14 Noise and Vibration

14.1 *Introduction and Methodology*

This section addresses noise and vibration effects anticipated to result from the construction of the scheme. The scope of the assessment has been determined as follows:

- the results of baseline noise monitoring; and
- a review of the proposed construction method and programme.

The assessment considers impacts that may result from the proposed construction and sets out mitigation measures to reduce adverse impacts where appropriate.

A glossary of terminology to assist the reader can be found in Appendix H.

14.1.1 *Guidance*

Noise

(a) British Standard (BS) 5228: Part 1

Construction work involves various activities, undertaken by different types of plant, at different locations and at varying times. As a consequence, construction noise levels at noise-sensitive locations vary with time as the noise sources move progressively closer or further away from a property, and as the activities themselves change. The main activities are likely to be confined to excavation works in designated working areas at Lepe and West Gurnard.

In order to determine which properties would be significantly affected by noise during the construction phase, noise predictions at selected receiver locations have been carried out in accordance with the methodology set out in British Standard (BS) 5228: Part 1: 1997 *Noise and vibration control on construction and open sites*.

The BS5228 methodology involves calculating noise levels at chosen receptors taking into account the source noise level, the local topography as well as the nature of the ground cover.

There are no national criteria for limiting noise levels from construction sites/activities; the Control of Pollution Act 1974, the Act that pertains to such activities, leaves it to Local Authorities to recommend criteria appropriate to their area of jurisdiction.

However, a value that has been widely applied as a limit for daytime construction activities in civil engineering projects is 75dB(A), measured as an equivalent noise level ($L_{Aeq,T}$) at the nearest noise sensitive location.

This value was recommended in the former Department of Environment Advisory Leaflet (AL) 72 *Noise control on building sites*, which is now out of print. BS5228 suggests that the noise limit should be 10dB(A) lower during the evening period and that noise levels at night may need to be as low as 40dB(A) to avoid disturbance.

Appropriate noise levels applicable to the works will need to be discussed and agreed with the Environmental Health Officers at New Forest District Council, and the Isle of Wight Council in advance of the works. Any noisy works required outside of normal working hours will be notified to the officer, whose consent will be required.

(b) Draft Guidelines for Noise Impact Assessment

A joint working party of the Institute of Acoustics and Institute of Environmental Management and Assessment produced the draft Guidelines for Noise Impact Assessment in 2002.

These guidelines are currently in draft format, but are of use in this assessment. The draft guidelines state that the assessor should set an impact scale appropriate for the assessment being undertaken. The impact scale shown in Table 14.1 has been adopted here.

Table 14.1 *Impact Scale for Comparison of Future Noise against Existing Noise*

Change in Noise Level dB(A)	Subjective Response	Significance
0	No change	No impact
0.1 to 2.9	Barely perceptible	Slight impact
3.0 to 4.9	Noticeable	Moderate impact
5.0 to 9.9	Up to a doubling or halving in loudness	Substantial impact
10.0 or more	More than a doubling or halving in loudness	Severe impact

The above criteria reflect key benchmarks of human response to changes in noise level. For example, a 3dB(A) change is generally taken to be the smallest change perceptible to the human ear and a 10dB(A) change is heard as a doubling or halving of the loudness of a source. The 5dB(A) category has been included as it provides a greater definition of the assessment of changes in noise level.

Vibration

(c) BRE Digest 403

BRE Digest 403 *Damage to structures from groundborne vibration* gives information on the current UK position concerning damage to buildings from groundborne vibration caused by construction, blasting and road traffic.

This document provides an overview of current standards, provides guidance on the parameters to measure and where to measure them, and states the limits recommended in BS5228: Part 4 and BS7385 for minor damage from piling operations and cosmetic damage from transient vibration respectively. Of particular note is the following excerpt from the introduction of this Digest:

> *Although vibrations induced in buildings by groundborne excitation are often noticeable, there is little evidence that they produce even cosmetic damage (such as small cracks in plaster). This lack of data is one of the reasons why the British Standards Institution (BSI) did not provide guidance before 1992 and why there is still no International Organization for Standardization (ISO) guidance limits. It also indicates that damage solely attributable to vibrations is not common. Some European countries have provided quantitative guidance in their codes for some years; however, it is not strictly valid to apply these limits in the UK because the data on which they are based relate to different structural types and settings.*

(d) British Standard 7385 Part 1

Part 1 of BS7385:1990 *Evaluation and measurement for vibration in buildings* sets out the basic principles for carrying out vibration measurements and processing data, with respect to evaluating vibration effects on buildings.

