CEMEX UK and Grundon Waste Management Limited

Grundon Waste Management Depot Banbury

Noise and Vibration Report

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1. INTRODUCTION

Rupert Taylor Ltd was instructed by JSA Architects and Planners on behalf of CEMEX UK and Grundon Waste Management Limited to carry out a study of the levels of airborne noise and vibration on a proposed residential development site at Higham Way, Banbury adjacent to the Chiltern Mainline Railway.

This report describes the work undertaken and the findings of the study.

2. POLICY GUIDANCE AND ADVICE FOR NOISE AND VIBRATION

Introduction
This is an outline application and so the focus has been on Cherwell District Council's local policy. The documents listed below provide a context for that policy and other guidance which will be relevant during the detailed design stage.

Noise Policy Statement for England
Government policy on noise is set out in the Noise Policy Statement for England ("NPSE"), dated March 2010, which is itself referred to in the National Planning Policy Framework (March 2012). NPSE seeks to "clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise" (paragraph 1.4). The Explanatory Note sets out (at paragraph 2.22-5) its aims to:

a. avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development;

b. mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development; and

c. where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

National Planning Practice Guidance
National Planning Practice Guidance (Reference ID: 30-005-20140306) includes the above terms in identifying four increasing levels of effect ranging from "no observed effect" to "unacceptable adverse effect".

Cherwell District Council Policy

The council's polices on noise sensitive development in relation to noise from road traffic and railways are set out in polices EN7 and EN8 respectively (reproduced in Appendix 1 of this report). In each case three categories are defined based on the average values of the daytime (07:00-23:00) and the night-time (23:00-07:00) noise. The noise index used for these noise bands is the L_{Aeq} which is the average noise level over the specified period.

An additional level is defined in paragraph 9.19 of the council policy which sets conditions based on the maximum noise level in the night-time period. Where individual noise events regularly exceed 82dB L_{Amax} during the night-time period (23:00 - 07:00hrs) the policy applicable to the middle of the three bands in EN7 or EN8 apply.

Policy EN9 states that applications will be refused where vibration levels are likely to affect the material comfort of users.

Cherwell District Council Pre-application Comments

JSA held pre-application discussions with Cherwell District Council's Planning Department and made a pre-application submission. The council's response to that submission included the following comments relating to noise.

Under 'Noise and Vibration' the officer's report refers to the consent granted for a light maintenance depot for train vehicles[1] on the land opposite the application site and states that due regard must be given to this development in the design of the scheme.

The council's internal consultation with their Landscape Architect includes, under the heading 'Railway Corridor,' the suggestion that 'noise levels and any future upgrades of the line are considered'. It then goes on to discuss possible use of noise walls to mitigate the noise and visual impact of the adjacent railway though landscape mitigation of the walls might be necessary.

British Standard 8233:2014
Guidance on sound insulation and noise reduction for buildings

This standard provides guideline levels inside dwellings for daytime and night-time and for outdoor amenity spaces.

[1] March 2015 Application Number 14/01621/F.

British Standard 6472-1:2008
Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting
This standard provides guideline levels for vibration inside dwellings for the daytime (16-hr) and night-time (8-hr). The vibration level is the accumulated vibration over the relevant period and is known as the vibration dose value (VDV). Five categories of VDV vibration are defined for residential occupiers having different likelihoods of adverse comment.

Other guidance
The World Health Organisation (WHO) has published *Guidelines for Community Noise (1999)* and the *Night Noise Guidelines for Europe* (2009). The guidance in the 1999 document is taken into account in BS8233. WHO states that the Night Noise Guidelines for Europe are an extension of the 1999 Guidelines.

3. NOISE AND VIBRATION STUDY

Noise from railway line

Fuller details of the survey and methodology in relation to the railway noise and vibration are included in Appendix 2.

Noise survey locations

The noise levels from individual passenger and freight trains passing the site were measured during a weekday afternoon[2] at the southern end of the site beyond the Transco Depot (Figure 1).

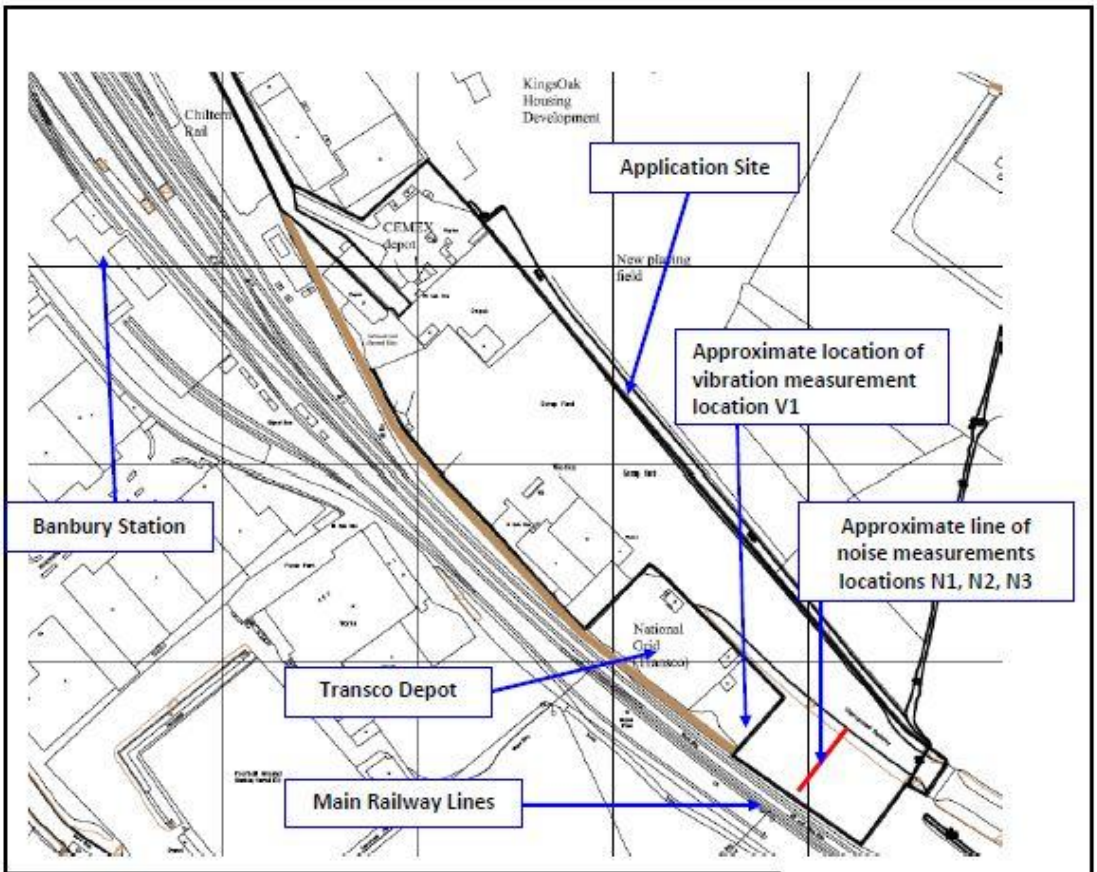

Figure 1 Site Plan showing approximate locations of monitoring points

This area was selected because is was considered to be the part of the site most affected by the railway noise owing to its proximity to the main up and down lines, its wide, relatively unrestricted view of these tracks, and its distance from Banbury Station where trains are expected to be

