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DIBDEN TERMINAL

Proof of evidence
of

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1. QUALIFICATIONS AND EXPERIENCE

1.1 My name is Rupert Maurice Thornely-Taylor. I am a Fellow of the Institute of Acoustics and have specialised exclusively in the subjects of noise, vibration and acoustics for more than thirty-six years. I have been an independent consultant in these subjects for the past thirty-two years, and head the practice known as Rupert Taylor F.I.O.A. and am a director of the associated company Rupert Taylor Ltd. I was a member of the Noise Advisory Council chaired by the Secretary of State for the Environment for ten years and was a member of the Scott Committee on whose report the noise sections of the Control of Pollution Act 1974 were based. I was chairman of the Working Group on Noise Monitoring and deputy chairman of the Working Group on Noise as a Hazard to Health.

1.2 I have carried out consultancy contracts for a large number of government and local government clients, and promoters or objectors to many major infrastructure projects in the United Kingdom and overseas. I have been expert witness in many High Court and County Court actions, in a large number of public inquiries and Parliamentary Select Committees, and have been called to give evidence to the Royal Commission on Environmental Pollution. I am the author and joint author of several books, published in countries from Russia to Japan as well as the United Kingdom, and many articles and papers on noise, and have been an invited speaker in many international conferences on the subject.

1.3 Between March and August 1996 I was under contract to the Department of the Environment to study the application of Planning Policy Guidance PPG 24 PLANNING AND NOISE, to identify any need for additional guidance and to make recommendations on possible methods that could be developed and adopted in the guidance.

1.4 I have been engaged as noise and vibration consultant to ABP since June 2000 and advised Hann Tucker Associates in the preparation of the Noise and Vibration Technical Statements, and Adams Hendry in the drafting of the Environmental Statement.

2 SCOPE AND STRUCTURE OF EVIDENCE

2.1 The evidence presented in this proof is concerned with noise and vibration arising from both the construction and the operating phases of the project.

3 NOISE AND VIBRATION UNITS

Noise

3.1 The noise levels to which I will refer are expressed using the decibel scale. The decibel scale has the characteristic that it measures proportions rather than absolute quantities, so that, for example, doubling the amount of energy in a sound (for example by putting two identical sound sources close together) always causes an increase of 3 decibels, whether it is a doubling of a large or of a small amount of noise energy. However, as I shall explain, the perceived loudness of a doubling of noise energy is quite small, and certainly much less than a doubling. A tenfold increase in the amount of energy gives an increase of 10 decibels, although, once again, the perceived increase in loudness is not nearly as great as the increase in energy would suggest and a ten fold increase in energy is certainly not a tenfold increase in loudness.

3.2 The kind of decibel scale most commonly used for overall noise assessment is known as the 'A-weighted decibel' or dB(A). The 'A-weighting' is a method of causing measuring instruments to respond in approximately the same manner as does the human ear, which is comparatively insensitive to low-pitched and very high-pitched sound. For example, two sounds which are perceived as the same loudness may have widely differing physical magnitudes if one is a low rumble and the other is a whistle. Without 'A' weighting, the low rumble would measure some 30 decibels more than the whistle, even though they both sound equally loud. In 'A-weighted decibels' both sounds would have the same decibel, or dB(A), level. Noise levels in dB(A), like the basic decibel scale, measure proportions so that a 10 dB(A) increase is a doubling of loudness and a 10 dB(A) decrease is a halving of loudness. Judgment of loudness is subjective, and dependent on the characteristics of the sound, but the '10 dB(A) increase is a doubling of loudness' rule is a useful general guide. For example, ten motor cycles close together sound only about twice as loud as one motor cycle, and certainly not ten times as loud; the same is true of one motorcycle which emits ten times as much sound power as another. As a further guide, one may say that a sound level of less than 20 dB(A) is virtual silence, 30 dB(A) is very quiet. 50 dB(A) is a moderate level of noise, 70 dB(A) is quite noisy and in a noise level of 90 dB(A) one has to shout to be understood.

