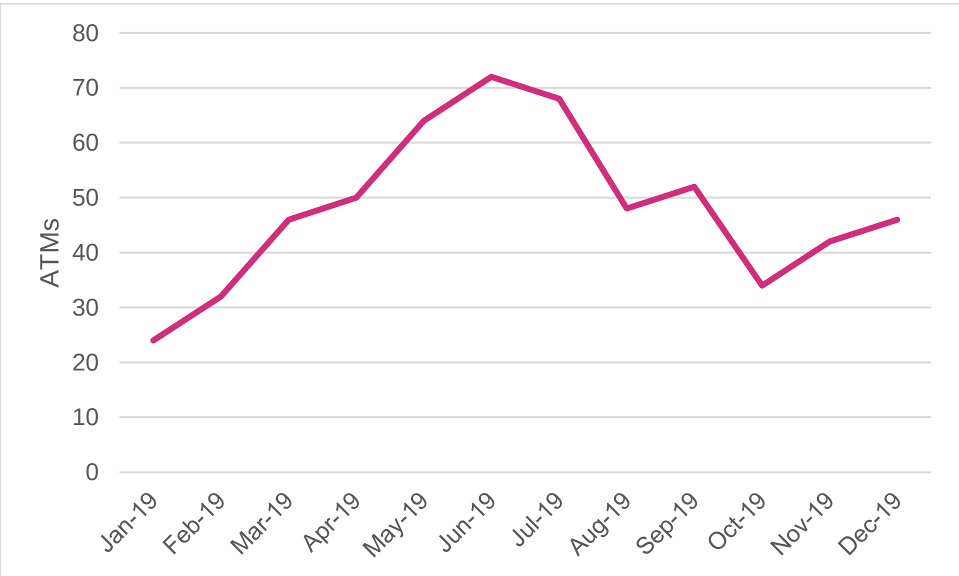
Table 2.11: Helicopter parameters for emission calculations

Mode	Power	Shaft horsepower	Time (min)
Idle	7%	46	5
Take-off and climb	78%	507	3
Approach	38%	247	5.5

Table 2.12: Helicopter emission indices and fuel flow

Mode	Fuel flow (kg/s)	NOx (g/kg)	PM10 (g/kg)
Idle	0.01	1.85	0.12
Take Off	0.04	7.25	0.21
Approach	0.02	4.82	0.16

Inset 2.1: Monthly profile for helicopter use



Auxiliary power units (APUs)

2.6.30 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.

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

2.6.32 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 2.13** 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. 2.20). Emissions were factored for each hour of the year using the .hfc file created for the aircraft movements.

2.6.33 **Figure 7.27** presents the modelled sources for the APUs at the stands. The APUs were modelled as volume.

2.6.34 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 2.13: APU emission factors

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	A306	TSCP 700-5	1.73	0.11	
9	B788	Hamilton Sundstrand APS5000	1.04	0.06	

MCAT	Code		APU	NOx (kg/hour)	PM_{10} (kg/hour)
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

2.6.35 Engine testing occurs at the Engine Run Up Bay (ERUB) shown in **Figure 7.28**. A total of 313 tests during 2017 were recorded. 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.

2.6.36 In the future scenarios, the total number of tests was assumed to increase in line with the growth in ATMs. **Table 2.14** show the figures used and **Figure 7.29** provides the locations.

