



Appendix 11.5

Dispersion Modelling Input Data: Ecological Receptors

Air Quality Environmental Impact Assessment
Appendix 11.5 - Dispersion Modelling Input Data: Ecological
Receptors

Redbourn Road, Hemel Hempstead



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1.0 INTRODUCTION

1.1.1 The Development has the potential to cause air quality impacts at ecological receptors as a result of exhaust emissions associated with vehicles travelling to and from the Site, as well as other potential cumulative developments, during the operational phase. In order to assess changes in oxides of nitrogen (NO_x) and ammonia (NH₃) concentrations, and nitrogen deposition, at sensitive locations, detailed dispersion modelling was undertaken in accordance with the following methodology.

1.2 Dispersion Model

1.2.1 Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 5.1.0.2). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and Department for Environment, Food and Rural Affairs (DEFRA).

1.2.2 The model requires input data that details the following parameters:

- Assessment area;
- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;
- Roughness length (z₀); and,
- Monin-Obukhov length.

1.2.3 Additional options can also be selected within the ADMS-Roads user interface in order to take account of site specific characteristics that may affect model outputs, such as canyons.

1.2.4 The relevant inputs are detailed in the following Sections.

1.3 Scenarios

1.3.1 Pollutant levels were predicted for the following scenarios in order to quantify predicted Process Contributions (PCs) at discrete receptor positions:

- Baseline - Conditions without the Development or any other potential cumulative developments. This is the background pollutant level in addition to modelled contribution from road vehicle exhaust emissions based on 2024 traffic flows;
- Development Alone (DA) - This is the background pollutant level in addition to modelled contribution from road vehicle exhaust emissions based on 2024 traffic flows, as well as trips generated as a result of the Development; and,
- In-combination (IC) - Conditions with the Development and other potential cumulative developments. This is the background pollutant level in addition to the modelled contribution from road vehicle exhaust emissions from the Development and other potential cumulative developments completed by 2041.

1.4 Modelled Receptors

1.4.1 Discrete receptor locations were included in the model to quantify changes in pollution levels at the relevant habitats within Howe Grove Wood Local Nature Reserve (LNR). Reference should be made to Appendix 11.3 for a summary of the positions.

1.5 Traffic Flow Data

1.5.1 Traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as Heavy Duty Vehicle (HDV) proportion, was provided by i-Transport, the Transport Consultants for the project.

1.5.2 A summary of the traffic flow data is provided in Table A11.5.1.

1.5.3 It should be noted that an updated road layout is proposed as part of the Development and the East Hemel Hempstead Development located to the south of the Site (Planning reference: 5/2024/2171). As such, additional links were included within the 2041 IC scenario.

Table A11.5.1 Traffic Data

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
L1	B487 East of Site	17,133	18,525	24,213	2.12	1.84	1.52
L2	B487 West of Site	17,133	18,525	24,213	2.12	1.84	1.52
L3	Holtsmere End Lane Slow Phase (SP)	168	168	-	5.90	5.90	-
L4	Holtsmere End Lane	168	168	-	5.90	5.90	-
L5	B487 Redbourn Road, West of Holtsmere End Lane	23,264	24,703	30,475	1.99	1.75	1.56
L6	B487 Redbourn Road SP, Between Shenley Road	23,264	24,703	30,475	1.99	1.75	1.56
L7	B487 Redbourn Road, West of Shenley Road	23,264	24,703	30,475	1.99	1.75	1.56
L8	B487 Redbourn Road SP, East of Swallowdale Lane Roundabout	23,264	24,703	30,475	1.99	1.75	1.56
L9	B487 Redbourn Road SP, West of Swallowdale Lane Roundabout	26,433	27,534	32,724	1.93	1.75	1.63
L10	B487 Redbourn Road, West of Swallowdale Lane Roundabout	26,433	27,534	32,724	1.93	1.75	1.63
L11	B487 Redbourn Road SP, East of Redbourn Road Roundabout	26,433	27,534	32,724	1.93	1.75	1.63
L12	St Agnells Lane SP	8,936	9,011	8,753	5.00	4.85	5.37
L13	St Agnells Lane	8,936	9,011	8,753	5.00	4.85	5.37
L14	A4147 SP, West of Redbourn Road Roundabout	22,621	22,784	25,292	2.82	2.77	2.17
L15	A4147, West of Redbourn Road Roundabout	22,621	22,784	25,292	2.82	2.77	2.17
L16	A4147 SP, East of Aycliffe Drive Roundabout	22,621	22,784	25,292	2.82	2.77	2.17
L17	A4147 SP, West of Aycliffe Drive Roundabout	24,760	24,926	26,102	2.41	2.42	2.02

