Appendix A16.1: Air Quality Annexes

1 Introduction

1.1.1 This air quality technical appendix supports Chapter 16 (Air Quality) and includes the following annexes:

- Annex A - Mapped Background Concentration Comparison
- Annex B - Project Specific Air Quality Monitoring Results;
- Annex C - Model Verification Project Specific Air Quality Monitoring Results;
- Annex D - IAN 170 Long Term Trend Adjustment Calculations
- Annex E - Detailed Assessment Results TG(16) Approach – Sensitive Receptors; and
- Annex F - Detailed Assessment Results – Designated Sites.

2 Annex A – Mapped Background Concentrations Comparison

2.1.1 A comparison of mapped annual mean background NO_2 concentrations against locally monitored concentrations is provided in Table 1.

Table 1: Mapped background concentration comparison

Monitoring Site				Annual Mean NO_2 Concentration		
Name	**Description**	**X(m)**	**Y(m)**	**Monitored**	**Mapped**	**Difference**
1	Give way sign at junction before bridge	301794	742051	5.2	4.4	-0.8
4	Wooden telegraph pole across from bins	300056	749192	4.7	3.2	-1.5
9	Lamppost next to national speed limit signs	293933	757525	8.5	4.1	-4.4
10	Lamppost	293888	757643	7.5	4.1	-3.4
15	Passing place	289188	764082	5.8	3.9	-1.9
					Average	**-2.4**

2.1.2 Table 1 shows that mapped values represent locally monitored concentrations reasonably well, underestimating annual mean NO_2 background concentrations by approximately 2.4 µg/m^3. It was not considered necessary to adjust the mapped values for the purpose of the assessment.

2.1.3 For the purpose of assessment, mapped values were not adjusted for underestimation. The consequence of this was a conservative estimate of impacts resulting from the calculation of a higher model adjustment factor, which led to increased confidence in the robustness of impact predictions. Prior to making conclusions regarding the potential for exceedance of total annual mean NO_2 concentration predictions, consideration was made of the findings of the mapped background concentration comparison as shown in Table 1.

3 Annex B – Project Specific Air Quality Monitoring Results

3.1.1 A six-month monitoring programme using diffusion tubes was undertaken between February 2015 to August 2015 at 25 selected locations for the A9 southern section projects (referred to as Project 02 to Project 05 in Chapter 1 of the ES). The details of monitoring sites for the proposed scheme (those numbered 11-25) are presented in Table 2 and are highlighted in grey. The locations of these monitoring sites within the study area are shown on Figure A16.1.

Table 2: Proposed scheme specific monitoring location details

Name	Description	X(m)	Y(m)	Height (cm)	A9 Dualling Project Number	Type
1	Give way sign at junction before bridge	301794	742051	230	P2	Background
2	Bus stop on A9 SB c/way	301716	742296	280	P2	Kerbside
3	Bus stop on A9 NB c/way	301627	742283	290	P2	Kerbside
4	Wooden telegraph pole across from bins	300056	749192	260	P3	Background
5	Parking sign preceding lay-by 28	299718	749202	160	P3	Roadside
6	Give way sign at junction with A9	299468	749766	230	P3	Roadside
7	Parking sign preceding lay-by 39	294309	757006	240	P4	Roadside
8	Silver pole near average speed camera adjacent to SB c/way	294307	757028	270	P4	Roadside
9	Lamppost next to national speed limit signs	293933	757525	290	P4	Background
10	Lamppost	293888	757643	360	P4	Background
11	No stopping sign A9 SB c/way	291761	762837	175	P5	Roadside
12	Bridge inspection stairwell railing	291608	763070	90	P5	Roadside
13	Fence post preceding lay-by 44	290595	763746	210	P5	Roadside
14	Hazard road sign	289259	764207	260	P5	Roadside
15	Passing place	289188	764082	240	P5	Background
16	Road sign A9 SB c/way Killiecrankie turn off	288916	764293	130	P5	Roadside
17	Parking sign preceding lay-by 46	288882	764285	160	P5	Roadside
18	Parking sign preceding lay-by 49	286952	764924	160	P5	Roadside
19	Parking sign preceding lay-by 51	285565	765243	160	P5	Roadside
20	Maintenance bay behind safety barrier	283906	765683	240	P5	Roadside
21	No stopping sign A9 SB c/way	283067	765516	160	P5	Kerbside
22	Metal pole near wooden telegraph pole	280540	765883	460	P5	Roadside
23	Wooden telegraph pole beside petrol station price sign	280489	765759	310	P5	Roadside
24	No parking sign in deceleration lane	280474	765910	190	P5	Roadside
25	Give way sign at A9/Calvine junction adjacent to northbound carriageway	280149	765947	160	P5	Roadside