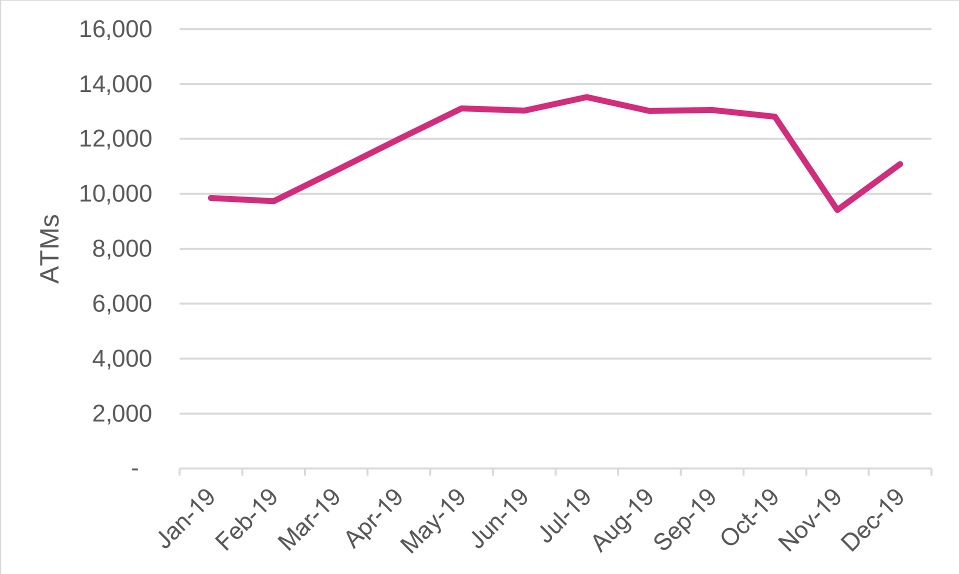
2.6.37 The emissions were calculated using the same approach as for the aircraft in the LTO cycle. The average test cycle assumed was 10mins at 100% thrust and 25mins at 7% (idle) thrust.

2.6.38 Engine testing was assumed to be spread temporally between 06:00-23:00, in line with LLAOL operating instructions (Ref. 2.21). A monthly profile was applied to the emissions based on the 2019 ATM distribution as shown in **Inset 2.2**. The engine tests were included in the model as volume sources with a height of 5m.

Table 2.14: 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	406	319	486

Inset 2.2: Monthly profile of engine testing



Fire training ground

2.6.39 The fire training ground is currently located to the east of the airport as shown in **Figure 7.28**. 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. 2.6) and converted for use in the assessment (**Table 2.15**). 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 2.15**.

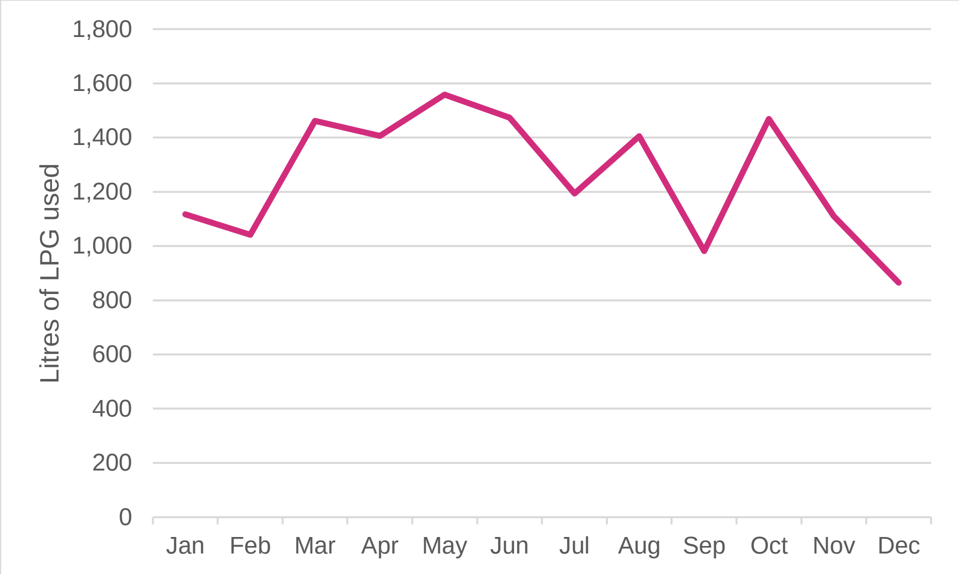
2.6.40 LLAOL provided information on the typical operating times of the fire training ground. Typically, they would operate between 10:00-12:30 for day-time exercises and between 20:00-22:00 for night exercises. LLAOL also provides the fuel used per month. This information was used to derive a monthly use profile for the fire training ground. This was reflected in the modelling using a monthly (**Inset 2.3**) and diurnal profile. The fire training ground was included in the model as a volume source with a height of 10m.