The measurement of vibration in a building can be conducted for a variety of purposes. The standard highlights three common reasons for measuring vibration in buildings and provides recommendations on the survey method and equipment to be used:

- **Problem recognition.** Where it is reported that a building is vibrating at such a level as to cause concern to occupants, it may be necessary to establish whether or not the levels warrant concern for structural integrity. For the purposes of problem recognition, exploratory monitoring is recommended. This involves conducting limited measurements of the vibration affecting a building or area and can indicate the existence of a problem requiring further investigation. Neither the equipment nor the methodology recommended for this type of monitoring are highly sophisticated and it should be noted that large errors are not uncommon.
- **Control monitoring.** Where maximum permitted vibration levels have been established by some entity and those vibrations have to be measured and reported. For the purposes of control monitoring, it is recommended that a field survey be conducted consisting of a limited number of vibration measurement locations in order to assess the vibration severity in comparison with values stipulated in codes or regulations. The sophistication of the equipment and methodology necessary for a field survey would depend in part on the sophistication of the values stipulated.
- **Diagnosis.** Where it has been established that vibration levels require further investigation, measurements are made in order to provide information for mitigation procedures. When structures are being subjected to vibration excitation of a magnitude that could have serious consequences, the structural behaviour should be assessed in a thorough manner via an engineering analysis. It is anticipated that an engineering analysis would include a response analysis as well as an estimate of structure loading. A full engineering analysis requires a measurement system which would enable frequency to be estimated to ± 1 % and damping to ± 10 %.

With respect to exploratory monitoring of groundborne vibrations caused by external plant and machinery, the standard indicates that the vibration may be either transient or continuous and recommends equipment capable of measuring the peak particle velocity time history over a frequency range 1Hz to 300Hz.

The standard gives advice on the placement of equipment and states that measurements should be carried out by fixing the transducer to the foundation or a typical load bearing point on the main load bearing external wall at ground floor level.

Building related factors that should be considered when assessing the severity of vibration affecting a building are also discussed. These include:

- the type and condition of building;
- the natural frequency and damping of the structure;
- the building base dimensions; and
- the influence of soil.

Finally, this part of the standard quantifies three different levels of damage to structures:

- **Cosmetic**. The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.
- **Minor**. The formation of large cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks.
- **Major**. Damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks, etc.

(e) British Standard 7385 Part 2

Part 2 of BS7385 provides guidance on assessing the possibility of vibration-induced damage in buildings due to a variety of sources and sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated.

The standard reiterates that there is a major difference between the sensitivity of people in feeling vibration and the onset of levels of vibration which may damage the structure. The levels of vibration at which people are likely to comment are below levels of vibration which may damage buildings, except at lower frequencies.

The full assessment method presented takes into account the magnitude, frequency and duration of recorded vibration together with consideration of the type of building which is exposed.

Although the criteria contained within BS7385 are useful when appraising the relative severity of structural vibration, it is important to note that they are not intended to be adopted as acceptable or non-acceptable limits for vibration. The criteria in BS7385 are in Table 14.2.

Table 14.2 *Transient vibration guide values for cosmetic damage*

Type of Building	**Peak component particle velocity in frequency range of predominant pulse**	
	4Hz to 15Hz	**15Hz and above**
Reinforced or framed structures industrial and heavy commercial buildings	50mm/s at 4Hz and above	
Unreinforced or light framed structures residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz Increasing to 50mm/s at 40Hz and above
NOTE 1 Values referred to are at the base of the building. NOTE 2 For unreinforced or light framed structures at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.		

BS7385 asserts that minor damage is possible at vibration magnitudes that are greater than twice those given in Table 14.2 above, and that major damage to a building structure may occur at values greater than four times the stated values.

For transient vibration below a frequency of 4Hz, where a high displacement is associated with a relatively low peak component particle velocity value, it is recommended that a maximum displacement of 0.6mm (zero to peak) should be used.

Likewise, where the dynamic loading caused by continuous vibration results in dynamic magnification due to resonance then the guide values in Table 14.2 may need to be reduced by up to 50%, especially at the lower frequencies where lower guide values apply.

14.1.2 *Assessment*

(a) Summary of Approach to Construction Noise and Vibration Assessment

The approach to this assessment is summarised below.

- The existing noise climate has been established, through noise measurements.
- Noise emission levels have been predicted for the construction works using the prediction methodology set out in BS5228. The predicted construction noise levels have been assessed against the absolute criterion and the existing ambient noise levels.
- The impacts from vibration have been considered.