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travelling faster than at positions nearer to the station where over 95% of passenger services stop.

The three noise measurement locations (N1, N2, N3) were along the red line shown on Figure 1; the principal location (N1) was approximately 5m from the site boundary.

The noise levels from passing passenger trains and freight trains from were measured and train timetables were consulted to determine the number of passenger and freight trains which could potentially pass the site during the daytime (07:00-23:00) and night-time (23:00-0700) periods. The overall average noise levels for trains in the daytime and the night-time periods were then calculated by combining the measured noise levels for passenger and freight trains during the survey with the expected numbers of trains in the daytime and night-time so that they could be compared to the noise criteria in Policy EN8.

Measurements of the maximum noise levels during train pass-bys were also recorded for comparison with the noise criterion in Policy 9.19.

Results of railway noise study
The estimated Categories in Policy EN8 for the daytime and night-time periods estimated from the site data for locations N1, N2, and N3 are shown in Table 4.1.

Table 4.1 Estimated Policy Categories at noise monitoring locations

Location	**Description**	**EN8 Daytime**	**EN8 Night-time**	**Para 9.19 $L_{Amax,S}$**
N1	5m from site boundary	(iii)	(ii)	(ii)
N2	25m from site boundary	(iii)	(iii)/(ii)	(ii)
N3	45m from site boundary	(iii)	(iii)	(ii)

Future upgrades to the railway line affecting noise levels
Cherwell DC's pre-application response included the comment that noise levels and future upgrades of the line should be considered.

Project Evergreen
Chiltern Railways is the principal operator of passenger trains that run south of Banbury (the other train operating companies are Cross Country and Great Western Railways).

Chiltern Railways has been investing in a range of line upgrades since the late 1990s in a 20-year programme that they have called Project Evergreen. The improvements affect the performance of the network on which they operate and some of the improvements are relevant to services through Banbury. The upgrades do not necessarily directly affect the running of trains directly but relate to other parts of the routes that run through Banbury. Phase 1 (Evergreen1) was completed in 2001, and Evergreen 2 is also understood to be complete. Evergreen 3 is in three phases and will provide services from a new station at Oxford to London Marylebone (*ie*, not passing the application site). As part of Phase 1 (completed in 2011) work at Anyho Junction (south of Banbury) enabled permitted track speeds to be increased. Phase 2 does not involve services running through Banbury.

Banbury Upgrade
Network Rail is currently implementing a project to provide new signalling systems along a route from Leamington Spa through Banbury to Heyford; the benefits include reduced maintenance and operating costs. There is also a track renewals programme which includes rationalising the layout at Banbury station. Together these works will improve operational flexibility and reduce maintenance requirements.

Chiltern Railways have commented that this upgrade will not lead directly to any increase in the number of trains that they operate through the station, nor do they anticipate any significant change to the speed of trains approaching the station (the majority of their trains call at Banbury).

Other projects
No information about plans with firm dates for implementation has been found.

Conclusions
It does not appear that projects currently being implemented are likely to have a significant affect on the speed or number of passenger trains operating through Banbury station and passing the application site. No information about changes to future freight services has been found.

Although no definite indication of future increases in railway noise is available the potential effects of such changes have been considered in Appendix 2 of this report under the heading ‘Uncertainty’.

The conclusion was that there could be an effect though it is not expected to be large and so a slightly higher degree of mitigation might be necessary. However, until a housing layout out has been developed for a later stage of the planning process the degree of mitigation necessary for any particular part of a detailed scheme will not be known since the presence of the development will itself reduce the level of railway noise at most locations. This matter can therefore be considered during detailed design.

Noise mitigation

For the daytime period the council's policy in respect of a category (iii) site requires the development to incorporate suitable sound insulation and mechanical ventilation as part of the design. Those elements would be specified when a scheme had been worked up for a full application.

Paragraph 9.18 of the council's noise policy states: '*Where there is a clear need for noise sensitive development in a location satisfying the criteria described in clause (ii) of the above policies, development will be expected to achieve a constant specified internal acoustic environment, ie: the design is likely to have to incorporate acoustic mechanical ventilation*.' It is assumed therefore that this approach could be applied to this site and so would require mitigation as outlined above for the daytime to ensure acceptable internal levels for the night-time period, too, for those parts of the site that fall into Category (ii).

Any development on the site will change the propagation of railway noise across the site and noise levels at most locations will be lower than for the undeveloped site. When a scheme design is in place the noise levels at specific façades and windows can be predicted and then the appropriate level of mitigation determined.

This outline application also illustrates noise mitigation applied to the site itself in the form of a 3m screen which consists of a 3m high bund or a thin 3m noise barrier depending on the location of the screen on the site.

The detailed effect of this screen can only be evaluated in relation to a specific scheme where the heights and locations of façades and windows are known. However, to assist with consideration of the principle of the screen the potential acoustic benefit of this screen has been investigated in relation to the undeveloped site.

For passenger trains operated by diesel multiple units and for freight trains where the locomotive is not running on full power the screen could provide a useful degree of noise reduction at ground level (*eg*, amenity areas).

However, if a locomotive is running on full power then, because the noise source is at a higher position, the screen would be much less effective and only the part of the site nearest to barrier at ground level would benefit.

The screen could itself have some visual impact which could be reduced by the use of planting or integral greening without affecting its acoustic performance.

Vibration from the railway line

Vibration levels were also measured at a location at the southern end of the site (V1). The most southerly hard surface available on which to mount the vibration sensor was a concrete plinth that supports a security fence along the southern boundary of the Transco Depot (see Figure 1) Owing to the undergrowth on the site the closest location to the railway that was accessible along that fence-line was approximately 12m from the boundary between the application site and the railway.