2.6.41 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 shown in **Figure 7.29**.

Table 2.15: 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 2.3: Monthly profile for the LPG used at the fire training ground



Ground Support Equipment (GSE)

2.6.42 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, 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.

2.6.43 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 2.16**.

2.6.44 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 2.17**. 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.

2.6.45 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's operations safety instructions (Ref. 2.21), which states the maximum speed limit of 20mph.

2.6.46 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) which would have lower emissions.

2.6.47 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**.

Table 2.16: GSE fleet fuel use

GSE type	Euro Class/Stage	Diesel (litres)
Passenger cars	1	3,911
	2	11,734
	3	5,872
	4	14,483
	5	6,636
Light commercial	2	440
	3	10,799
	4	37,439
	5	30,599
	6	23,738
Heavy duty	III	19,443
	IV	2,601
	V	21,466
	VI	202,484
NRMM	IIIA	284,152
Total		**675,797**

Table 2.17: Emission factors for GSE

Vehicle	Emission factor	
	NOx	PM_{10}
NRMM (g/tonnes)		
Stage IIIA	15,653	950
Road vehicles (g/km)		

Vehicle	Emission factor	
	NOx	PM_{10}
Car (Euro 1)	0.67	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)	0.66	<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)	0.96	<0.01
HGV (Euro III)	6.43	0.16
HGV (Euro IV)	4.24	0.03
HGV (Euro V)	6.07	0.04
HGV (Euro VI)	0.50	<0.01

Ground Power Units (GPUs)

2.6.48 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. 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.

2.6.49 LLAOL also provided the make and model of the GPUs which were diesel-fuelled Guinault GA100 units. 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 2.18**. The fraction NOx that was pNO_2 was assumed to be the same as the fraction for a Euro 3 HGV or bus, 14% (taken from the NAEI).

2.6.50 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.

2.6.51 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. Therefore, the GPU emissions assumed for the DS future scenarios are conservative.

Table 2.18: Emission factors for GPUs

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

Energy and Heating Combustion Plant

2.6.52 Details of the energy and heating plant were provided by LLAOL and are presented in **Table 2.19** and the locations are shown in **Figure 7.30**. 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 2.4** 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 information to inform the profile of usage. Therefore, the monthly total natural gas consumption profile was applied to all the energy and heating plant.

2.6.53 The fuel serving specific buildings were apportioned to the plant located at the 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.

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

2.6.55 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 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 and solar water heating panels would be installed on the roof, as well as ground source heating and cooling systems under the Proposed Development to deliver a source of sustainable energy.

2.6.56 The model input parameters for the boiler and generator locations are provided in **Table 2.20**.

Table 2.19: Details of the heating and energy plant in 2019

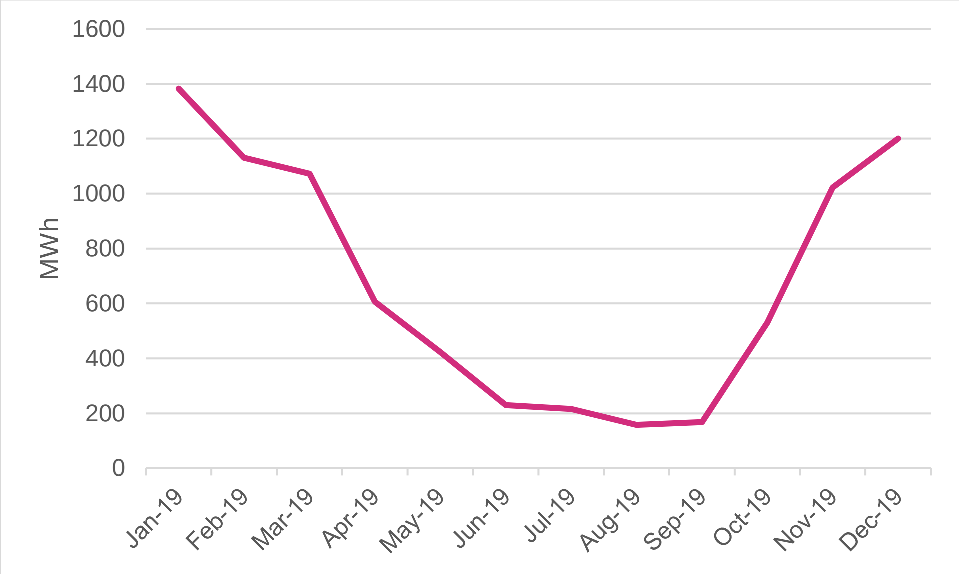
Plant type	Location	Thermal input (kW)	Fuel type
Boiler 1	T1 (Old Terminal Building)	1,050	Natural gas
Boiler 2	T1 (Old Terminal Building)	1,050	Natural gas