3.3 The measurement of sound levels in decibels involves a kind of averaging process in which the fluctuating pressure signal is squared, averaged, and the square root obtained. This process is known as r.m.s. averaging, and it takes place over a defined time. There are two standard averaging times, 1/8 second, known as 'F' response and 1 second, known as 'S' response. In the present context, the dB(A) levels to which I refer are to be measured using the 'S' response.

3.4 The basic dB(A) scale can only measure the instantaneous level of sound, and where the level of sound fluctuates up and down, as it normally does in the environment, the dB(A) level also fluctuates. When it is necessary to measure a fluctuating noise environment by means of single number, an index known as equivalent continuous sound level, or L_{Aeq}, is employed. L_{Aeq} (which in some documents is referred to as L_{eq} rather than L_{Aeq} - the two terms have the same meaning) is a long term average of the amount of energy in the fluctuating sound, expressed in dB(A). In the case of a continuous, unchanging sound, its L_{Aeq} level is the same as its sound level in dB(A). Because a 3 decibel change is caused by a doubling or halving of sound energy, then it follows that if the sound energy entering an ear or a microphone over a particular period of time is doubled or halved, because the same sound went on for twice or half as long as it did previously, then the amount of energy received will be doubled or halved. The result is that the L_{Aeq} level will go up or down by 3 dB just as it would if the amount of energy in the sound, rather then the duration of the sound, had doubled or halved.

3.5 The consequence is that the L_{Aeq} scale will measure either the level of sound, or the duration of sound, or a combination of both such as the number and noise level of a series of train passages. Since the L_{Aeq} index is based on the dB(A) scale, it will measure loudness in the same way, that is, an increase of 10 units on the L_{Aeq} scale sounds like a doubling in loudness if the increase is due to the same sound just getting louder. Alternatively, a 10 unit increase could be due to a tenfold increase in the number of sounds all of the same individual loudness and duration.

Vibration

3.6 Although low frequency airborne noise from sources such as heavy lorries can cause perceptible movement of building elements, such as rattling of windows, which is described by people as vibration, in my evidence the term ‘vibration' is restricted to displacement of the ground or of structures due to the propagation of waves through the ground. (The low frequency airborne effect to which I have referred is not normally caused by electric railways.)

3.7 Wave propagation in the ground takes several forms. Some waves spread out underground in a manner analogous to sound waves in air (although there exist both compressional and shear waves), others travel on the surface in a manner more analogous to the surface ripples of a pool of water. These waves travel at different speeds and are attenuated at different rates. The underground waves, or body waves as they are sometimes called, may undergo reflection from underground features such as rock strata.

3.8 In the case of trains running on the surface, surface waves are important. For railways in tunnel, body waves are of prime importance since these transmit ground-borne noise which may be radiated inside noise-sensitive buildings.

3.9 The basic units of vibration measurements relate to the movement of the surface which is vibrating. This can be measured either in units of velocity in metres per second (m/s) or of acceleration in metres per second per second (m/s^2). For small values millimetres may be used instead of metres.

3.10 In fact, the decibel scale is sometimes used for the measurement of vibration as well as of noise, and for example, when velocity is measured in decibels above a reference level of one billionth of a metre per second then a velocity level of 120 dB is 1 millimetre per second (1 mm/s).

3.11 Again, as with noise, human sensitivity to vibration depends on the frequency of the vibration. There are weighting curves like the 'A-weighting' of noise measurements in dB(A). The sensitivity of a person to vibration depends to some extent on the direction of the vibration relative to their posture at the time - for example vertical vibration in the floor is perceived differently by a standing person and a person lying down. There are therefore different weighting curves for vibration in the vertical (up and down the spine), horizontal (front to back) and lateral (side to side) directions. The most sensitive is the vertical direction (known as 'z-axis'). Weighted acceleration of 'z-axis' in units of m/s^2 is approximately equal to velocity in units of m/s multiplied by 50, provided that the frequency of the vibration is greater than 8 cycles per second (8 Hz).

3.12 As is the case with noise, it is necessary to take account of the effect of intermittency on human response, when vibration is not continuous. Whereas with noise this is done using the L_{Aeq} index, for vibration the method used is to sum the fourth power of the weighted acceleration, and express the fourth root of the result as an index known as vibration dose value or VDV, which now forms the basis of advice given in the 1992 edition of British Standard 6472.