- Where appropriate, mitigation measures have been set out to ameliorate any identified adverse impacts.

14.2 *Baseline Conditions*

Noise Survey

A number of ambient noise surveys were undertaken in Lepe, Hampshire and West Gurnard, Isle of Wight between 17th and 22nd June 2005 to establish the noise climate in the local area. Table 14.3 and Figures 14.1 and 14.2 show the receptors where noise monitoring was undertaken.

Table 14.3 Noise Monitoring Receptors

Site	Location
A	The Helmsman, Lepe
B	Stone Farm, Lepe
C	The Causeway, Gurnard
D	Upper Horn Hill, Gurnard
E	Jamesbridge, Gurnard
F	Hillside, Gurnard

For the purpose of this assessment the long term survey results at Lepe and West Gurnard have been used.

Continuous measurements were undertaken at two potentially noise-sensitive locations in close proximity to the designated working areas. The locations were:

- Location B: Stone Farm, Lepe. Measurements were free field.

- Location E: Jamesbridge, West Gurnard. This is a residential property, and measurements were taken at the façade.

Measurements were undertaken during the weekend and weekday periods. Measured noise levels taken over a 12 hour period, corresponding to the anticipated working day, have been used to produce a mean average over the five day period. The range in noise levels measured over the survey period is also given to show the variation in the daily Leq, 12hr level.

The baseline noise survey report, which includes monitoring locations and detailed survey results can be viewed in Appendix I. A summary of the measured levels is shown in Table 14.4.

The weather during the surveys was dry with wind speeds of less than 2m/s; these conditions are suitable conditions for environmental noise measurements.

Table 14.4 *Summary of measured ambient noise levels, dB*

Site	Location	Noise Levels dB(A)					
		Daytime (0700-1900hrs)		Evening (1900-2300 hrs)		Night-time (2300 -0700 hrs)	
		$L_{Aeq, 12hr}$	$L_{A90, 12 hr}$	$L_{Aeq, 4hr}$	$L_{A90, 4 hr}$	$L_{Aeq, 8hr}$	$L_{A90, 8hr}$
B	Stone Farm, Lepe	48 (45-50)	40 (35-45)	43(39-51)	36(29-46)	43(37-48)	37(30-44)
E	Jamesbridge, West Gurnard	50 (47-57)	36 (35 -38)	45 (44-46)	33 (31-35)	44(42-45)	31 (28-33)

No major construction noise is envisaged at Mopley in Hampshire or at Broadfields on the Isle of Wight (although a generator will be used on both sites) and therefore a noise survey was not undertaken.

Noise Survey Summary

The area surrounding the site in Lepe is predominantly rural with the closest residential properties being those located on Lepe Road to the north and also Stone Farm to the north-east of the site. Lepe Country Park, which is open to the public (with a café in the lower car park area) lies adjacent to the south of the drill rig site. The noise environment was subjectively governed by agricultural activity, local traffic on Lepe Road and distant road traffic noise.

The area surrounding the site in West Gurnard is predominantly open fields with some residential property located opposite the main road, Rew Street. To the north of the site, and closer to the Solent, the area becomes more residential. Livestock were visible in the surrounding area and boating and water sport activities in the Solent were noted to generate noise.

14.3 Impact Assessment and Mitigation

14.3.1 *Construction Noise*

Disruption due to construction is a localised phenomenon and is temporary in nature. In general, only people living within 100m of the site boundary are likely to be seriously impacted by construction noise.

No properties lie within 100m of the proposed drill rig site at Lepe although several properties lie within 100m of the proposed drill rig site at Gurnard.

The construction activities associated with the installation of the new pipeline and the horizontal directional drilling (HDD) at Lepe and West Gurnard will be operational 7 days a week for 12 hours (7am-7pm) per day. On two occasions the site may require continual 24 hour operation, therefore night time (2300 – 0700 hrs) periods have also been assessed.

Plant equipment at the temporary rig sites will include the following:

- A 250 tonne horizontal drill rig, a handling crane, a contained power pack containing two diesel engines,
- a 30t excavator,
- a contained drilling lubricant mixing and recycling plant, and
- a 350 Kva generator.

The total sound pressure level for this equipment is 90 dB(A) at 10m (based on maximum estimate from contractor).

For the purpose of predicting the likely construction noise impact, the construction works have been predicted in two areas:

- **Lepe drill rig site** (currently an arable field): the drill rig access and temporary working area will be 350m from the shoreline and will lie in the New Forest National Park. There is a car park, The Helmsman (café/information centre) and a beach used by visitors.

