

14 Noise and Vibration

14.1 Introduction

- 14.1.1 This chapter assesses the noise and vibration impacts associated with the construction, and subsequent operation, of the proposed EfW CHP facility.
- 14.1.2 The construction and operation of the facility have the potential to affect noise levels at existing sensitive receptors adjacent to the site and located along surrounding roads subject to changes in traffic flows.
- 14.1.3 This assessment considers construction noise and vibration impacts, operational noise generated by the facility and changes in traffic noise levels on the local road network. Decommissioning of the EfW CHP facility is not specifically addressed in this assessment, as noise and vibration impacts will be comparable to those for construction.
- 14.1.4 There are residential properties to the north and west of the development site, at a significantly greater height than the site.
- 14.1.5 There are residential properties to the north-east and east of the development site, separated from the site by the existing railway line. The properties to the north-east are at a significantly greater height than the site.
- 14.1.6 To the south lies Her Majesty's Naval Base (HMNB) Devonport and Devonport Dockyard, with the associated noise sources for such facilities.
- 14.1.7 A description of the noise and vibration terminology employed within this chapter is provided in Appendix 14.1.

14.2 Relevant Legislation and Policy

National Policy Guidance

- 14.2.1 Planning Policy Guidance PPG24 'Planning and Noise' ⁽¹⁾ was introduced by the Department of the Environment in 1994. PPG24 was issued to:

'...provide advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business ... It outlines some of the main considerations which local planning authorities should take into account in drawing up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.'
- 14.2.2 For new developments that would introduce noise into an area PPG24 confirms, in Annex 3, that it is appropriate to continue using previously established noise assessment methods, for example for 'Noise from road traffic' (Annex 3, paragraph 1), 'Noise from industrial and commercial developments' (Annex 3, paragraphs 19-20) and 'Noise from construction sites' (Annex 3, paragraph 21).

Legislation

- 14.2.3 Construction noise and vibration impacts are not covered directly by legislation. However, the Control of Pollution Act (CoPA, 1974) ⁽²⁾ and Part III of the Environmental Protection Act (EPA, 1990) ⁽³⁾ contain sections which can be applied to construction noise and vibration.
- 14.2.4 Under Section 60 of the CoPA a Local Authority can serve a notice on a contractor in order to control construction works. Under Section 61 of the CoPA a contractor can apply for 'prior consent' to carry out construction works, in order to agree in advance with the Local Authority the details of the works and the methods to be employed to minimise noise.
- 14.2.5 Under the EPA a Local Authority can serve an abatement notice on a contractor if they consider noise or vibration from construction works to amount to a statutory nuisance. In addition, individuals can also pursue private action under the EPA.
- 14.2.6 The EPA can also be used by the Local Authority, or a member of the public, to take action against industrial or commercial sources of noise affecting residential properties.

14.3 Assessment Methodology

Baseline Noise Measurements

- 14.3.1 Measurements have been carried out at locations representative of surrounding sensitive receptors, 1.2 to 1.5 metres above ground level. All monitoring locations were located at least 3.5m from any reflecting surface, other than the ground, and complied with the requirements of British Standard BS 7445: 1991/2003 'Description and Measurement of Environmental Noise' ⁽⁴⁾.

Construction Noise

Prediction Methodology

- 14.3.2 The noise levels generated by construction activities and experienced by any nearby sensitive receptors, such as residential properties, depend upon a number of variables, the most significant of which are:
- the noise generated by plant or equipment used on site, generally expressed as sound power levels (L_w);
 - the periods of operation of the plant on the site, known as its 'on-time';
 - the distance between the noise source and the receptor; and
 - the attenuation provided by ground absorption and any intervening barriers.
- 14.3.3 Construction noise predictions have been carried out based on the methodology outlined in BS 5228-1: 2009 'Code of practice for noise and vibration control on construction and open sites. Part 1: Noise' ⁽⁵⁾. BS 5228 predicts noise as an equivalent continuous noise level averaged over a period such as 1 hour ($L_{Aeq,1h}$).
- 14.3.4 BS 5228 contains a database of the noise emission from individual items of equipment, activities and routines to predict noise from construction activities at identified receptors. The prediction

method gives guidance on the effects of different types of ground, barrier attenuation and how to assess the impact of fixed and mobile plant.

Significance Criteria

- 14.3.5 Noise levels generated by construction activities are regulated by guidelines and subject to Local Authority control. No UK national noise limits exist for construction noise. However, guidance on acceptable noise levels is provided in British Standard BS 5228: 2009.
- 14.3.6 Plymouth City Council provides a Code of Practice for the Control of Pollution and Noise from Demolition and Construction Sites ⁽⁶⁾. The Council's policy includes acceptable hours of work, which are:
- Monday – Friday: 08:00 to 18:00
 - Saturday: 08:30 to 13:00
- 14.3.7 Appendix 2 of the Code of Practice provides noise limits which are reproduced in Table 14.1 below. The limits apply at 1 metre from the façade of any sensitive receptor and are dependant on prevailing ambient noise levels and specific time periods. For example, for weekday daytime working, noise limits are given for the 10 hour working day (08:00 to 18:00), any 3 hour period during the working day, and any 5 minute period during the working day.
- 14.3.8 Work may be permitted outside of these hours in exceptional circumstances and only by prior agreement with the Council and will be conditional on the contractor informing local residents in advance of the proposed activity. Noise limits are given for evening and night-time periods and for Sundays.

Table 14.1: City of Plymouth Acceptable Construction Noise Levels

Existing ambient L_{Aeq} (measured on fast response over the appropriate hour given in note 2)	Normal weekday working (excluding bank holidays)							
	Daytime (0800-1800)			Evening (1800-2200)			Night-time (2200-0800)	
	L_{Aeq} (10 hrs)	L_{Aeq} (any 3 hrs)	L_{Aeq} (any 5 mins)	L_{Aeq} (4 hrs)	L_{Aeq} (any 1 hr)	L_{Aeq} (any 5 mins)	L_{Aeq} (any 1 hr)	$L_{Amax,fast}$
35	60	64	80	50	53	60	40	45
40	65	69	81	55	58	60	45	50
45	65	69	81	60	63	66	50	55
50	70	74	86	60	63	66	55	60
55	70	74	86	65	68	71	60	65
60	75	79	91	65	68	71	65	70
65	75	79	91	70	73	76	70	75
70	75	79	91	75	78	81	75	80
75	80	84	96	80	83	90	80	85

- 1 All noise levels are in dB(A) as measured on FAST response.
- 2 Existing ambient L_{Aeq} should be measured during 0800-1000; 1900-2100; or 0200-0400 as appropriate.
- 3 Saturday morning levels (0800-1000 hours) should be as for weekday DAYTIME.
- 4 Saturday afternoons should be as for weekday EVENING.
- 5 Sundays and Bank Holidays should be as for WEEKDAY NIGHTS.

- 14.3.9 A significant effect is deemed to occur if the construction noise level exceeds the applicable limit in Table 14.1. A scheme for the assessment of the significance is proposed and presented in Table 14.2.

Table 14.2: Scheme for Assessment of Construction Noise Levels

Construction Noise Level Above Applicable Limit (dB)	Significance
< 1	Negligible
1 < 3	Low
3 < 5	Medium
> 5	High

- 14.3.10 The significance criteria provided in Table 14.2 have been employed for the assessment of the significance of construction noise levels.

Construction Vibration

Prediction Methodology

- 14.3.11 The limit of human perception to vibration is in the order of 0.15 mms^{-1} to 0.3 mms^{-1} peak particle velocity (ppv), in the frequency range 0.1 Hz to 1500 Hz. The human body is not equally sensitive to all frequencies of vibration and weighting curves to reflect the frequency dependency of the body have been developed and are contained within ISO Standards. The weighting gives a good correlation between the measured vibration level and the subjective feeling or impact produced by the vibration.
- 14.3.12 Ground vibrations may cause reactions ranging from 'just perceptible' through 'concern' to 'alarm' and 'discomfort'. The subjective response varies widely and is a function of situation, information, time of day and duration.
- 14.3.13 Buildings are reasonably resilient to ground-borne vibration and vibration-induced damage is rare. Vibration induced damage can arise in different ways, making it difficult to arrive at universal criteria that will adequately and simply indicate damage risk. Damage can occur directly due to high dynamic stresses, due to accelerated ageing or indirectly, when high quasi-static stresses are induced by, for example, soil compaction.
- 14.3.14 The vibration ppv due to specific construction works has been estimated at sensitive receptors using example measured source data and the appropriate propagation relationship taken from BS 5228-2: 2009 'Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration' ⁽⁷⁾.

