Appendix 12.12

Ecology Noise Modelling Results

Contents

Annexes

Tables

1 Introduction

1.1.1 The Environmental Impact Assessment (EIA) of the potential noise and vibration impacts for sensitive receptors is presented in **Chapter 17** in **Volume 1** of the Environmental Statement, and follows the guidance for Detailed Assessment provided in the DMRB, Volume 11, Section 3, Part 7 '*Noise and Vibration'* (The Highways Agency *et al*, 2011, thereafter referred to as HD213/11).

1.1.2 Potential impacts of operational road traffic noise are considered for leaving the existing A9 route alignment unchanged, or implementing the Proposed Scheme, referred to as the Do-Minimum and Do-Something scenarios respectively.

1.1.3 Impacts and significance of operational road traffic noise are considered in **Chapter 17** in **Volume 1** based on outputs from the traffic model. This appendix presents the findings of specific noise modelling carried out to identify potential impacts on sensitive ecology features.

1.1.4 Potential impacts of construction stage noise on sensitive ecology features are also discussed within this appendix.

2 Operational Noise

2.1 Baseline

2.1.1 **Chapter 12** in **Volume 1** presents sensitive ecology features that could be affected by changes in noise and vibration levels; these are listed in **Table 12.12.1**. From the closest point (e.g. nearest designated feature or ancient woodland) to the existing road, each feature has been modelled against the Do-Minimum (DM) and Do-Something (DS) scenario for the opening year (2026) and future operational baseline (2041). Changes in noise levels are presented in **Annex A** and locations of noise modelling shown in **Drawings 12.65** to **12.70** (**Volume 3**). Potential impacts based on these findings are discussed in **Chapter 12** (**Volume 1**).

2.1.2 Throughout the assessment process, the requirement for specific noise modelling information in relation to qualifying features of the River Spey - Insh Marshes Special Protection Area (SPA) and Ramsar site (breeding wigeon) was identified and are included as a specific sensitive ecology feature.

2.1.3 **Chapter 17, Volume 1** predicts that the Do-Minimum and Do-Something scenarios will have no discernible increase in vibration levels, which are not considered further.

Table 12.12.1: Sensitive ecology features

Feature
River Spey Special Area of Conservation(SAC) and Site of Special Scientific Interest (SSSI)
Ancient Woodland
Insh Marshes SAC and National Nature Reserve (NNR)
River Spey – Insh Marshes Ramsar, Special Protection Area (SPA) and SSSI
Breeding wigeon locations (confidential)

2.2 Summary of Noise Model Results

2.2.1 The model of road traffic noise predicts that most of the ecological receptors modelled show either reductions, or relatively minor increases, in operational noise levels in both 2026 and 2041; these levels are listed in **Annex A**.

2.2.2 Noise levels range from the threshold of hearing at 0 decibels (dB) to levels of over 130dB at which point the noise becomes painful. Noise levels over 80dB are considered potentially damaging to human hearing. **Table 12.12.2** presents a guide to the weighted sound pressure levels in common areas and activities.