- **West Gurnard drill rig site** (a grassy field): the drill rig site lies approximately 300m landward from the shoreline. There are several residential dwellings adjacent to the working area.

14.3.2 *Construction Impacts: New Forest*

Predictions have been carried out of the noise levels likely to be generated by each of the above phases at the closest noise-sensitive receptors. The predictions have been undertaken for the noise sensitive receptors at the following locations within the New Forest National Park in the Lepe area:

- Position A: The Helmsman
- Position B: Stone Farm

These locations are considered representative of the majority of noise-sensitive receptors in close proximity to the proposed works. Details of the construction equipment assumed in the calculations are contained in Appendix I.

The predicted construction noise levels are shown in Table 14.5. The predictions are in terms of the 12 hour L_{Aeq} noise index, which represents the construction noise level generated over the proposed working day. If works proceed over a 24 hour period, construction noise levels would remain the same level at night, due to operation of all plant 100 %of the time.

Table 14.5 *Predicted construction noise levels, façade $L_{Aeq,\ 12\ hours}$ dB(A) - Lepe*

Site	Location	Construction Phase
Lepe	A	53.3
	B	57.3

When comparing the predicted values against the 75dB criterion adopted for this assessment, it can be seen that the construction work is expected to generate noise levels below the threshold at all receivers.

It should be noted that the predictions are representative of the worst-case noise levels where the works are at the closest location relative to the receptors.

The change in ambient noise levels during the noisiest period of the works is shown in Table 14.6. The existing measured ambient noise levels have been adjusted by +3dB to allow for façade reflections.

Table 14.6 *Change in ambient noise levels due to construction, dB(A) - Lepe*

Location	Period	Measured existing ambient noise level dB	Construction Phase	Greatest change +/-
A	Day	51 (48-53)	55.3 (54.4-56.1)	4.3(6.4-3.1)
	Night	43(37-48)	53.4(53.1-54.2)	10.4(16.1-6.2)
B	Day	51 (48-53)	58.2 (57.8 – 58.7)	7.2 (9.8 – 5.7)
	Night	43(37-48)	58.2 (57.8 – 58.7)	15.2(20.8-10.7)
Figures in parenthesis represent the range in daily $LA_{eq,12hr}$ levels and night time $L_{Aeq,8hr}$ levels.				

I.1. It can be seen from Table 14.6 that the predicted changes in ambient noise levels will range from **substantial adverse** at Stone Farm to a **severe adverse impact** at the Helmsman. It should be noted that the latter property is not residential and therefore is not a sensitive receptor. Construction noise levels are at least 15dB below the 75dB criterion adopted for this assessment.

Following the implementation of the mitigation measures below, typical noise levels from the construction works can be reduced by approximately 5 to 10dB(A).

M.1. Several safeguards will be adopted to minimise the effects of construction noise and these include the measures specified in the various EC Directives and UK Statutory Instruments that limit noise emissions from a variety of construction plant (described in Appendix I).

Under *Section 61* of the Control of Pollution Act 1974 Act, the contractor and the local authority should agree a prior consent for construction works, authorising certain activities to be carried out in a specified manner.

The precise noise mitigation measures to control noise and vibration from the activities will be discussed with the New Forest District Council in advance of the works.

All plant items will be properly maintained and operated according to manufacturers recommendations in such a manner as to avoid causing excessive noise and all plant will be sited so that the noise impact at nearby noise sensitive properties is minimised.

The Local Community will be kept fully informed about the nature and timing of activities.

Partial screening around noisy equipment will be put up on the site to shield particularly noisy activities.

Mitigation measures such as agreeing working times and other measures to be adhered to during the construction period (including traffic movements – section 16 'Traffic and Transport') are discussed in Appendix I.

If a 5 - 10dB noise reduction is achieved through the implementation of the mitigation measures, there will be **no significant residual impacts,** during the daytime at the Helmsmann and Stone Farm at Lepe.

I.2. No significant noise impacts are envisaged at Mopley as a result of the modifications to the booster station.

14.3.3 *Construction Impact: Isle of Wight*

Predictions have been carried out of the noise levels likely to be generated by each of the above phases at the closest noise-sensitive receptors. The predictions have been undertaken for the noise sensitive receptors at the following locations in West Gurnard:

- Position C: The Causeway, West Gurnard
- Position D: 1 Upper Horn Hill, West Gurnard
- Position E: Jamesbridge, West Gurnard
- Position F: Hillside, West Gurnard

These locations are considered representative of the majority of noise-sensitive receptors in close proximity to the proposed works. Details of the construction equipment assumed in the calculations is contained in Appendix I.

