



Project name:
Warfield Air Quality - HRA

Project ref:
60571087

From:

Date: 28/01/2021

To:
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CC:

Warfield Neighbourhood Plan

Overview

Warfield Neighbourhood Plan Group has prepared a Neighbourhood Plan (NP). This project assesses impact on air quality of the NP's policies on internationally designated ecological sites that require a Habitats Regulation Assessment (HRA).

The Warfield Neighbourhood Plan Group is led by Warfield Parish Council, but the area it encompasses is under the jurisdiction of Bracknell Forest Council. The Plan is predicted to cause an increase in local traffic which will affect roads beyond the Council's jurisdiction. As such, roads in the nearby Council areas of Surrey Heath and the Royal Borough of Windsor and Maidenhead will be affected. One of the main issues regarding an increase in road traffic is atmospheric pollution, particularly through nitrogen deposition on sensitive habitats. For the Warfield NP, the Thames Basin Heath Special Protection Area (SPA) and Windsor Forest & Great Park Special Area of Conservation (SAC) have been identified as being sensitive to potential increases in road traffic. This project considers the impact of changes in traffic flow on concentrations of nitrogen oxides (NO_x), ammonia (NH₃) and nitrogen deposition at the closest ecological receptors within The Thames Basin Heath SPA and Windsor Forest & Great Park SAC.

Methodology

Traffic Data

The road network consists of several links adjacent to the SAC and SPA. There are three main areas of focus: road links south of Bracknell (around the Thames Basin Heath SPA), the M3 from Bagshot to Brick Hill (Thames Basin Heath SPA) and road links around Windsor Forest Great Park SAC. Traffic data in the form of 24-hour AADT (Annual Average Daily Traffic) based on 2019 data and forecast to 2037 are shown in Table 1. Baseline traffic data were calculated and provided by an external traffic team.

The traffic data provided AM and PM peak hour traffic flows for east and west bound traffic. These were combined to avoid extrapolating differences which may only occur in one peak hour and used to estimate daily average speeds. The Base and Future Base scenarios (both without the Neighbourhood Plan) used 2019 traffic data. The future year without the Neighbourhood Plan (2037 Do-Minimum) traffic flows were calculated by an external traffic team. It is anticipated that daily average flows will increase between 2019 and 2037 on a majority of road links. The Neighbourhood Plan is predicted to further increase daily average flows in 2037 compared with the situation without the Neighbourhood Plan (but with expected traffic growth) by less than 55 vehicles per day. The heavy-duty vehicle (HDV) percentage and average speed were also calculated by an external traffic team.

Table 1 Traffic Data

Road Link ID	Base 2019/Future Base 2037			2037 Do Minimum			2037 Do Something			
	AADT	HDV %	Daily Mean Speed (kph)	AADT	HDV %	Daily Mean Speed (kph)	AADT	HDV %	Daily Mean Speed (kph)	Change in ADDT between DM and DS
4a	19667	1.0	30	20471	1.1	28	20500	1.1	28	29
4b	19667	1.0	30	20471	1.1	28	20500	1.1	28	29
4c	19667	1.0	30	20471	1.1	28	20500	1.1	28	29
5	14052	0.5	36	14563	0.8	34	14601	0.8	34	38
6	14052	0.5	55	14563	0.8	54	14601	0.8	54	38
7	14052	0.5	48	14563	0.8	45	14601	0.8	45	38
8	14053	0.5	79	15349	0.9	75	15397	0.9	75	48
10	10240	0.0	89	13669	0.0	83	13669	0.0	83	0
10a	10240	0.0	89	13669	0.0	83	13669	0.0	83	0
11a SB	14289	0.0	85	16235	0.0	82	16268	0.0	82	33
11b NB	14250	0.0	85	16868	0.0	82	16879	0.0	82	11
11b NBa	14250	0.0	85	16868	0.0	82	16879	0.0	82	11
12	8916	0.0	91	10938	0.0	88	10938	0.0	88	0
15	15873	0.0	30	16979	0.0	29	17020	0.0	29	41
16	15873	0.0	78	16979	0.0	78	17020	0.0	78	41
17	15873	0.0	82	16979	0.0	80	17020	0.0	80	41
17a	15873	0.0	82	16979	0.0	80	17020	0.0	80	41
18	4979	0.8	77	5229	0.7	77	5246	0.7	77	17
19	4979	0.8	84	5229	0.7	85	5246	0.7	85	17
20	14513	1.2	82	14920	1.2	82	14935	1.2	82	15
21	6858	1.4	83	7219	1.5	81	7222	1.5	81	3
24	11828	1.9	40	11605	1.5	40	11605	1.5	40	0
25	11828	1.9	40	11605	1.5	40	11605	1.5	40	0
26	11828	1.9	34	11605	1.5	34	11605	1.5	34	0
27	11828	1.9	34	11605	1.5	34	11605	1.5	34	0
28	11828	1.9	34	11605	1.5	34	11605	1.5	34	0
29	11828	1.9	40	11605	1.5	40	11605	1.5	40	0
30	11828	1.9	34	11605	1.5	34	11605	1.5	34	0
32	13824	2.0	32	13896	2.2	31	13921	2.2	31	25
36	49665	5.6	63	51386	5.9	63	51386	5.9	63	0
40a*	49665	5.60	77	51200	5.88	64	51200	5.88	64	0
41	62731	5.1	88	66489	5.3	87	66543	5.3	87	54
41a	62731	5.1	88	66489	5.3	87	66543	5.3	87	54
42	31366	5.1	69	33244	5.3	68	33272	5.3	68	28
42a	31366	5.1	69	33244	5.3	68	33272	5.3	68	28
44	29584	2.1	92	31316	2.1	92	31341	2.1	92	25
45	17315	2.7	50	18361	2.5	50	18370	2.5	50	9
53	121955	9.9	108	138122	10.6	105	138159	10.6	105	37
53a	121955	9.9	108	138122	10.6	105	138159	10.6	105	37
58	20062	1.0	78	24518	1.3	70	24545	1.3	70	27
60	131260	9.9	106	149891	10.5	103	149895	10.5	103	4
60a	131260	9.9	106	149891	10.5	103	149895	10.5	103	4