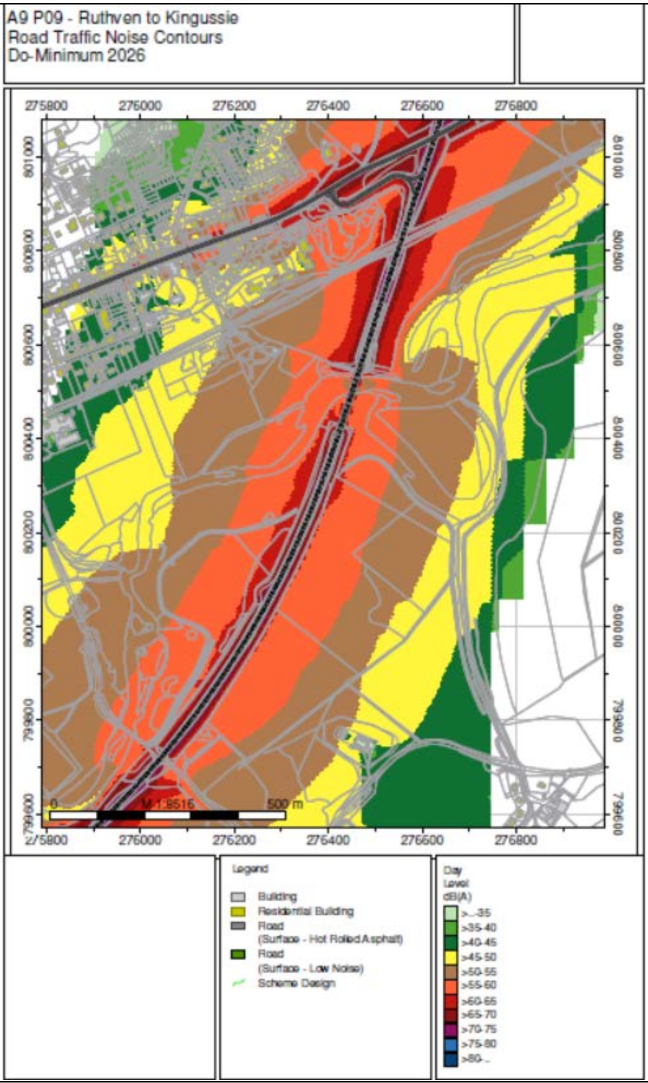
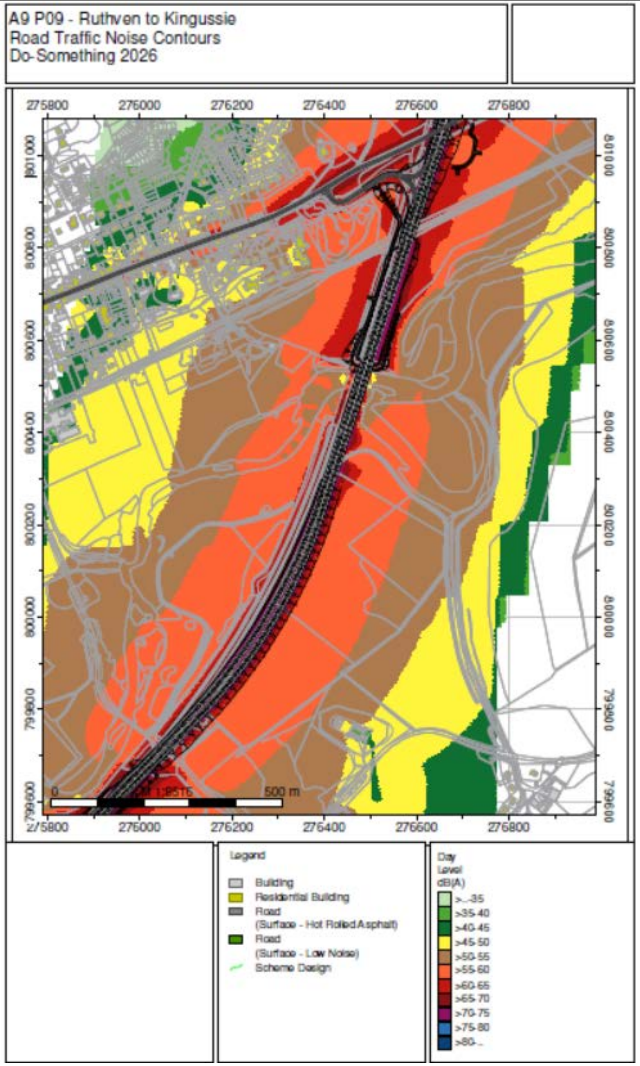
Table 12.12.2: Common noise levels

Source	Sound Pressure Level, dB(A)
Threshold of hearing – silent	0
Quiet bedroom	25-35
Quiet rural area	45-50
Suburban areas away from main traffic routes	50-60
Conversational speech at 1m distance	60-70
Busy urban street corner	70-80
Passenger car at 60 kmh and 7m distance	72
Health & Safety 'lower exposure action value' to prevent damage to hearing	80
Heavy diesel lorry at 40kmh and 7m distance	85
Pneumatic drill (un-silenced) at 7m distance	95
Threshold of pain	130

2.2.3 Noise contour mapping presented in **Drawing 17.2** to **17.41** (**Volume 3**) illustrates that throughout most of the proposed scheme, changes in operational road noise are minor. Increases in operational road noise are widespread throughout areas of the Insh Marshes NNR and are also present in parts of the River Spey – Insh Marshes SPA and Ramsar. This is where the Proposed Scheme is situated offline to the east of the existing route, with decreases observed in areas of the NNR to the west of the route. The contour maps presented on **Drawings 17.2** to **17.41** (**Volume 3**) indicate likely increases in noise of between 2-3dB and 3-4 dB. To further inform the assessment process, absolute noise level contours in this area have been generated and are presented in **Figures 1 and 2**.

2.2.4 In the short term, to 2026, the modelling shows relatively minor increases in noise in certain areas of the NNR and an area of ancient woodland. In this same period, there are noise reductions predicted for sections of the River Spey SSSI and SAC and a significant reduction of 7.9dB in a separate ancient woodland location.

2.2.5 In the longer term, to 2041, there are only very minor increases of a maximum 0.4dB in certain areas of the River Spey SAC/ SSSI, the Insh Marshes designations and in an area of ancient woodland.

Figure 1: Operational Noise Contours Do-Minimum 2026	Figure 2: Operational Noise Contours Do-Something 2026
	

3 Construction Noise

3.1 Background

3.1.1 An overall assessment of construction noise has been undertaken for a range of identified phases of the construction programme. This assessment has considered potential construction noise levels at various distances from the works (source of noise) to provide an indication of changes in construction noise over distance.