Significance Criteria - Nuisance

- 14.3.15 Guidance on the nuisance effects of vibration is provided in BS 5228-2 Annex B, adapted below as Table 14.3.

Table 14.3: Guidance on Effects of Vibration Levels

Vibration Level	Effect	Significance
0.14 mms ⁻¹	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible
0.3 mms ⁻¹	Vibration might be just perceptible in residential environments.	Low
1 mms ⁻¹	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	Medium
10 mms ⁻¹	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High

14.3.16 The estimated ppv values due to construction works on site are compared to the target limits specified in Table 14.3 to determine the significance of the vibration effects in terms of nuisance.

Significance Criteria – Building Damage

14.3.17 BS 7385-2: 1993 ‘Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration’⁽⁸⁾ provides guidance on vibration levels likely to result in cosmetic damage, and is referenced in BS 5228-2. Limits for transient vibration, above which cosmetic damage could occur, are given in Table 14.4.

Table 14.4: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mms ⁻¹ at 4 Hz and above	
Un-reinforced or light framed structure Residential or light commercial buildings	15 mms ⁻¹ at 4 Hz increasing to 20 mms ⁻¹ at 15 Hz	20 mms ⁻¹ at 15 Hz increasing to 50 mms ⁻¹ at 40 Hz and above
Note 1: Values referred to are at the base of the building. Note 2: For un-reinforced or light framed structures and residential or light commercial buildings, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

14.3.18 The guide values relate predominantly to transient vibration which does not give rise to resonant responses in structures. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 14.4 may need to be reduced by up to 50%.

14.3.19 The estimated ppv values due to construction works on site are compared to the target limits specified in BS 7385-2 to determine the significance of the vibration effect in terms of cosmetic building damage.

Operational Plant Noise

Prediction Methodology

14.3.20 A noise propagation model has been developed in the SoundPLAN suite of programs, which implements a range of calculation methods, including the ISO 9613-2 calculation method for industrial noise sources⁽⁹⁾. Input data for the model were sourced from MVV as follows:

- OS base mapping for the site and surroundings (including residential buildings).
- Ground elevation data for the site and surroundings.
- EfW CHP facility plan and elevation drawings.
- Noise protection specification, and accompanying spreadsheet, providing octave band internal noise levels to all buildings, octave band sound power levels for external plant and octave band sound reduction data for building walls, roofs and ventilation louvers^{(10),(11)}.
- HGV traffic numbers entering and leaving the site between the plant buildings and the junction with the dockyard North Access Road.

14.3.21 The model consists of a detailed three dimensional representation of the proposed facility and the surroundings and has been employed to calculate noise levels at surrounding sensitive receptors due to noise breakout from the facility buildings, noise emission from external sources and noise emission from HGVs on site.

Significance Criteria

14.3.22 BS 4142: 1997, 'Method for rating industrial noise affecting mixed residential and industrial areas'⁽¹²⁾ is commonly used for the assessment of operational fixed plant noise. It has been confirmed with Plymouth City Council Public Protection Service that this method should be employed to assess the operational noise levels from the proposed facility.

14.3.23 The basis of the standard is a comparison between the background noise level in the vicinity of residential locations and the rating level of the noise source under consideration. The relevant parameters in this instance are as follows:

- Background Noise Level – $L_{A90,T}$ – defined in the Standard as 'the 'A' weighted sound pressure level of the residual noise at the assessment position which is exceeded for 90 % of the given time interval, T, measured using time weighting F (fast).
- Specific Noise Level – $L_{Aeq,Tr}$ – the equivalent continuous 'A' weighted sound pressure level of the source in question over a given time interval.
- Rating Level – $L_{Ar,Tr}$ – the specific noise level plus any adjustment made for the characteristic features of the noise.

14.3.24 A correction of +5 dB is made to the specific noise level if one or more of the features noted below is considered to be present (only one +5 dB correction is made regardless of the specific noise level containing one or more of the following characteristics):

- the noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.);
 - the noise contains distinct impulses (bangs, clatters or thumps); or
 - the noise is irregular enough to attract attention.
- 14.3.25 Once any adjustments have been made, the background and the rating noise levels are compared. The standard states that the greater this difference is, the greater is the likelihood of complaints, as follows:
- a difference of around +10 dB or more indicates that complaints are likely;
 - a difference of around +5 dB is of marginal significance; and
 - if the rating level is more than 10 dB below the measured background level, this is a positive indication that complaints are unlikely.
- 14.3.26 The standard specifies a one hour assessment period during the day and a five minute assessment period during the night.
- 14.3.27 Plymouth City Council Public Protection Service have indicated that the rating level should be no greater than 5 dB(A) above the prevailing background noise level at any residential receptor.

Construction and Operational Road Traffic Noise

Prediction Methodology

- 14.3.28 The proposed facility will have an impact on traffic flows on existing roads in the area surrounding the site both during construction and once the development is operational. The assessment focuses on the impact at existing residential properties located along surrounding affected roads. These affected roads include the North Access Road to the dockyard.
- 14.3.29 The magnitude of the impact of the additional traffic generated by the construction and operation of the development has been assessed by calculating the change in the 18 hour traffic noise levels ($L_{A10,18h}$) at a selection of sensitive receptors along affected roads.
- 14.3.30 The calculations have employed the methodology provided in Calculation of Road Traffic Noise (CRTN) ⁽¹³⁾, which is the standard methodology adopted in the UK for the calculation of noise levels from road traffic.

Significance Criteria

- 14.3.31 It is generally accepted that changes in road traffic noise levels of 1 dB(A) or less are imperceptible, and changes of up to 3 dB(A) are required to be perceptible. An increase of 10 dB(A) is generally perceived as a doubling in loudness.
- 14.3.32 Based on these perceptions, a scheme for the assessment of significance of changes in road traffic noise levels to residential receptors is proposed and presented in Table 14.5.

Table 14.5: Scheme for Assessment of Changes in Road Traffic Noise Levels

Change in Noise Level (dB)	Subjective Response	Significance
< 1	None	Negligible
1 < 3	Perceptible	Low
3 < 5	Noticeable	Medium
> 5	Intrusive	High

14.3.33 The significance criteria provided in Table 14.5 have been employed for the assessment of the significance of changes in road traffic noise levels.

14.4 Baseline Conditions

Monitoring Locations

14.4.1 A meeting was held on site with a member of Plymouth City Council Public Protection Service, at which the proposed noise monitoring locations were accepted as being representative of the surrounding residential areas. An additional monitoring location at a specific residential property was proposed by the Public Protection Service member and included in the baseline noise survey.

14.4.2 Apart from one specific property, access to residential properties was not possible. Short term manned monitoring was carried out at locations adjacent to residential areas. Long term unmanned monitoring was carried out at two locations on the site boundary representative of the noise climate at surrounding residential areas, and at the additional residential property mentioned above.

14.4.3 The noise monitoring locations are detailed in Table 14.6. Figure 14.1 shows a plan of the site and surrounding area with the monitoring locations indicated.

Table 14.6: Noise Monitoring Locations

Measurement Location	Duration	Details
ST1	Short term	Location on Poole Park Road
ST2	Short term	Location on Savage Road
ST3	Short term	Location on Wombwell Crescent
LT1	Long term	Representative of properties on Savage Gardens and on Wolseley Road and Hamoaze Avenue
LT2	Long term	Representative of properties on Talbot Gardens
LT3	Long term	Garden of 38 Moor Lane

Note: Location LT3 is at a considerable distance from the site. This monitoring location was included at the request of Plymouth City Council Public Protection Service.

Instrumentation

14.4.4 Details of the instrumentation employed in the baseline noise survey are provided in Appendix 14.2, Table A14.2.1.

14.4.5 The calibration of the instrumentation was checked before and after each series of measurements. No significant changes (+/- 0.1 dB) were noted.

Meteorological Conditions

14.4.6 Details of weather conditions during the survey are given in Appendix 14.2, Table A14.2.2.

14.4.7 Generally, conditions were within the limits specified in the standards for acceptable noise measurements.

Measured Noise Levels

14.4.8 For the short term monitoring, L_{Aeq} and L_{A90} levels were logged in 5 minute intervals. For the long term monitoring, L_{Aeq} and L_{A90} levels were logged in 15 minute intervals. All noise measurements were taken at between 1.2 and 1.5 metres above ground level, and located at least 3.5 metres from any vertical reflecting surfaces. The reported noise levels are thus free-field levels.