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
L18	A4147, West of Aycliffe Drive Roundabout	24,760	24,926	26,102	2.41	2.42	2.02
L19	Piccotts End Road, North of Roundabout	493	529	494	3.77	3.74	3.76
L19a	Piccotts End Road, South of Roundabout	4,032	3,906	4,041	2.24	1.96	2.48
L20	A4147 Link Road	24,760	24,926	26,102	2.41	2.42	2.02
L21	Leighton Buzzard Road	20,448	20,424	21,711	3.84	3.77	3.97
L22	Galley Hill	14,268	14,340	14,700	2.16	2.11	2.19
L23	A4146 Leighton Buzzard Road	19,027	19,077	22,220	2.30	2.13	2.31
L24	A4146 Leighton Buzzard Road SP	19,027	19,077	22,220	2.30	2.13	2.31
L25	Warners End Road SP	18,395	8,490	21,239	1.49	1.51	1.34
L26	Warners End Road	18,395	8,490	21,239	1.49	1.51	1.34
L27	Warners End Road SP, Between Gadebridge Road	18,395	8,490	21,239	1.49	1.51	1.34
L28	Warners End Road, West of Gadebridge Road	18,395	8,359	21,108	1.49	1.56	1.38
L29	Leighton Buzzard Road SP, South of Roundabout	22,950	3,128	29,323	3.47	3.28	3.43
L30	Leighton Buzzard Road, South of Roundabout	22,950	3,128	29,323	3.47	3.28	3.43
L31	Leighton Buzzard Road SP, North of Combe Street	22,950	23,128	29,323	3.47	3.28	3.43
L32	Leighton Buzzard Road SP, South of Combe Street	29,250	29,539	32,373	2.91	2.83	2.97
L33	Leighton Buzzard Road, South of Combe Street	29,250	29,539	32,373	2.91	2.83	2.97
L34	A4146 Slow Southbound (SB), Towards Station Road Roundabout	14,625	14,770	16,187	2.91	2.83	2.97

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
L35	A4146 Slow Northbound (NB), Towards Station Road Roundabout	14,625	14,770	16,187	2.91	2.83	2.97
L36	Station Road Westbound (WB)	12,365	12,458	11,927	4.86	4.74	5.13
L37	Station Road Eastbound (EB)	12,365	12,458	11,927	4.86	4.74	5.13
L38	Station Road EB SP	12,365	12,458	11,927	4.86	4.74	5.13
L39	Station Road	24,729	24,916	23,853	4.86	4.74	5.13
L40	A414 South of Roundabout	27,504	27,838	33,568	3.81	3.70	3.18
L41	A414 EB, East of Station Road Roundabout	18,013	18,104	21,484	3.36	3.09	3.12
L42	A414 EB SP, West of Jarman Road Roundabout	9,007	9,052	10,742	3.36	3.09	3.12
L43	A414 WB SP, East of Station Road Roundabout	18,013	18,104	21,484	3.36	3.09	3.12
L44	A414 WB, East of Station Road Roundabout	18,013	18,104	21,484	3.36	3.09	3.12
L45	Jarman Way Roundabout Slip	9,007	9,052	10,742	3.36	3.09	3.12
L46	A414 EB, East of Jarman Way Roundabout	9,534	9,568	11,938	3.70	3.44	3.15
L47	A414 SP, WB, East of Jarman Way Roundabout	19,067	19,136	23,875	3.70	3.44	3.15
L48	A414 EB, East of Jarman Way Roundabout Slip	19,067	19,136	23,875	3.70	3.44	3.15
L49	A414 EB SP, West of White Hart Road Roundabout	19,067	19,136	23,875	3.70	3.44	3.15
L50	A414 WB, West of White Hart Road Roundabout	19,067	19,136	23,875	3.70	3.44	3.15
L51	A414 EB, East of White Hart Road Roundabout	19,067	19,136	23,875	3.70	3.44	3.15
L52	A414 WB SP, East of White Hart Road Roundabout	19,067	19,136	23,875	3.70	3.44	3.15