Vibration levels from passing passenger and freight trains were measured (as vibration dose values – VDVs) and the numbers of trains in the timetable were used to estimate the overall VDVs for the daytime (16-hr) and night-time (8-hr) periods.

Results of railway vibration study

Policy EN9 which deals with vibration does not set a numerical criterion but specifies that vibration levels should not be likely to affect the material comfort of end users.

The estimated daytime and night-time VDVs have therefore been compared to guidance in BS6472 on the likelihood of adverse comment from residential occupiers for the daytime and night-time periods as follows:

Period	**Estimated VDV at V1**	**Adverse comment is not expected**	**Low probability of adverse comment**
Day	**0.13**	< 0.2	0.2 to 0.4
Night	**0.1**	< 0.1	0.1 to 0.2

The daytime evaluation is therefore ‘Adverse comment not expected’ and for the night-time it is just within the category ‘Adverse comment possible’.

Future upgrades to the railway line affecting vibration levels

Future changes to services have the potential to affect vibration as well as noise from the railway. It was concluded in the section above on future schemes and noise effects that there was no firm information available and so a review of potential effects had been undertaken for noise which is included in Appendix 2 of this report. A similar assessment has been carried out for vibration and that is also included n Appendix 2.

For the daytime period the predicted VDV values were mainly in the BS6472 category 'Adverse Comment is not expected' and at worst were in the category 'Low Probability of adverse comment'. For the night-time the predicted values were mainly in the 'Low Probability of adverse comment' and at worst in the lower half of the category 'Adverse comment possible'.

The conclusion was that based on current investigations the site is not subject to high levels of vibration but that at the detailed design stage further studies should be undertaken to determine whether any mitigation is required as part of the design.

Proposed Light Rail Maintenance Depot (LRMD)

In March 2015 Cherwell granted consent to Chiltern Railways for the construction and operation of the above depot. The site of the proposed depot is on the opposite side of the railway from the application site and overlaps approximately the lower third of the application site as shown on Figure 2.

Cherwell DC asked in their pre-application responses that this development should be considered in the design of any scheme on the application site. As this is an outline application a preliminary appraisal of noise from the LRMD has been made and its potential implications for the design of the scheme have been noted.

Information on noise levels from the LRMD

The Environmental Statement (ES) deposited with the planning application for the LRMD included predictions of average noise levels for the construction and operation phases of the depot including plots of noise contours. Those plots have been reproduced in Appendix 3 of this report overlaid on plans that show the outline of the Grundon/CEMEX application site.

Noise from the Construction of the LRMD

According to the ES construction is programmed to take 12 months and is expected to be undertaken during the hours 0800-1900 Monday to Friday and 0800-1300 on Saturdays. Approximately the southern half of

the Grundon site would be within the 65-70 dB noise band (average level, L_{Aeq}); the current daytime average levels there on the undeveloped site (from railway noise) are about 8 dB lower (see the first of the noise contour plots in Appendix 3). On the remainder of the site predicted construction noise levels fall within the noise band 55-65 dB (average level, L_{Aeq}). Those levels are also likely to be higher than the current average noise levels from railway noise on the undeveloped site.

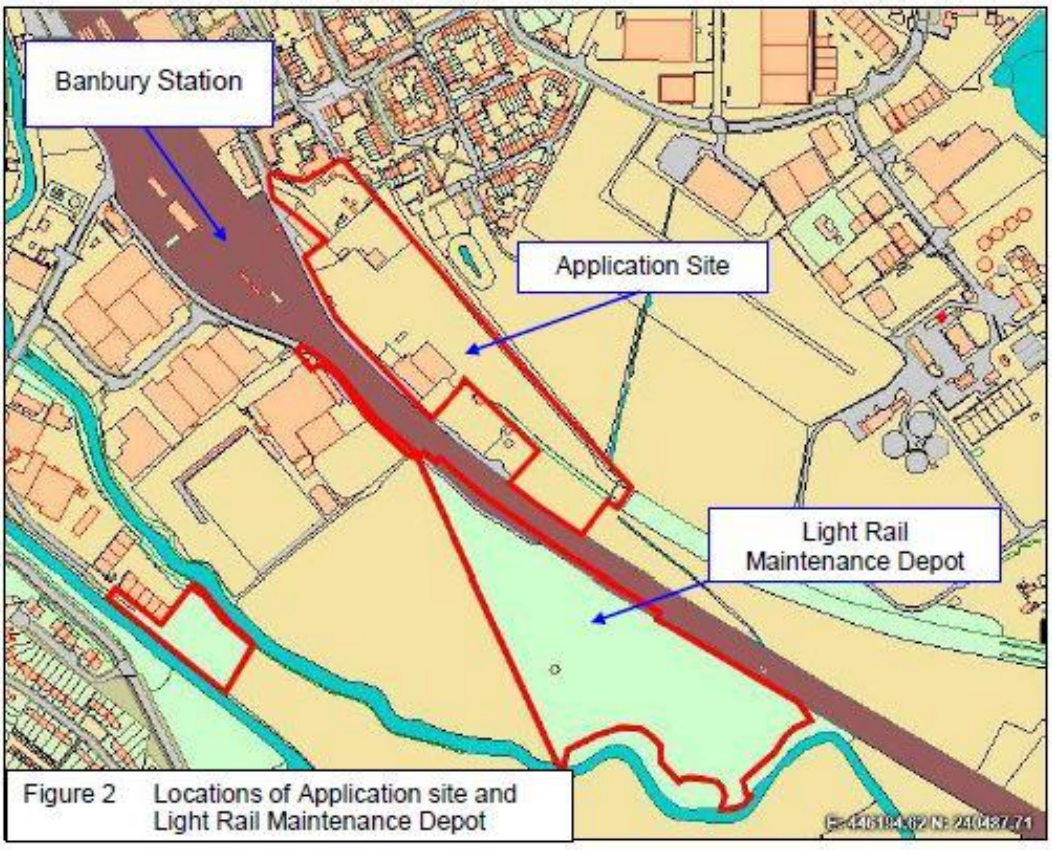


Figure 2 Locations of Application site and Light Rail Maintenance Depot

Implications of Construction noise for the design of a scheme on the application site

Average noise levels during construction predicted by the LRMD's consultants are higher than the current average levels for the undeveloped site. Several factors need to be considered when considering the implications.

