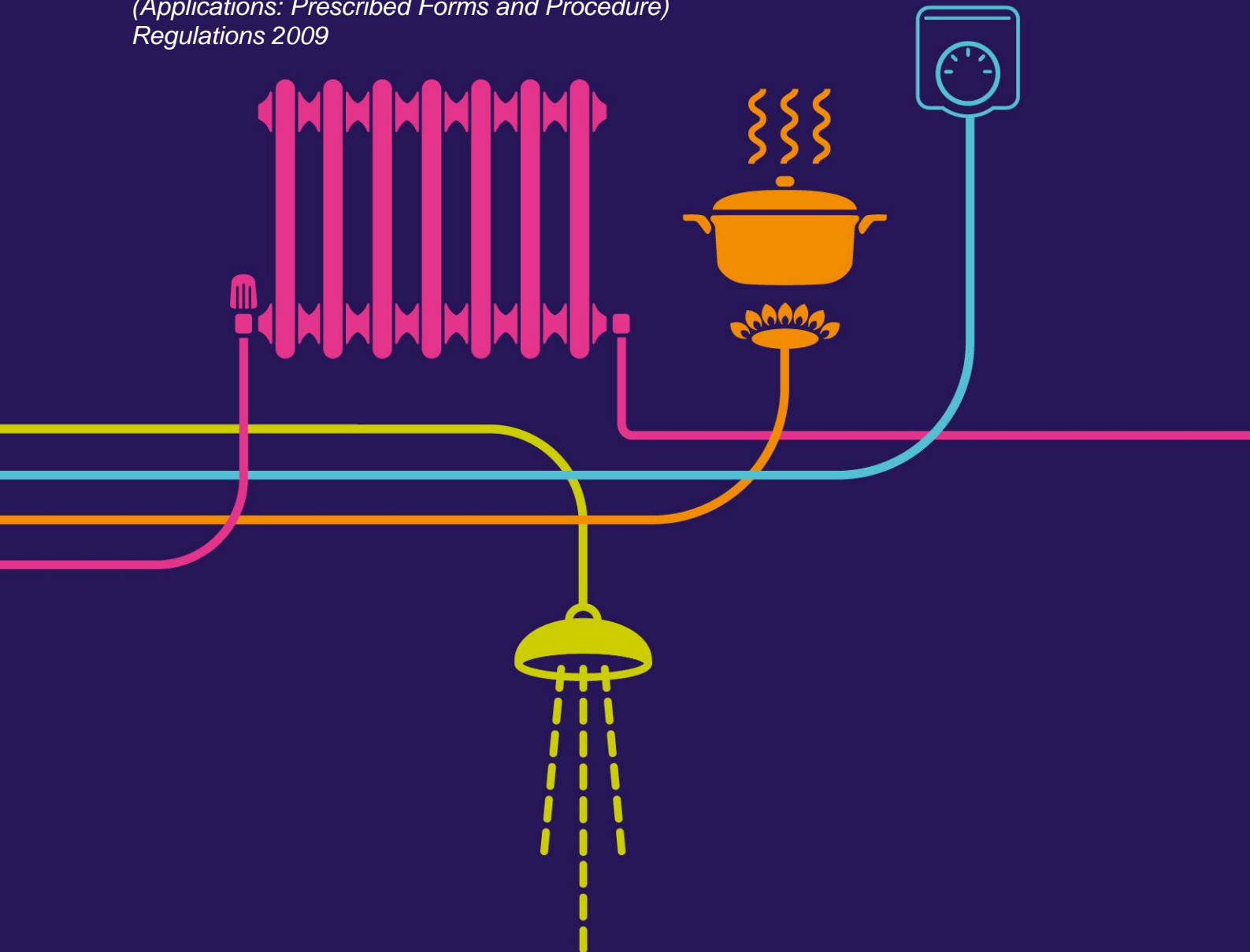


Appendix 10.2: Noise Model Inputs

River Humber Gas Pipeline Replacement Project

*Under Regulation 5(2)(a) of the Infrastructure Planning
(Applications: Prescribed Forms and Procedure)
Regulations 2009*





CONTENTS

Tables	ii
Figures	ii
DCO Documents Referenced	ii
Abbreviations	iii
APPENDIX 10.2: NOISE ASSESSMENT INPUT DATA	1