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
L53	A414 WB, East of White Hart Road Roundabout	19,067	19,136	23,875	3.70	3.44	3.15
L54	Leverstock Green Way SP	11,150	11,172	12,435	2.43	2.49	2.63
L55	Leverstock Green Way	22,301	22,344	24,871	2.43	2.49	2.63
L56	Leverstock Green Way Roundabout Slip	11,150	11,172	12,435	2.43	2.49	2.63
L57	A414 EB, East of Leverstock Green Way Roundabout	15,967	16,280	25,031	6.79	6.69	4.70
L58	A414 WB SP, East of Leverstock Green Way Roundabout	15,967	16,280	25,031	6.79	6.69	4.70
L59	A414 WB, East of Leverstock Green Way Roundabout	15,967	16,280	25,031	6.79	6.69	4.70
L60	Breakspear Way EB	28,928	29,543	36,675	5.40	5.29	6.46
L61	Breakspear Way WB SP	28,928	29,543	36,675	5.40	5.29	6.46
L62	Breakspear Way WB	28,928	29,543	36,675	5.40	5.29	6.46
L63	Breakspear Way EB, Slip onto A414	9,877	9,807	11,406	5.12	5.14	7.16
L64	A414 NB Slip onto M1	15,531	15,457	17,509	7.87	7.89	9.04
L65	M1 NB	86,429	86,397	94,318	12.94	12.97	13.34
L65a	M1 NB, Between B487	86,429	86,397	94,318	12.94	12.97	13.34
L65b	M1 NB, North of B487	86,429	86,397	94,318	12.94	12.97	13.34
L66	M1 SB	86,429	86,397	94,318	12.94	12.97	13.34
L66a	M1 SB, Between B487	86,429	86,397	94,318	12.94	12.97	13.34
L66b	M1 SB, South of B487	86,429	86,397	94,318	12.94	12.97	13.34
L67	A414 Slip Road off M1 SB	16,356	16,327	18,063	8.35	8.39	9.63
L68	A414 SB	22,936	23,770	30,329	5.30	5.26	5.94
L69	Breakspear Way Slip onto A414 SB	16,308	7,136	23,088	3.97	3.93	5.05

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
L70	Breakspear Way Slip Off A414 NB	22,016	22,653	28,245	5.22	5.12	5.87
L71	M1 NB, North of Westwick Row	70,572	70,565	76,631	14.04	14.05	14.27
L72	M1 SB, North of Westwick Row	70,572	70,565	76,631	14.04	14.05	14.27
L73	A414 NB	27,716	28,342	34,369	6.75	6.63	7.05
L74	Redbourn Road SP, South of Redbourn Road Roundabout	22,217	23,362	31,207	4.73	4.43	3.37
L75	Redbourn Road, South of Redbourn Road Roundabout	22,217	23,362	31,207	4.73	4.43	3.37
L76	Redbourn Road SP, North of A4147 Roundabout	22,217	23,362	31,207	4.73	4.43	3.37
L77	B487 SP	18,235	18,668	22,455	4.59	4.41	4.13
L78	B487 Queensway	18,235	18,668	22,455	4.59	4.41	4.13
L79	B487 SP, West of Alexandra Road	18,235	18,668	22,455	4.59	4.41	4.13
L79a	B487 Queensway SP, West of Alexandra Road	18,235	18,668	22,455	4.59	4.41	4.13
L80	B487 Queensway, West of Alexandra Road	18,235	18,668	22,455	4.59	4.41	4.13
L81	A4147 SP, East of Redbourn Road	23,791	24,608	27,186	5.18	5.00	4.69
L82	A4147, East of Redbourn Road	23,791	24,608	27,186	5.18	5.00	4.69
L83	Maylands Avenue	22,687	23,545	28,520	7.75	7.49	6.84
L84	Maylands Avenue Canyon SP	22,687	23,545	28,520	7.75	7.49	6.84
L85	Maylands Avenue, North of Leverstock Green Way Roundabout	22,687	23,530	28,505	7.75	7.73	7.03
L86	Swallowdale Lane	10,301	10,467	11,317	4.54	4.21	5.46