Notes: Road links in **bold** were identified as key links to be modelled.

* Link 40a was manually calculated based on the assumption that AADT on Link 36 and Link 40a would equate to AADT on Link 41.

The calculated ADDT for Link 40a is comparable to 2019 ADDT estimates made by the DFT.

Receptors

Ecological receptors were taken on 10 links identified by the ecology team as being key links to be modelled. These are in bold in Table 1. Transects were located to the north of these road links, where possible, so that they are predominantly downwind of the road. The ecological receptors were placed perpendicular to the road, every 10 metres, up to 200m from the road. The closest receptor to each road was placed at the edge of the designated site. The ecological receptors relevant to this project are included in Table 2.

Table 2 Receptor locations, height and distance from road

ID	X Coordinate	Y Coordinate	Height (m)	Distance from Road (m)	Ecological Designation
Link 16_3.9m	496296	174789	0	3.9	Windsor Forest Great Park SAC
Link 16_10m	496291	174792	0	10	Windsor Forest Great Park SAC
Link 16_20m	496283	174798	0	20	Windsor Forest Great Park SAC
Link 16_30m	496274	174804	0	30	Windsor Forest Great Park SAC
Link 16_40m	496266	174810	0	40	Windsor Forest Great Park SAC
Link 16_50m	496258	174815	0	50	Windsor Forest Great Park SAC
Link 16_60m	496250	174821	0	60	Windsor Forest Great Park SAC
Link 16_70m	496242	174827	0	70	Windsor Forest Great Park SAC
Link 16_80m	496233	174833	0	80	Windsor Forest Great Park SAC
Link 16_90m	496225	174838	0	90	Windsor Forest Great Park SAC
Link 16_100m	496217	174844	0	100	Windsor Forest Great Park SAC
Link 16_110m	496209	174850	0	110	Windsor Forest Great Park SAC
Link 16_120m	496201	174855	0	120	Windsor Forest Great Park SAC
Link 16_130m	496193	174861	0	130	Windsor Forest Great Park SAC
Link 16_140m	496184	174867	0	140	Windsor Forest Great Park SAC
Link 16_150m	496176	174873	0	150	Windsor Forest Great Park SAC
Link 16_160m	496168	174878	0	160	Windsor Forest Great Park SAC
Link 16_170m	496160	174884	0	170	Windsor Forest Great Park SAC
Link 16_180m	496152	174890	0	180	Windsor Forest Great Park SAC
Link 16_190m	496143	174896	0	190	Windsor Forest Great Park SAC
Link 16_200m	496135	174901	0	200	Windsor Forest Great Park SAC
Link 8_3.2m	493463	173707	0	3.2	Windsor Forest Great Park SAC
Link 8_10m	493458	173712	0	10	Windsor Forest Great Park SAC
Link 8_20m	493450	173718	0	20	Windsor Forest Great Park SAC
Link 8_30m	493442	173725	0	30	Windsor Forest Great Park SAC
Link 8_40m	493435	173731	0	40	Windsor Forest Great Park SAC
Link 8_50m	493427	173737	0	50	Windsor Forest Great Park SAC
Link 8_60m	493419	173744	0	60	Windsor Forest Great Park SAC
Link 8_70m	493412	173750	0	70	Windsor Forest Great Park SAC
Link 8_80m	493404	173757	0	80	Windsor Forest Great Park SAC