Plant type	Location	Thermal input (kW)	Fuel type
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
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.			

Table 2.20: Model input parameters of boilers and generators

Sources	OS coordinates of centroid (X, Y)	Height (m)	Velocity (m/s)	Temperature (℃)
Boiler 1	511838, 221463	12.0	1.0	100
Boiler 2	511838, 221463	12.0	1.0	100
Boiler 3	511891, 221488	30.0	0.7	100
Boiler 4	511891, 221488	30.0	0.7	100
Boiler 5	511891, 221488	30.0	0.8	100
Boiler 6	511911, 220950	3.4	-	100
Boiler 7	511911, 220950	3.4	-	100
Boiler 8	511911, 220950	3.4	-	100
Boiler 9	511359, 221462	2.5	0.1	100
Boiler 10	511359, 221462	2.5	0.1	100
Boiler 11	511976, 221901	7.0	0.1	100
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	-	-
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*	-	2.0	-	-
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 2.4: Gas consumption (MWh) for boilers (2019)



Traffic Data

2.6.57 Traffic data has been provided for the air quality assessment by the surface access team. Traffic data provided represents the average conditions occurring in four specific time periods (morning peak, inter-peak, afternoon peak and off-peak). For the time periods in **Table 2.21** 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 2.21: 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)

2.6.58 Modelled speeds were reduced to 20kph at junctions following the LAQM guidance (Ref. 2.22).

2.6.59 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. 2.23). The EFT only forecasts emissions up to 2030. Therefore, for the 2039 and 2043 scenarios, 2030 factors have been used.

2.6.60 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**.

2.6.61 Two sets of traffic data for each 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 (Core traffic data). The results have been reported in **Appendix 7.3** in Volume 3 of the PEIR.

Construction Traffic

2.6.62 Construction traffic data for the construction period was provided by the constructability team. Phase 1 construction traffic is predicted to occur from 2025 to 2027; Phase 2a from 2033 to 2036; and Phase 2b from 2037 to 2040.

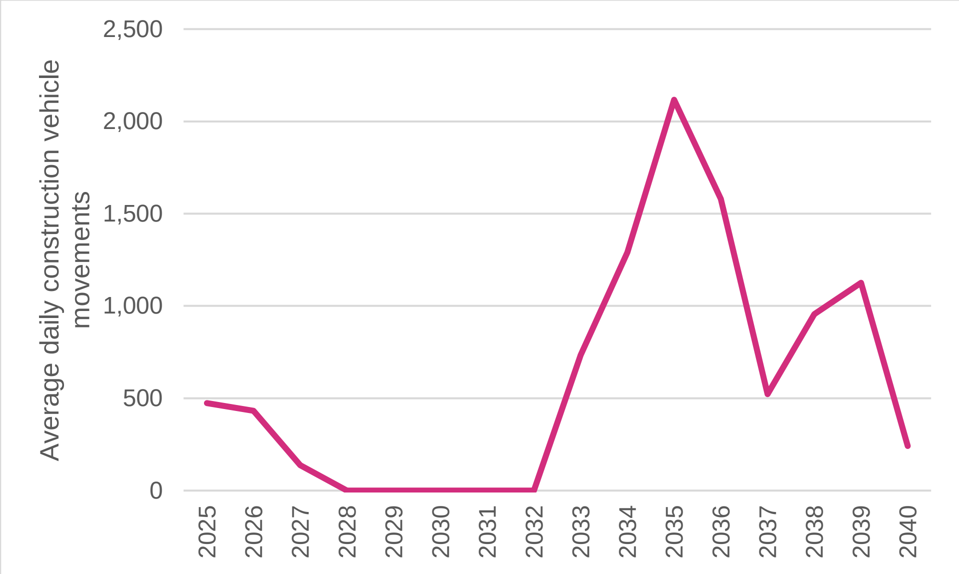
2.6.63 The year with peak construction traffic movements for each Phase have been used in the assessment. For example, the data shows that 2035 is the year when peak construction traffic movements are predicted to occur across all stages, considering both the operatives (construction-related workers) and construction-related delivery vehicle movements. This would occur in 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 (unless after 2030, in which case 2030 factors have been used) from the latest version of the Defra EFT. This combines the peak construction traffic with the peak operational traffic within the Phase, which is considered to create a worst-case scenario, in terms of total volumes of traffic and emissions.