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
L87	Three Cherry Lane	5,845	5,754	1,817	2.20	2.22	0.27
L88	Hogg End Lane SP	196	196	-	17.05	17.05	0.00
L89	Hogg End Lane	196	196	-	17.05	17.05	0.00
L90	Cherry Tree Lane	1,678	1,678	-	0.00	#VALUE!	0.00
L91	Cherry Tree Lane SP	1,678	1,678	-	0.00	#VALUE!	0.00
L92	Punch Bowl Lane	198	198	-	11.22	11.22	0.00
L93	Green Lane SP	5,823	5,813	404	2.25	2.45	14.40
L94	Green Lane	5,823	5,813	404	2.25	2.45	14.40
L95	Green Lane South of Boundary Way	21,516	22,513	31,452	5.83	5.59	7.95
L96	Hempstead Road, West of New Roundabout	-	-	24,213	-	-	1.52
L97	Hempstead Road, East of New Roundabout	-	-	24,213	-	-	1.52
L98	East Hemel Link, South of Hemel Hempstead Road	-	-	3,008	-	-	0.99
L99	East Hemel Link, South of Punch Bowl Road	-	-	4,202	-	-	3.59
L100	East Hemel Link, North of Boundary Way	-	-	5,840	-	-	2.59
L101	East Hemel Link, South of Green Lane	-	-	2,342	-	-	2.06
R1	Swallowdale Lane Roundabout	19,999	20,901	24,838	2.40	2.16	2.18
R2	Redbourn Road Roundabout	20,052	20,673	24,494	3.30	3.12	2.66
R3	Aycliffe Drive Roundabout	23,690	23,855	25,697	2.61	2.59	2.09
R4	Piccotts End Road Roundabout	13,511	13,572	14,185	2.41	2.40	2.07

Link		24-hour AADT Flow			HDV Proportion of Fleet (%)		
		2024 Baseline	2024 DA	2041 IC	2024 Baseline	2024 DA	2041 IC
R5	Leighton Buzzard Road Roundabout	19,626	19,692	21,183	2.71	2.64	2.62
R6	Bury Hill Roundabout	19,652	19,841	23,809	2.98	2.86	2.87
R7	Combe Street Roundabout	26,100	26,333	30,848	3.16	3.03	3.19
R8	Station Road Roundabout	16,787	16,929	18,966	3.67	3.52	3.46
R9	Jarman Way Roundabout	13,905	13,965	17,010	3.53	3.27	3.14
R10	White Hart Road Roundabout	19,067	19,136	23,875	3.70	3.44	3.15
R11	Leverstock Green Way Roundabout	17,318	17,589	23,125	5.40	5.30	4.46
R12	Green Lane Roundabout	22,261	22,744	26,201	5.88	5.78	6.13
R13	A4147 Roundabout	21,414	22,213	26,949	4.86	4.64	4.02
R14	Eastman Way Roundabout	18,926	19,540	22,341	6.09	5.86	5.73
R15	Hogg End Lane Roundabout	3,955	4,194	1,606	2.47	2.46	3.33
R16	Boundary Way Roundabout	13,670	14,163	15,928	5.07	4.95	8.03
R17	New Hemel Hempstead Road Roundabout	-	-	17,145	-	-	1.49

1.5.4 Road parameters, elevated road links and canyon data for inputs into the model were identical to those described in Appendix 11.3 - Detailed Air Quality Assessment Methodology.

1.6 **Emission Factors**

1.6.1 The NO_x emission factor was calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 13.1). This has been produced by DEFRA and incorporates COPERT 5.8 vehicle emission factors and fleet information.

1.6.2 The NH₃ emission factor was calculated using the relevant traffic flows and the Calculator for Road Emissions of Ammonia (CREAM) workbook (version V2A) released by Air Quality

Consultants Ltd (AQC) in 2025. Reference should be made to the accompanying report¹ for details of the calculation methodology. There is current uncertainty over NH₃ emissions from vehicles and how these may change due to electrification of the fleet. As such, an emission factor for 2024 was used throughout the assessment to minimise potential uncertainty in the model results.

1.7 Meteorological Data

1.7.1 Meteorological data used in the assessment was taken from Luton Airport meteorological station over the period 1st January 2024 to 31st December 2024 (inclusive). Luton Airport is located at NGR: 511948, 221574, which is approximately 11.1km north-east of the Site. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

1.7.2 All meteorological records used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 11.11 in the Air Quality Chapter for a wind rose of the utilised meteorological data.

1.8 Roughness Length

1.8.1 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.5m was used to describe the modelling extents and meteorological site. This is considered appropriate for the morphology of both areas and is suggested within ADMS-Roads as being suitable for 'parkland, open suburbia'.

1.9 Monin-Obukhov Length

1.9.1 A minimum Monin-Obukhov length of 30m was used to describe the modelling extents. This value is considered appropriate for the nature of the area and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

¹ Development of CREAM Emissions Model Version 2, AQC, 2025.