Tables

Table	Title
Table 10-1	Noise and Vibration Assessment – Indicative Construction Schedule used for Noise Assessment
Table 10-2	Noise and Vibration Assessment – Indicative Construction Plant used for Noise Assessment
Table 10-3	Noise and Vibration Assessment – Sound Power Data used for Noise Assessment
Table 10-4	Noise and Vibration Assessment – Indicative Hourly HGV Flow Used for Noise Assessment
Table 10-5	Noise and Vibration Assessment – Distances used in the assessment of Noise and Vibration from the TBM
Table 10-6	Noise and Vibration Assessment – Scaling Factors used in Prediction of Vibration from Vibratory Piling
Table 10-7	Noise and Vibration Assessment – Constants used in Prediction of Vibration from Vibratory Piling

Figures

Figure Number	Title
None Referenced.	

DCO Documents Referenced

DCO Document Reference	Title of Document
None Referenced.	

Abbreviations

AGI	Above Ground Installation
TBM	Tunnel Boring Machine
HGV	Heavy Goods Vehicle

APPENDIX 10.2: NOISE ASSESSMENT INPUT DATA

- 10.1.1 The Construction noise assessment has been undertaken in accordance with BS 5228 -1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* and BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*.
- 10.1.2 Table 10-1 details the indicative construction schedule supplied by the Applicant.

Table 0-1 Noise and Vibration Assessment – Indicative Construction Schedule used for Noise Assessment

Activity	Construction Month																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
Crossings																																					
Dewatering																																					
Set Up Admin Facility																																					
Admin Facility - Tunnelling																																					
Admin Facility - Pipeline																																					
ROW Fencing																																					
Pre-Construction Drainage																																					
Topsoil Strip																																					
Hard Standing																																					
Pipe Stringing																																					
Pipe Bending																																					
Mainline Welding																																					
Tie In Crews																																					
Non-destructive testing																																					
Coating																																					
Excavation																																					
Lower and Lay																																					
Backfill																																					
Post Construction Drainage																																					
Re-grade																																					
Top Soil Replacement																																					
Permanent Reinstatement																																					
Testing																																					
Cathodic protection Welding / Installation																																					
Tunnelling Contractor																																					
Set up Compound																																					
Piling to Drive Pit																																					
Excavate Drive Pit																																					
Ground Treatment and cast Base																																					
Tunnel Boring Machine (TBM) Launch and Build																																					
Tunnel Drive																																					
Tunnel Clean / Repair Leaks																																					
Pipe Installation																																					
Prepare Cofferdam and Pipe Stringing																																					
Prepare Tunnel																																					
Install Pipe																																					
Post Installation																																					
Grouting																																					
Above Ground Installation (AGI) and Tie-ins																																					
AGI Works																																					

Activity	Construction Month																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
Tie Ins																																					
Backfill tie ins and Cofferdam																																					
Crossings																																					
Dewatering																																					
Line pipe Delivery																																					
Set Up Admin Facility																																					
Preparing ROW																																					
ROW Fencing																																					
Pre-Construction Drainage																																					
Topsoil Strip																																					
Hard Standing																																					
Pipe Stringing																																					
Pipe Bending																																					
Mainline Welding																																					
Tie In Crews																																					
Non-destructive testing																																					
Coating																																					
Excavation																																					
Lower and Lay																																					
Backfill																																					
Post Construction Drainage																																					
Re-grade																																					
Top Soil Replacement																																					
Permanent Reinstatement																																					
Testing																																					
Cathodic protection Welding / Installation																																					
Tunnelling Contractor																																					
Set up Compound																																					
Piling to Drive Pit																																					
Excavate Drive Pit																																					
Ground Treatment and cast Base																																					
Retrieve TBM																																					
Tunnel Clean / Repair Leaks																																					
Pipe Installation																																					
Prepare Cofferdam and Winch																																					
Install Pipe																																					
Post Installation																																					
Grouting																																					
AGI and Tie-ins																																					
AGI Works																																					
Tie Ins																																					
Backfill tie ins and Cofferdam																																					

10.1.3 Table 10-2 details the indicative construction plant likely to be used during each stage of construction and the percentage use time supplied by the Applicant.