2.6.64 A summary of the construction traffic data assessed in provided in **Table 2.22**. The total average daily traffic flow predicted as a result of the construction phase is shown in **Inset 2.5**.

Table 2.22: Summary of total construction traffic assessed

Assessment scenario	Peak construction year	AADT	HDV%
Phase 1 (2027 DS)	2025	474	44.3
Phase 2a (2039 DS)	2035	2,117	20.1
Phase 2b (2043 DS)	2039	1,125	24.3

Inset 2.5: Construction traffic movements



2.6.65 The 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. The full route is shown in **Figure 7.31**.

Car Parks

2.6.66 Information on the number of spaces per car park (existing and future) were provided by the design team. Information provided by LLAOL 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.

2.6.67 Emissions were calculated in accordance with the Cambridge Environmental Research Consultants (CERC) note on modelling car parks (Ref. 2.24).

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

2.6.69 **Table 2.23** shows the details of the car parks modelled, spaces and movements for each modelled year. The location of the car parks is shown in **Figure 7.32** to **Figure 7.35**.

Table 2.23: 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	-	-	-	839	-	-	-

ID	Name	Spaces				Daily movements			
		2019 and DM	2027	2039	2043	2019 and DM	2027	2039	2043
2	Car Hire existing 1	650	-	-	-	270	-	-	-
3	TUI existing	500	437	-	-	577	577		
4	Staff overflow	320	414	-	-	133	320		
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	293	293	293	358	358	358	358
11	Existing small 2	370	273	273	273	426	426	426	426
12	Existing small 3	195	207	207	207	225	225	225	225
13	Existing small 4	148	176	176	176	171	171	171	171
14	Existing small 5	109	146	146	146	126	126	126	126
15	ATC/staff	130	126	126	126	150	150	150	150
16	Existing small 6	168	193	193	193	194	194	194	194
P1	MSCP (tiered)	-	-	1,070	1,059	-	-	1,234	1,222
P2	Surface parking (trailer)	-	-	481	477	-	-	555	550
P3	Block parking (mid-stay)	-	1,866	1,818	1,801	-	776	756	749
P4	MSCP	-	4,077	3,972	3,935	-	4,704	4,583	4,539
P5	Deck surface parking	-	2,690	1,283	1,271	-	3,103	1,481	1,467
P6	Block parking	-	1,372	1,733	-	-	1,583	1,999	-
P7	Surface parking	-	3,255	1,524	-	-	3,755	1,758	-
P8	Surface parking	-	-	642	-	-	-	740	-

ID	Name	Spaces				Daily movements			
		2019 and DM	2027	2039	2043	2019 and DM	2027	2039	2043
P9	Deck and surface parking	-	2,207	2,150	2,129	-	2,546	2,480	2,457
P10	Surface parking	-	-	1,230	3,353	-	-	1,419	3,868
P11	Block parking	-	-	2,888	5,551	-	-	3,332	6,405
P12	MSCP	-	-	-	2,357	-	-		2,719
P13	Surface parking	-	933	909	901	-	1,077	1,049	1,039