3.1.2 The data provided in **Table 12-12-1** assumes the absence of any screening mitigation placed between construction activities and receptors, though such mitigation measures to attenuate noise may be implemented. The nature of construction noise is not continuous; site plant is operated ('on-time') between 10 and 50% of the time. The exception to this relates to diesel generators, which may operate for up to 80% of the time.

Table 12-12-1: Predicted construction noise levels, $L_{Aeq,T}$ dB

Construction Activities	Distances					
	10m	20m	50m	100m	200m	350m
1. Site Clearance	86.8	80.8	71.4	63.8	56.3	50.2
2. Compound Construction	74.8	68.8	59.3	51.8	44.3	38.2
3. Compound operation	77.5	71.5	62.0	54.5	47.0	40.9
4. Stock proofing	85.5	79.5	70.0	62.5	55.0	48.9
5. Pre-earthworks drainage	80.2	74.2	64.7	57.2	49.7	43.6
6. Earthworks - General	87.0	81.0	71.5	64.0	56.5	50.4
7. Earthworks rolling and compaction	84.4	78.4	68.9	61.4	53.9	47.8
8. Sub Formation	86.5	80.5	71.0	63.5	56.0	49.9
9. Drainage	80.2	74.2	64.7	57.2	49.7	43.6
10. Paving	86.6	80.6	71.1	63.6	56.1	50.0
11. Central Reserve	84.0	78.0	68.5	61.0	53.5	47.4
12. Road Marking	80.0	74.0	64.5	57.0	49.5	43.4
13. Signage	87.0	81.0	71.5	64.0	56.5	50.4
14. Bridge Foundation Construction	86.3	80.2	70.8	63.3	55.7	49.7
15. Bridge Abutment	85.9	79.8	70.4	62.9	55.3	49.2
16. Bridge Deck	83.3	77.3	67.9	60.3	52.8	46.7

3.1.3 Noise and vibration impacts during construction and demolition have been considered further in proximity to three locations: the River Spey crossing, the Highland Main Line (HML) railway crossing and an area of proposed rock-removal at Ralia. These three locations represent the worst-case areas for noise and vibration disturbance in terms of the scale of, and methods proposed for, construction/ demolition activities.

3.2 River Spey Crossing

3.2.1 At present, the final method of construction for the foundations and abutments of the replacement Spey crossing on the A9 are not finalised, pending the findings of the geotechnical site investigation and the consequent decision in relation to foundation design. It is likely that piling will be required for the foundations for the Spey Crossing, and vibro-piling may be required to remove steel piles from the old foundation areas of the existing structure. An overview of likely noise outputs from piling operations and the noise levels at distance intervals out to 250m are provided in **Table 12-12-2**.

3.2.2 Using the calculation methods set out in BS5228-1:2009+A1:2014[1], the plant components in **3.4.4 Annex B** have been used to calculate the potential noise impacts resulting from the phased demolition of the existing River Spey crossing; see **Table 12-12-2**. The potential noise impacts have been calculated at 5m intervals to 50m, 10m intervals from 50m to 100m and 50m intervals out to 250m, to provide enough detailed information in relation to the potential impacts on receptors.

3.2.3 It is clear that certain activities have the potential to generate significant noise levels. A level of 75dB LAeq (a weighted, equivalent sound level) is typically used as a limit for construction activities before mitigation would be required; those levels in excess of 75dB are highlighted in red in **Table 12-12-2**. For ecological receptors, a different noise level may trigger a response in the potential species affected.

Impacts on Birds

3.2.4 In terms of breeding bird species, Wright *et al*. (2010)[2] quote 69.9dB as the level of noise above which waders are disturbed; levels above this threshold are highlighted in blue in **Table 12-12-2**.

[1] BSI Standards Publication, *Code of practice for noise and vibration control on construction and open sites*. 2004.

[2] Wright, M. D., Goodman, P., & Cameron, T. C. (2010). Exploring behavioural responses of shorebirds to impulsive noise. Wildfowl. 60: 150-16

Table 12-12-2: Noise Levels Generated by different Piling Methods

Piling methods	Calculated Noise Levels, L_{Aeq}, dB at stated distances below																	
	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	150	200	250
Driven Piling – Vibration Driven	89	83	80	77	75	74	72	71	70	69	68	66	65	64	63	60	57	55
Driven Piling - Hammer	90	84	81	78	76	75	73	72	71	70	69	67	66	65	64	61	58	56