14.4.9 Short term noise measurements were carried out at ST1 (Poole Park Road) between 13:20 and 13:45 on 16/7/10. The measured levels are provided in Table 14.7.

14.4.10 The noise climate at ST1 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

14.4.11 Short term noise measurements were carried out at ST2 (Savage Road) between 12:50 and 13:20 on 16/7/10. The measured levels are provided in Table 14.8.

14.4.12 The noise climate at ST2 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

Table 14.7: Measured Noise Levels at Location ST1

Time	L_{Aeq} (dB)	L_{A90} (dB)
13:20:00	57	47
13:25:00	59	47
13:30:00	58	48
13:35:00	53	48
13:40:00	59	47

Table 14.8: Measured Noise Levels at Location ST2

Time	L _{Aeq} (dB)	L _{A90} (dB)
12:50:00	49	47
12:55:00	54	48
13:00:00	60	48
13:05:00	55	46
13:10:00	59	47
13:15:00	53	48

14.4.13 Short term daytime noise measurements were carried out at ST3 (Wombwell Crescent) between 14:05 and 14:40 on 16/7/10. The measured levels are provided in Table 14.9.

Table 14.9: Measured Daytime Noise Levels at Location ST3

Time	L _{Aeq} (dB)	L _{A90} (dB)
14:05:00	58	46
14:10:00	53	43
14:15:00	55	46
14:20:00	50	44
14:25:00	54	44
14:30:00	54	44
14:35:00	55	43

14.4.14 Short term night-time measurements were carried out at ST3 (Wombwell Crescent) between 01:05 and 01:40 on 30/7/10. The measured levels are provided in Table 14.10.

14.4.15 The noise climate at ST3 was dominated by local road traffic during both daytime and night-time periods.

Table 14.10: Measured Night-time Noise Levels at Location ST3

Time	L _{Aeq} (dB)	L _{A90} (dB)
01:05:00	38	35
01:10:00	36	34
01:15:00	37	34
01:20:00	37	34
01:25:00	37	34
01:30:00	35	33
01:35:00	37	36

14.4.16 Long term unmanned measurements were carried out at LT1 between 16/7/10 and 20/7/10. The measured noise levels are presented in Appendix 14.2, Figure A14.2.1.

14.4.17 The measured data were processed to provide average daytime (07:00 to 19:00), evening (19:00 to 23:00) and night-time (23:00 to 07:00) L_{Aeq} values for weekdays and weekends, and minimum daytime and night-time L_{A90} values. The results are provided in Table 14.11.

Table 14.11: Measured Noise Levels at Location LT1

Weekday / Weekend	Period	L _{Aeq} (dB)	Minimum L _{A90} (dB)
Weekday	Daytime	51	Daytime 40 dB(A)
Weekday	Evening	46	
Weekday	Night-time	42	
Weekend	Daytime	47	Night-time 34 dB(A)
Weekend	Evening	46	
Weekend	Night-time	41	

14.4.18 The noise climate at LT1 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

14.4.19 Long term unmanned measurements were carried out at LT2 between 16/7/10 and 28/7/10. The measured noise levels are presented in Appendix 14.2, Figure A14.2.2.

14.4.20 The measured data were processed to provide average daytime (07:00 to 19:00), evening (19:00 to 23:00) and night-time (23:00 to 07:00) L_{Aeq} values for weekdays and weekends, and minimum daytime and night-time L_{A90} values. The results are provided in Table 14.12.

14.4.21 The noise climate at LT2 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

Table 14.12: Measured Noise Levels at Location LT2

Weekday / Weekend	Period	L _{Aeq} (dB)	Minimum L _{A90} (dB)
Weekday	Daytime	56	Daytime 41 dB(A)
Weekday	Evening	43	
Weekday	Night-time	42	
Weekend	Daytime	49	Night-time 31 dB(A)
Weekend	Evening	44	
Weekend	Night-time	45	

14.4.22 Long term unmanned measurements were carried out at LT3 between 29/7/10 and 3/8/10. The measured noise levels are presented in Appendix 14.2, Figure A14.2.3.

14.4.23 The measured data were processed to provide average daytime (07:00 to 19:00), evening (19:00 to 23:00) and night-time (23:00 to 07:00) L_{Aeq} values for weekdays and weekends, and minimum daytime and night-time L_{A90} values. The results are provided in Table 14.13.

Table 14.13: Measured Noise Levels at Location LT3

Weekday / Weekend	Period	L _{Aeq} (dB)	Minimum L _{A90} (dB)
Weekday	Daytime	47	Daytime 36 dB(A)
Weekday	Evening	42	
Weekday	Night-time	37	
Weekend	Daytime	50	Night-time 30 dB(A)
Weekend	Evening	43	
Weekend	Night-time	38	

14.4.24 The noise climate at LT3 was dominated by distant road traffic.

14.4.25 Following the noise survey, the results were supplied to Plymouth City Council Public Protection Service. In a subsequent telephone conversation followed up by email ⁽¹⁴⁾, the following were agreed:

- The prevailing minimum daytime and night-time free field background L_{A90} noise levels at the monitoring locations.
- A preliminary target Rating Level of 5 dB(A) above minimum background noise level for daytime and night-time periods at surrounding sensitive receptors.

14.4.26 The minimum background noise levels, taken from the measured data at Locations LT1, LT2 and LT3, were adjusted using the short term measurements at ST1, ST2 and ST3 to provide representative minimum background noise levels at surrounding sensitive receptors for employment in the operational noise assessment. These are provided in Table 14.14.

Table 14.14: Minimum Background Noise Levels for Employment in Assessment

Measurement Location	Details	Minimum Background Noise Level (dB L _{A90})	
		Daytime	Night-time
LT1	Representative of properties on Savage Gardens and on Wolseley Road and Hamoaze Avenue	41	34
LT2	Representative of properties on Talbot Gardens	41	31
LT3	Garden of 38 Moor Lane. Representative of properties in this area.	36	30

14.5 Incorporated Mitigation

Construction

14.5.1 It is expected that the contractor will follow Best Practicable Means to minimise the noise impact upon the local community. Best Practicable Means will include the following:

- All construction plant and equipment should comply with EU noise emission limits.
- Proper use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good efficient working order.
- Selection of inherently quiet plant where appropriate. All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers.
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- Plant and equipment such as flat bed lorries, skips and chutes should be lined with noise attenuating materials. Materials should be handled with care and be placed, not dropped. Materials should be delivered during normal working hours.
- All ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimum noise disturbance, i.e. furthest from receptors or behind close boarded noise barriers. If necessary, acoustic enclosures should be provided and/or acoustic shielding.

- Construction contractors should be obliged to adhere to the codes of practice for construction working and piling given in BS 5228 and the guidance given therein minimising noise emissions from the site.
- Reference should be made to the Building Research Establishment, BRE 'Pollution Control' guidelines, Parts 1-5 ⁽¹⁵⁾.

Operation

14.5.2 The plant has been designed to minimise operational noise levels as far as is practicable, including

- Selection of low noise plant items. For example, the ACCs employ large diameter, low speed fans to provide the lowest possible noise emission for this type of equipment
- Selection of wall and roof cladding constructions to minimise noise breakout from the plant buildings. High performance multi-layered cladding systems have been chosen for each part of the facility to provide the necessary reduction in breakout noise resulting from the calculated internal noise levels.
- Selection of acoustic attenuated ventilation openings to minimise noise breakout from the plant buildings. High performance attenuated vents have been chosen for each part of the facility to provide the necessary reduction in breakout noise resulting from the calculated internal noise levels.

14.5.3 In addition, preliminary calculations indicated the significant noise contribution of HGV traffic entering and leaving the site. A 3-metre high acoustic barrier, expected to be a close-boarded fence, has been specified to the HGV route to mitigate this noise source. The final extent of this barrier will be decided during the detailed design.

14.6 Impact Assessment

Construction Noise

14.6.1 Noise levels resulting from construction activities have been predicted at five selected receptors. These receptors have been chosen as being representative of the closest noise sensitive properties in different directions from the development site. The selected receptors are:

- C1: 25-36 Talbot Gardens;
- C2: 1-12 Talbot Gardens;
- C3: 13-18 Savage Road;
- C4: 471 Wolseley Road; and
- C5: 21 Hamoaze Avenue.