2.7 Model setup and verification

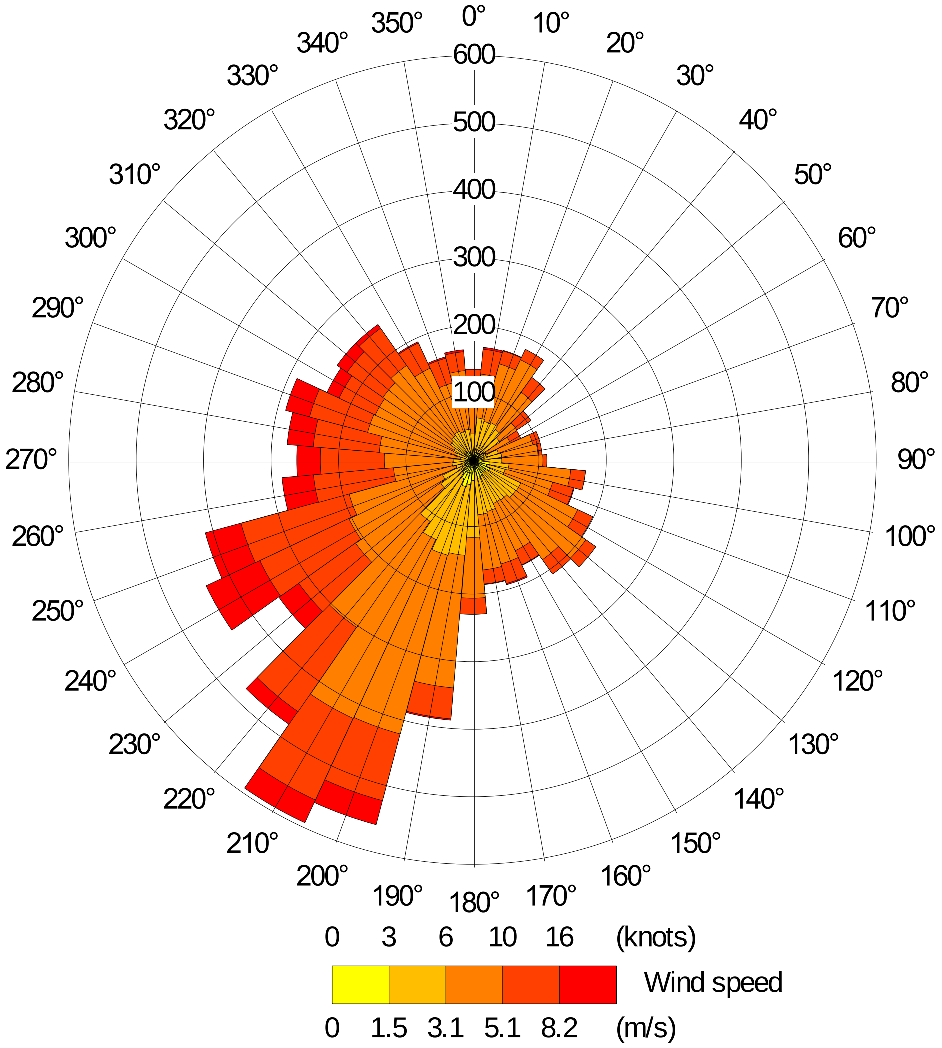
Meteorological Data

2.7.1 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. 2.25) in model-ready format for one year (2019).

2.7.2 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(16) 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%.

2.7.3 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 2.6** identifies the predominant wind direction as south-westerly.

Inset 2.6: The airport 2019 wind rose



Other Parameters

2.7.4 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.

2.7.5 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

2.7.6 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.

2.7.7 The method taken for this conversion in the assessment follows the approach described by Clapp and Jenkin (Ref. 2.26), 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.

Terrain

2.7.8 Terrain has not been included in the modelling for the PEIR. Sensitivity tests will be carried out for the ES and results with terrain presented in the ES.

Model Verification

2.7.9 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 principles laid out in Section A3.223 of LAQM TG(16) (Ref. 2.22). 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.

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

2.7.11 LAQM TG(16) 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.

2.7.12 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.

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

2.7.14 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(16) 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.

2.7.15 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** in Volume 3 of the PEIR.