Table 0-2 Noise and Vibration Assessment – Indicative Construction Plant used for Noise Assessment

ACTIVITY DESCRIPTION	PLANT DESCRIPTION	No. Plant	%USE
Crossings	22te Tracked Excavator	1	50
	Auger Bore Machine c/w power pack	1	90
	Pay welder	1	10
	Grinder	1	10
	25 t Articulated Dumper	1	10
Dewatering Tunnel and Pipeline	Rotary coring rig	1	90
	4" Super Silent Pumps	4	100
Line pipe Delivery	8 Leg Tipper Wagon	1	10
	JCB	1	60
	100te Crawler Crane	1	60
	44te Flatbed Trailer and Tractor Unit	2	60
Set Up Admin Facility	Transit Tipper	1	40
	Concrete Trucks	2	10
	Concrete Poker	1	40
	Compressor	1	40
	Stihl Saw	1	50
	Hammer	2	50
	40te AT Mobile Crane	1	60
	22te Tracked Excavator	1	60
	Extendable Fork Truck	1	20
	30ft Rigid / 40ft Artic Lorry	1	50
Admin Facility - Tunnelling	500kVA Super Silent Diesel Generators	12	100
	Wheel Wash	1	40
	Diesel Jet Wash	1	30
Admin Facility - Pipeline	500kVA Super Silent Diesel Generators	12	100
	Wheel Wash	1	40
	Diesel Jet Wash	1	30
Preparing ROW	Transit Tipper	1	40
	JCB	1	80
	36te Tracked Excavator	1	80
	8 Leg Tipper Wagon	1	50
	Agricultural Tractor and Trailer	1	60
	Vibro Roller	1	20
ROW Fencing	Transit Tipper	1	20
	JCB	1	80
	Hydraulic Fencepost Auger for JCB	1	60
	Agricultural Tractor and Trailer	1	50
	Hammer	2	60
Pre-Construction Drainage	JCB	1	80
	Agricultural Tractor and Trailer	3	80
	Trenching Machine	1	80
	Stone Cart	1	80

ACTIVITY DESCRIPTION	PLANT DESCRIPTION	No. Plant	%USE
	8 Leg Tipper Wagon	1	50
Topsoil Strip	Transit Tipper	1	40
	D6	1	80
	D8	2	80
	25te Tracked Excavator	3	80
	25 t Articulated Dumper	2	80
Hard Standing	Transit Tipper	1	20
	D6	2	80
	36te Tracked Excavator	2	80
	25 t Articulated Dumper	2	80
	Vibro Roller	2	80
	8 Leg Tipper Wagon	3	60
Pipe Stringing	Transit Tipper	1	80
	100te Crawler Crane	1	80
	36te Tracked Excavator	1	80
	Side Booms	1	80
Pipe Bending	100te Crawler Crane	1	40
	30ft Rigid / 40ft Artic Lorry	1	40
Mainline Welding	Transit Tipper	1	40
	36te Tracked Excavator	2	80
	Side Booms	4	80
	Weld sets	11	80
	Pay welder	5	40
	Agricultural Tractor and Trailer	1	60
	Propane torch	3	60
Tie-in Crews	Transit Tipper	1	40
	36te Tracked Excavator	2	80
	Side Booms	3	80
	Weld sets	3	80
	Pay welder	1	40
	Agricultural Tractor and Trailer	1	60
	Propane torch	3	60
Coating	Coating Rig	2	80
	Blasting Rig	2	80
Excavation	Transit Tipper	1	20
	45te Tracked Excavator	1	80
	36te Tracked Excavator	2	80
	25 t Articulated Dumper	1	80
	4" Super Silent Pumps	2	80
Lower and Lay	Transit Tipper	1	40
	36te Tracked Excavator	2	80
	Side Booms	4	80
	Weld sets	3	50
	Pay welder	1	50
	Agricultural Tractor and Trailer	1	60
	Propane torch	3	50
	4" Super Silent Pumps	2	80