First, because the ES envisaged a 12-month construction period and starting the process soon after gaining consent, there is the possibility that some or all of the depot construction will be completed before any development is occupied on the application site. Secondly, once the application site is developed the propagation of noise across it will be changed and the construction noise will not propagate freely across the

site. Thirdly, although the construction noise is expected to be at a higher level than the train noise at some locations, any residential buildings in place would have noise insulation and mechanical ventilation and so some mitigation of the construction noise for occupiers would be provided.

Methods for assessing the significance of construction noise on residential occupiers are provided in British Standard BS 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites. When a scheme design is undertaken the situation on site at the time should be reviewed and BS5228 can be referred to in order to determine whether the measures incorporated to take account of noise from the railway requires any adjustment to take account of any construction noise that might be present when the buildings are occupied.

Noise from the Operation of the LRMD
During operation the predicted noise contours for the depot show that about the southernmost third of the site would experience average noise levels in the range 45 – 50 dB; across the remainder of the site the predicted levels are not more than 45 dB (see second plot in Appendix 3). It is believed that the depot would operate at night as well as in the daytime.

Implications of Operating noise for the design of a scheme on the application site
Although those predicted depot levels are below the average railway noise levels on the application site, the noise level between trains would be lower and so there is the potential for disturbance at the part of the site nearest to the depot, particularly at night. However, as noted above in respect of construction noise, a development application site and the noise mitigation that would be incorporated into the design would also mitigate the noise from the depot.

A method for assessing sound from the operation of industrial and commercial premises is provided in British Standard BS 4142:2014 Methods for rating and assessing industrial and commercial sound. When a scheme design is undertaken the situation on site at the time should be reviewed, for example, it might be possible to measure actual noise from the operation of the LRMD rather than use the predicted values in the ES. BS4142 can then be referred to in order to determine whether the measures incorporated to take account of noise from the railway require any adjustment.

4. SUMMARY AND CONCLUSIONS

Noise Sources

The principal source of noise at the site is the adjoining Chiltern Main Line Railway. Although road traffic noise (from the M40) was audible on the site during the survey, train noise dominates.

Cherwell District Council's pre-application response notes that this application must take account of the March 2015 planning consent for the construction of a Light Rail Maintenance Depot for Chiltern Rail on the opposite side of the railway from the application site.

Railway noise on the application site

Classification of the site

Cherwell DC's noise policy EN8 defines three categories for application sites based on railway noise levels averaged over the daytime and night time periods. The policy provides the following responses to development applications for each of the categories:

Category (i) (the highest noise level)	Will be refused
Category (ii) (intermediate noise level)	Will be generally resisted
Category (iii) (the lowest level defined)	Will be expected to achieve a specified internal acoustic environment

An additional criterion applies where the maximum noise levels for individual events regularly exceed 82 dB ($L_{Amax,\ S}$) (Para 9.19) and if that is exceeded then the site is designated as Category (ii) even on the basis of the average noise levels it would be classified as Category (ii).

Railway noise has been estimated at the southern end of the application site, which is considered the part most affected by the railway noise, at a position 5m from the site boundary. It is estimated that the noise levels there correspond to Category (iii) for the daytime and Category (ii) for the night-time.

At other parts of the site the level of railway noise will be lower but it is not expected that the noise levels will fall below those specified in Category (iii) and so noise mitigation will still be required though the performance necessary will vary across the site.

Noise mitigation

For the daytime period the council's policy in respect of a category (iii) site requires the development to incorporate suitable sound insulation and mechanical ventilation as part of the design. Those elements would be specified when a scheme had been worked up for a full application.

Paragraph 9.18 of the council's noise policy states: '*Where there is a clear need for noise sensitive development in a location satisfying the criteria described in clause (ii) of the above policies, development will be expected to achieve a constant specified internal acoustic environment, ie: the design is likely to have to incorporate acoustic mechanical ventilation*.' It is assumed therefore that this approach could be applied to this site and so would require mitigation for the night-time period (as outlined above for the daytime period) to ensure acceptable internal levels for the night-time period, too, for those parts of the site that fall into Category (ii).

This outline application also illustrates noise mitigation applied to the site itself in the form of a 3m screen which consists of a 3m high bund or a thin 3m noise barrier depending on the location of the screen on the site.

The detailed effect of this screen can only be evaluated in relation to a specific scheme where the heights and locations of façades and windows are known. However, the potential acoustic benefit of this screen has been investigated in relation to the undeveloped site and it has been concluded that for most trains (*ie*, not involving a locomotive operating at full power) the screen could provide a useful degree of noise reduction at ground level (*eg*, amenity areas). For a locomotive is running on full power the screen would be much less effective and only the part of the site nearest to barrier at ground level would benefit.

The screen could itself have some visual impact which could be reduced by the use of planting or integral greening without affecting its acoustic performance.

This noise screen would therefore be in addition to mitigation applied to the development itself in the form of mitigation at the façades and mechanical ventilation.

Future increases in railway noise
No firm data was found for the effect of any future railway schemes but an evaluation of hypothetical future increases in the speeds or numbers of trains concluded that the increased noise levels would be small and could be accommodated by the mitigation approach currently proposed.

Railway vibration on the application site
Cherwell DC Policy EN9 which deals with vibration does not set a numerical criterion but specifies that vibration levels should not be likely to affect the material comfort of end users.

BS6472 provides guidance on the likelihood of adverse comment from residential occupiers for the daytime and night-time periods based on the vibration dose value (VDV) for each of those periods and that guidance has therefore been considered when evaluating the site. The effects of hypothetical increases in the level of vibration from trains or the number of trains have also been reviewed.

The conclusion was that based on current investigations the site is not subject to high levels of vibration but that at the detailed design stage further studies should be undertaken to determine whether any mitigation is required as part of the design.

Light Maintenance Depot

The Environmental Statement for this development predicts average noise levels for the construction and operation phases of the depot including noise contours that show levels on the Grundon application site. Construction is programmed to take 12 months and is expected to be undertaken during the hours 0800-1900 Monday to Friday and 0800-1300 on Saturdays. Approximately the southern half of the Grundon site would be within the 65-70 dB noise band (average level, L_{Aeq}); the current daytime average levels there on the undeveloped site (from railway noise) are about 8 dB lower. On the remainder of the site predicted construction noise levels fall within the noise band 55-65 dB (average level, L_{Aeq}). Those levels are also likely to be higher than the current average noise levels from railway noise on the undeveloped site.