3.1.2 The six-months of monitoring data collected are presented in Table 3. Those sites within the study area are highlighted in grey. As in Table 2, the other monitoring sites relate to the other southern sections of the A9 dualling programme.

Table 3: Average measured NO_2 concentration ($\mu g/m^3$) for the six monitoring periods

Site	A9 Dualling Project Number	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
1	P2	6.7	5.8	4.5	2.9	4.9	4.8
2	P2	35.1	30.4	26.9	25.8	28.6	28.3
3	P2	46.3	47.1	38.8	34.1	44.0	45.2
4	P3	6.6	5.1	3.6	3.3	4.1	3.9
5	P3	-	29.5	25.3	20.3	26.2	29.5
6	P3	-	18.6	13.8	14.2	16.8	17.7
7	P4	26.6	27.5	22.4	22.2	29.5	31.2
8	P4	22.9	19.7	14.4	14.3	14.3	16.8

Site	A9 Dualling Project Number	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
9	P4	13.4	10.5	6.7	5.0	7.7	5.3
10	P4	11.2	9.0	5.7	3.5	5.4	8.2
11	P5	-	30.2	30.9	30.8	36.1	34.1
12	P5	-	19.6	16.6	16.3	19.2	20.3
13	P5	-	25.5	24.5	23.6	20.8	27.9
14	P5	12.9	11.5	9.3	7.7	7.7	8.6
15	P5	8.6	6.9	5.5	3.9	4.2	4.0
16	P5	28.1	24.8	22.7	21.3	24.2	27.5
17	P5	20.7	19.9	15.9	16.5	15.8	19.6
18	P5	25.8	24.4	22.5	18.6	21.6	27.7
19	P5	33.4	32.3	27.2	26.7	28.0	32.7
20	P5	23.2	21.1	15.3	15.1	14.1	15.3
21	P5	29.3	25.5	19.6	19.3	19.5	25.1
22	P5	22.4	20.3	14.5	16.2	15.4	16.9
23	P5	9.2	9.3	6.7	4.1	5.0	5.8
24	P5	29.4	28.3	21.3	23.5	24.2	28.9
25	P5	28.0	30.5	23.7	23.1	24.7	27.4

3.1.3 To address diffusion tube monitoring results for systematic over/underestimation, a bias adjustment factor is applied. The 2015 national bias factor (0.88) was used for the purposes of this assessment. The 2015 national bias factor was the bias adjustment factor determined from Local Authority co-location studies throughout the UK and has been collated by Defra's LAQM Helpdesk[1].

3.1.4 As the Baseline Year is 2015 and the monitoring campaign took place in 2015 for a period of 6 months rather than the full year, the monitoring campaign results had to be adjusted to be able to represent the 2015 annual mean NO_2 concentrations at each of the locations sampled. This adjustment allowed a comparison to be made between monitoring data and AQO on an annual mean basis. The calculation of the annualisation/seasonal adjustment factor is shown below in Table 4 in accordance with LAQM.TG(16) Box A3.2 (Defra, 2016).

Table 4: Annualisation/seasonal adjustment

NO_2 concentration ($\mu g/m^3$)	Falkirk Grangemouth MC Monitoring Station	Grangemouth Moray Monitoring Station	Average
Period 1	17.2	11.2	
Period 2	21.9	15.8	
Period 3	17.5	15.0	
Period 4	10.3	8.0	
Period 5	12.1	11.9	
Period 6	10.8	10.5	
Average Period Mean (A)	15.8	12.2	
2015 Annual Mean (B)	18.5	14.9	
Annual Mean/Period Mean ratio (A/B)	1.17	1.22	1.19

[1] http://laqm.defra.gov.uk/documents/Database_Diffusion_Tube_Bias_Factors_v09_16-Final.xls

3.1.5 The estimated annual mean NO_2 concentrations for Baseline Year 2015 are presented in Table 5. Those sites within the study area are highlighted in grey and referenced as 11-25. Other monitoring sites relate to the other southern sections of the A9 dualling programme.