Table 12.12.3: River Spey crossing demolition - calculated noise impacts

Phase	Calculated Noise Levels, LAeq, dB at stated distances below																	
	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	150	200	250
1. Parapet Removal	83	77	73	71	69	67	66	65	64	63	61	60	59	58	57	53	51	49
2. Removal of Expansion Joints	93	87	83	81	79	77	76	75	74	73	71	70	69	68	67	63	61	59
3. Removal of Deck Furniture	93	87	83	81	79	77	76	75	74	73	71	70	69	68	67	63	61	59
4. Clearing of Road Surface	87	81	78	75	73	72	70	69	68	67	66	65	63	62	61	58	55	53
5. Mechanical Concrete Breaking	91	85	81	79	77	75	74	73	72	71	69	68	67	66	65	62	59	57
6. Hydrodemolition	88	82	79	76	74	72	71	70	69	68	67	65	64	63	62	59	56	54
7. Deck Removal	81	75	72	69	67	66	64	63	62	61	60	58	57	56	55	52	49	47
8. Pier Breakdown	91	85	82	79	77	76	74	73	72	71	70	68	67	66	65	62	59	57

Impacts on Freshwater Fish

3.2.5 The construction and demolition works associated with the River Spey crossing have the potential to affect freshwater fish species, such as salmon and sea lamprey, through disturbance generated by noise and vibration.

3.2.6 The main effects of underwater noise can be categorised into injurious and auditory effects. Very high levels of underwater noise, caused by activities such as blasting, can cause injury in the form of tissue damage, resulting in temporary or permanent hearing threshold shift (deafness), or even more severe damage. Lower levels of noise may be audible, and in some situations, will be sufficiently loud to cause a behavioural response such as avoidance or hiding.

3.2.7 The sensitivity of hearing, and the frequency range over which sound can be heard, varies from species to species, and therefore the levels of noise which cause a behavioural response vary. Atlantic salmon have insensitive hearing that only perceives low frequency sound (less than 400 hertz (Hz)).

3.2.8 For underwater construction noise to have an adverse impact upon salmon, it must be louder, at some or all frequencies, than the ambient river noise. The underwater construction noise must also be above the hearing threshold of salmon at the frequencies of interest, and must be sufficiently loud to cause a behavioural avoidance response.

3.2.9 The following threshold levels, proposed by Nedwell *et al*., 2007[3], were used for evaluating the potential behavioural response of Atlantic salmon due to underwater piling noise in the River Dee:

- ≥100dBht (noise effects in water) (Species): 100% avoidance
- 90dBht (Species): Strong avoidance reaction by most individuals
- 75dBht (Species): Mild avoidance reaction occurs in a majority of individuals
- 0 – 50dBht (Species): Low likelihood of disturbance.

3.2.10 Hawkins and Johnstone (1978)[4] researched the hearing of Atlantic salmon using a cardiac conditioning technique. The minimum sound level that the fish would respond to across a range of frequencies was determined in a laboratory and in the sea. The research concluded that the fish responded only to low frequency tones (below 380Hz) with most acute hearing at 160Hz (onset of response observed at 95dB). It was also determined that the behavioural response correlated better to water particle motion than sound pressure.

3.2.11 Hawkins and Johnstone[4] concluded that since the Atlantic salmon swim bladder is not always completely filled, and is disconnected from the skull, it plays no part in the hearing of the species. This differs from Ostariophysi[5], which have Weberian apparatus that connects the swim bladder to the auditory system, and which generally display far more acute hearing.

3.2.12 The research also noted that the sensitivity of the fish was not affected by the level of sea noise, but it was likely that their hearing of sounds would be masked by ambient noise in a turbulent

[3] Nedwell J, Turnpenny A, Lovell J, Parvin S, Workman R, Spinks J, et al. A validation of the dBht as a measure of the behavioral and auditory effects of underwater noise. Department of Business, Enterprise and Regulatory. 2007.
[4] Hawkins, A. D., & Johnstone, A. D. F. (1978). The hearing of the Atlantic Salmon, Salmo salar. Journal of fish biology. 13: 655-673
[5] A super-order of bony fishes that includes minnows and carps.

river. Therefore, in a turbulent river environment, these fish have a poor ability to discriminate signals from background noise.

3.2.13 The blue line in **Figure 12.12.1** displays graphically the lowest level of sound that can be perceived by Atlantic salmon over the frequency range tested by Hawkins and Johnstone (1978)[6].

3.2.14 The 50dBht salmon level is shown by the red line, within which there is a low likelihood of disturbance to salmon. The absolute values are presented in

3.2.15 **Table** 12.12.4.