However, there is the possibility that some or all of the depot construction will be completed before any development is occupied on the application site. Furthermore, once the application site is developed the propagation of noise across it will be changed and the construction noise will not propagate freely across the site. Any residential buildings in place would have noise insulation and mechanical ventilation and so at a later stage the need to upgrade this mitigation to take account of any construction noise could be reviewed.

During operation the predicted noise contours for the depot show that about the southernmost third of the site would experience average noise levels in the range 45 – 50 dB; across the remainder of the site the predicted levels are not more than 45 dB. Although those predicted depot levels are below the average railway noise levels on the application site the noise level between trains between trains would be lower and so there is the potential for disturbance at the part of the site nearest to the depot, particularly at night.

However, as noted above in respect of construction noise, a development application site and the noise mitigation that would be

incorporated into the design would also mitigate the noise from the depot whether any change to the specification could be considered at a later stage.

Summary

Noise
If the whole of this site was within Category (iii) then façade mitigation would be required as set out in the council's policy in order to provide a suitable internal acoustic environment for residential use. Although parts of the site fall into Category (ii), the same approach to mitigation can be applied with a suitably enhanced performance specification as provided for by paragraph 9.1.18 of the council's policy.

Paragraph 9.18 states that '*Where there is a clear need for noise sensitive development in a location satisfying the criteria described in clause (ii) of the above policies, development will be expected to achieve a constant specified internal acoustic environment, ie: the design is likely to have to incorporate acoustic mechanical ventilation*.'

At the most affected area of the application site at the southern end it is estimated that the three survey locations correspond to the following categories based on the average noise levels for Daytime and Night-time and also on the maximum noise levels (night-time only):

Location	Daytime	Night-time	$L_{Amax,S}$
1 5m from site boundary	(iii)	(ii)	(ii)
2 25m from site boundary	(iii)	(iii)/(ii)	(ii)
3 45m from site boundary	(iii)	(iii)	(ii)

Currently then the most affected location is in Category (iii) as regards daytime levels and Category (ii) based on night-time levels.

The specific floors, façades, and windows/rooms requiring that mitigation package (*ie*, upgraded window insulation and alternative/mechanical ventilation) will be determine by further modelling once a layout has been agreed at a later design stage.

That approach will also enable increase in noise levels on the developed site from the construction or operation of the proposed Light Rail Maintenance Depot or from any programmed increase in noise from the railway to be considered as part of the detailed design.

Vibration

Based on current investigations the site is not subject to high levels of vibration but at the detailed design stage further studies should be undertaken to determine whether any mitigation is required as part of the design.

APPENDIX I

Cherwell DC Policy on Noise

EN7 DEVELOPMENT SENSITIVE TO NOISE GENERATED BY ROAD TRAFFIC WILL BE:

(I) REFUSED WHERE EXTERNAL NOISE LEVELS EXCEED LAeq. 16hr = 72dB AND LAeq 8hr =66dB BETWEEN 07:00-23:00 hrs AND 23:00-7:00 hrs RESPECTIVELY.

(Ii) GENERALLY RESISTED WHERE EXTERNAL NOISE LEVELS BETWEEN 07:00-23:00 hrs AND 23:00-07:00 hrs FALL INTO THE RANGES LAeq 16hr = 63 to 72dB AND LAeq 8 hr = 57 to 66dB RESPECTIVELY.

(Iii) EXPECTED TO ACHIEVE A SPECIFIED INTERNAL ACOUSTIC ENVIRONMENT WHEN THE EXTERNAL NOISE LEVELS BETWEEN 07:00-23:00 hrs AND 23:00-07:00 hrs FALL INTO THE RANGES LAeq 16 hr = 55 TO 63dB AND LAeq 8 hr = 45 to 57dB RESPECTIVELY.

EN8 DEVELOPMENT SENSITIVE TO NOISE GENERATED BY RAIL TRAFFIC WILL BE:

(I) REFUSED WHERE EXTERNAL NOISE LEVELS EXCEED LAeq 16 hr = 74dB BETWEEN 07:00 - 23:00 HRS AND LAeq 8hr = 66dB BETWEEN 23:00 AND 07:00 hrs.

(Ii) GENERALLY RESISTED WHERE EXTERNAL NOISE LEVELS BETWEEN 07:00 - 23:00 AND 23:00 - 07:00 FALL INTO THE RANGES LAeq 16 hr = 66 to 74dB AND LAeq 8 hr = 59 to 66dB RESPECTIVELY.

(Iii) EXPECTED TO ACHIEVE A SPECIFIED INTERNAL ACOUSTIC ENVIRONMENT WHEN EXTERNAL NOISE LEVELS BETWEEN 07:00 - 23:00 AND 23:00 - 07:00 hrs FALL INTO THE RANGES LAeq 16 hr = 55 to 66 dB AND LAeq 8 hr = 45 to 59 dB RESPECTIVELY.

EN9 NOTWITHSTANDING POLICIES EN7 AND EN8 DEVELOPMENT SENSITIVE TO VIBRATION WILL BE REFUSED IN LOCATIONS WHERE VIBRATION LEVELS ARE LIKELY TO AFFECT THE MATERIAL COMFORT OF END USERS.

9.17 Government advice contained in PPG24: Planning and Noise states that noise sensitive developments should be separated from major sources of noise wherever practicable. The above policies seek to ensure that noise-sensitive developments such as new dwellings are not located in positions where they will be subject to severe noise pollution. Other classes of noise-sensitive development would include nursing homes, hostels, hospitals, hotels, residential colleges and schools.

9.18 Where there is a clear need for noise sensitive development in a location satisfying the criteria described in clause (ii) of the above policies, development will be expected to achieve a constant specified internal acoustic environment, ie: the design is likely to have to incorporate acoustic mechanical ventilation.

9.19 Where individual noise events regularly exceed 82dB LAmax during the night-time period (23:00 - 07:00hrs) the criteria described in clause (ii) in the above policies shall apply.

9.20 The specific guidance contained in Policies EN7 and EN8 must not be taken to mean that where noise levels are below those specified in clause (iii) of these policies, noise will not be a consideration. In these circumstances noise levels may be a material planning consideration depending on local circumstances and conditions and particularly where levels are approaching those specified in clause (iii) above.

APPENDIX 2

Studies of noise and vibration from the railway

A2.1 SITE SURVEY

Site conditions
Although distant road traffic noise from the M40 motorway was audible during the survey the principal source of noise is the Chiltern Mainline a twin-track railway which runs adjacent to the site. The railway is about a metre above the lowest part of the application site (*ie*, on a slight embankment).