3.13 Vibration can also give rise to re-radiated airborne noise. In this case the noise is measured using the dB(A) scale, and for all recent railway projects where ground-borne noise has been an issue, the maximum value of the re-radiated noise level measured on 'S' response, known as $L_{Amax,S}$ has been adopted as the assessment index.

4 ASSESSMENT CRITERIA

4.1 Noise and vibration can result in a range of impacts. These include indirect impacts such as the consequences of having to avoid opening windows facing the noise source, and direct impacts such as annoyance, reduced speech intelligibility, and interference with task performance. The thresholds of significant noise effect indicate cases where inconvenience arises from, for example, the need to sleep with windows closed and provide ventilation from other windows not directly facing the noise source, because sleep disturbance could occur with wide open windows. In such cases, mitigation in the form of acoustic glazing may need to be installed. This issue is discussed in more detail below.

4.2 There are two basic approaches to setting evaluative criteria. They may be based on absolute levels (of noise or vibration) or on relative levels - i.e. the level of the new noise or vibration compared to the ambient levels at the receptor. In this study, the appropriate basis for criteria has been selected according to the circumstances. Thus, in practice, both approaches are used for different situations.

4.3 Except where otherwise stated, the criteria apply to residential buildings, and to occupied non-residential buildings using daytime thresholds only. Special buildings, e.g. churches, theatres etc., were considered individually.

4.4 Changes in road traffic flow may occur during either construction or operation and the same criteria are used for this topic in each case (**Table A.1**). Criteria relating to other sources of noise or vibration are specific to either the construction phase (**Tables A.2** to **A.4)** or to the operating phase (**Tables A.5** to **A.7**).

5 THE APPROACH ADOPTED IN THE ENVIRONMENTAL STATEMENT

5.1 In line with normal practice in the preparation of Environmental Statements, the process carried out was as follows. The baseline conditions were assessed, and prior to studying means of mitigating effects the likely noise and vibration impacts, and their effects, were identified. The Environmental Statement (and the Technical Statements which support it) reported effects without mitigation, although these are, of course, hypothetical given that the next stage of the process was to identify available methods to reduce the extent of significant effects by the incorporation or addition of mitigation measures.

5.2 It is the residual effects, after taknig into account the effect of mitigation, that inform the decision-making process.

6 NOISE AND VIBRATION EFFECTS

6.1 The scheme has been designed from the outset to avoid impacts. For example the layout of the terminal has been designed so that the nearest berth is separated from Hythe Marina Village by the area of the Creek; the aggregate wharf and handling area has been located in the northern part of the site close to the existing Military Port; an empty container stack has been located around the aggregates area and rail terminal; some of the nearest properties and farms along Main Road are separated from the operational terminal by an extensive area of nature conservation enhancement.

Noise

Construction

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6.2 At Hythe Marina Village and Hythe the highest daytime noise levels occur during phase 1 construction, as a result of re-construction of the Marina Bund and excavation of the creek, and phase 3, as a result of earthworks and marine works. After mitigation the assessment has concluded that the noise levels will be of marginal magnitude and therefore not significant. However, due to the sensitivity of the receiving environment, the impact of construction noise on Hythe Marina Village, is assessed to be of minor significance.

6.3 Similarly the mitigated noise levels generated by construction activity at Marchwood are of marginal magnitude, as they are 4 – 5 dB(A) below the threshold of moderate magnitude. Due to the high sensitivity of the receiving environment, the overall impact of construction noise on Marchwood is assessed to be of minor significance.

6.4 At the individual properties of Veals Farm, Locks Farm, Pilgrims Inn and Marchwood Priory the mitigated noise levels from construction will cause an increase in noise levels of marginal magnitude. The predicted noise levels are all below the threshold at which the magnitude is assessed to be moderate and therefore of significance. However, due to the sensitivity of these locations and the timescale over which the impact will be felt, overall the impact is considered to be of minor significance.

ROAD IMPROVEMENTS

6.5 The noise arising from the construction of the road improvements is assessed to create an adverse impact of major significance at Border Oaks. However, it should be noted that this property is owned by the applicant ABP.