- 1.9.2 A minimum Monin-Obukhov length of 30m was used to describe the meteorological site. This value is considered appropriate for the nature of the area and is suggested within ADMS-Roads as being suitable for 'mixed urban/industrial'.

1.10 **Background Pollutant Levels**

- 1.10.1 Background annual mean NH₃ concentrations and nitrogen deposition rates were obtained from the APIS website². The relevant values are summarised in Table A11.5.2.

Table A11.5.2 Background Pollution Levels - NH₃ Concentrations and Nitrogen Deposition Rates

Pollutant	Annual Mean NH ₃ Concentration (µg/m ³)	Annual Nitrogen Deposition Rate (kgN/ha/yr)
E1	1.21	27.59
E2	1.21	27.59
E3	1.21	27.59
E4	1.21	27.59
E5	1.21	27.59
E6	1.21	27.59
E7	1.21	27.59
E8	1.19	27.61
E9	1.19	27.61
E10	1.19	27.61
E11	1.19	27.61
E12	1.19	27.61
E13	1.19	27.61

- 1.10.2 Background annual mean nitrogen dioxide (NO₂) and NO_x concentrations for the baseline and completion year were obtained from the DEFRA website³ for each modelled receptor location. The relevant values are summarised in Table A11.5.3.

² UK Air Pollution Information System, www.apis.ac.uk.

³ <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2021>.

1.10.3 It should be noted that DEFRA has only released background data up to 2040. These have therefore been reviewed and considered for the completion year of 2041.

Table A11.5.3 Background Pollution Levels - NO₂ and NO_x Concentrations

Pollutant	2024 Annual Mean Concentration (µg/m ³)		2040 Annual Mean Concentration (µg/m ³)	
	NO _x	NO ₂	NO _x	NO ₂
E1	9.86	12.85	6.16	7.79
E2	9.86	12.85	6.16	7.79
E3	9.86	12.85	6.16	7.79
E4	9.86	12.85	6.16	7.79
E5	9.86	12.85	6.16	7.79
E6	9.86	12.85	6.16	7.79
E7	9.86	12.85	6.16	7.79
E8	9.13	11.82	5.64	7.10
E9	9.13	11.82	5.64	7.10
E10	9.13	11.82	5.64	7.10
E11	9.13	11.82	5.64	7.10
E12	9.13	11.82	5.64	7.10
E13	9.13	11.82	5.64	7.10

1.11 NO_x to NO₂ Conversion

1.11.1 Predicted annual mean NO_x concentrations were converted to NO₂ concentrations using the spreadsheet (version 9.1) provided by DEFRA, which is the method detailed within DEFRA guidance⁴.

⁴ Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

1.12 Deposition

1.12.1 Nitrogen deposition rates were calculated using the conversion factors provided within the Institute of Air Quality Management (IAQM) 'A guide to the assessment of air quality impacts on designated nature conservation sites'⁵. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used for the determination of nitrogen deposition are presented within Table A11.5.4.

Table A11.5.4 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor ($\mu\text{g}/\text{m}^2/\text{s}$ to $\text{kg}/\text{ha}/\text{yr}$ of pollutant species)
	Grassland	Forest	
NO ₂	0.0015	0.003	95.9
NH ₃	0.020	0.030	260

1.12.2 The relevant deposition velocity for each ecological receptor was selected from Table A11.5.4 based on the vegetation type at the specific location.

1.13 Verification

1.13.1 In order to minimise uncertainty in model predictions and associated potential effects on Howe Grove Wood LNR, a verification factor of 1.4918 was applied to all modelling results. This was determined using the methodology outlined within Appendix 11.3.

⁵ A guide to the assessment of air quality impacts on designated nature conservation sites v1.1., IAQM, 2020.

2.0 **ABBREVIATIONS**

AADT	Annual Average Daily Traffic
ADM	Air Dispersion Modelling
AQC	Air Quality Consultants
CERC	Cambridge Environmental Research Consultants
CREAM	Calculator for Road Emissions of Ammonia
DA	Development Alone
DEFRA	Department of Environment, Food and Rural Affairs
EB	Eastbound
HDV	Heavy Duty Vehicles
IAQM	Institute of Air Quality Management
IC	In-combination
LNR	Local Nature Reserve
PC	Process Contribution
NB	Northbound
NH ₃	Ammonia
NO _x	Nitrogen oxide
NO ₂	Nitrogen dioxide
SB	Southbound
SP	Slow Phase
WB	Westbound
Z ₀	Surface Roughness