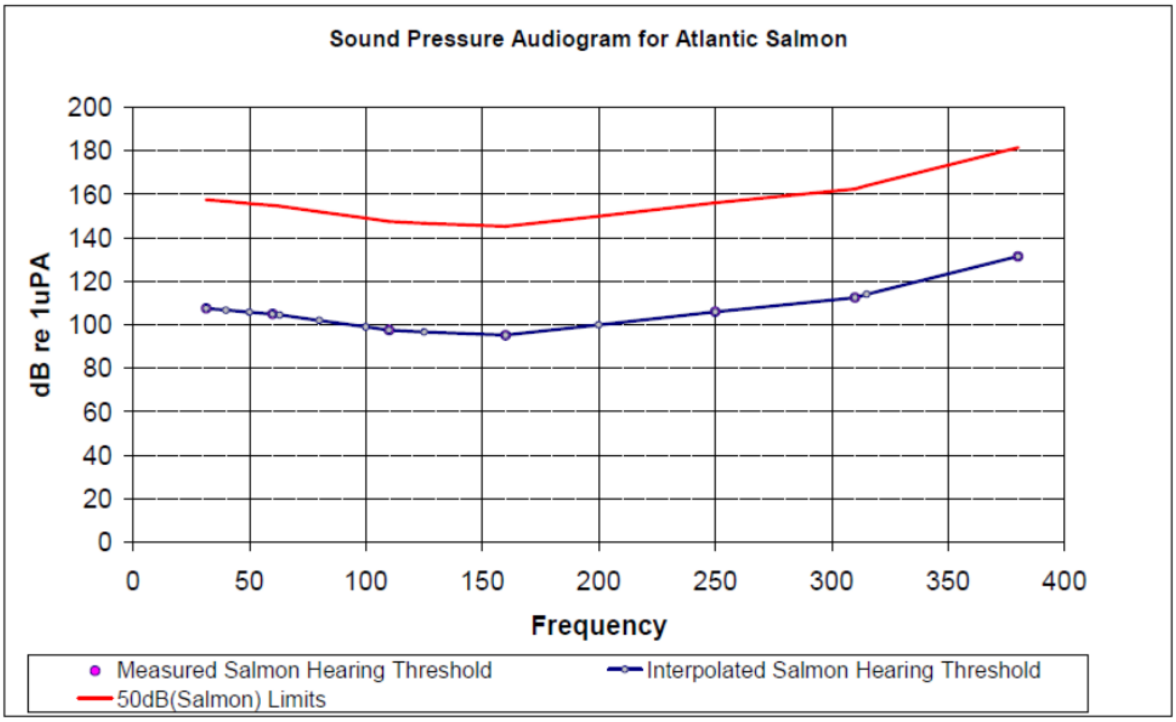


Figure 12.12.1: Sound pressure audiogram for Atlantic Salmon

Table 12.12.4: Hearing threshold levels for Atlantic salmon (Salmo salar)

Frequency (Hz)	31.5	60	110	160	250	310	380	Total
Salmon Hearing Threshold dB	107.5	105	97.5	95.2	106	112.5	131.5	131.8
+50dB$_{ht}$ (Salmon) Threshold	157.5	155	147.5	145.2	156	162.5	181.5	181.8

3.2.16 An assessment of the potential impacts of vibro-piling has been carried out based upon work undertaken for Scottish Water, in the River Dee, for a new raw water intake pipe for the Inchgarth Water Treatment Works (WTW). For the Inchgarth project, a series of measurements were undertaken throughout the period of work when a cofferdam within the river was installed to undertake the works. As the piling was within the river rather than on the banks, this is considered to represent a worst case scenario, as there are no 'boundary layer' changes between the ground and earth. None of the measured levels during the creation of the cofferdam within the river exceed the +50dBht (salmon) threshold at which the onset of avoidance behaviour may

[6] Hawkins, A. D., & Johnstone, A. D. F. (1978). The hearing of the Atlantic Salmon, Salmo salar. Journal of fish biology. 13: 655-673

be expected within the third octave centre frequencies. As such, vibro-piling operations within or adjacent to a river are considered unlikely to result in injury or avoidance behaviour in salmon.

3.2.17 Current research on driven pilling (Harding, *et al*, 2016 and Halcrow 2012) considers it is unlikely that it will generate avoidance behaviour or physical damage to fish, however mitigation such as bubble curtains within the river; neoprene 'dolly' and interstitial device between the pile and piling hammer; and 'soft start' techniques to reduce hammer drop height should be implemented to ensure that driven piling does not affect fish within the River Spey.

3.3 Highland Main Line Bridge

3.3.1 Demolition of the HML railway bridge has the potential to disturb nearby ecological receptors, including breeding birds associated with the River Spey – Insh Marshes SPA and Ramsar sites.

3.3.2 Using the calculation methods set out in BS5228-1:2009+A1:2014, the plant components in **3.4.4Annex B** have been used to calculate the potential noise impacts resulting from the phased demolition of the HML railway bridge; see **Table 12.12.5** The potential noise impacts have been calculated at 5m intervals to 50m, 10m intervals from 50m to 100m and 50m intervals out to 250m, to provide reasonably detailed information in relation to the potential impacts on sensitive species.

3.3.3 Those levels in excess of 75dB LAeq are highlighted in red in **Table 12.12.5**, as this is a level which is often considered the limit for construction noise at residential receptors. It has been assumed that the intervening ground is acoustically hard and no barriers have been considered, although temporary noise barriers may be put in place by the Contractor, which would reduce the impact.