6.6 Other properties close to the A326, notably Pilgrim Inn, Marchwood C of E Infant School and the residential properties Sittva and Woodlands, are predicted to experience noise impacts which are of moderate or substantial magnitude before mitigation. After mitigation the magnitude of these impacts reduces, but due to other factors such as the high sensitivity of the receiving environment and the continuous frequency with which the effects occur, this adverse impact is assessed to be of moderate significance.

6.7 For all the other assessment locations along the A326 the magnitude of the construction noise impact before mitigation is either marginal or moderate. However, due to the implementation of mitigation, the overall level of significance of this impact is assessed to be minor.

RAIL IMPROVEMENTS

6.8 Rail improvement construction activity is solely as a result of the improvements proposed to the Fawley Goods Loop and the junction between the Fawley branch line and the London to Weymouth main line.

Operation

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6.9 After mitigation the noise from the operation of the Terminal is assessed to have an adverse impact of minor significance during the night at Marchwood, Pilgrim Inn, Marchwood Priory, Veals Farm and Locks Farm. This is mainly due to the high sensitivity of these receivers and the frequency with which impacts are predicted to occur, as the magnitude of the change in noise level created by Terminal operations is considered to be marginal. During the daytime the overall impact of noise from Terminal operations at these locations is assessed to be insignificant.

6.10 At Hythe Marina Village and Hythe, the noise generated by Terminal operations is assessed to have an adverse impact of minor significance during both daytime and night-time. Without mitigation the magnitude of the noise impact at these locations is moderate and therefore of significance. After mitigation the magnitude reduces to one that is marginal, and therefore not of significance. However, the impact has been assessed to have an overall impact of minor significance mainly due to the sensitivity of the receiving environment.

6.11 Noise from Terminal operations is assessed to have an insignificant impact at all other assessment locations.

ROAD TRAFFIC

6.12 At all assessment locations along the A326, noise generated by Terminal generated traffic is assessed to be adverse and of minor significance. Although mitigation measures are possible (noise barriers), the assessment concludes that they are not required as the magnitude of the impact is marginal, and therefore not of significance. The overall level of significance is assessed as minor because of the high sensitivity of the receiving environment and the continuous frequency with which the impact will occur.

RAIL TRAFFIC

6.13 Calculations have been carried out to re-assess the impact of noise from Terminal rail traffic with track side noise barriers installed through Marchwood and Rushington. With barriers in place the residual impact of noise from rail traffic on Marchwood is assessed to be insignificant or minor during both daytime and night-time.

6.14 Noise barriers alongside the track at Rushington ensure that the impact of noise from rail traffic is reduced during the night-time. Without barriers the magnitude of the noise impact is assessed as being moderate or substantial. However, with barriers the overall adverse impact of noise generated by rail traffic from the terminal is assessed to be of minor significance during night-time. During the daytime the impact is assessed to be insignificant.

Vibration

Construction

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6.15 Vibration from quay wall piling could potentially generate adverse comment at Hythe Marina Village and Hythe when piling gets closer than about 1200 metres, which occurs mostly during phase 3 of the construction of the terminal. No mitigation is possible of these vibration levels. The magnitude of this impact is therefore considered to be moderate. Considering the high sensitivity of the receiving environment and the timescale over which the impact is predicted to occur, the overall level of significance of this adverse impact is assessed to be moderate.

6.16 For the other assessment locations the magnitude of vibration levels as a result of quay wall piling and from general piling activities within the terminal is marginal and therefore not significant. However, the overall level of significance for this adverse impact is assessed as being of minor significance, due to the high sensitivity of the receiving environments, the lack of mitigation and the time scale over which the activity will be taking place.

ROAD IMPROVEMENTS

6.17 Examination of the construction activity occurring as a result of the road improvements has identified that no operations will be taking place which are likely to give rise to perceptible vibration.

RAIL IMPROVEMENTS

6.18 Rail improvement construction activity is solely as a result of the improvements proposed to the Fawley Goods Loop and the junction between the Fawley branch line and the London to Weymouth main line. The vibration impacts resulting from the construction of these proposals are dealt with within a separate application and supporting ES.

Operation

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6.19 There are no operational activities within the Terminal site which will generate perceptible vibration. No residual vibration impacts will therefore result from the operation of the Terminal.