Table 5: Estimated 2015 annual mean NO_2 concentrations

Site	A9 Dualling Project Number	6 Month Period Mean (µg/m^3)	Data Capture (100% = 6 months)	Annualisation / Seasonal Adjustment Ratio	Bias Adjustment Ratio	Estimated 2015 Annual Mean (µg/m^3)
1	P2	4.9	100	1.19	0.87	5.1
2	P2	29.2	100	1.19	0.87	30.3
3	P2	42.6	100	1.19	0.87	**44.2**
4	P3	4.5	100	1.19	0.87	4.6
5	P3	26.2	83	1.19	0.87	27.1
6	P3	16.2	83	1.19	0.87	16.8
7	P4	26.5	100	1.19	0.87	27.6
8	P4	17.1	100	1.19	0.87	17.7
9	P4	8.1	100	1.19	0.87	8.4
10	P4	7.1	100	1.19	0.87	7.4
11	P5	32.4	83	1.19	0.87	33.5
12	P5	18.4	83	1.19	0.87	19.0
13	P5	24.5	83	1.19	0.87	25.3
14	P5	9.6	100	1.19	0.87	10.0
15	P5	5.5	100	1.19	0.87	5.7
16	P5	24.8	100	1.19	0.87	25.7
17	P5	18.1	100	1.19	0.87	18.8
18	P5	23.4	100	1.19	0.87	24.3
19	P5	30.1	100	1.19	0.87	31.2
20	P5	17.4	100	1.19	0.87	18.0
21	P5	23.0	100	1.19	0.87	23.9
22	P5	17.6	100	1.19	0.87	18.3
23	P5	6.7	100	1.19	0.87	6.9
24	P5	25.9	100	1.19	0.87	26.9
25	P5	26.2	100	1.19	0.87	27.2

Exceedances are highlighted in **Bold** and **Underlined**

4 Annex C - Model Verification Project Specific Air Quality Monitoring Results

4.1.1 An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG(16) identifies several statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. The statistical parameters used in this assessment are:

- root mean square error (RMSE);
- fractional bias (FB); and
- correlation coefficient (CC).

4.1.2 A brief explanation of each statistic is provided in Table 6, and further details can be found in LAQM.TG(16) Box A3.7 (Defra, 2016).

Table 6: Model performance statistics

Statistical Parameter	Comments	Ideal Value
RMSE	RMSE is used to define the average error or uncertainty of the model. If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if model predictions are of an annual mean NO_2 objective of 40µg/m^3 and the RMSE is 10µg/m^3 or above, it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4µg/m^3 for the annual mean NO_2 objective.	0.01
FB	It is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.00
CC	It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

4.1.3 These parameters estimate how the model results agree or diverge from observations.

4.1.4 These calculations have been carried out prior to, and after, model adjustment and provide information on the improvement of the model predictions as a result of the application of the adjustment factor.

Model Verification Methodology

4.1.5 The verification process involves a review of the annual mean modelled pollutant concentrations against corresponding monitoring data to determine how closely the air quality model corresponds. The acceptable limits of model verification are set out in LAQM.TG(16). Depending on the outcome it may be considered that there is no need to adjust any of the modelled results (LAQM.TG(16)).

4.1.6 Alternatively, the model may not correlate against the monitoring data. There is then a need to check all the input data to ensure that it is reasonable and accurately represented in the air quality modelling process.

4.1.7 Where all input data, such as traffic data, emissions rates, and background concentrations have been checked and considered reasonable, then the model requires adjustment to best align with the monitoring data. This may either be a single adjustment factor to be applied to the modelled concentrations across the study area, or a range of different adjustment factors to account for different zones in the study area e.g. motorways, local roads. Suitable monitoring locations were selected and used in the verification process, considering the site types, position of the diffusion tubes and representation of local air quality environment.

4.1.8 The non-adjusted modelled versus monitored NO_2 concentrations at those locations determined as suitable for the verification process are presented in Table 7.