ID	X Coordinate	Y Coordinate	Height (m)	Distance from Road (m)	Ecological Designation
Link 8_90m	493396	173763	0	90	Windsor Forest Great Park SAC
Link 8_100m	493389	173770	0	100	Windsor Forest Great Park SAC
Link 8_110m	493381	173776	0	110	Windsor Forest Great Park SAC
Link 8_120m	493373	173782	0	120	Windsor Forest Great Park SAC
Link 8_130m	493366	173789	0	130	Windsor Forest Great Park SAC
Link 8_140m	493358	173795	0	140	Windsor Forest Great Park SAC
Link 8_150m	493350	173802	0	150	Windsor Forest Great Park SAC
Link 8_160m	493343	173808	0	160	Windsor Forest Great Park SAC
Link 8_170m	493335	173815	0	170	Windsor Forest Great Park SAC
Link 8_180m	493327	173821	0	180	Windsor Forest Great Park SAC
Link 8_190m	493320	173827	0	190	Windsor Forest Great Park SAC
Link 8_200m	493312	173834	0	200	Windsor Forest Great Park SAC
Link 19_3.75m	496782	168682	0	3.75	Windsor Forest Great Park SAC
Link 19_10m	496782	168688	0	10	Windsor Forest Great Park SAC
Link 19_20m	496781	168698	0	20	Windsor Forest Great Park SAC
Link 19_30m	496780	168708	0	30	Windsor Forest Great Park SAC
Link 19_40m	496779	168718	0	40	Windsor Forest Great Park SAC
Link 19_50m	496778	168728	0	50	Windsor Forest Great Park SAC
Link 19_60m	496777	168738	0	60	Windsor Forest Great Park SAC
Link 19_70m	496776	168748	0	70	Windsor Forest Great Park SAC
Link 19_80m	496776	168758	0	80	Windsor Forest Great Park SAC
Link 19_90m	496775	168768	0	90	Windsor Forest Great Park SAC
Link 19_100m	496774	168778	0	100	Windsor Forest Great Park SAC
Link 19_110m	496773	168788	0	110	Windsor Forest Great Park SAC
Link 19_120m	496772	168798	0	120	Windsor Forest Great Park SAC
Link 19_130m	496771	168808	0	130	Windsor Forest Great Park SAC
Link 19_140m	496770	168818	0	140	Windsor Forest Great Park SAC
Link 19_150m	496769	168828	0	150	Windsor Forest Great Park SAC
Link 19_160m	496769	168838	0	160	Windsor Forest Great Park SAC
Link 19_170m	496768	168848	0	170	Windsor Forest Great Park SAC
Link 19_180m	496767	168858	0	180	Windsor Forest Great Park SAC
Link 19_190m	496766	168868	0	190	Windsor Forest Great Park SAC
Link 19_200m	496765	168878	0	200	Windsor Forest Great Park SAC
Link 11_2.2m	493721	171833	0	2.2	Windsor Forest Great Park SAC
Link 11_10m	493727	171828	0	10	Windsor Forest Great Park SAC
Link 11_20m	493736	171823	0	20	Windsor Forest Great Park SAC

ID	X Coordinate	Y Coordinate	Height (m)	Distance from Road (m)	Ecological Designation
Link 11_30m	493744	171817	0	30	Windsor Forest Great Park SAC
Link 11_40m	493752	171811	0	40	Windsor Forest Great Park SAC
Link 11_50m	493760	171805	0	50	Windsor Forest Great Park SAC
Link 11_60m	493768	171800	0	60	Windsor Forest Great Park SAC
Link 11_70m	493777	171794	0	70	Windsor Forest Great Park SAC
Link 11_80m	493785	171788	0	80	Windsor Forest Great Park SAC
Link 11_90m	493793	171783	0	90	Windsor Forest Great Park SAC
Link 11_100m	493801	171777	0	100	Windsor Forest Great Park SAC
Link 11_110m	493809	171771	0	110	Windsor Forest Great Park SAC
Link 11_120m	493818	171765	0	120	Windsor Forest Great Park SAC
Link 11_130m	493826	171760	0	130	Windsor Forest Great Park SAC
Link 11_140m	493834	171754	0	140	Windsor Forest Great Park SAC
Link 11_150m	493842	171748	0	150	Windsor Forest Great Park SAC
Link 11_160m	493850	171742	0	160	Windsor Forest Great Park SAC
Link 11_170m	493858	171737	0	170	Windsor Forest Great Park SAC
Link 11_180m	493867	171731	0	180	Windsor Forest Great Park SAC
Link 11_190m	493875	171725	0	190	Windsor Forest Great Park SAC
Link 11_200m	493883	171719	0	200	Windsor Forest Great Park SAC
Link 44_2.3m	485508	165856	0	2.3	Thames Basin Heath SPA
Link 44_10m	485515	165854	0	10	Thames Basin Heath SPA
Link 44_20m	485525	165853	0	20	Thames Basin Heath SPA
Link 44_30m	485535	165851	0	30	Thames Basin Heath SPA
Link 44_40m	485545	165849	0	40	Thames Basin Heath SPA
Link 44_50m	485555	165847	0	50	Thames Basin Heath SPA
Link 44_60m	485564	165846	0	60	Thames Basin Heath SPA
Link 44_70m	485574	165844	0	70	Thames Basin Heath SPA
Link 44_80m	485584	165842	0	80	Thames Basin Heath SPA
Link 44_90m	485594	165840	0	90	Thames Basin Heath SPA
Link 44_100m	485604	165839	0	100	Thames Basin Heath SPA
Link 44_110m	485614	165837	0	110	Thames Basin Heath SPA
Link 44_120m	485623	165835	0	120	Thames Basin Heath SPA
Link 44_130m	485633	165833	0	130	Thames Basin Heath SPA
Link 44_140m	485643	165832	0	140	Thames Basin Heath SPA
Link 44_150m	485653	165830	0	150	Thames Basin Heath SPA
Link 44_160m	485663	165828	0	160	Thames Basin Heath SPA
Link 44_170m	485673	165827	0	170	Thames Basin Heath SPA