Weather conditions were cloudy with a slight breeze, with the wind direction coming from the east and the motorway. All three noise monitoring positions were free-field locations.

Engineering works were taking place along the railway line and whilst this activity did not generate any engineering noise (apart from the occasional JCB movement), it did result in the use of the train warning horn for every train movement from the south east. However, logging on the sound level meter recording individual train pass-bys was not started until after the horn was sounded and so did not affect those values. It is not known whether these works had any material effect on the operation of the railway.

Survey locations
Attended measurements were carried out at the southern part of the site beyond the Transco Depot. This area was selected because is was considered to be the part of the site most affected by the railway noise owing to its proximity to the main up and down lines, its wide, relatively unrestricted view of these tracks, and its distance from Banbury Station where trains are expected to be travelling faster than at positions nearer to the station where over 95% of passenger services stop.

Attended measurements could not be carried out after 17:00 because the site closed then. There was no secure location in that area where noise recording equipment could be left overnight to log noise levels automatically.

The noise measurement locations were along the red line shown on Figure 1 (in Section 3 of this report). The principal location (N1) was approximately 5m from the site boundary in line with some railway buffers on the tracks and also approximately in line with the metal fence around the Transco Depot nearest to the railway.

Noise measurements were also undertaken at two further locations: N2 which was 20m from N1 along a line perpendicular to the railway, and N3, a further 20m along that perpendicular line which is shown in Figure 1.

Vibration was measured at a location (V1) on the southern edge of the Transco Depot compound. Unfortunately that part of the site nearest to the railway is covered in scrubland and there were very few hard standing locations suitable for mounting the accelerometers. The closest location to the railway that was accessible was on the concrete plinth supporting the fence round the Transco Depot and was about 12m from the boundary with the railway.

The triaxial accelerometer/base plate was located on the flat surface of the concrete plinth supporting the metal fence around the compound, with the x-axis measurement (channel 1) in a horizontal direction parallel to the railway line, the y-axis measurement (channel 2) in a horizontal direction perpendicular to the railway line, and the z-axis measurement (channel 3) in a vertical direction.

Survey equipment
Values of SEL and $L_{Amax,\ S}$ from individual train pass-bys were measured using a CEL 593C Precision Computing Sound Level Meters set to trigger automatically. A second such meter was set to record the statistical indices, too, over 10-minute periods.

Vibration was recorded on a 4 channel SVANTEK SVAN 958A Sound and Vibration Analyser. The 4 channels encompass a triaxial accelerometer system (SV207B outdoor vibration transducer) mounted on a heavy base plate with levelling spikes, and a microphone channel which was not utilised for these tests.

Site data
Data was acquired during the period 12.15-17.00.

The noise levels recorded at locations N1 to N3 are shown in Tables A2.1 to A2.3 respectively. Vibration data at V1 are shown Table A2.4.

In those tables the train direction is the observed direction of the train when viewed from the site. The direction L> R is the Down Line (away from London) and is the far track with respect to the site. The train direction R>L is the Up line (towards London) and is the nearer track to the site.

Not all passing trains were logged. For some passenger pass-bys the number of cars (*ie*, coaches) forming the train was noted; in some cases it was not clear and they are shown with a dual value in the tables.

Table A2.1 Noise data at Location N1

Time	Train Type / Operator	Train Direction	$L_{Amax,S}$ dB	L_{Aeq} dB	SEL dB	Event Duration (sec) [1]	Speed Duration (sec) [2]	Comments[3]
12.13	1st GW	L>R	65.2	62.1	72.7	12		
12.30	Cross C	L>R	67.7	64.4	75.4	13		5 cars
12.33	Cross C	R>L	79.8	72.9	85.8	20	6.0	4 cars 34 mph
12.36	Chiltern	L>R	68.3	64.2	77.2	20		3/4 cars
12.38	1st GW	R>L	78.3	70.3	82.9	18		2 cars
12.42	Chiltern	R>L	76.0	70.4	81.7	13		3 cars
12.43	Chiltern	L>R	67.5	63.3	73.5	10		3 cars
12.48	Freight	L>R	74.1	68.0	79.1	13		
12.55	Cross C	R>L	80.3	74.7	86.8	16	14.0	5 cars 18 mph
12.58	Cross C	L>R	69.3	64.4	74.8	11	11.0	4 cars 19 mph
13.04	Chiltern	L>R	68.6	65.1	75.2	10	3.0	2 cars 34 mph
13.12	Freight	L>R	80.2	72.5	88.4	39		
13.13	Chiltern	R>L	56.2	55.3	64.1	8		3 cars
13.20	Chiltern	L>R	65.6	61.8	72.9	13	5.0	2/3 cars 21/31 mph
13.30	Cross C	L>R	68.7	65.8	76.9	13	5.3	
13.31	Freight	R>L	85.1	76.3	92.5	42		
13.34	Freight	R>L	73.8	63.8	84.2	110	26.0	
13.41	Chiltern	L>R	69.3	638	74.9	13	3.8	3 cars 41 mph
13.47	Chiltern	R>L	85.6	76.6	90.5	25		5/6 cars
13.50	Freight	L>R	79.7	74.9	93.4	70	54.0	
13.55	Cross C	L>R & R>L	85.4	77.2	89.7	18	6.5	4 cars 32 mph

Table A2.1 Noise data at Location N1

Time	Train Type / Operator	Train Direction	$L_{Amax,S}$ dB	L_{Aeq} dB	SEL dB	Event Duration (sec) [1]	Speed Duration (sec) [2]	Comments[3]
14.00	Freight	R>L	85.0	75.9	89.5	23	4.0	
14.12	Chiltern	L>R	82.3	70.6	84.8	26		5 cars
14.14	Chiltern	R>L	83.1	73.9	88.8	31		5/6 cars
14.28	Freight	L>R	68.8	61.5	79.5	63		
14.34	Chiltern	L>R	74.2	68.7	96.8	25	6.4	4 cars 32 mph
14.42	Chiltern	R>L	78.2	72.3	84.7	17	7.0	4 cars 29mph
14.43	Chiltern	L>R	70.6	66.4	76.9	11		4 cars

Notes
1 From SEL evaluation
2 From on site observation of time for train to pass fixed point opposite viewing point
3 Speeds estimated from nominal length for a DMU car of 23m