14.6.2 The receptor locations are shown in Figure 14.1.

14.6.3 The following major activities have been assumed during the construction of the proposed facility:

- site clearance;

- earthworks;
 - excavation and foundations;
 - piling;
 - slab construction;
 - steelwork construction;
 - services and fitting; and
 - access road construction.
- 14.6.4 Distances from the closest approach of the construction works to each selected receptor are given in Appendix 14.3, Table A14.3.1.
- 14.6.5 The assumed plant to be used during each construction activity and their 'on-times' (the percentage of time that an item of plant is operational per day or hour or other relevant time period) are given in Appendix 14.3, Table A14.3.2. Sound power levels for plant items have been sourced from BS 5228-1.
- 14.6.6 Construction noise levels have been calculated for a 10 hour working day, a worst-case 3 hour period and a worst-case 5 minute period. For all calculations it has been assumed that construction works are being carried out at the closest approach to each receptor and there is direct line of sight between the works and the receptor. The detailed results of the calculations are given in Appendix 14.3, Tables A14.3.3 to A14.3.5.
- 14.6.7 Appendix 14.3, Tables A14.3.6 to A14.3.10 present the assessments for each receptor location for the 10 hour working day. The significance of construction noise levels above the limit value is taken from Table 14.2.
- 14.6.8 Appendix 14.3, Tables A14.3.11 to A14.3.15 present the assessments for each receptor location for the worst-case 3 hour period. The significance of construction noise levels above the limit value is taken from Table 14.2.
- 14.6.9 Appendix 14.3, Tables A14.3.16 to A14.3.20 present the assessments for each receptor location for the worst-case 5 minute period. The significance of construction noise levels above the limit value is taken from Table 14.2.

- 14.6.10 Table 14.15 shows the results for receptor C1: 25-36 Talbot Gardens. It can be seen that there are significant effects for a number of site activities for both the 10 hour working day and the worst-case 3 hour period, due to the closeness of the receptor.
- 14.6.11 However, these are worst-case noise levels, with construction activities being carried out at the closest approach. For the major part of the works, noise levels will be significantly less than these.
- 14.6.12 The worst-case 5 minute noise limit is not exceeded.

Table 14.15: Construction Noise Assessment – Receptor C1

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
L_{Aeq,10h} dB								
Predicted Noise Level L _{Aeq,10h} dB	78	79	77	68	74	76	72	74
Level Above Acceptable L _{Aeq} dB	+8	+9	+7	-2	+4	+6	+2	+4
Significance of Effect	High	High	High	None	Med	High	Low	Med
L_{Aeq,3h} dB								
Predicted Noise Level L _{Aeq,3h} dB	80	80	78	69	75	77	74	75
Level Above Acceptable L _{Aeq} dB	+6	+6	+4	-5	+1	+3	0	+1
Significance of Effect	High	High	Med	None	Neg	Low	None	Neg
L_{Aeq,5min} dB								
Predicted Noise Level L _{Aeq,5min} dB	84	80	79	69	76	79	77	75
Level Above Acceptable L _{Aeq} dB	-2	-6	-7	-17	-10	-7	-9	-11
Significance of Effect	None	None	None	None	None	None	None	None

14.6.13 Table 14.16 shows the results for receptor C2: 1-12 Talbot Gardens. This receptor is in the same area as C1 and there are significant effects for site clearance, earthworks, excavations and foundations and piling for the 10 hour working day. There are significant effects, assessed as low, for site clearance, earthworks and excavations and foundations for the 3 hour period.

14.6.14 As for receptor C1, these are worst-case noise levels, with construction activities being carried out at the closest approach. For the major part of the works, noise levels will be significantly less than these.

14.6.15 The worst-case 3 hour and 5 minute limits are not exceeded.

Table 14.16: Construction Noise Assessment – Receptor C2

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
L_{Aeq,10h} dB								
Predicted Noise Level L _{Aeq,10h} dB	75	76	76	72	70	71	68	70
Level Above Acceptable L _{Aeq} dB	+5	+6	+6	+2	0	+1	-2	0
Significance of Effect	Med	High	High	Low	None	Neg	None	None
L_{Aeq,3h} dB								
Predicted Noise Level L _{Aeq,3h} dB	77	77	77	73	71	73	70	71
Level Above Acceptable L _{Aeq} dB	+3	+3	+3	-1	-3	-1	-4	-3
Significance of Effect	Low	Low	Low	None	None	None	None	None
L_{Aeq,5min} dB								
Predicted Noise Level L _{Aeq,5min} dB	81	78	77	73	72	75	73	71
Level Above Acceptable L _{Aeq} dB	-5	-8	-9	-13	-14	-11	-13	-15
Significance of Effect	None	None	None	None	None	None	None	None

14.6.16 Table 14.17 shows the results for receptor C3: 13-18 Savage Road. There are no significant effects for the 10 hour working day, the worst-case 3 hour period or the worst-case 5 minute period.

Table 14.17: Construction Noise Assessment – Receptor C3

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
L_{Aeq,10h} dB								
Predicted Noise Level L _{Aeq,10h} dB	69	71	68	67	64	66	63	65
Level Above Acceptable L _{Aeq} dB	-6	-4	-7	-8	-11	-9	-12	-10
Significance of Effect	None	None	None	None	None	None	None	None
L_{Aeq,3h} dB								
Predicted Noise Level L _{Aeq,3h} dB	71	72	69	68	65	67	65	65
Level Above Acceptable L _{Aeq} dB	-8	-7	-10	-11	-14	-12	-14	-14
Significance of Effect	None	None	None	None	None	None	None	None
L_{Aeq,5min} dB								
Predicted Noise Level L _{Aeq,5min} dB	74	72	70	68	66	69	68	66
Level Above Acceptable L _{Aeq} dB	-17	-19	-21	-23	-25	-22	-23	-25
Significance of Effect	None	None	None	None	None	None	None	None

14.6.17 Table 14.18 shows the results for receptor C4: 471 Wolseley Road. There are no significant effects for the 10 hour working day, the worst-case 3 hour period or the worst-case 5 minute period.

Table 14.18: Construction Noise Assessment – Receptor C4

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
L_{Aeq,10h} dB								
Predicted Noise Level L _{Aeq,10h} dB	67	69	66	65	62	63	60	63
Level Above Acceptable L _{Aeq} dB	-3	-1	-4	-5	-8	-7	-10	-3
Significance of Effect	None	None	None	None	None	None	None	None
L_{Aeq,3h} dB								
Predicted Noise Level L _{Aeq,3h} dB	69	70	67	65	63	65	62	63
Level Above Acceptable L _{Aeq} dB	-5	-4	-7	-9	-11	-9	-12	-11
Significance of Effect	None	None	None	None	None	None	None	None
L_{Aeq,5min} dB								
Predicted Noise Level L _{Aeq,5min} dB	71	70	68	66	64	67	65	64
Level Above Acceptable L _{Aeq} dB	-15	-16	-18	-20	-22	-19	-21	-22
Significance of Effect	None	None	None	None	None	None	None	None

14.6.18 Table 14.19 shows the results for receptor C5: 21 Hamoaze Avenue. There are no significant effects for the 10 hour working day, the worst-case 3 hour period or the worst-case 5 minute period.

Table 14.19: Construction Noise Assessment – Receptor C5

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
L_{Aeq,10h} dB								
Predicted Noise Level L _{Aeq,10h} dB	67	69	63	62	59	61	58	63
Level Above Acceptable L _{Aeq} dB	-3	-1	-7	-8	-11	-9	-12	-7
Significance of Effect	None	None	None	None	None	None	None	None
L_{Aeq,3h} dB								
Predicted Noise Level L _{Aeq,3h} dB	69	70	64	63	60	63	60	64
Level Above Acceptable L _{Aeq} dB	-5	-4	-10	-11	-14	-11	-14	-10
Significance of Effect	None	None	None	None	None	None	None	None
L_{Aeq,5min} dB								
Predicted Noise Level L _{Aeq,5min} dB	72	71	65	63	61	65	63	64
Level Above Acceptable L _{Aeq} dB	-14	-15	-21	-23	-25	-21	-23	-22
Significance of Effect	None	None	None	None	None	None	None	None

14.6.19 Apart from residential properties on Talbot Gardens (receptors C1 and C2) it is predicted that the noise limits for the 10 hour working day, the worst-case 3 hour period and the worst-case 5 minute period will not be exceeded at surrounding residential receptors.

14.6.20 Where the 10 hour and 3 hour noise limits are exceeded at Talbot Gardens, this will be for a relatively short period of time, only when construction works are in close proximity to these properties. For the major part of the construction works, noise levels will be below the noise limits.