ROAD TRAFFIC

6.20 Although the road traffic generated by the Terminal will create vibration the assessment concludes that at the preliminary stage these impacts are of such small magnitude that they are insignificant. Therefore the residual vibration impacts created by Terminal road traffic are assessed to be insignificant.

RAIL TRAFFIC

6.21 There are no vibration impacts from rail traffic which are of sufficient magnitude to warrant mitigation. It can be concluded therefore that any vibration impacts generated from rail traffic are insignificant.

Summary

- The construction and operation of the Dibden Terminal proposals has the potential to generate significant noise and vibration impacts.
- A number of mitigation measures, many of which are inherent to the proposals, will be implemented which will minimise potential noise and vibration impacts. These include the re-construction of Hythe Marina Bund, shrouding of the piling activity, the installation of

noise barriers and the proposed use of a Section 61 consent procedure.

- After mitigation measures the assessment concludes that the majority of construction noise impacts from the Terminal will be of minor significance, even though the predicted magnitude of the impacts are classified as marginal as they remain well below the thresholds set out in national guidelines.

- Noise impacts from road construction are of moderate or major significance on some receptors close to the A326. This is due to the significant magnitude of the impacts and the sensitivity of the receiving environment. It should be noted that these impacts are of short term duration.

- During operation the assessment concludes that there will only be noise impacts of minor significance resulting from the operation of the Terminal and the road traffic it generates. Similarly rail traffic, after mitigation, will generate noise impact of minor significance.

- The assessment concludes that the only significant vibration impact occurs as a result of piling activity during the construction of the Terminal. During phase 3 of the development, piling of the quay wall is predicted to have a vibration impact of moderate significance on Hythe Marina Village and Hythe. General piling activity during construction of the Terminal is predicted to have a minor adverse impact.

- No significant vibration impacts are likely to occur during the operation of the Terminal or from the rail and road traffic generated.

GLOSSARY

dB Decibel. The decibel scale measures levels relative to a reference, either a fixed reference when measuring absolute levels, or another level when expressing changes. If the quantity is power-like (i.e. could be expressed in watts) the level in decibels is 10 times the common logarithm of the ratio of the measured quantity to the reference quantity. If the quantity is a physical amplitude such as pressure or voltage, and the power of the quantity is related to the its square, then the decibel level is 20 times the common logarithm of the ratio of the measured quantity to the reference quantity. Thus doubling of power gives a 3 dB increase, while a doubling of pressure gives a 6 dB increase.

L_A A-weighted sound pressure level. The units are decibels, abbreviated dB (or dB(A) if the subscript A is omitted). A-weighting is a frequency weighting which discriminates against low frequency and very high frequency sound in order to approximate the frequency response of the human ear. The subscript *s* or *f* signifies that the time constant of the measurement is either 'slow' (1 second) or 'fast' (125 milliseconds)

L_{Amax} The maximum value of L_A reached during one or more noise events. (See reference to 's' and '*f*' subscripts above).

$L_{Aeq,T}$ Equivalent continuous sound level. The root mean square sound pressure level determined over time interval T expressed in decibels. May be regarded as the level of a notional steady sound which has the same energy in period T as an actual time-varying sound which occurs in the same period. Sound level, duration and number of events are treated such that doubling the number of events, or doubling the duration of an event, has the same effect as doubling the number of sources (i.e. doubling the energy), which in the decibel scale is an increase of 3 dB (see above).

L_{A10} The A-weighted sound level in dB which is exceeded for 10% of the time period stated.

ppv Peak particle velocity, the highest instantaneous velocity reached by a vibrating surface.

VDV Vibration Dose Value, the fourth root of the time integral of the fourth power of the frequency-weighted vibration velocity. The frequency weightings are specified in BS 6841:1987 and BS 6472:1992. The units are ms-1.75.

SEL_v Sound Exposure Level (or Single Event Level), the time integral of the squared sound pressure expressed in decibels. May be regarded as $L_{Aeq,T}$ normalised so that T is one second regardless of the actual duration of the event. Is used to construct $L_{Aeq,T}$ for a period containing many noise events, from knowledge of the SEL_v for each individual event.