ID	X Coordinate	Y Coordinate	Height (m)	Distance from Road (m)	Ecological Designation
Link 44_180m	485683	165825	0	180	Thames Basin Heath SPA
Link 44_190m	485692	165823	0	190	Thames Basin Heath SPA
Link 44_200m	485702	165821	0	200	Thames Basin Heath SPA
Link 20_2.9m	485021	165128	0	2.9	Thames Basin Heath SPA
Link 20_10m	485027	165124	0	10	Thames Basin Heath SPA
Link 20_20m	485035	165118	0	20	Thames Basin Heath SPA
Link 20_30m	485044	165113	0	30	Thames Basin Heath SPA
Link 20_40m	485052	165107	0	40	Thames Basin Heath SPA
Link 20_50m	485060	165101	0	50	Thames Basin Heath SPA
Link 20_60m	485068	165095	0	60	Thames Basin Heath SPA
Link 20_70m	485076	165090	0	70	Thames Basin Heath SPA
Link 20_80m	485085	165084	0	80	Thames Basin Heath SPA
Link 20_90m	485093	165078	0	90	Thames Basin Heath SPA
Link 20_100m	485101	165073	0	100	Thames Basin Heath SPA
Link 20_110m	485109	165067	0	110	Thames Basin Heath SPA
Link 20_120m	485117	165061	0	120	Thames Basin Heath SPA
Link 20_130m	485126	165055	0	130	Thames Basin Heath SPA
Link 20_140m	485134	165050	0	140	Thames Basin Heath SPA
Link 20_150m	485142	165044	0	150	Thames Basin Heath SPA
Link 20_160m	485150	165038	0	160	Thames Basin Heath SPA
Link 20_170m	485158	165032	0	170	Thames Basin Heath SPA
Link 20_180m	485167	165027	0	180	Thames Basin Heath SPA
Link 20_190m	485175	165021	0	190	Thames Basin Heath SPA
Link 20_200m	485183	165015	0	200	Thames Basin Heath SPA
Link 58b_3.5m	496495	164548	0	3.5	Thames Basin Heath SPA
Link 58b_10m	496497	164554	0	10	Thames Basin Heath SPA
Link 58b_20m	496501	164563	0	20	Thames Basin Heath SPA
Link 58b_30m	496504	164572	0	30	Thames Basin Heath SPA
Link 58b_40m	496508	164582	0	40	Thames Basin Heath SPA
Link 58b_50m	496511	164591	0	50	Thames Basin Heath SPA
Link 58b_60m	496515	164601	0	60	Thames Basin Heath SPA
Link 58b_70m	496518	164610	0	70	Thames Basin Heath SPA
Link 58b_80m	496521	164619	0	80	Thames Basin Heath SPA
Link 58b_90m	496525	164629	0	90	Thames Basin Heath SPA
Link 58b_100m	496528	164638	0	100	Thames Basin Heath SPA
Link 58b_110m	496532	164648	0	110	Thames Basin Heath SPA