ACTIVITY DESCRIPTION	PLANT DESCRIPTION	No. Plant	%USE
Backfill	Transit Tipper	1	10
	45te Tracked Excavator	1	80
	36te Tracked Excavator	2	80
	25 t Articulated Dumper	1	80
	4" Super Silent Pumps	2	80
Post Construction Drainage	JCB	1	80
	Agricultural Tractor and Trailer	3	80
	Trenching Machine	1	80
	Stone Cart	1	80
	8 Leg Tipper Wagon	1	50
Re-grade	Transit Tipper	1	20
	D6	2	80
	36te Tracked Excavator	2	80
	Hydraulic Breaker mounted on excavator	2	80
	Pulveriser mounted on excavator	2	80
	25 t Articulated Dumper	2	80
	8 Leg Tipper Wagon	3	60
Top Soil Replacement	Grader / Blade	1	80
	Transit Tipper	1	20
	D8	2	80
	36te Tracked Excavator	2	80
	25 t Articulated Dumper	2	80
	Agricultural Tractor and Trailer	1	80
Permanent Reinstatement	Ripper	1	80
	Transit Tipper	1	60
	JCB	1	80
	Seeder	1	80
	Agricultural Tractor and Trailer	1	80
Testing	Power Harrow	1	80
	36te Tracked Excavator	1	50
	Side boom	1	50
	Agricultural Tractor and Trailer	1	50
Cathodic Protection Welding / Installation	4" Super Silent Pump	1	70
	Boring Rig	1	80
	Grout Batching Plant	1	40
	JCB	1	80
Set up Compound and Treatment Works	8 Leg Tipper Wagon	1	10
	Transit Tipper	1	40
	100te Crawler Crane	1	80
	250te AT Mobile Crane	1	80
	22te Tracked Excavator	1	80
	100te Crawler Crane	1	60
	Loading Shovel	1	60
	Concrete Trucks	2	10
	Concrete Poker	1	40
	Compressor	1	40
Concrete Pump	1	60	

ACTIVITY DESCRIPTION	PLANT DESCRIPTION	No. Plant	%USE
	Stihl Saw	1	50
	Hammer	2	50
	Extendable Fork Truck	1	20
Piling to Drive Pit	Transit Tipper	1	40
	Rotary piling rig 1200mm diameter	2	80
	22t Tracked Excavator	1	80
	Extendable Fork Truck	1	60
	Concrete Trucks	2	60
	Concrete Poker	1	40
	Compressor	1	40
	8 Leg Tipper Wagon	2	60
Excavate Drive Pit and Cast Base	Transit Tipper	1	40
	32t Tracked Excavator	2	80
	22t Tracked Excavator	2	80
	25 t Articulated Dumper	2	80
	8 Leg Tipper Wagon	1	10
	Concrete Poker	1	40
	Compressor	1	40
	Concrete Pump	1	60
	Stihl Saw	1	50
	Hammer	2	50
	Extendable Fork Truck	1	20
TBM Launch and Build	Transit Tipper	1	40
	100te Crawler Crane	1	80
	350t+ AT Mobile Crane	1	80
	22te Tracked Excavator	1	60
	Extendable Fork Truck	1	60
Tunnel Drive	Transit Tipper	1	40
	100t Crawler Crane	1	80
	Gantry Crane	1	80
	22te Tracked Excavator	2	60
	Extendable Fork Truck	1	60
	Loading Shovel	1	60
	25 t Articulated Dumper	1	80
	8 Leg Tipper Wagon	2	60
Tunnel Clean / Repair Leaks	Transit Tipper	1	40
	100te Crawler Crane	1	60
	22te Tracked Excavator	1	60
	Extendable Fork Truck	1	60
	Gantry Crane	1	80
Prepare Cofferdam and Pipe Stringing	Transit Tipper	1	40
	350te+ AT Mobile Crane	1	80
	Pipe Thruster c/w Power Packs	1	80
	Gantry Crane	1	80
	100te Crawler Crane	1	60
	22te Tracked Excavator	4	80
	36te Tracked Excavator	4	80