2.7.16 The outcome of the model verification exercise is reported in **Appendix 7.2** in Volume 3 of the PEIR.

3 SIGNIFICANCE CRITERIA

3.1 Assessment of impacts at human receptors

3.1.1 For the assessment of long-term impacts and significance at sensitive human receptors, the approach described in the EPUK/IAQM guidance (Ref. 3.27) is used. This is best practice for undertaking air quality assessments.

3.1.2 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 3.1**).

Table 3.1: 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%	Major	Major	Major	Moderate	Moderate
Medium	6-10%	Major	Major	Moderate	Moderate	Minor
Low	2-5%	Major	Moderate	Moderate	Minor	Negligible
Very low	1%	Moderate	Moderate	Minor	Negligible	Negligible

3.1.3 Slight and substantial impacts from the EPUK/IAQM guidance have been called ‘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, ‘**major’** or ‘**moderate’** impacts are usually judged to result in **significant effects** in the absence of additional factors, and ‘**minor’** or ‘**negligible’** impacts usually result in effects which are **not significant**.

3.1.4 The guidance also provides advice for determining the magnitude of change for hourly mean NO_2 concentrations, which is shown in **Table 3.2**. The impact descriptor is determined by considering the process contribution only. However, in assessing the significance, consideration is also given to total pollutant concentrations, including background concentrations, and comparison of these with the hourly mean NO_2 objective.

Table 3.2: Magnitude of change for hourly mean NO_2 concentrations

Change in hourly mean concentrations at receptor in the assessment year	Magnitude of Change	Impact Descriptor
<10% of hourly mean NO_2 threshold	Imperceptible	Negligible
10-20% of hourly mean NO_2 threshold	Small	Slight
20-50% of hourly mean NO_2 threshold	Medium	Moderate
>50% of hourly mean NO_2 threshold	Large	Substantial

3.1.5 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.

3.1.6 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 not result in a significant effect.

3.2 Assessment of impacts at ecological receptors

3.2.1 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. 3.28) (Ref. 3.29). Information on sensitive habitats for the designated sites has been taken from the APIS website (Ref. 2.15) in consultation with the Project ecologists.

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

3.2.3 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.

3.2.4 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.

3.2.5 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. For the PEIR, ammonia emissions from road traffic were not calculated. Consultation with Natural England on the method for assessing ammonia emissions for the ecological sites will be carried out and any updates to the methodology will be included in the ES. Ammonia is only emitted from road vehicles as a by-product of the diesel engine gas treatment; it is not emitted from aircraft engines.

3.2.6 For an assessment of nitrogen deposition, NOx has first been converted to NO_2 using the Clapp and Jenkin approach (Ref. 2.26), 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); and
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).

3.2.7 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 1 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. 3.28) (Ref. 3.29).

3.2.8 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.

3.2.9 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.

4 ODOUR IMPACT METHODOLOGY

4.1.1 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. 4.30) 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.

4.1.2 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.

4.1.3 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.

4.1.4 There is no relevant guidance for assessment of odours in an internal environment, however, the IAQM guidance on Odours (Ref. 4.31) 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 requested and will be used to inform the assessment in the ES if available.

4.2 Source pathway receptor assessment

4.2.1 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).

4.2.2 The IAQM guidance suggests that the following factors are considered for the SPR as shown in **Table 4.1**. This approach has been used for the assessment of baseline and future operations at the airport.

Table 4.1: 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.

4.3 Sniff testing

4.3.1 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. Sniff tests are designed to assess the odour impact by recording some or all of the Frequency, Intensity, Duration, Offensiveness and Receptor Sensitivity (FIDOR) factors, along with any aggravating characteristics.

4.3.2 Sniff testing was undertaken on four separate dates. All staff doing sniff testing have undertaken acuity tests and each of them is within the acceptable range. In addition, the weather forecast had been considered prior to the surveys. This is to ensure sniff tests were carried out under appropriate weather conditions, for instance wind directions, wind speed, amount of rainfall and temperature prior to the surveys were considered.