ID	X Coordinate	Y Coordinate	Height (m)	Distance from Road (m)	Ecological Designation
Link 58b_120m	496535	164657	0	120	Thames Basin Heath SPA
Link 58b_130m	496538	164666	0	130	Thames Basin Heath SPA
Link 58b_140m	496542	164676	0	140	Thames Basin Heath SPA
Link 58b_150m	496545	164685	0	150	Thames Basin Heath SPA
Link 58b_160m	496549	164695	0	160	Thames Basin Heath SPA
Link 58b_170m	496552	164704	0	170	Thames Basin Heath SPA
Link 58b_180m	496556	164713	0	180	Thames Basin Heath SPA
Link 58b_190m	496559	164723	0	190	Thames Basin Heath SPA
Link 58b_200m	496562	164732	0	200	Thames Basin Heath SPA
Link 41_9m	490649	164824	0	9	Thames Basin Heath SPA
Link 41_10m	490649	164823	0	10	Thames Basin Heath SPA
Link 41_20m	490642	164816	0	20	Thames Basin Heath SPA
Link 41_30m	490636	164808	0	30	Thames Basin Heath SPA
Link 41_40m	490629	164800	0	40	Thames Basin Heath SPA
Link 41_50m	490623	164793	0	50	Thames Basin Heath SPA
Link 41_60m	490616	164785	0	60	Thames Basin Heath SPA
Link 41_70m	490610	164778	0	70	Thames Basin Heath SPA
Link 41_80m	490604	164770	0	80	Thames Basin Heath SPA
Link 41_90m	490597	164762	0	90	Thames Basin Heath SPA
Link 41_100m	490591	164755	0	100	Thames Basin Heath SPA
Link 41_110m	490584	164747	0	110	Thames Basin Heath SPA
Link 41_120m	490578	164739	0	120	Thames Basin Heath SPA
Link 41_130m	490571	164732	0	130	Thames Basin Heath SPA
Link 41_140m	490565	164724	0	140	Thames Basin Heath SPA
Link 41_150m	490559	164716	0	150	Thames Basin Heath SPA
Link 41_160m	490552	164709	0	160	Thames Basin Heath SPA
Link 41_170m	490546	164701	0	170	Thames Basin Heath SPA
Link 41_180m	490539	164693	0	180	Thames Basin Heath SPA
Link 41_190m	490533	164686	0	190	Thames Basin Heath SPA
Link 41_200m	490526	164678	0	200	Thames Basin Heath SPA
Link 32_4.6m	488085	166453	0	4.6	Thames Basin Heath SPA
Link 32_10m	488088	166449	0	10	Thames Basin Heath SPA
Link 32_20m	488095	166442	0	20	Thames Basin Heath SPA
Link 32_30m	488101	166434	0	30	Thames Basin Heath SPA
Link 32_40m	488108	166426	0	40	Thames Basin Heath SPA
Link 32_50m	488114	166419	0	50	Thames Basin Heath SPA

ID	X Coordinate	Y Coordinate	Height (m)	Distance from Road (m)	Ecological Designation
Link 32_60m	488121	166411	0	60	Thames Basin Heath SPA
Link 32_70m	488127	166403	0	70	Thames Basin Heath SPA
Link 32_80m	488133	166396	0	80	Thames Basin Heath SPA
Link 32_90m	488140	166388	0	90	Thames Basin Heath SPA
Link 32_100m	488146	166380	0	100	Thames Basin Heath SPA
Link 32_110m	488153	166373	0	110	Thames Basin Heath SPA
Link 32_120m	488159	166365	0	120	Thames Basin Heath SPA
Link 32_130m	488166	166357	0	130	Thames Basin Heath SPA
Link 32_140m	488172	166350	0	140	Thames Basin Heath SPA
Link 32_150m	488178	166342	0	150	Thames Basin Heath SPA
Link 32_160m	488185	166334	0	160	Thames Basin Heath SPA
Link 32_170m	488191	166327	0	170	Thames Basin Heath SPA
Link 32_180m	488198	166319	0	180	Thames Basin Heath SPA
Link 32_190m	488204	166311	0	190	Thames Basin Heath SPA
Link 32_200m	488211	166304	0	200	Thames Basin Heath SPA
Link 53_13.9m	491371	162242	0	13.9	Thames Basin Heath SPA
Link 53_20m	491375	162237	0	20	Thames Basin Heath SPA
Link 53_30m	491380	162229	0	30	Thames Basin Heath SPA
Link 53_40m	491386	162221	0	40	Thames Basin Heath SPA
Link 53_50m	491392	162212	0	50	Thames Basin Heath SPA
Link 53_60m	491397	162204	0	60	Thames Basin Heath SPA
Link 53_70m	491403	162196	0	70	Thames Basin Heath SPA
Link 53_80m	491409	162188	0	80	Thames Basin Heath SPA
Link 53_90m	491415	162180	0	90	Thames Basin Heath SPA
Link 53_100m	491420	162171	0	100	Thames Basin Heath SPA
Link 53_110m	491426	162163	0	110	Thames Basin Heath SPA
Link 53_120m	491432	162155	0	120	Thames Basin Heath SPA
Link 53_130m	491438	162147	0	130	Thames Basin Heath SPA
Link 53_140m	491443	162139	0	140	Thames Basin Heath SPA
Link 53_150m	491449	162130	0	150	Thames Basin Heath SPA
Link 53_160m	491455	162122	0	160	Thames Basin Heath SPA
Link 53_170m	491461	162114	0	170	Thames Basin Heath SPA
Link 53_180m	491466	162106	0	180	Thames Basin Heath SPA
Link 53_190m	491472	162098	0	190	Thames Basin Heath SPA
Link 53_200m	491478	162089	0	200	Thames Basin Heath SPA

Model Setup

Road traffic emissions of NO_x were derived using Defra's current Emission Factor Toolkit (EFT v10.1) and associated tools¹. Road traffic emissions of NH₃ were derived using Air Quality Consultants' Calculator for Road Emissions of Ammonia (CREAM) V1A)².