ACTIVITY DESCRIPTION	PLANT DESCRIPTION	No. Plant	%USE
	Side Booms	6	80
	Concrete Pump	1	60
	Compressor	1	40
	Stihl Saw	1	50
	Hammer	2	50
	Extendable Fork Truck	1	80
	Diesel Weld Set	1	60
Install Pipe	Transit Tipper	1	50
	100te Crawler Crane	1	60
	Gantry Crane	1	80
	22te Tracked Excavator	2	60
	Pipe Thruster c/w power packs	1	80
Post Installation	Transit Tipper	1	50
	350te+ AT Mobile Crane	1	80
	100te Crawler Crane	1	60
	22te Tracked Excavator	2	60
	Pipe Thruster c/w power packs	1	80
	Stihl Saw	1	50
	Extendable Fork Truck	1	20
Grouting	Transit Tipper	1	50
	100te Crawler Crane	1	60
	22te Tracked Excavator	2	60
	Extendable Fork Truck	1	80
	Grout Batching Plant	1	80
	Grout Pump	1	80
AGI Works	Transit Tipper	1	60
	JCB	1	80
	22te Tracked Excavator	2	60
	Extendable Fork Truck	1	80
	Weld sets	3	50
	Pay welder	1	50
	Propane torch	3	50
	8 Leg Tipper Wagon	1	10
	4" Super Silent Pumps	2	80
Tie ins	Transit Tipper	1	60
	100te Crawler Crane	1	60
	22te Tracked Excavator	2	60
	Weld sets	3	50
	Pay welder	1	50
	Propane torch	3	50
	8 Leg Tipper Wagon	1	10
	Transit Tipper	1	50
Back Filling tie-ins Cofferdam	32t Tracked Excavator	2	80
	22t Tracked Excavator	2	80
	25 t Articulated Dumper	2	80
	Hydraulic Breaker mounted on excavator	2	80
	Pulveriser mounted on excavator	2	80

ACTIVITY DESCRIPTION	PLANT DESCRIPTION	No. Plant	%USE
	8 Leg Tipper Wagon	1	10
	Vibro Roller	2	80
	4" Super Silent Pumps	2	80
Night Time Works at Goxhill	Diesel generators	12	100
	Air compressors	1	40
	Crane	2	80
	small loader	1	60
	slurry treatment plant	1	80
	Grout batching/mixing	1	80
	forklift	1	60
Night Time Works at Paull	Generators	12	100
	Winches	2	80
	Crawler crane	2	80
	forklift	1	60

10.1.4 Table 10-3 presents the sound power data used for each type of plant in the noise assessment along with the source reference, the majority of which are contained in British Standard 5228:2009+A1:2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' Part 1 (BS5228).

Table 0-3 Noise and Vibration Assessment – Sound Power Data used for Noise Assessment

PLANT	REFERENCE	Sound Power LWA
100t Crawler Crane	BS 5228-1 Reference Table Number C.4.52	103dBA
22t Tracked Excavator	BS 5228-1 Reference Table Number C.2.3	106dBA
25 t Articulated Dumper	BS 5228-1 Reference Table Number C.4.1	109dBA
250t AT Mobile Crane	BS 5228-1 Reference Table Number C.4.50	99dBA
250t+ Winch c/w Power Packs	BS 5228-1 Reference Table Number C.3.7	98dBA
25t Tracked Excavator	BS 5228-1 Reference Table Number C.2.20	96dBA
30ft Rigid / 40ft Artic Lorry	BS 5228-1 Reference Table Number C.6.23	110dBA
32t Tracked Excavator	BS 5228-1 Reference Table Number C.2.15	104dBA
350te+ AT Mobile Crane	BS 5228-1 Reference Table Number C.4.50	99dBA

36t Tracked Excavator	BS 5228-1 Reference Table Number C.5.18	108dBA
4" Super Silent Pumps	http://www.sldpumpspower.co.uk/diesel-pumps/diesel-pump-hire/supersilent-diesel-pumps/cd150-6-hushpac-decibeater/	89dBA
40t AT Mobile Crane	BS 5228-1 Reference Table Number C.4.44	88dBA
44t Flatbed Trailer and Tractor Unit	BS 5228-1 Reference Table Number C.4.74	108dBA
45t Tracked Excavator	BS 5228-1 Reference Table Number C.2.14	107dBA
500kVA Super Silent Diesel Generators	http://www.aggreko.co.uk/pdf/Diesel-generator-information-sheet	93dBA
8 Leg Tipper Wagon	BS 5228-1 Reference Table Number C.8.20	107dBA
Agricultural Tractor and Trailer	BS 5228-1 Reference Table Number C.4.75	107dBA
Auger Bore Machine c/w power pack	BS 5228-1 Reference Table Number C.3.16	107dBA
Blasting Rig	http://www.cdc.gov/niosh/docs/76-179/pdfs/76-179.pdf	110dBA
Boring Rig	BS 5228-1 Reference Table Number C.3.16	107dBA
Coating Rig	http://www.graco.com/content/dam/graco/aftd/literature/catalogs/303253EN-A/303253EN-A.pdf	106dBA
Compressor	BS 5228-1 Reference Table Number C.3.19	103dBA
Concrete Poker	BS 5228-1 Reference Table Number C.4.33	106dBA
Concrete Pump	BS 5228-1 Reference Table Number C.3.26	103dBA
Concrete Trucks	BS 5228-1 Reference Table Number C.4.20	108dBA
Diesel Jet Wash	BS 5228-1 Reference Table Number C.3.13	91dBA
Diesel Weld Set	BS 5228-1 Reference Table Number C.3.31	101dBA
Extendable Fork Truck	BS 5228-1 Reference Table Number C.2.35	99dBA
Gantry Crane	BS 5228-1 Reference Table Number C.4.43	98dBA
Grader / Blade	BS 5228-1 Reference Table Number C.6.31	114dBA
Grinder	BS 5228-1 Reference Table Number C.4.94	108dBA
Grout Batching Plant	http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf	105dBA
Grout Pump	http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf	90dBA
Hammer	BS 5228-1 Reference Table Number C.1.6	111dBA