4.3.3 The sniff testing followed the methodology contained in Appendix 1 of the EA's H4 Guidance (Ref. 4.32). In accordance with the guidance it was ensured that the assessor 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 assessor 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.

4.3.4 Sniff testing was undertaken for a period of five minutes per monitoring location. Wind speed and direction were observed by the assessors throughout the survey periods and recorded to allow subsequent analysis and identification of emission sources to be undertaken. Additional information at each monitoring location was recorded regarding the following:

a. location of test;
b. weather conditions, such as cloud coverage;

c. temperature;
d. whether any odour was constant or intermittent;
e. the character of the odour, including the intensity, persistence and a description of the odour;
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 or industrial practices, that could be either the source, a contributor to, or a confounding factor in a particular odour event.

4.3.5 The scores for the intensity and offensiveness of the odour were determined using the criteria in **Table 4.2**.

Table 4.2: 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

Sniff test locations

4.3.6 All field odour survey forms completed during the survey are contained in **Appendix 7.2** in Volume 3 of the PEIR. **Table 4.3** presents the sniff test locations. Locations were selected at publicly accessible locations around the airport.

Table 4.3: 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

Location ID	Location description	OS Grid reference	
		X	Y
5	Vauxhall Way	511057	221386
6	Luton Parkway Station Exit (North)	510552	220660

5 HEALTH IMPACT ASSESSMENT METHODOLOGY

5.1.1 The air quality assessment will determine the population affected by significant concentrations. This is considered in **Chapter 13** of Volume 2 of this PEIR and will be included in the ES.

6 ASSUMPTIONS AND LIMITATIONS

Table 6.1: Summary of assumptions and limitations

Source	Assumptions and limitations
Fixed wing aircraft	Emissions of pNO2 were derived using the fractions described in the Project for the Sustainable Development of Heathrow (PSDH) (Ref. 1.17) air quality methodology; these were 4.5% pNO2 at 100% thrust, 5.3% at 85% thrust, 15% at 30% thrust and 37.5% at 7% thrust. For intermediate thrust settings, the pNO2 fractions were derived linearly.
Fixed wing aircraft	Emissions of PM10 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. 1.8). For turboprop engines, smoke number indices are not available in the FOI database, therefore, it was assumed that PM10 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 PM10 assumed to be PM2.5 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

Source	Assumptions and limitations
	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)) as specific radar track data was not available for the full year and for all aircraft.
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 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 PM2.5 fractions of PM10: 40% of PM10 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. 6.33), IATA HKIA study (Ref. 6.34), 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.

Source	Assumptions and limitations
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 pNO2 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.
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).
Engine testing	Detailed information on the aircraft type using the ERUB in 2019 was not available. 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 between 06:00-23:00 following LLAOL operating instructions. 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 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 pNO2 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.
GSE	Registration numbers were provided for the road vehicles. From these, the Euro Class could be obtained using the information from the DVLA or by assuming a Euro Class from the registration date.
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.
GSE	The pNO2 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 pNO2 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 OSI 003-19 which states a maximum speed limit of 20mph for airside vehicles.
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.
GPUs	The pNO2 fraction is 14% of the NOx emissions, taken from the NAEI for a Euro 3 LGV or bus.

Source	Assumptions and limitations
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 pNO2 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 emission 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 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 ‘BREEAM excellent’ criteria and will not have any gas combustion. For example, photovoltaic and solar water

Source	Assumptions and limitations
	heating 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.
Road traffic	Emissions for 'England (not London)' have been used in the EFT.
Construction traffic	The year with peak construction traffic movements for each Phase have been used in the assessment (i.e. 2025 for Phase 1; 2035 for Phase 2a; and 2039 for Phase 2b) Therefore, for example, 2025 construction traffic was added to 2027 operational and background available traffic data were used. This is assumed to represent a 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 the proposed Airport Access Road (AAR) to the airport. The construction traffic is assumed to use AAR as it will be built when the peak construction traffic period occurs.
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.
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

Source	Assumptions and limitations
	transport was 1,300 - the number of spaces was apportioned by area of each car park.

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
HDV	Heavy duty vehicle (goods vehicles and buses >3.5t gross vehicle weight)

Term	Definition
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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