14.6.21 If practical, the provision of noise barriers, close in to construction works, when working close to Talbot Gardens, would reduce noise levels by approximately 5 dB(A), resulting in low or negligible significance for the majority of these works. The practicality and effectiveness of these will be dependent on the nature and duration of the particular works, and the allowable proximity

of the barrier to the works (the barrier will need to be close to the works to provide any potential attenuation to the higher floors of properties on Talbot Gardens).

14.6.22 Overall, the significance of construction noise effects is assessed as negligible / low.

Off Site Electrical Cable Works and Steam Pipeline Works

14.6.23 As part of the construction works, the following works will also be carried out:

- Provision of electricity cable from the site to the North Intake Substation and construction of a new switchroom building.
- Provision of new steam pipework to connect into the existing system and replacement of some existing pipework.

14.6.24 The majority of these works will be carried out within HMNB Devonport and Devonport Dockyard, where there are no receptors of high sensitivity.

14.6.25 There are residential properties on Saltash Road, close to the works to connect into the North Intake Substation. Temporary significant noise effects could result from works in this area, although the duration of the works is expected to be relatively short. Adherence to the mitigation procedures outlined in paragraph 14.5.1 will reduce noise effects to a minimum.

Construction Vibration

14.6.26 All piling during construction works will be rotary bored piling. Ground borne vibration levels have been calculated at the receptor locations for piling works at the closest approach, employing measured source data from BS5228-2. The estimated ppv values are shown in Table 14.20.

Table 14.20: Predicted Construction Vibration Levels

Receptor	ppv (mms^{-1})
C1	< 0.1
C2	< 0.2
C3	< 0.1
C4	< 0.1
C5	< 0.1

14.6.27 With reference to the criterion values in Table 14.3, the predicted vibration levels are unlikely to be perceptible at surrounding residential receptors. The significance of ground borne vibration with respect to nuisance is assessed as negligible.

14.6.28 With reference to the criterion values in Table 14.4, the predicted vibration levels are well below the levels at which cosmetic damage to buildings might occur. The significance of ground borne vibration with respect to building damage is assessed as negligible.

Construction Traffic on Public Roads

- 14.6.29 The results of the construction traffic assessment have been employed to calculate the increases in noise levels to receptors along the construction traffic route. It is understood that construction traffic will mostly access and egress the site via Weston Mill Drive to the A38.
- 14.6.30 The number of vehicles per day will vary throughout the construction period. The worst-case has been considered, assuming 150 HGV movements per day (75 in / 75 out) and 308 car movements per day (154 in / 154 out).
- 14.6.31 The effects of the additional traffic during construction are presented in Appendix 14.3, Table A14.3.21, which shows the baseline traffic flows, the “with construction traffic” flows and the change in Basic Noise Level for each of the road links on the construction traffic route (Basic Noise Level is the calculated road traffic noise level at a reference distance of 10 metres from the edge of the carriageway). The results are summarised in Table 14.21 below.

Table 14.21: Changes in Noise Levels on Public Roads Due to Construction Traffic

Road Link	Basic Noise Level (dB L _{A10,18h})		Change (dB L _{A10,18h})
	2011 Baseline	2011 With Construction	
Link between Site Roundabout and Wolseley Rd / Weston Mill Drive junction	63.6	64.6	1.0
Weston Mill Drive east of Wolseley Rd junction	69.5	69.8	0.3
Weston Mill Drive east of Ferndale Road	69.6	69.9	0.3
Weston Mill Drive west of A38	69.6	69.9	0.3
A38 westbound on-slip - one way flows	65.5	66.0	0.5
A38 westbound off-slip - one way flows	64.3	64.9	0.6
A38 Eastbound on-slip - one way flows	65.4	65.9	0.5
A38 Eastbound off-slip - one way flows	65.2	65.7	0.5
A38 westbound (west of Weston Mill Drive) - one way flows	76.3	76.4	0.2
A38 westbound (east of Weston Mill Drive) - one way flows	76.0	76.2	0.2
A38 eastbound (west of Weston Mill Drive) - one way flows	76.2	76.4	0.2
A38 eastbound (east of Weston Mill Drive) - one way flows	76.3	76.4	0.2

- 14.6.32 Apart from the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive, the increases in noise level are all below 1 dB(A), the significance of which is assessed as negligible with reference to Table 14.5.
- 14.6.33 The increase on the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive is 1 dB(A). However, there are no sensitive residential receptors adjacent to this link. The nearest residential properties front on to Wolseley Road and Weston Mill Drive and

the noise climate at these properties is dominated by road traffic on these two links. Weston Mill Community Primary School is located on the eastern side of the Wolseley Road / Weston Mill Drive junction, but again the existing noise climate here is dominated by road traffic noise. Hence, the resultant increases in noise levels due to construction traffic will be less than 1 dB(A) and the significance of these noise increases is assessed as negligible.

Operational Noise

- 14.6.34 The operational noise model, consisting of a detailed three dimensional representation of the proposed facility and the surroundings, has been employed to calculate noise levels at surrounding sensitive receptors due to noise breakout from the facility buildings, noise emission from external plant and noise emission from HGVs on site (between the junction with the dockyard North Access Road and the facility buildings).
- 14.6.35 The model employs the calculation methodology provided in ISO 9613-2, which is the standard methodology for the calculation of noise levels from industrial sources within the UK and most of Europe. The methodology takes account of the following:-
- Noise breakout from the facility buildings
 - Noise from external fixed plant (e.g. ACCs, transformer, coolers, stack)
 - Attenuation of noise with distance
 - The frequency spectrum of the noise from each source
 - The ground topography between the facility and surrounding receptors, enabling corrections to be made for shielding and ground absorption (these corrections will take account of the unusual topography of this particular site, with the receptors located above the level of the facility)
- 14.6.36 A summary of the input data to the model is provided in Appendix 14.4.
- 14.6.37 Two periods have been considered:
- the daytime period (when HGVs will be accessing and leaving the site); and
 - the night-time period (no HGV traffic).
- 14.6.38 For each period, free-field L_{Aeq} noise levels have been calculated at all floors of surrounding buildings (free-field levels have been calculated, rather than facade levels, for direct comparison with the prevailing background noise levels).
- 14.6.39 For the daytime period, one situation has been considered:
- a worst-case weekday hour, with the maximum number of HGV arrivals and departures (23 in / 23 out).
- 14.6.40 During weekends, the total number of daily HGV movements on and off site will be less than during the week. The daytime noise impact for weekend periods will thus be less than reported here for the weekday.

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- 14.6.41 For the night-time period, two situations have been considered (since night-time noise from the EfW CHP facility is steady, a 1 hour period can be employed in place of the 5 minute period specified in BS 4142):
- a usual night-time hour, with no workshop activity; and
 - an unusual night-time hour, with workshop activity (the workshop will be operational during the night-time period on very few occasions throughout the year).
- 14.6.42 Maintenance staff will only normally be employed during the day time, not at night. There will, for example, be standby items of equipment (e.g. pumps) which can be brought into operation in the event of equipment breakdown. Repair work can then be carried out during the daytime.
- 14.6.43 For the daytime period, a +5 dB(A) correction has been applied to derive the Rating Level, to account for the irregularities in the noise from the facility due to HGV operations.
- 14.6.44 It is proposed that no +5 dB(A) correction need be applied for the night-time period to derive the Rating Level, since there is no HGV traffic and the emitted noise is steady and broadband (measurements on a similar facility in Mannheim, Germany have demonstrated the non-tonal nature of the emitted noise). See Appendix 14.5 for further details, which provides measured noise levels for this comparable plant in Germany. However, for comparison, results are presented with and without the +5 dB(A) correction.
- 14.6.45 Figure 14.2 shows a plan of the site and surrounding area, with the receptor locations shown.

14.6.46 Table 14.22 presents the results for the worst-case weekday hour. The levels shown are the maximum for each receptor (usually the top floor).

Table 14.22: Operational Noise Levels – Worst Case Weekday Hour

Receptor	Calculated Free-Field Noise Level (dB L _{Aeq,1 hour})	Rating Level (dB L _{Ar,1 hour})	Target Noise Level (dB(A))	Rating Level minus Target Noise Level (dB(A))
R1	38	43	46	-3
R2	40	45	46	-1
R3	40	45	46	-1
R4	37	42	46	-4
R5	35	40	46	-6
R6	38	43	46	-3
R7	37	42	46	-4
R8	33	38	46	-8
R9	31	36	46	-10
R10	36	41	46	-5
R11	33	38	46	-8
R12	35	40	46	-6
R13	33	38	46	-8
R14	33	38	46	-8
R15	35	40	46	-6
R16	38	43	46	-3
R17	39	44	46	-2
R18	39	44	46	-2
R19	37	42	46	-4
R20	38	43	46	-3
R21	41	46	46	0
R22	40	45	46	-1
R23	41	46	52 *	-6

* Short term measurement of daytime background noise levels at R23 on 11/3/11.
 Minimum measured L_{A90,5 mins} = 47 dB(A)

14.6.47 Inspection of the results in Table 14.22 shows that the estimated Rating Level is at or below the target noise level at all receptors.