Table 7: Non-adjusted modelled vs monitored NO_2

Monitor ID	X(m)	Y(m)	A9 Dualling Project Number	Monitored Annual Mean NO_2 (µg/m³)	Non-Adjusted Modelled Annual Mean NO_2 (µg/m³)	Monitored versus Modelled (% Difference)
8	294307	757028	P4	17.7	11.8	-33.5%
12	291608	763070	P5	19.0	11.1	-41.5%
20	283906	765683	P5	18.0	9.6	-46.7%
22	280540	765883	P5	18.3	9.5	-48.1%

4.1.9 The initial comparison between the predicted concentrations and monitoring data illustrates that the model tends to under predict NO_2 concentrations over the modelled area.

4.1.10 Model adjustment was undertaken in accordance with LAQM.TG(16). A line-of-best-fit using linear regression was plot through the monitored and modelled source contribution of NO_x from Roads (Road-NO_x). The slope of the line-of-best-fit was 2.059 and this value was used to adjust modelled concentrations. The adjusted modelled concentrations versus monitored NO_2 concentrations are presented in Table B3. Modelled Road-NO_x concentrations predicted at sensitive receptors in the base and opening year scenarios were multiplied by the adjustment factor (2.059) to account for the under-prediction of Road NO_x by the model.

Table 8: Adjusted modelled vs monitored NO_2

Monitor ID	X(m)	Y(m)	A9 Dualling Project Number	Monitored Annual Mean NO_2 (µg/m³)	Adjusted Modelled Annual Mean NO_2 (µg/m³)	Monitored versus Modelled (% Difference)
8	294307	757028	P4	17.7	20.0	12.9%
12	291608	763070	P5	19.0	19.4	2.2%
20	283906	765683	P5	18.0	16.6	-8.1%
22	280540	765883	P6	18.3	16.4	-10.2%

4.1.11 The summary results and model performance statistics defined in LAQM.TG(16) are provided in Table 9.

Table 9: Model performance statistics

	No Adjustment	NO_x Roads Adjustment
Adjustment Factor	-	2.059
Correlation Co-efficient	-0.025	0.085
RMSE	**7.843**	**1.667**
Fractional Bias	0.540	0.009
Within +10%	0	0
Within -10%	0	2
Within +-10%	0	2
Within +10 to 25%	0	1
Within -10 to 25%	0	1
Within +-10 to 25%	0	2
Over +25%	0	0
Under -25%	4	0
Greater +- 25%	4	0
Within +- 25%	0	4

4.1.12 A comparison of the performance of the annual mean modelled concentrations from the air quality model against the annual mean monitoring data was undertaken. The results show that all of the four modelled concentrations are within +/-25% of monitored concentrations. The model performance statistics show that the uncertainty in the predictions of adjusted total annual mean NO_2 was good as the RMSE is less than 4µg/m^3 (10%) for the study area.

5 Annex D – IAN 170 Long Term Trend Adjustment Calculations

5.1.1 The calculation of the Long Term Trend adjustment factor as detailed in IAN 170 is set out in Table 10.

Table 10: Long term trend adjustment calculations

Receptor	Base 2015 (µg/m^3)	Projected Base 2026 (µg/m^3)	Ratio A	Ratio B	Adjustment Factor (Ratio A * Ratio B)
1	6.9	2.9	0.48	0.71	1.48
2	6.0	2.1	0.59	0.71	1.21
3	5.0	1.9	0.63	0.71	1.13
4	6.6	1.9	0.63	0.71	1.13
5	4.1	2.0	0.61	0.71	1.16
6	3.8	2.1	0.58	0.71	1.24
7	10.0	5.3	0.38	0.71	1.87
8	3.7	3.6	0.42	0.71	1.68
9	7.5	1.9	0.61	0.71	1.17
10	7.3	1.9	0.63	0.71	1.13
11	4.4	2.6	0.49	0.71	1.44
12	4.5	3.5	0.43	0.71	1.66
13	9.6	1.9	0.61	0.71	1.16
14	7.3	2.1	0.61	0.71	1.17
15	5.8	2.1	0.61	0.71	1.17
16	9.0	2.1	0.63	0.71	1.13
17	3.3	3.7	0.40	0.71	1.76
18	3.5	2.8	0.47	0.71	1.51
19	3.5	3.2	0.44	0.71	1.62
20	3.2	3.9	0.41	0.71	1.74
21	8.3	2.2	0.48	0.71	1.48
22	5.3	2.2	0.51	0.71	1.41
23	3.0	3.1	0.43	0.71	1.67
24	3.2	3.2	0.42	0.71	1.69
25	8.4	2.1	0.56	0.71	1.27
26	13.8	4.0	0.40	0.71	1.77
27	3.7	2.1	0.55	0.71	1.30
28	3.3	2.1	0.53	0.71	1.34
29	3.1	2.9	0.44	0.71	1.61
30	3.0	2.4	0.49	0.71	1.47
31	3.5	2.7	0.46	0.71	1.56
32	6.1	3.0	0.43	0.71	1.64