Hydraulic Breaker mounted on excavator	BS 5228-1 Reference Table Number C.1.9	118dBA
Hydraulic Fencepost Auger for JCB	BS 5228-1 Reference Table Number C.3.18	103dBA
JCB	BS 5228-1 Reference Table Number C.4.66	97dBA
Loading Shovel	BS 5228-1 Reference Table Number C.9.8	114dBA
Misc. 110 Grinders	BS 5228-1 Reference Table Number C.6.31	114dBA
Pay welder	Based on Caterpillar D6	109dBA
Pipe Thruster c/w Power Packs	BS 5228-1 Reference Table Number C.3.7	98dBA
Power Harrow	BS 5228-1 Reference Table Number C.4.74	108dBA
Propane torch	BS 5228-1 Reference Table Number C.3.35	93dBA
Pulveriser mounted on excavator	BS 5228-1 Reference Table Number C.1.5	100dBA
Ripper	http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf	105dBA
Rotary coring rig	BS 5228-1 Reference Table Number C.3.18	103dBA
Rotary piling rig 1200mm diameter	BS 5228-1 Reference Table Number C.3.17	104dBA
Seeder	BS 5228-1 Reference Table Number C.4.74	108dBA
Side boom	BS 5228-1 Reference Table Number C.4.37	77dBA
Stihl Saw	BS 5228-1 Reference Table Number C.5.36	115dBA
Stone Cart	BS 5228-1 Reference Table Number C.2.30	107dBA
Transit Tipper	BS 5228-1 Reference Table Number C.8.20	107dBA
Trenching Machine	BS 5228-1 Reference Table Number C.4.64	103dBA
Vibro Roller	BS 5228-1 Reference Table Number C.5.25	103dBA
Weld sets	BS 5228-1 Reference Table Number C.3.32	101dBA
Wheel Wash	BS 5228-1 Reference Table Number C.3.13	91dBA

10.1.5 Table 10-4 presents the indicative hourly HGV flows used for the noise assessment.

Table 0-4 Noise and Vibration Assessment – Indicative Hourly HGV Flow Used for Noise Assessment

Construction Month	GOXHILL		PAULL	
	2 way	1 way	2 way	1 way
1	1	1	0	0
2	1	1	0	0

Construction Month	GOXHILL		PAULL	
	2 way	1 way	2 way	1 way
3	5	2	0	0
4	3	2	0	0
5	7	3	0	0
6	5	2	0	0
7	5	2	0	0
8	2	1	0	0
9	2	1	0	0
10	1	1	0	0
11	1	1	0	0
12	8	4	0	0
13	8	4	0	0
14	8	4	0	0
15	8	4	0	0
16	8	4	1	1
17	8	4	1	1
18	8	4	1	1
19	8	4	4	2
20	8	4	1	1
21	8	4	7	4
22	8	4	1	1
23	8	4	1	1
24	8	4	1	1
25	7	3	1	1
26	6	3	1	1
27	3	1	1	1
28	2	1	1	1
29	1	1	1	1
30	1	1	1	1
31	1	1	1	1
32	1	1	1	1
33	4	2	8	4
34	6	3	7	4
35	1	1	1	1

10.1.6 Table 10-5 presents the distances from each sensitive receptor used in the assessment of noise and vibration from the TBM.