Detailed dispersion modelling was undertaken using ADMS-Roads v5.0 to model concentrations of NO_x and NH₃ using the parameters in Table 3 for the following scenarios:

1. 2019 Baseline – 2019 traffic data, emission factors and background concentrations;
2. 2037 Future Baseline – 2019 traffic data, 2030 emission factors and background concentrations (the latest projected year available from Defra);
3. 2037 Do -Minimum – 2037 traffic data without Neighbourhood Plan, 2030 emission factors and background concentrations;
4. 2037 Do-Something – 2037 traffic data with Neighbourhood Plan in place, 2030 emission factors and background concentrations.

Table 3 General ADMS-Roads Model Conditions

Variables	ADMS-Roads Model Input
Surface roughness at source	0.5m
Surface roughness at Metrological Site	0.2m
Minimum Monin-Obukhov length for stable conditions	30m
Terrain types	Flat
Receptor location	x, y coordinates determined by GIS, z = 0m for ecological receptors.
Emissions	NO _x – Defra's EFT v10.1. NH ₃ – CREAM V1A
Meteorological data	1 year (2019) hourly sequential data from Heathrow Airport meteorological station.
Receptors	Ecological
Model output	Long-term (annual) mean NO _x and NH ₃ concentrations.

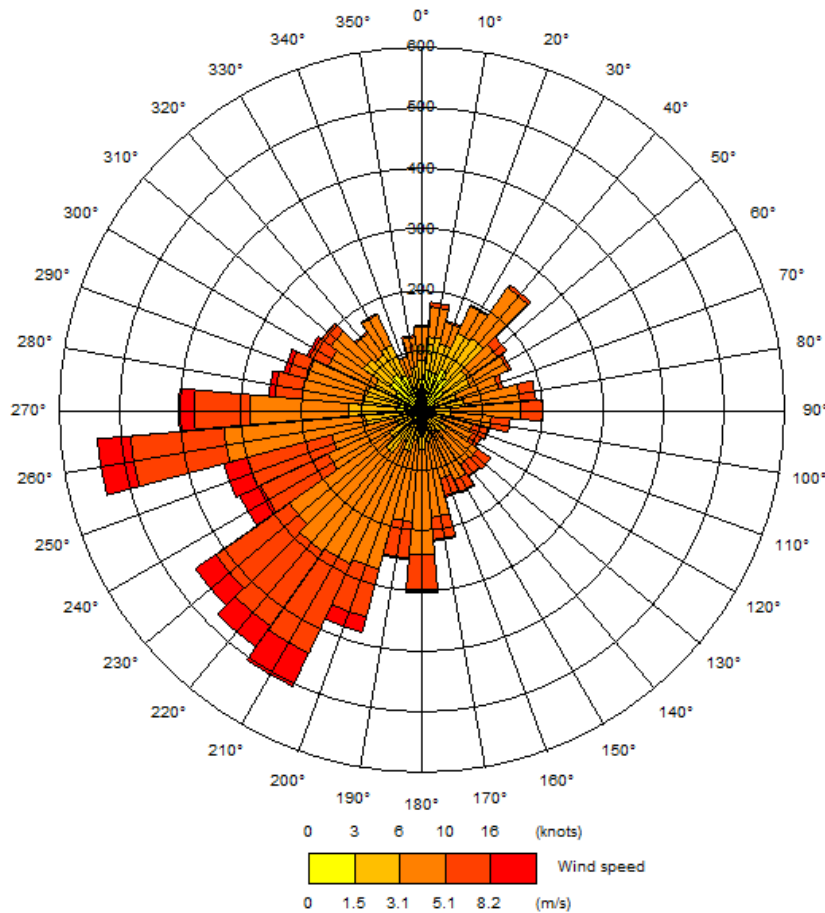
¹ <https://laqm.defra.gov.uk/>

² <https://www.aqconsultants.co.uk/resources/ammonia-emissions-from-roads-for-assessing-impacts>

Meteorological Data

One year (2019) of hourly sequential observation data from Heathrow Airport meteorological station has been used in this assessment to correspond with the baseline year. The station is located approximately 10km east of the closest ecological site (Windsor Forest Great Park SAC) and experiences meteorological conditions that are representative of those experienced within the air quality study area. Figure 1 shows that the dominant direction of wind is from the south-west, as is typical for the UK. The wind speed ranges from 0-18 knots (0- ~9.3 m/s).