5.1.2 Long Term Trend adjustment factors were applied to TG(16) Approach results to account for potential underestimation in forecasting of pollution concentrations.

6 Annex E – Detailed Assessment Results TG(16) Approach – Sensitive Receptors

6.1.1 The detailed results of annual mean NO_2 concentrations at sensitive receptors following the TG(16) approach are presented in Table 11.

Table 11: Annual mean NO_2 concentrations - (TG(16) approach)

Receptor	Base 2015 (µg/m³)	DM 2026 (µg/m³)	DS 2026 (µg/m³)	Change (µg/m³)
1	6.9	3.0	3.4	0.4
2	6.0	2.1	2.2	0.1
3	5.0	1.9	2.0	0.1
4	6.6	2.0	2.1	0.1
5	4.1	2.0	2.0	0.0
6	3.8	2.2	2.4	0.2
7	10.0	5.7	6.6	0.9
8	3.7	3.8	4.2	0.4
9	7.5	2.0	2.0	0.1
10	7.3	1.9	1.9	0.0
11	4.4	2.7	3.1	0.4
12	4.5	3.8	4.4	0.7
13	9.6	2.0	2.0	0.1
14	7.3	2.1	2.2	0.1
15	5.8	2.1	2.2	0.1
16	9.0	2.1	2.1	0.0
17	3.3	3.9	3.2	-0.8
18	3.5	2.9	2.3	-0.6
19	3.5	3.4	2.4	-1.0
20	3.2	4.2	2.8	-1.4
21	8.3	2.2	2.5	0.3
22	5.3	2.3	2.4	0.2
23	3.0	3.3	4.5	1.2
24	3.2	3.3	3.8	0.5
25	8.4	2.1	2.4	0.3
26	13.8	4.3	5.1	0.8
27	3.7	2.1	2.4	0.3
28	3.3	2.2	1.7	-0.6
29	3.1	3.1	4.2	1.1
30	3.0	2.5	3.2	0.7
31	3.5	2.9	3.2	0.3
32	6.1	3.1	3.9	0.8

7 Annex F – Detailed Assessment Results - Designated Sites

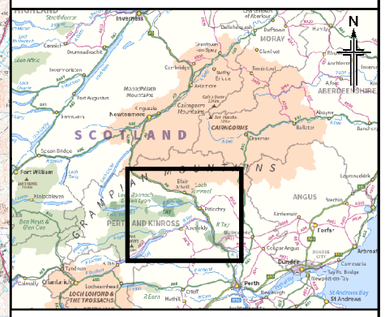
7.1.1 The detailed results of annual mean NO_x concentrations at designated sites in the 2015 Baseline, Do-Minimum (DM) (2026) and Do-Something (DS) (2026) scenarios are presented in Table 12.