The predicted construction noise levels are shown in Table 14.7. The predictions are in terms of the 12 hour L_{Aeq} noise index, which represents the construction noise level generated over the proposed working day.

Table 14.7 *Predicted construction noise levels, façade $L_{Aeq, 12\ hours}$ dB(A) - Gurnard*

Site	Location	Construction Phase
West Gurnard	C	80.4
	D	76.8
	E	76.2
	F	71.6

When comparing the predicted values against the 75dB criterion adopted for this assessment, it can be seen that the construction work is expected to generate noise levels above the threshold at all receivers except F.

It should be noted that the predictions are representative of the worst-case noise levels where the works are at the closest location relative to the receptors.

The change in ambient noise levels during the noisiest period of the works is shown in Table 14.8.

Table 14.8 *Change in ambient noise levels due to construction, dB(A) - Gurnard*

Location	Period	Measured existing daytime ambient noise level $L_{Aeq, 1hr}$	Constructio n Phase	Greatest change +/-
C	Day	50 (47-57)	80.4	30.4 (33.4 – 23.4)
	Night	44(42-45)	80.4	36.4(38.4-35.4)
D	Day	50 (47-57)	76.8	26.8 (29.8-19.8)
	Night	44(42-45)	76.8	32.8(34.8-31.8)
E	Day	50 (47-57)	76.2	26.2 (29.2- 19.2)
	Night	44(42-45)	76.2	32.2(34.2-31.2)

Location	Period	Measured existing daytime ambient noise level $L_{Aeq, 1hr}$	Construction Phase	Greatest change +/-
F	Day	50 (47-57)	71.6	21.6 (24.6-14.6)
	Night	44(42-45)	71.6	27.6(29.6-26.6)
Figures in parenthesis represent the range in daily $LA_{eq,12hr}$ levels and night time $L_{Aeq,8hr}$ levels.				

I.3. It can be seen from the above table that the predicted changes in ambient noise levels at the four properties on Rew Street will result in a **severe adverse impact** at all sensitive receptors.

M.3. Several safeguards will be adopted to minimise the effects of construction noise and these include the measures specified in the various EC Directives and UK Statutory Instruments that limit noise emissions from a variety of construction plant (described in Appendix I).

Under *Section 61* of the Control of Pollution Act 1974 Act, the contractor and the local authority should agree a prior consent for construction works, authorising certain activities to be carried out in a specified manner.

The precise noise mitigation measures to control noise and vibration from the activities will be discussed with the Isle of Wight Council in advance of the works.

All plant items will be properly maintained and operated according to manufacturers recommendations in such a manner as to avoid causing excessive noise, all plant will be sited so that the noise impact at nearby noise sensitive properties is minimised and the Local Community will be kept fully informed about the nature and timing of activities.

Partial screening around noisy equipment will be put up on the site to shield particularly noisy activities.

Mitigation measures such as agreeing working times and other measures to be adhered to during the construction period (including traffic movements – section 16 'Traffic and Transport') are discussed in Appendix I.

Following the implementation of the mitigation measures, typical noise levels from the construction works can be reduced by approximately 5 to 10dB(A). Even if a 10dB noise reduction is achieved through the implementation of the mitigation measures, the noise impacts at Rew Street will remain a **severe adverse impact** at all locations.

14.3.4 *Vibration Assessment*

There is no means of predicting vibration levels within properties due to the variable factors taken into account e.g., soil type and building type. Therefore, it is recommended that if vibration is a nuisance to residents, and complaints arise, noise and vibration surveys should be undertaken to assess whether vibration is ground-borne or airborne and mitigation measures adopted if necessary.

There are currently no British Standards that provide a methodology to predict levels of vibration from construction activities, other than that contained within BS5228: Part 4, which relates to percussive or vibratory piling only.

I.4. Vibration from the activities is unlikely to cause any damage to properties but may cause annoyance. If complaints arise, measurements should be undertaken and any necessary mitigation adopted.

A previous Southern Water project at Western Yar River Crossing, Isle of Wight involved the 250 tonne horizontal directional drilling at close proximity to residential receptors and there were no complaints associated with vibration from the construction site. Consequently, it is envisaged that there would be **no significant impacts** on residents as a result of vibration.

14.3.5 *Operational Impacts*

I.5. There will be no long-term adverse noise impacts as a result of activities associated with the proposed scheme.