3.3.4 In terms of breeding bird species, Wright *et al.* (2010)[7] quote 69.9dB as the level of noise above which waders are disturbed; levels above this threshold are highlighted in blue in **Table 12.12.5**.

3.4 Rock Removal Techniques

3.4.1 Noise and vibration generated by rock removal may affect nearby ecological receptors.

3.4.2 Using the calculation methods set out in BS5228-1:2009+A1:2014, the plant components in **3.4.4Annex B** have been used to calculate the potential noise impacts resulting from the phased removal of rock; see **Table 12.12.6**. As per the demolition of the HML railway bridge, it has been assumed that the intervening ground is acoustically hard and no barriers have been considered, although temporary noise barriers may be put in place by the Contractor, which would reduce the impact.

3.4.3 The potential noise impacts have been calculated at 5m intervals to 50m, 10m intervals from 50m to 100m and 50m intervals out to 250m, to provide reasonably detailed information in relation to the potential impacts on sensitive species.

3.4.4 Those calculated results which exceed the construction noise level of 75dB LAeq are highlighted in red in **Table 12.12.6.** In terms of breeding bird species, Wright *et al*. (2010) quote 69.9dB as the level of noise above which waders are disturbed; those levels highlighted in red and blue in the **Table 12.12.4** indicate those distances at which a level of 75dB and 69.9dB respectively, are exceeded.

[7] Wright, M. D., Goodman, P., & Cameron, T. C. (2010). Exploring behavioural responses of shorebirds to impulsive noise. Wildfowl. 60: 150-16

Table 12.12.5: Highland Main Line bridge demolition - calculated noise impacts

Phase	Calculated Noise Levels, LAeq, dB at stated distances below																	
	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	150	170	200
1. Parapet Removal	84	78	74	72	70	68	67	66	65	64	62	61	60	59	58	54	53	52
2. Removal of Expansion Joints	94	88	84	82	80	78	77	76	75	74	72	71	70	69	68	64	63	62
3. Removal of Deck Furniture	94	88	84	82	80	78	77	76	75	74	72	71	70	69	68	64	63	62
4. Clearing of Road Surface	88	82	79	76	74	73	71	70	69	68	67	65	64	63	62	59	58	56
5. Mechanical Concrete Breaking	92	86	82	80	78	76	75	74	73	72	70	69	68	67	66	62	61	60
6. Hydrodemolition	89	83	79	77	75	73	72	71	70	69	67	66	65	64	63	60	58	57
7. Deck Removal	82	76	73	70	68	66	65	64	63	62	60	59	58	57	56	53	51	50
8. Pier Breakdown	92	86	82	80	78	76	75	74	73	72	70	69	68	67	66	62	61	60
9. Excavation	81	75	72	69	67	66	64	63	62	61	60	58	57	56	55	52	51	49

Table 12.12.6: Rock drilling and materials processing - calculated noise impacts

Phase	Calculated Noise Levels, LAeq, dB at stated distances below																	
	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	150	200	250
1. Rock Drilling for Blast Holes	94	88	85	82	80	79	77	76	75	74	73	71	70	69	68	65	62	60
2. Rock Breaking	103	97	94	91	89	88	86	85	84	83	82	80	79	78	77	74	71	69
3. Rock Ripping	86	80	76	74	72	70	69	68	67	66	64	63	62	61	60	56	54	52
4. Removal of Released Rock	95	89	85	83	81	79	78	77	76	75	73	72	71	70	69	65	63	61
5. Crushing & Screening of Rock	96	90	87	84	82	81	79	78	77	76	75	73	72	71	70	67	64	62

References

Halcrow, February 2012 'Underwater Noise from Piling' Document: CEOAOE/020 Version: 01-00 Inchgarth Raw Water Intakes

Harding. H, Bruintjes. R, Radford. A.N, and Simpson. S.D. (2016), 'Measurement of Hearing in the Atlantic salmon (*Salmo salar*) using Auditory Evoked Potentials, and effects of Pile Driving Playback on salmon Behaviour and Physiology', Scottish Marine and Freshwater Science Vol 7 No 11

Annex A

Ecology Operational Noise Modelling Results ($L_{A10,18h}$ dB Free-Field)

Annex A Ecology Operational Noise Modelling Results ($L_{A10,18h}$ dB Free-Field)

Table A.1: Ecology operational noise modelling results (LA10,18h dB Free-Field)