Figure 1 Wind Rose of Heathrow Met Data 2019



Background Data

Background data for NO₂ and NO_x concentrations for 2019 and 2030 have been sourced from Defra’s 2018-based background maps for receptors within the nearest 1km by 1km grid squares (Table 4). The data shows that the mapped background concentrations are predicted to decrease between 2019 and 2030.

Table 4 Defra Mapped Background Pollutant Concentrations ($\mu\text{g}/\text{m}^3$)

Grid Square (X, Y)	Local Authority	Annual Mean Concentrations			
		2019 NO _x	2019 NO ₂	2030 NO _x	2030 NO ₂
495500,175500	Windsor & Maidenhead	18.0	13.3	12.9	9.8
493500,173500	Windsor & Maidenhead	14.7	11.1	10.6	8.2
496500,174500	Windsor & Maidenhead	16.1	12.0	11.5	8.8
496500,168500	Windsor & Maidenhead	15.9	11.9	11.4	8.7
493500,174500	Windsor & Maidenhead	15.6	11.7	11.4	8.7
493500,171500	Bracknell Forest	15.8	11.9	11.3	8.7
485500,165500	Bracknell Forest	14.3	10.8	10.1	7.9
488500,166500	Bracknell Forest	14.8	11.1	10.4	8.1
490500,164500	Surrey Heath	15.8	11.9	11.0	8.5
491500,162500	Surrey Heath	18.9	13.9	12.7	9.7
496500,164500	Surrey Heath	18.3	13.6	12.2	9.3
489500,160500	Surrey Heath	18.5	13.6	12.7	9.7

Ecological Data

The annual mean critical levels of NO_x and NH₃ concentrations above which adverse effects on ecosystems may occur based on present knowledge are summarised in Table 5.

Table 5 Annual Mean Critical Levels (NO_x and NH₃)

Pollutant	Critical Level
Oxides of nitrogen (NO _x)	30 $\mu\text{g}/\text{m}^3$
Ammonia (NH ₃)	3 $\mu\text{g}/\text{m}^3$ 1 $\mu\text{g}/\text{m}^3$ for lichens and bryophytes

The Air Pollution Information System³ (APIS) provides 'a searchable database and information on pollutants and their impacts on habitats and species'. The parameters for *Atlantic acidophilous beech forests* in the Windsor Forest and Great Park SAC and for *Dwarf Shrub Heath* in the Thames Basin SPA were taken from APIS and are presented in Table 6.

No change in the APIS concentrations or deposition rates have been assumed from the APIS 2016-2018 values to 2019 nor to the future year.

³ <http://www.apis.ac.uk/>

Table 6 Air Pollution Information System (APIS) Data of the Ecological Receptors.

Receptor	Av. N Dep Rate kgN/ha/yr	Critical Load Av. N Dep Rate kgN/ha/yr	Total Av. Acid Dep Rate keq/ha/yr	Nitrogen Av. Acid Dep Rate keq/ha/yr	Critical Load Nitrogen Av. Acid Dep Rate keq/ha/yr	Ammonia µg/m ³	Habitat	APIS Data Year
Link 16 (Transect)	24.56	10 - 20	1.94	1.75	0.357-2.763	1.35	Atlantic acidophilous beech forests	2016 - 2018
Link 19 (Transect)	20.93	10 - 20	1.69	1.5	0.357-2.763	0.97	Atlantic acidophilous beech forests	2016 - 2018
Link 11 (Transect)	21.07	10 - 20	1.68	1.51	0.357-2.763	1.02	Atlantic acidophilous beech forests	2016 - 2018
Link 8 (Transect)	20.93	10 - 20	1.69	1.5	0.357-2.763	0.97	Atlantic acidophilous beech forests	2016 - 2018
Link 44 (Transect)	13.45	10 - 20	1.108	0.96	1.035-2.344	1.18	Dwarf Shrub Heath	2016 - 2018
Link 20 (Transect)	13.45	10 - 20	1.108	0.96	1.035-2.344	1.18	Dwarf Shrub Heath	2016 - 2018
Link 58b (Transect)	12.65	10 - 20	1.06	0.903	1.035-2.344	1.06	Dwarf Shrub Heath	2016 - 2018
Link 41 (Transect)	13.14	10 - 20	1.1	0.939	1.035-2.344	1.07	Dwarf Shrub Heath	2016 - 2018
Link 32 (Transect)	13.45	10 - 20	1.108	0.96	1.035-2.344	1.18	Dwarf Shrub Heath	2016 - 2018
Link 53 (Transect)	13.14	10 - 20	1.1	0.939	1.035-2.344	1.07	Dwarf Shrub Heath	2016 - 2018

Verification

Local air quality monitoring was conducted by Surrey Heath Council near the M3. This allowed a comparison between modelled and measured concentrations to be made which enabled the model results to be adjusted so that they could be brought in-line with measured concentrations. Though the Royal Borough of Windsor and Maidenhead (RBWM) conducts air quality monitoring on the modelled road network, these were not deemed appropriate for this assessment as they represent 'stop-start' traffic in congested urban areas whereas all ecological receptors are located in open areas with free-flowing traffic. Therefore, RBWM's monitoring data was excluded from the verification process. Diffusion tube monitoring data from Surrey Heath Council used for verification is presented in Table 7.