14.6.48 In support of the calculated noise levels in Table 14.22, Figure 14.3 shows calculated operational daytime noise level contours at a height of 1.5 metres above ground across the site and surrounding area.

14.6.49 Table 14.23 presents the results for a usual night-time hour (i.e no workshop activity). The levels shown are the maximum for each receptor (usually the top floor). The numbers in brackets show the results with the +5 dB(A) correction to derive the Rating Level.

Table 14.23: Operational Noise Levels – Usual Night-time Hour (no workshop activity)

Receptor	Calculated Free-Field Noise Level (dB L _{Aeq,1 hour})	Rating Level (dB L _{Ar,1 hour})	Target Noise Level (dB(A))	Rating Level minus Target Noise Level (dB(A))
R1	37	37 (42)	39	-2 (+3)
R2	39	39 (44)	39	0 (+5)
R3	39	39 (44)	39	0 (+5)
R4	37	37 (42)	39	-2 (+3)
R5	33	33 (38)	39	-6 (-1)
R6	37	37 (42)	39	-2 (+3)
R7	36	36 (41)	39	-3 (+2)
R8	32	32 (37)	39	-7 (-2)
R9	29	29 (34)	36	-7 (-2)
R10	35	35 (40)	36	-1 (+4)
R11	32	32 (37)	36	-4 (+1)
R12	32	32 (37)	36	-4 (+1)
R13	29	29 (34)	36	-7 (-2)
R14	30	30 (35)	36	-6 (-1)
R15	30	30 (35)	36	-6 (-1)
R16	30	30 (35)	36	-6 (-1)
R17	27	27 (35)	36	-9 (-4)
R18	25	25 (30)	36	-11 (-6)
R19	24	24 (29)	36	-12 (-7)
R20	36	36 (41)	39	-3 (+2)
R21	39	39 (44)	39	0 (+5)
R22	35	35 (40)	39	-4 (+1)
R23	27	27 (32)	39	-12 (-7)

14.6.50 Inspection of the results in Table 14.23 shows that the estimated Rating Level is at or below the target noise level at all receptors, assuming no +5 dB(A) correction to the Rating Level.

14.6.51 With the +5 dB(A) correction, the target noise level is exceeded at 12 of the receptor locations, by up to 5 dB(A).

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- 14.6.52 In support of the calculated noise levels in Table 14.23, Figure 14.4 shows calculated operational night-time noise level contours at a height of 1.5 metres above ground across the site and surrounding area.
- 14.6.53 Table 14.24 presents the results for an unusual night-time hour, with activity in the workshop. As stated previously, this will be a very rare occurrence. The levels shown are the maximum for each receptor (usually the top floor). The numbers in brackets show the results with the +5 dB(A) correction to derive the Rating Level.
- 14.6.54 Inspection of the results in Table 14.24 shows that the estimated Rating Level is at or below the target noise level at all receptors, assuming no +5 dB(A) correction to the Rating Level.
- 14.6.55 With the +5 dB(A) correction, the target noise level is exceeded at 12 of the receptor locations, by up to 5 dB(A). It is noted that the target noise level is not exceeded at receptors R15, R16, R17, R18 and R19, which are the closest receptors to the workshop.
- 14.6.56 In support of the calculated noise levels in Table 14.24, Figure 14.5 shows calculated operational night-time noise level contours (with workshop activity) at a height of 1.5 metres above ground across the site and surrounding area.
- 14.6.57 It is concluded that, for daytime and night-time operation of the plant, the target noise levels as set by Plymouth City Council Public Protection Service will not be exceeded, if, as discussed above and supported by the information in Appendix 14.5, the +5 dB(A) correction to the night-time Rating Level is not applied.

Table 14.24: Operational Noise Levels – Unusual Night-time Hour (with workshop activity)

Receptor	Calculated Free-Field Noise Level (dB L _{Aeq,1 hour})	Rating Level (dB L _{Ar,1 hour})	Target Noise Level (dB(A))	Rating Level minus Target Noise Level (dB(A))
R1	37	37 (42)	39	-2 (+3)
R2	39	39 (44)	39	0 (+5)
R3	39	39 (44)	39	0 (+5)
R4	37	37 (42)	39	-2 (+3)
R5	33	33 (38)	39	-6 (-1)
R6	37	37 (42)	39	-2 (+3)
R7	36	36 (41)	39	-3 (+2)
R8	32	32 (37)	39	-7 (-2)
R9	29	29 (34)	36	-7 (-2)
R10	35	35 (39)	36	-1 (+4)
R11	32	32 (37)	36	-4 (+1)
R12	32	32 (37)	36	-4 (+1)
R13	29	29 (34)	36	-7 (-2)
R14	30	30 (35)	36	-6 (-1)
R15	30	30 (35)	36	-6 (-1)
R16	31	31 (36)	36	-5 (0)
R17	31	31 (36)	36	-5 (0)
R18	28	28 (33)	36	-8 (-3)
R19	25	25 (30)	36	-11 (-6)
R20	36	36 (41)	39	-3 (+2)
R21	39	39 (44)	39	0 (+5)
R22	35	35 (40)	39	-4 (+1)
R23	27	27 (32)	39	-12 (-7)

14.6.58 Table 14.25 presents the changes in daytime L_{Aeq} levels resulting from operation of the plant. The prevailing ambient noise levels employed in the table are the minimum daytime L_{Aeq} levels from Tables 14.11 and 14.12, whether for weekday or weekend periods.

14.6.59 The maximum increase in the ambient daytime noise level is 1.0 dB(A) at receptor R21. At all other receptors, the increases are less than 1.0 dB(A).

14.6.60 Overall, the significance of these increases is assessed as negligible.

Table 14.25: Change in Daytime Ambient Noise Levels Resulting From Plant Operation

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1 \text{ hour}}$)	Prevailing Ambient Noise Level (dB $L_{Aeq,12 \text{ hour}}$)	Ambient Noise Level with Plant Operation (dB $L_{Aeq,12 \text{ hour}}$)	Increase in Ambient Noise Level (dB $L_{Aeq,12 \text{ hour}}$)
R1	38	47	47.5	0.5
R2	40	47	47.8	0.8
R3	40	47	47.8	0.8
R4	37	47	47.4	0.4
R5	35	47	47.3	0.3
R6	38	47	47.5	0.5
R7	37	47	47.4	0.4
R8	33	47	47.2	0.2
R9	31	49	49.1	0.1
R10	36	49	49.2	0.2
R11	33	49	49.1	0.1
R12	35	49	49.2	0.2
R13	33	49	49.1	0.1
R14	33	49	49.1	0.1
R15	35	49	49.2	0.2
R16	38	49	49.3	0.3
R17	39	49	49.4	0.4
R18	39	49	49.4	0.4
R19	37	49	49.3	0.3
R20	38	47	47.5	0.5
R21	41	47	48.0	1.0
R22	40	47	47.8	0.8
R23	41	54 *	54.2	0.2

* Short term measurement of daytime noise levels at R23 on 11/3/11. Average measured $L_{Aeq} = 54$ dB(A)

14.6.61 Table 14.26 presents the changes in night-time L_{Aeq} levels resulting from operation of the plant (assuming no activity in the workshop). The prevailing ambient noise levels employed in the table are the minimum night-time L_{Aeq} levels from Tables 14.11 and 14.12, whether for weekday or weekend periods.

14.6.62 The maximum increase in the ambient night-time noise level is just over 2 dB(A) at receptors R2, R3 and R21. Receptors R4, R6, R7, R20 and R22 experience increases between 1 and 2 dB(A). Overall, the significance of these increases is assessed as negligible/low.