Feature	Drawing Ref. (12.65 to 12.70)	X	Y	Do-Min 2026 dB(A)	Do-Min 2041 dB(A)	Change DM Long Term (DM41-DM26) dB(A)	Do-Some 2026 dB(A)	Do-Some 2041 dB(A)	Change Do-Some Short Term (DS26-DM26) dB(A)	Change Do-Some Long Term (DS41-DM41) dB(A)
River Spey SSSI, Ancient Woodland	A	268888.91	794650.03	48.9	49.3	0.4	48.6	48.9	-0.3	-0.4
River Spey SSSI	B	269001.83	795484.7	50.4	50.8	0.4	47.7	48.0	-2.7	-2.8
River Spey SSSI and SAC	C	269902.12	797142.79	49.6	50.0	0.4	47.2	47.5	-2.4	-2.5
River Spey SSSI and SAC	D	270686.12	797600.45	49.2	49.5	0.3	49.2	49.4	0	-0.1
River Spey SSSI and SAC, River Spey – Insh Marshes SPA, Ancient Woodland	E	272306.64	798058.12	57.3	57.7	0.4	55.7	56.0	-1.6	-1.7
River Spey SAC	F	274411.21	798804.22	56.8	57.2	0.4	56.7	57.0	-0.1	-0.2
Insh Marshes SAC, River Spey – Insh Marshes SSSI, SPA, Ramsar, Ancient Woodland	G	275279.72	799195.65	51.5	51.9	0.4	53.3	53.6	1.8	1.7
Insh Marshes, NNR	H	276140.62	799698.33	54.4	55.1	0.7	56.2	56.5	1.8	1.4
Insh Marshes SAC, NNR, River Spey – Insh Marshes SSSI, SPA	I	276498.19	800388.14	56.1	56.6	0.5	55.4	55.7	-0.7	-0.9
Insh Marshes SAC, NNR, River Spey – Insh Marshes SSSI, SPA	J	276909.33	800939.88	50.0	50.4	0.4	52.2	52.5	2.2	2.1
Insh Marshes SAC, NNR, River Spey – Insh Marshes SSSI, SPA	K	277410.65	801512.85	52.5	52.9	0.4	54.0	54.3	1.5	1.4
Ancient woodland	L	276809.8	801452	69.1	69.5	0.4	61.2	61.5	-7.9	-8
Insh Marshes SAC, NNR, River Spey – Insh Marshes SSSI, SPA, Ramsar, River Spey SAC	M	279097.48	802197.87	62.9	63.2	0.3	63.0	63.2	0.1	0
Ancient woodland	N	279571.2	802913	54.0	54.4	0.4	55.6	55.9		1.5
Insh Marshes SAC, River Spey – Insh Marshes SSSI, SPA, Ramsar, River Spey SAC	O	280793.96	803358.75	60.1	60.3	0.2	60.4	60.5	0.3	0.2

Feature	Drawing Ref. (12.65 to 12.70)	X	Y	Do-Min 2026 dB(A)	Do-Min 2041 dB(A)	Change DM Long Term (DM41-DM26) dB(A)	Do-Some 2026 dB(A)	Do-Some 2041 dB(A)	Change Do-Some Short Term (DS26-DM26) dB(A)	Change Do-Some Long Term (DS41-DM41) dB(A)
Breeding wigeon location 1	Confidential	Confidential	Confidential	49.6	50.0	0.4	52.4	52.7	2.8	2.7
Breeding wigeon location 2	Confidential	Confidential	Confidential	53.0	53.4	0.4	55.4	55.7	2.4	2.3
Breeding wigeon location 3	Confidential	Confidential	Confidential	51.2	51.7	0.5	54.3	54.6	3.1	2.9
Breeding wigeon location 4	Confidential	Confidential	Confidential	52.0	52.4	0.4	53.5	53.8	1.5	1.4

Annex B

Plant & Equipment Components

Annex B Plant and Equipment Components

Table B.1 details the proposed plant and equipment components required to be employed to remove the Spey Crossing and the Highland Main Line (HML) railway bridge. These plant components have been based upon the description of the activities within the CH2M Fairhurst Joint Venture (CFJV) 'River Spey Bridge - Demolition Report, 2016, coupled with practical knowledge of the author (Ian Stanworth, Senior Acoustics Consultant, Member of the Institute of Acoustics). **Table B.2**: Removal of rock and processing of freed material - plant and equipment components for drilling and materials processing details the proposed plant and equipment components for the proposed methods of rock removal and processing of freed material.

The plant components have been broken down by phase of construction and activity, and an indication of the numbers of specific items of plant is made, together with the acoustic 'on-time', which is important for calculating noise impacts. This is not the time that the equipment is switched on, but rather the period of time within the working day that the equipment is operating within 3dB of its maximum noise level. This effectively means the percentage of the period when the equipment is operational and the equipment is operating at full power.

In terms of the working day, it is assumed that equipment will be switched on for approximately 80% of the working day; that is 10 hours in a 12-hour day or eight hours per 10-hour day.