Table 0-5 Noise and Vibration Assessment – Distances used in the assessment of Noise and Vibration from the TBM

Receptor	1	2	3	4	5	6	7	8	9	10	11	12
Chapel Farm (Goxhill)	1204	1621	2076	2510	2954	3424	3867	4331	4776	5222	5678	6125

Receptor	1	2	3	4	5	6	7	8	9	10	11	12
Marshlands (Goxhill)	1068	1523	2000	2450	2904	3381	3830	4297	4747	5196	5653	6103
Spring Farm (Goxhill)	787	1230	1698	2146	2598	3073	3523	3988	4437	4886	5342	5792
Fir Tree Farm - Bungalow (Goxhill)	557	873	1292	1720	2159	2626	3070	3530	3977	4423	4877	5326
Fir Tree Farm - House (Goxhill)	465	810	1246	1682	2127	2597	3043	3505	3954	4401	4856	5305
Lynton Stud Farm (Paull)	577	881	1293	1719	2156	2621	3065	3524	3971	4417	4870	5318
Paull Holme Residential Property (Paull)	5008	4555	4083	3636	3186	2716	2273	1822	1390	980	629	479
Lodge (Paull)	5115	4660	4186	3737	3284	2810	2362	1901	1457	1020	601	300
Dems Wood (Paull)	5369	4914	4439	3990	3537	3063	2614	2153	1707	1267	833	441
Lakes Farm (Paull)	4804	4349	3873	3425	2972	2497	2051	1587	1147	717	327	350
South Pasture (Paull)	4625	4173	3700	3256	2809	2341	1908	1462	1058	705	520	687
Boreas Hill Farm (Paull)	5640	5184	4708	4258	3804	3327	2878	2411	1961	1513	1056	608
Rose Hill Farm (Paull)	5369	4923	4457	4023	3587	3133	2716	2288	1904	1550	1246	1077

10.1.7 Ground borne noise predictions from the TBM have been undertaken using empirical formulae contained within BS5228 Annex E. The predictions are based upon research from tunnel boring field measurements. The equation used to predict ground borne noise from the TBM is presented in equation 1.

$$SPL=127-54 \log_{10} r \quad \text{[Equation 1]}$$

Where *SPL*= resultant sound pressure level in dB (A)

r = distance measured along the ground surface, in metres

10.1.8 Predictions of HGV construction noise impacts generated by the Scheme have been undertaken for areas up to 300m from the red line boundary utilising the calculation methods contained within BS5228.

10.1.9 Predictions have been undertaken using the sound power method. The formulae used to predict noise from HGV movements is presented in equation 2.

$$SPL = LWA - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d \quad [\text{Equation 2}]$$

Where SPL = resultant sound pressure level in dB (A)

LWA = reference sound power

Q = Hourly HGV flow

V = speed (in mph)

d = Distance from haul route (in meters)

10.1.10 Vibrations from the TBM have been predicted using empirical formulae contained within BS5228-2 Annex E. The formulae used to predict the peak particle velocity (PPV) in millimetres per second (mm/s-1) is presented in equation 3.

$$V_{res} = \frac{180}{X^{1.3}} \quad [\text{Equation 3}]$$

Where V_{res} = resultant PPV, in millimetres per second

X = distance measured along the ground surface, in metres

10.1.11 Vibrations from vibratory piling have been predicted using empirical formulae contained within BS5228-2 Annex E. The formulae used to predict the peak particle velocity (PPV) in millimetres per second (mm/s-1) is presented in equation 4.

$$V_{res} = \frac{K_v}{X^{\delta}} \quad [\text{Equation 4}]$$

Where K_v = Scaling Factor

X = distance (m)

δ = constant

10.1.12 Different values of K_v are presented in Table 10-6. For the calculations undertaken a K_v value of 266 has been assumed.

Table 0-6 Noise and Vibration Assessment – Scaling Factors used in Prediction of Vibration from Vibratory Piling

Scaling Factors		Probability of predicted value being exceeded
K _v	60	50%
K _v	126	33.3%
K _v	266	5%

10.1.13 Different values of δ are presented in Table 10-7. For the calculations undertaken a δ value of 1.4 has been assumed.

Table 0-7 Noise and Vibration Assessment – Constants used in Prediction of Vibration from Vibratory Piling

δ	1.3	all operations
δ	1.2	start up and run down
δ	1.4	steady state