Table 14.26: Change in Night-time Ambient Noise Levels Resulting From Plant Operation

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1 \text{ hour}}$)	Prevailing Ambient Noise Level (dB $L_{Aeq,8 \text{ hour}}$)	Ambient Noise Level with Plant Operation (dB $L_{Aeq,8 \text{ hour}}$)	Increase in Ambient Noise Level (dB $L_{Aeq,8 \text{ hour}}$)
R1	37	41	42.5	1.5
R2	39	41	43.1	2.1
R3	39	41	43.1	2.1
R4	37	41	42.5	1.5
R5	33	41	41.6	0.6
R6	37	41	42.5	1.5
R7	36	41	42.2	1.2
R8	32	41	41.5	0.5
R9	29	42	42.2	0.2
R10	35	42	42.8	0.8
R11	32	42	42.4	0.4
R12	32	42	42.4	0.4
R13	29	42	42.2	0.2
R14	30	42	42.3	0.3
R15	30	42	42.3	0.3
R16	30	42	42.3	0.3
R17	27	42	42.1	0.1
R18	25	42	42.1	0.1
R19	24	42	42.1	0.1
R20	36	41	42.2	1.2
R21	39	41	43.1	2.1
R22	35	41	42.0	1.0
R23	27	41	41.2	0.2

14.6.63 Table 14.27 presents the changes in night-time L_{Aeq} levels resulting from operation of the plant (assuming activity in the workshop). The prevailing ambient noise levels employed in the table are the minimum night-time L_{Aeq} levels from Tables 14.11 and 14.12, whether for weekday or weekend periods.

14.6.64 The maximum increase in the ambient night-time noise level is just over 2 dB(A) at receptors R2, R3 and R21. Receptors R4, R6, R7, R20 and R22 experience increases between 1 and 2 dB(A). Overall, the significance of these increases is assessed as negligible/low.

Table 14.27: Change in Night-time Ambient Noise Levels Resulting From Plant Operation (with activity in workshop)

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1\text{ hour}}$)	Prevailing Ambient Noise Level (dB $L_{Aeq,8\text{ hour}}$)	Ambient Noise Level with Plant Operation (dB $L_{Aeq,8\text{ hour}}$)	Increase in Ambient Noise Level (dB $L_{Aeq,8\text{ hour}}$)
R1	37	41	42.5	1.5
R2	39	41	43.1	2.1
R3	39	41	43.1	2.1
R4	37	41	42.5	1.5
R5	33	41	41.6	0.6
R6	37	41	42.5	1.5
R7	36	41	42.2	1.2
R8	32	41	41.5	0.5
R9	29	42	42.2	0.2
R10	35	42	42.8	0.8
R11	32	42	42.4	0.4
R12	32	42	42.4	0.4
R13	29	42	42.2	0.2
R14	30	42	42.3	0.3
R15	30	42	42.3	0.3
R16	31	42	42.3	0.3
R17	31	42	42.3	0.3
R18	28	42	42.2	0.2
R19	25	42	42.1	0.1
R20	36	41	42.2	1.2
R21	39	41	43.1	2.1
R22	35	41	42.0	1.0
R23	27	41	41.2	0.2

14.6.65 It is concluded that, for daytime and night-time operation of the plant, the significance of increases in daytime and night-time ambient noise levels will be negligible or negligible/low.

Baling Operations

14.6.66 During periods of plant shutdown, waste will be shredded, baled and stored in order to avoid diverting waste away from the EfW CHP to landfill. During these shutdown periods, the following will apply:

Daytime

- Normal waste delivery HGV traffic
- Elevated noise levels in bale store and bunker (see Table A14.4.2 in Appendix 14.4)
- Maintenance works ongoing in boiler house and turbine hall
- Transformer operating on part load
- Workshop operational (internal reverberant level = 85 dB(A))

Night-time

- Elevated noise levels in bale store and bunker
- Maintenance works ongoing in boiler house and turbine hall
- Transformer operating on part load
- Workshop operational (internal reverberant level = 80 dB(A))

14.6.67 For daytime and night-time, free-field L_{Aeq} noise levels have been calculated at all floors of surrounding buildings (free-field levels have been calculated, rather than facade levels, for direct comparison with the prevailing background noise levels).

14.6.68 Table 14.28 presents the results for the worst-case daytime hour. The levels shown are the maximum for each receptor (usually the top floor). A +5 dB(A) penalty has been applied to account for the character of the noise.

14.6.69 Noise levels during baling operations are generally well below those for standard plant operation. Where this is not the case, noise levels are dominated by factors other than the baling operations:

- Receptors R15 to R19 are dominated by noise from the adjacent workshop, which is operational during standard plant operation and during plant shutdown.
- Receptors R22 and R23 are dominated by noise from HGV traffic, which will be present during standard plant operation and during shutdown.

14.6.70 Examination of Table 14.28 shows that the Rating Level is below the target noise level at all receptors.

Table 14.28: Baling Operations – Worst Case Daytime Hour

Receptor	Calculated Free-Field Noise Level (dB L _{Aeq,1 hour})	Rating Level (dB L _{Ar,1 hour})	Target Noise Level (dB(A))	Rating Level minus Target Noise Level (dB(A))
R1	30	35	46	-11
R2	31	36	46	-10
R3	30	35	46	-11
R4	28	33	46	-13
R5	30	35	46	-11
R6	29	34	46	-12
R7	29	34	46	-12
R8	27	32	46	-14
R9	26	31	46	-15
R10	31	36	46	-10
R11	28	33	46	-13
R12	32	37	46	-9
R13	31	36	46	-10
R14	31	36	46	-10
R15	34	39	46	-7
R16	37	42	46	-4
R17	39	44	46	-2
R18	39	44	46	-2
R19	37	42	46	-4
R20	29	34	46	-12
R21	34	39	46	-7
R22	38	43	46	-3
R23	41	46	52 *	-6

14.6.71 Table 14.29 presents the results for the worst-case night-time hour. The levels shown are the maximum for each receptor (usually the top floor). A +5 dB(A) penalty has been applied to account for the character of the noise.

14.6.72 Noise levels during baling operations are generally well below those for standard plant operation. Where this is not the case, noise levels are dominated by factors other than the baling operations:

- Receptors R15 to R19 are dominated by noise from the adjacent workshop, which is operational during plant shutdown.

14.6.73 Examination of Table 14.29 shows that the Rating Level is below the target noise level at all receptors.

Table 14.29: Baling Operations – Worst Case Night-time Hour

Receptor	Calculated Free-Field Noise Level (dB L _{Aeq,1 hour})	Rating Level (dB L _{Ar,1 hour})	Target Noise Level (dB(A))	Rating Level minus Target Noise Level (dB(A))
R1	17	22	39	-17
R2	17	22	39	-17
R3	19	24	39	-15
R4	19	24	39	-15
R5	22	27	39	-12
R6	23	28	39	-11
R7	23	28	39	-11
R8	20	25	39	-14
R9	17	22	36	-14
R10	25	30	36	-6
R11	22	27	36	-9
R12	24	29	36	-7
R13	22	27	36	-9
R14	21	26	36	-8
R15	27	32	36	-4
R16	28	33	36	-3
R17	30	35	36	-1
R18	27	32	36	-4
R19	24	29	36	-7
R20	16	21	39	-18
R21	19	24	39	-15
R22	21	26	39	-13
R23	21	26	39	-13

14.6.74 It is concluded that, for daytime and night-time baling and maintenance operations, noise levels to surrounding sensitive receptors will be acceptable.

- 14.6.75 Additionally, considering the contributions of the baling operations to the overall noise levels at surrounding receptors, baling operations during standard plant operation should also be acceptable.

Operational Vibration

- 14.6.76 There are no sources of significant ground borne vibration in the complement of plant items. All internal plant items such as turbines, generators, compressors etc. will be suitably mounted to minimise the transfer of vibration energy to the building structure.
- 14.6.77 Taking this into account, and the distances from the plant to surrounding sensitive receptors, the significance of operational vibration is assessed as negligible.

Operational Traffic on Public Roads

- 14.6.78 The results of the operational traffic assessment have been employed to calculate the increases in noise levels to receptors along affected routes. These affected routes include the North Access Road to the dockyard.
- 14.6.79 The effects of the additional traffic resulting from the development are presented in Appendix 14.4, Tables A14.4.1 and A14.4.2, which show the baseline traffic flows, the “with development traffic” flows and the change in Basic Noise Level for each of the road links (Basic Noise Level is the calculated road traffic noise level at a reference distance of 10 metres from the edge of the carriageway). The data in Table A14.4.1 includes the natural growth in traffic over time from 2011 to 2014. The data in Table A14.4.2 includes the natural growth in traffic over time from 2011 to 2014, plus traffic resulting from two other developments that have the potential to be constructed in future and which have specifically been modelled in an Annex to the Transport Assessment (see ES Appendix 12.1, Annex G) at the request of Plymouth City Council Officers. The results are summarised in Tables 14.25 and 14.26 below. The road links are shown in Figure 14.6, referenced to the Link I.D. numbers in the tables.