Table A2.2 Noise data at Location N2

Time	Train Type / Operator	Train Direction	$L_{Amax,S}$ dB	L_{Aeq} dB	SEL dB	Event Duration (sec) [1]	Speed Duration (sec) [2]	Comments[3]
14.58	Cross C	L>R	66.1	61.7	74.1	17		4 cars
15.00	Chiltern	R>L	87.3	77.3	89.3	16		4 cars
15.03	Chiltern	L>R	72.5	64.9	79.5	28	5.0	3 cars 31 mph
15.12	1st GW	R>L	56.3	55.6	62.2	5	10.0	3 cars 15 mph
15.13	Freight	R>L	75.0	69.4	85.1	38		
15.14	Freight	L>R	81.0	68.3	84.5	42		
15.20	Cross C	R>L	75.5	70.3	82.9	18	6.0	3/4 cars 26/34 mph
15.28	Chiltern	R>L	73.8	78.6	88.3	11	3.3	3 cars 47 mph
15.29	Cross C	L>R	65.7	72.6	83.1	9		4 cars
15.35	Freight	R>L	86.6	74.3	91.4	52		
15.36	Chiltern	L>R						
15.42	Chiltern	L>R	65.4	63.1	72.6	9	7.5	3 cars 21 mph
15.45	Chiltern	R>L	66.3	63.0	74.3	13	7.5	3/4 cars 21/27 mph

Notes
1 From SEL evaluation
2 From on site observation of time for train to pass fixed point opposite viewing point
3 Speeds estimated from nominal length for a DMU car of 23m

Table A2.3 Noise data at Location N3

Time	Train Type / Operator	Train Direction	$L_{Amax,S}$ dB	L_{Aeq} dB	SEL dB	Event Duration (sec) [1]	Speed Duration (sec) [2]	Comments[3]
15.59	Cross C	R>L	80.5	72.2	82.9	12		4 cars
16.04	Chiltern	R>L	63.0	61.3	70.8	9	3.6	3 cars 43 mph
16.06	Chiltern	L>R	68.2	64.6	75.9	14	4.1	3 cars 38 mph
16.12	Chiltern	R>L	81.2	76.8	84.4	23	15.0	4 cars 14mph
16.20	Cross C	R>L	68.6	65.8	76.0	10	6.0	5 cars
16.21	Freight	R>L	80.9 59.3	73.1 58.7	85.1 67.6	16 8.0	48.0	Meter triggered twice
16.24	Cross C	L>R	63.6	61.4	71.2	9	6.2	4 cars 33 mph
16.31	Chiltern	L>R	60.4	59.4	69.3	10	3.5	2 cars 29 mph
16.42	Chiltern	L>R	64.1	61.9	72.7	11		4 cars

Notes
1 From SEL evaluation
2 From on site observation of time for train to pass fixed point opposite viewing point
3 Speeds estimated from nominal length for a DMU car of 23m

Table A2.4 Vibration data at V1

Time	Train Type / Operator	Train Direction	VDV 1 [1] ($m/s^{1.75}$)	VDV 2 [2] ($m/s^{1.75}$)	VDV 3 [3] ($m/s^{1.75}$)	Event Duration (secs)
14.00	Freight	R>L	0.001	0.0009	0.014	16
14.12	Chiltern	L>R	0.0006	0.0007	0.009	34
14.14	Chiltern	R>L	0.001	0.0007	0.013	30
14.30	Freight	L>R	0.0007	0.0007	0.009	93
14.34	Chiltern	L>R	0.0008	0.0005	0.013	24
14.38	Cross C	R>L	0.0008	0.0005	0.012	21
14.42	Chiltern	R>L	0.0008	0.0007	0.010	19
14.43	Chiltern	L>R	0.0008	0.0006	0.012	18
15.00	Chiltern	R>L	0.0007	0.0004	0.010	22
15.35	Freight	R>L	0.002	0.001	0.018	34
15.42	Chiltern	L>R	0.0007	0.0005	0.010	14
15.56	Cross C	L>R	0.001	0.0006	0.016	21
16.12	Chiltern	R>L	0.0005	0.0007	0.004	41
16.21	Freight	R>L	0.003	0.003	0.044	138
16.31	Chiltern	L>R	0.002	0.001	0.026	19

Notes
1 x-axis – transverse – parallel to railway
2 y-axis – radial – perpendicular to railway
3 z-axis – vertical

A2.2 NOISE

Methodology
The average SEL values for passenger trains and for freight trains were calculated from the site data. Train timetables were consulted to determine the number of passenger and freight trains which could potentially pass the site during the daytime (07:00-23:00) and night-time (23:00-0700) periods for that day. The total average noise levels (*ie*, period L_{Aeq} values) for trains in the daytime and the night-time were then calculated using the average SELs for passenger and freight trains and the numbers of trains.

Measurements of the maximum noise levels during train pass-bys were also recorded for comparison with noise criterion in Policy 9.19.

Train movements
The composite Working Time Table (WTT) includes the 'slots' available for passenger and freight trains throughout the day and night including the scheduled arrival/departure times at Banbury (even for non-stopping and non-passenger services). Some printed timetables Chiltern and Cross Country passenger services were also obtained from Banbury station staff during the site visit and they were compared to the composite WTT.

Not all trains for which slots are provided will run every day. Passenger services might only run on certain days of the week, for example, and freight services are even more variable and might only run 'when required'.

Table A2.5 shows the total number of passenger and freight services with a timetable slot to run line south of Banbury Station deduced from the WTT and the numbers considered reasonable to use in determining the period L_{Aeq} values.

Table A2.5 Overall numbers of trains by type and period

Period	Train Type	WTT	Number used for calculations
Day	Passenger	179	178
	Freight	74	54
Night	Passenger	22	24
	Freight	36	28

Determination of Period L_{Aeq} values

Period L_{Aeq} values have been estimated by first calculating the average SEL value for each train operator for each track and then using the number of train movements for each operator on each track to determine the contribution to the period L_{Aeq}. The contributions have then been combined logarithmically to determine the period L_{Aeq}. That process has been carried out for the daytime and night-time periods.

This process leads to slightly higher overall estimates for the period L_{Aeq} values than the simpler approach of determining an average SEL from all passenger trains and a second one for all freight trains and applying the total number of movements of each train type.