Table 7 Surrey Heath Council Diffusion Tube Monitoring Data used for Verification

Tube ID	Location	Site Type	X,Y	Height (m)	Annual Mean NO ₂ ug/m ³ 2019
SH5	Chestnut Avenue	Roadside	489465,160596	1.75	32.5
SH7	M3 Brickhill roadside	Roadside	496105,164401	1.75	39.5
SH35	Prior End	Roadside	489196,160203	1.75	28.0
SH36	Youlden Drive	Roadside	489355,160385	1.75	30.0
SH37	Crawley Drive	Roadside	489083,160265	1.75	33.4

The results of the monitoring were compared to modelled results for the same locations, and a verification factor calculated in line with methods outlined in LAQM TG(16). Details of this comparison can be found in Table 8.

Table 8 Summary of NO₂ Verification Exercise

Tube ID	Measured Road NO _x Contribution (µg/m ³)	Modelled Road NO _x Contribution (µg/m ³) before adjustment	Road NO _x Factor	Monitored NO ₂ (µg/m ³)	Modelled NO ₂ (µg/m ³) before adjustment	Modelled NO ₂ (µg/m ³) after adjustment
SH5	37.4	24.7	1.51	32.5	26.5	32.7
SH7	53.1	22.1	2.41	39.5	25.1	30.8
SH35	27.9	18.5	1.51	28.0	23.4	28.2
SH36	32.1	29.9	1.07	30.0	29.0	36.3
SH37	39.3	17.6	2.24	33.4	22.9	27.5
Overall Road NO_x Factor			1.53			

Table 8 shows that the unadjusted model under predicts the annual mean concentrations of NO_x. To account for this bias, the factor of the difference between the modelled and measured road NO_x contribution at the diffusion tube locations were compared, in line with the methodology described in LAQM.TG(16). The model under-predicted the road NO_x contribution by 33-50 %. The uncertainty of the adjusted model was considered using the Route Mean Square Error (RMSE) calculation. An RMSE value of within 10% of the national air quality objective of 40 µg/m³ for NO₂ is considered to demonstrate good agreement, i.e. 4 µg/m³. The RMSE value for the adjusted model is approximately 5.5 µg/m³ which is within 14% of the NO₂ objective and is considered acceptable.

Therefore, the NO_x verification factor used is 1.53. In the absence of verification for NH₃, a factor of 1.0 has been used based upon professional judgement and experience of verification studies in other areas.

Deposition velocities

Deposition of nitrogen from road traffic derived NH₃ and NO₂ are estimated using the AQTAG deposition velocities that are cited in the 2020 IAQM guidance⁴, as shown in Table 9. Deposition velocities for short vegetation were applied to data for the transects with 'dwarf shrub heath' the dominant feature (Thames Basin SPA), whilst deposition velocities for forest were applied to data for those transects with 'Atlantic acidophilous beech forests' present (Windsor SAC).

Table 9 Air Pollution Information System (APIS) Data of the Ecological Receptors.

Pollutant	Habitat	Nitrogen deposition conversion rates	Deposition velocity
NO ₂	Forest	1 µg/m ³ NO ₂ = 0.29 kgN/ha/yr	0.003 m/s
NH ₃	Forest	1 µg/m ³ NH ₃ = 7.8 kgN/ha/yr	0.030 m/s
NO ₂	Short Vegetation	1 µg/m ³ NO ₂ = 0.14 kgN/ha/yr	0.0015 m/s
NH ₃	Short Vegetation	1 µg/m ³ NH ₃ = 5.19 kgN/ha/yr	0.020 m/s

Limitations

The following limitations are recognised:

- It has been assumed that the verification factor derived from the Surrey Heath Council monitoring data is representative of the whole modelled area;
- In the absence of monitoring data for NH₃ a verification factor has been used based upon professional judgement and experience of the CREAM tool;
- Without background monitoring data, it is assumed that the Defra and APIS concentrations correctly represent the background NO_x, NO₂ and NH₃ concentrations for the baseline and future year;

⁴ <https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf>

- The composition of the vehicle fleet outside of London was updated with the release of EFT v10.1. Air Quality Consultants' CREAM V1A tool was based upon the previous version of Defra's EFT (v9.1), therefore there are some differences in the vehicle fleets used to predict future concentrations of NO_x and NH₃ respectively.