Table 12: Annual mean NO_x concentrations

Receptor (Transect and Distance (m) from kerb)	X(m)	Y(m)	2015 Base (µg/m³)	2026 DM (µg/m³)	2026 DS (µg/m³)	Change (DS-DM) (µg/m³)
Tulach Hill (A0 m)	285201	765159	3.2	4.2	5.8	1.5
Tulach Hill (A10 m)	285201	765149	3.0	3.7	4.9	1.2
Tulach Hill (A20 m)	285202	765139	2.8	3.3	4.2	0.9
Tulach Hill (A30 m)	285202	765129	2.7	3.0	3.7	0.6
Tulach Hill (A40 m)	285202	765119	2.6	2.8	3.3	0.5
Tulach Hill (A50 m)	285202	765109	2.5	2.6	3.0	0.4
Tulach Hill (A60 m)	285203	765099	2.4	2.5	2.8	0.3
Tulach Hill (A70 m)	285203	765089	2.4	2.5	2.7	0.2
Tulach Hill (A80 m)	285203	765079	2.4	2.4	2.6	0.2
Tulach Hill (A90 m)	285204	765069	2.4	2.4	2.5	0.2
Tulach Hill (A100 m)	285204	765059	2.3	2.3	2.4	0.2
Tulach Hill (B70 m)	287043	764812	4.4	6.8	9.9	3.1
Tulach Hill (B80 m)	287038	764803	4.0	5.7	8.1	2.3
Tulach Hill (B90 m)	287033	764794	3.6	4.9	6.7	1.8
Tulach Hill (B100 m)	287028	764786	3.3	4.3	5.6	1.3
Tulach Hill (B110 m)	287023	764777	3.0	3.8	4.7	1.0
Tulach Hill (B120 m)	287018	764768	2.8	3.4	4.1	0.7
Tulach Hill (B130 m)	287013	764760	2.7	3.1	3.6	0.5
Tulach Hill (B140 m)	287008	764751	2.6	2.8	3.2	0.4
Tulach Hill (B150 m)	287003	764742	2.5	2.7	3.0	0.3
Tulach Hill (B160 m)	286998	764734	2.5	2.6	2.8	0.2
Tulach Hill (B170 m)	286993	764725	2.4	2.5	2.7	0.2
Tulach Hill (B180 m)	286988	764717	2.4	2.5	2.7	0.2
Tulach Hill (B190 m)	286983	764708	2.4	2.4	2.6	0.2
Tulach Hill (B200 m)	286978	764699	2.3	2.3	2.4	0.1
Aldclune & Invervack Meadows (C20 m)	289189	764255	11.3	22.5	N/A	-
Aldclune & Invervack Meadows (C30 m)	289189	764245	9.3	17.8	29.4	11.6
Aldclune & Invervack Meadows (C40 m)	289189	764235	7.7	14.3	24.4	10.0
Aldclune & Invervack Meadows (C50 m)	289189	764225	6.6	11.7	19.5	7.7
Aldclune & Invervack Meadows (C60 m)	289188	764215	5.7	9.8	15.8	6.0
Aldclune & Invervack Meadows (C70 m)	289188	764205	5.0	8.2	12.9	4.6
Aldclune & Invervack Meadows (C80 m)	289188	764195	4.5	7.0	10.6	3.6
Aldclune & Invervack Meadows (C90 m)	289187	764185	4.1	6.1	8.8	2.7
Aldclune & Invervack Meadows (C100 m)	289187	764176	3.7	5.3	7.3	2.0
Aldclune & Invervack Meadows (C110 m)	289187	764166	3.4	4.5	6.1	1.6
Aldclune & Invervack Meadows (C120 m)	289187	764156	3.2	4.1	5.2	1.2
Aldclune & Invervack Meadows (C130 m)	289186	764146	2.8	3.3	4.3	1.0
Pass of Killiecrankie (0 m)	291794	762503	4.2	6.4	7.5	1.0
Pass of Killiecrankie (10 m)	291784	762501	3.8	5.4	6.2	0.8
Pass of Killiecrankie (20 m)	291774	762499	3.4	4.6	5.2	0.6
Pass of Killiecrankie (30 m)	291764	762497	3.2	4.0	4.5	0.4
Pass of Killiecrankie (40 m)	291755	762495	3.0	3.6	3.9	0.3