Table 14.25: Changes in Noise Levels on Public Roads Due to Operational Traffic

Link I.D.	Road Link	Basic Noise Level (dB L _{A10,18h})		Change (dB L _{A10,18h})
		2014 Do Minimum	2014 Do Something	
1	Link between Site Roundabout and Wolseley Rd / Weston Mill Drive junction	63.7	65.3	1.6
2	Wolseley Rd south of Weston Mill Drive junction	70.2	70.4	0.1
3	Wolseley Rd south of Saltash Rd junction	67.5	67.7	0.2
4	Weston Mill Drive east of Wolseley Rd junction	69.7	70.0	0.3
5	Weston Mill Drive east of Ferndale Road	69.7	70.1	0.3
6	Weston Mill Drive west of A38	69.7	70.0	0.3
7	Saltash Rd	67.5	67.5	0.0
8	Wolseley Rd (north of Weston Mill Drive junction) - one way flows	66.9	66.9	0.0
9	Ferndale Rd	62.2	62.2	0.0
10	Carlton Terrace	60.1	60.2	0.1
11	A38 westbound on-slip - one way flows	65.6	65.7	0.1
12	A38 westbound off-slip - one way flows	64.4	65.0	0.6
13	A38 Eastbound on-slip - one way flows	65.6	66.0	0.4
14	A38 Eastbound off-slip - one way flows	65.3	65.4	0.1
15	A38 westbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
16	A38 westbound (east of Weston Mill Drive) - one way flows	76.1	76.2	0.1
17	A38 eastbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
18	A38 eastbound (east of Weston Mill Drive) - one way flows	76.4	76.5	0.1
19	Wolseley Rd north of Barne Rd junction- two way	60.9	60.9	0.0
20	Barne Rd east of Wolseley Rd junction - two way	65.5	65.5	0.0
21	Barne Rd west of Wolseley Rd junction - two way	63.9	63.9	0.0

Table 14.26: Changes in Noise Levels on Public Roads Due to Operational Traffic (with other potential developments)

Link I.D.	Road Link	Basic Noise Level (dB L _{A10,18h})		Change (dB L _{A10,18h})
		2014 Do Minimum	2014 Do Something	
1	Link between Site Roundabout and Wolseley Rd / Weston Mill Drive junction	63.8	65.3	1.6
2	Wolseley Rd south of Weston Mill Drive junction	70.4	70.5	0.1
3	Wolseley Rd south of Saltash Rd junction	67.7	67.9	0.2
4	Weston Mill Drive east of Wolseley Rd junction	70.0	70.3	0.3
5	Weston Mill Drive east of Ferndale Road	69.9	70.2	0.3
6	Weston Mill Drive west of A38	69.8	70.1	0.3
7	Saltash Rd	67.5	67.5	0.0
8	Wolseley Rd (north of Weston Mill Drive junction) - one way flows	67.3	67.3	0.0
9	Ferndale Rd	64.5	64.5	0.0
10	Carlton Terrace	60.7	60.8	0.1
11	A38 westbound on-slip - one way flows	65.8	65.8	0.0
12	A38 westbound off-slip - one way flows	64.6	65.1	0.5
13	A38 Eastbound on-slip - one way flows	65.7	66.1	0.4
14	A38 Eastbound off-slip - one way flows	65.5	65.5	0.1
15	A38 westbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
16	A38 westbound (east of Weston Mill Drive) - one way flows	76.2	76.2	0.1
17	A38 eastbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
18	A38 eastbound (east of Weston Mill Drive) - one way flows	76.4	76.5	0.1
19	Wolseley Rd north of Barne Rd junction- two way	60.9	60.9	0.0
20	Barne Rd east of Wolseley Rd junction - two way	65.5	65.5	0.0
21	Barne Rd west of Wolseley Rd junction - two way	63.9	63.9	0.0

- 14.6.80 Apart from the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive, the increases in noise level are all below 1 dB(A), the significance of which is assessed as negligible with reference to Table 14.5.
- 14.6.81 The increase on the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive is 1.6 dB(A). However, there are no sensitive residential receptors adjacent to this link. The nearest residential properties front on to Wolseley Road and Weston Mill Drive and the noise climate at these properties is dominated by road traffic on these two links. Weston Mill Community Primary School is located on the eastern side of the Wolseley Road / Weston Mill Drive junction, but again the existing noise climate here is dominated by road traffic noise. The resultant increases in noise levels due to operational road traffic will be less than 1 dB(A) and the significance of these noise increases is assessed as negligible.

14.7 Additional Mitigation

Construction

- 14.7.1 Where practical, noise barriers, close in to construction works, when working in the vicinity of properties on Talbot Gardens, will be provided. This will provide additional mitigation for the short-term significant construction noise effects at these properties. The practicality and effectiveness of these will be dependent on the nature and duration of the particular works, and the allowable proximity of the barrier to the works (the barrier will need to be close to the works to provide any potential attenuation to the higher floors of properties on Talbot Gardens).
- 14.7.2 Since it may be perceived by the local community that there could be noise impacts, MVV has undertaken to prepare and work to a noise monitoring protocol and action plan.

Operation

- 14.7.3 Since it may be perceived by the local community that there could be noise impacts, MVV has undertaken to prepare and work to a noise monitoring protocol and action plan.

14.8 Residual Effects (with Mitigation in Place)

Construction

- 14.8.1 With the provision of mitigation, as outlined in paragraph 14.7.1 and 14.7.2 above, and adherence to good site practices as outlined in paragraph 14.5.1, residual construction noise effects are assessed as negligible / low.
- 14.8.2 Construction vibration effects are assessed as negligible.

Operation

- 14.8.3 Assuming that no +5 dB(A) correction is required to derive the night-time Rating Level (as discussed previously and supported by the data in Appendix 14.5), operational noise levels at surrounding sensitive receptors are at, or below, the target noise levels proposed by Plymouth City Council Public Protection Service. Mitigation has been designed into the plant, as detailed in paragraphs 14.5.2 and 14.5.3, to reduce operational noise levels as far as is practicable. Operational noise effects are assessed as negligible / low.

14.8.4 Operational vibration effects are assessed as negligible.

14.8.5 Operational road traffic noise effects are assessed as negligible.

14.9 Conclusion

Construction

14.9.1 The construction noise assessment has shown that, for the major part of the construction works, construction noise levels to surrounding sensitive receptors will be below the proposed limit values.

14.9.2 For some construction activities, when working close to properties on Talbot Gardens, the noise limit values will be exceeded and significant effects will result. Where practicable, noise barriers, close in to construction works, when working in the vicinity of properties on Talbot Gardens, should be provided. This will reduce noise levels by approximately 5 dB(A), resulting in low or negligible significance for the majority of these works. The practicality and effectiveness of these will be dependent on the nature and duration of the particular works, and the allowable proximity of the barrier to the works (the barrier will need to be close to the works to provide any potential attenuation to the higher floors of properties on Talbot Gardens).

14.9.3 Overall, the significance of construction noise effects is assessed as negligible / low.

14.9.4 Taking into account the construction works to be carried out (and, in particular, the location and type of piling works) the significance of construction vibration effects is assessed as negligible.

Operation

14.9.5 With the comprehensive mitigation incorporated in the plant design, optimum plant orientation and location, and the provision of a 3-metre high noise barrier to the on-site HGV route, the significance of operational noise effects is assessed as negligible / low. This conclusion is based on the following:-

- The calculated daytime noise levels at surrounding receptors are at or below the target noise levels
- The calculated night-time noise levels at surrounding receptors are at or below the target noise levels (with, as discussed previously, no +5 dB(A) correction to derive the Rating Level)
- The maximum increase in the ambient daytime noise level due to plant operation is 1.0 dB(A) at receptor R21. At all other receptors, the increases are less than 1.0 dB(A).
- The maximum increase in the ambient night-time noise level is just over 2 dB(A) at receptors R2, R3 and R21. Receptors R4, R6, R7, R20 and R22 experience increases between 1 and 2 dB(A). At all other receptors, the increases are less than 1.0 dB(A).

14.9.6 Taking into account the type of plant to be employed, and the distances from the plant to surrounding sensitive receptors, the significance of operational vibration is assessed as negligible.

14.9.7 Operational vibration effects are assessed as negligible.

14.9.8 Operational road traffic noise effects are assessed as negligible.

14.10 References

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