Table B.1: River Spey crossing demolition/ Highland Main Line demolition - plant and equipment components for demolition works

Phase	Activity	Plant Description	# of Plant	% On-Time	Lw dB
1. Parapet removal	General operations	Hand tools	2	35%	90.0
	Cutting concrete	Hand-held circular saw	1	10%	107.0
	Lifting	Mobile telescopic crane (80t)	1	25%	105.0
	Distribution of materials	Lorry (4-axle wagon)	1	25%	108.0
	Ground excavation/ earthworks	Tracked excavator (30t) 170 kW	1	35%	103.0
2. Removal of expansion joints	Cutting concrete	Hand-held circular saw	1	10%	107.0
	Breaking up concrete	Breaker mounted on wheeled backhoe	1	30%	120.0
	Breaking road surface	Compressor	1	40%	93.0
	Breaking up concrete	Hand held pneumatic breaker	1	35%	111.0
	Distribution of materials	Lorry (4-axle wagon)	1	25%	108.0
	Distribution of materials	Wheeled excavator (18t)	1	20%	94.0
3. Removal of deck furniture	Breaking up concrete	Breaker mounted on wheeled backhoe	1	30%	120.0
	Breaking road surface	Compressor	1	40%	93.0
	Breaking up concrete	Hand held pneumatic breaker	1	35%	111.0
	Distribution of materials	Lorry (4-axle wagon)	1	25%	108.0
	Distribution of materials	Wheeled excavator (18t)	1	20%	94.0
4. Clearing of road surface	Road planing	Road planer 17 t	1	40%	110.0
	Breaking road surface	Compressor	1	40%	93.0
	Breaking up concrete	Hand held pneumatic breaker	1	35%	111.0
	Distribution of materials	Lorry (4-axle wagon)	1	30%	108.0
5. Mechanical concrete breaking	Breaking up concrete	Pulveriser mounted on excavator (30t)	2	35%	107.0
	Breaking up foundations	Breaker mounted on excavator (15t)	1	30%	118.0
	Distribution of materials	Wheeled excavator (18t)	1	40%	94.0
	Distribution of materials	Lorry (4-axle wagon)	2	25%	111.0

Phase	Activity	Plant Description	# of Plant	% On-Time	Lw dB
6. Hydrodemolition	Hydro demolition	High pressure water jetter	1	45%	111.0
	Hydro demolition	Suction pump	1	45%	108.0
	Hydro demolition	Suction tanker	1	45%	96.0
	Hydro demolition	Submersible pump	1	45%	88.0
	Power for lighting	Diesel generator	1	50%	93.0
	Distribution of materials	Wheeled excavator (18t)	1	40%	94.0
	Distribution of materials	Lorry (4-axle wagon)	2	25%	111.0
7. Deck removal	Lifting	Mobile telescopic crane (400t)	1	25%	106.0
	Breaking up/ cutting steel	Gas cutter	1	10%	107.0
	Lorry movements on access road	Lorry 44t	1	20%	107.0
8. Pier breakdown	Breaking up concrete	Pulveriser mounted on excavator (30t)	2	35%	107.0
	Breaking up brick foundations	Breaker mounted on excavator (15t)	1	30%	118.0
	Ground excavation/ earthworks	Tracked excavator (30t)	1	40%	103.0
	Distribution of materials	Lorry (4-axle wagon)	2	25%	111.0
9. Excavation	Ground excavation/ earthworks	Tracked excavator (30t) 170 kW	2	40%	106.0
	Distribution of materials	Lorry (4-axle wagon)	2	30%	111.0

Table B.2: Removal of rock and processing of freed material - plant and equipment components for drilling and materials processing

Phase	Activity	Plant Description	# of Plant	% On-Time	Lw dB
Rock Drilling for Blast Holes	Drilling Blast Holes	Tracked mobile drilling rig 23t	2	40%	121.0
	Pumping Water	Diesel Surface Water Pump 4in	1	25%	99.0
	Power for Temporary Site Cabin	Diesel Generator	1	25%	87.0
	Distribution of Materials	Lorry (4-axle wagon)	1	20%	108.0
Rock Breaking	Rock Breaking - Hard Rock	Volvo EC700B LC	2	50%	111.0
	Rock Breaking - Hard Rock	Volvo HB70 7t Breaker Attachment	2	40%	130.0
Rock Ripping	Rock Ripping - Hard Rock	Caterpillar 390F L Excavator	2	45%	112.0
Removal of Released Rock	Face Shovel Loading Dump Trucks	Tracked hydraulic excavator 47t	1	40%	119.0
	Dump Trucks on Haul Roads	Articulated dump truck 40t	2	25%	120.0
	Water Bowser	Tractor (towing water bowser)	1	20%	111.0
Crushing & Screening of Rock	Dump Trucks on Haul Roads	Articulated dump truck 40t	2	30%	120.0
	Breaking material	Tracked semi-mobile crusher 90t	1	50%	118.0
	Semi-Mobile Screen/ stockpiler	Screen stockpiler 17t	2	50%	112.0
	Pumping Surface Water	Diesel water pump	1	25%	109.0
	Water Bowser	Tractor (towing water bowser)	1	20%	111.0
	Distribution of Materials	Lorry (4-axle wagon)	2	30%	111.0