Receptor (Transect and Distance (m) from kerb)	X(m)	Y(m)	2015 Base (µg/m³)	2026 DM (µg/m³)	2026 DS (µg/m³)	Change (DS-DM) (µg/m³)
Pass of Killiecrankie (50 m)	291745	762492	2.8	3.3	3.5	0.2
Pass of Killiecrankie (60 m)	291735	762490	2.7	3.1	3.3	0.2
Pass of Killiecrankie (100 m)	291696	762481	2.5	2.6	2.7	0.1
Pass of Killiecrankie (110 m)	291686	762479	2.3	2.1	2.3	0.1
Pass of Killiecrankie (120 m)	291677	762477	2.3	2.1	2.1	0.0
Pass of Killiecrankie (130 m)	291667	762474	2.3	2.1	2.1	0.0
Pass of Killiecrankie (140 m)	291657	762472	2.3	2.1	2.1	0.0
Pass of Killiecrankie (150 m)	291647	762470	2.3	2.1	2.1	0.0
Pass of Killiecrankie (160 m)	291638	762468	2.3	2.1	2.1	0.0
Pass of Killiecrankie (170 m)	291628	762465	2.3	2.1	2.1	0.0
Pass of Killiecrankie (180 m)	291618	762463	2.3	2.1	2.1	0.0
Pass of Killiecrankie (190 m)	291608	762461	2.3	2.1	2.1	0.0
Aldclune & Invervack Meadows (A0 m)	283092	765539	6.9	12.4	14.2	1.8
Aldclune & Invervack Meadows (A10 m)	283094	765549	5.9	10.1	11.5	1.4
Aldclune & Invervack Meadows (A20 m)	283097	765559	5.1	8.3	9.4	1.1
Aldclune & Invervack Meadows (A30 m)	283100	765568	4.4	6.9	7.7	0.8
Aldclune & Invervack Meadows (A40 m)	283102	765578	4.0	5.8	6.4	0.6
Aldclune & Invervack Meadows (A50 m)	283105	765587	3.6	5.0	5.4	0.4
Aldclune & Invervack Meadows (A60 m)	283108	765597	3.2	4.3	4.6	0.3
Aldclune & Invervack Meadows (A70 m)	283110	765607	3.0	3.8	4.0	0.2
Aldclune & Invervack Meadows (A80 m)	283113	765616	2.8	3.3	3.5	0.2
Aldclune & Invervack Meadows (B0 m)	284043	765850	2.8	3.3	3.1	-0.2
Aldclune & Invervack Meadows (B10 m)	284045	765841	3.0	3.7	3.4	-0.3
Aldclune & Invervack Meadows (B20 m)	284046	765831	3.2	4.2	3.7	-0.5
Aldclune & Invervack Meadows (B30 m)	284047	765821	3.5	4.8	4.1	-0.7
Aldclune & Invervack Meadows (B40 m)	284048	765811	3.8	5.5	4.6	-0.9
Aldclune & Invervack Meadows (B50 m)	284050	765801	4.3	6.5	5.3	-1.2
Aldclune & Invervack Meadows (B60 m)	284051	765791	4.8	7.8	6.2	-1.6
Aldclune & Invervack Meadows (B70 m)	284052	765781	5.6	9.3	7.3	-2.1
Aldclune & Invervack Meadows (B80 m)	284053	765771	6.5	11.4	8.7	-2.8
Aldclune & Invervack Meadows (B90 m)	284055	765761	7.8	14.2	10.4	-3.8
Aldclune & Invervack Meadows (B100 m)	284056	765751	9.5	18.1	12.7	-5.4
Struan Wood (200 m)	278863	766362	2.0	1.8	1.9	0.1
Struan Wood (190 m)	278869	766370	2.0	1.8	1.9	0.1
Struan Wood (180 m)	278875	766378	2.2	2.1	2.3	0.1
Struan Wood (170 m)	278881	766386	2.2	2.2	2.4	0.1

Figure A16.1



Legend

- Project extents
- Air quality monitoring sites for Killiecrankie to Glen Garry
- Air quality monitoring sites
- Air quality monitoring sites for verification

INVERNESS
A9
GLEN GARRY
Killiecrankie to Glen Garry
BLAIR ATHOLL
PITLOCHRY
Pitlochry to Killiecrankie
BALLINLUIG
Tay Crossing to Ballinluig
DUNKELD
BIRNAM
Pass of Birnam to Tay Crossing
PERTH

Sites for verification
Scale 1:75,000

23
24
21
19
15
14
13

0 2.5 5 10 Kilometres

Rev.	Rev. Date	Purpose of revision	Orig/Dwn	Checkd	Rev'd	Apprv'd
0	NOV 2017	ES Publication	JCr	CS	MC	AJG

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Project: A9 DUALLING PERTH TO INVERNESS — Killiecrankie to Glen Garry

Drawing title

Environmental Statement
Air Quality Monitoring Sites and Monitoring Sites Used for Verification Process

Sheet 1 of 1

Drawing Status	FINAL
Scale	1:2,750,000 @ A3 — DO NOT SCALE
Jacobs No.	B2140005
BIM No.	
Drawing number	Figure A16.1 — Rev 0