The L_{Aeq} contributions from passenger and freight trains and the overall period L_{Aeq} values for location N1 (5m from site boundary) are:

Period	**Passenger**	**Freight**	**Overall L_{Aeq}**	**Scale**
Daytime	59.7	61.1	63.5	dB $L_{Aeq,16\text{-}hr}$
Night-time	53.6	61.9	62.5	dB $L_{Aeq,8\text{-}hr}$

At location N2 (25m from boundary) the period L_{Aeq} values are expected to be about by about 1 to 2 dB lower than at N1 and at location N3 (45m from boundary) about 4 to 5 dB lower than at N1

Measured L_{Amax} values

Paragraph 9.19 of Cherwell DC's noise policy sets a criterion based on L_{Amax} but does not directly specify the time-weighting to be used when measuring it. Elsewhere in the policy (paragraph 9.17) there is reference to the now withdrawn document Planning Policy Guidance 24: Planning and Noise (1994) (PPG24). PPG24 included a similar L_{Amax}-based criterion and specified the S time-weighting and so that was used for the survey.

$L_{Amax,S}$ values above 82 dBA were recorded at all three locations (N1, N2, and N3).

Classification of noise predictions in relation to Cherwell policy

For the period L_{Aeq} values above and estimated values at N2 and N3 the following categories in Policy EN8 apply:

Location	**Day**	**Night**
N1	(iii)	(ii)
N2	(iii)	(ii)
N3	(iii)	(iii)

Applying the $L_{Amax,S}$ policy in paragraph 9.19 has the effect that all locations would be classified as category (ii) based on night-time noise levels.

Consideration of uncertainty

Cherwell DC requested that future increases in railway noise should be considered as part of this study. The main report refers to possible future increases in the numbers of trains and/or train speeds but there is not sufficient information available to determine what those effects might be. Reference has been made in this Appendix to the question of interpreting the timetables to determine a reasonable number of trains on which to base the period L_{Aeq} calculations. Implicit in the method described above to estimate period L_{Aeq} values is the assumption that the ranges of speeds that occurred during the monitoring is representative of speeds over the whole of a 24-hour period.

In order to address these uncertainties the effect of specific changes in the number of trains or the speed of trains has been examined. As a further factor the possible increase of passenger capacity during peak periods by using more cars on some services has been examined. For this factor it has been assumed that during a peak period of 2 hours in the morning and 2 hours in the evening the number of cars on all passenger trains services is doubled. (It is also assumed that this change only applies to the daytime period.) The other variations considered were:

Increases of 25%, 50% and 100% in number of all trains
Increases of 25%, 50% and 100% in all train speeds
An increase of 25% in passenger train speed and 50% for freight trains

These variations have been applied separately and the resultant daytime and night-time L_{Aeq} values are shown Table A2.6 below in comparison to the 'Base Case' of predictions from the site measurements and values used for the numbers of trains in Table A2.5. Table A2.6 also shows the relevant Category in the council's policy EN8. Where the category is different from the Base Case it is shown in bold type.

Table A2.6 Revised period L_{Aeq} and corresponding EN8 Category

Variation	Change	Day	Category	Night	Category
'Base Case' (from survey)		**63.5**	(iii)	62.5	(ii)
Extra peak time coaches (2 x 2 hours)		63.9	(iii)	62.5	(ii)
Increase trains by	25%	64.5	(iii)	63.4	(ii)
	50%	65.3	(iii)	64.2	(ii)
	100%	66.5	**(ii)**	65.5	(ii)
Increase speed by	25%	65.4	**(ii)**	64.4	(ii)
	50%	67.0	**(ii)**	66.0	(**ii)/(i)**
	100%	69.5	**(ii)**	68.5	**(i)**
Increase speed by Passenger trains Freight trains	25% 50%	66.4	**(ii)**	65.8	(ii)

Table A2.6 shows that under some of the circumstances considered the category at location N1 (the most affected location) might increase to (i).

Combined changes of speed and number in some degree have not been examined but clearly there will be some combinations which would lead to a period L_{Aeq} that was in category (i).

It is not known which theoretical variations are likely to occur, or are even possible, in practice.

The practical implication of any increase in the period L_{Aeq} above what has been predicted based for the 'Base Case' from the survey is that the sound insulation provided by the façade/window etc of the affected buildings would need to be greater in order to provide the same internal noise levels. (That assumes that windows can remain closed because mechanical ventilation is installed.)

However, another practical factor is that on a developed site the noise levels at the façades will be lower than estimated at N1 for several reasons. First, the buildings are likely to be further from the railway than N1 is, secondly, the blocks are likely to be orientated with their window at an oblique angle to the railway (ie, the gable ends will face the tracks). Finally, the presence of other blocks on the site will further reduce railway noise at many of the façades.

The effect of these reductions and hence the actual noise levels at the façades can only be determined when a detailed housing layout is available be at a later stage in the planning process.

A2.3 VIBRATION

Methodology, Derivation of Period VDV Values
The approach was similar to that described above for noise. In the case of vibration the vibration dose values (VDVs) for individual trains were derived from the logged data for each of the three orthogonal directions: parallel to the railway, perpendicular to the railway, and in the vertical direction as is shown in Table A2.4. In practice vertical vibration dominated and so only that axis was used in the analysis.

The site data was used in conjunction with timetable information to derive values of VDV for the daytime (16-hour) and night-time (8-hour) periods.

The VDV derived for one of the freight trains was much higher VDV than the others and so when deriving the period VDVs it was assumed that all the freight trains produced a VDV of that value. Similarly, although there was not such a wide variation in the VDVs from the passenger trains, the highest passenger VDV was used to derive the period VDVs for passenger trains which were then combined with the freight VDVs to produce the overall period values. The results of these calculations are shown in Table A2.7 as the 'Base Case'.

Table A2.7 Period VDVs[1] including effect of increases in number of trains

Train type	Highest VDV	DAY No/Day	16-hr VDV	NIGHT No/Night	8-hr VDV
Passenger	0.026	179	0.10	29	0.060
Freight	0.044	54	0.12	28	0.101
	Overall VDV	**'Base Case'**	**0.13**		**0.10**
	Increased VDV	50%	0.19		0.16
		100%	0.26		0.21
	Increase trains by	50%	0.14		0.12
		100%	0.17		0.14

Note 1 VDVs are in units of $m/s^{1.75}$

Consideration of Uncertainty

Uncertainty has been addressed first by using the highest individual VDV value obtained for a passenger train and a freight train as (as described above) and secondly by estimating the effect of increasing the VDV above that by 50% and by 100%. Increases in the number of all trains by number of all trains by 50% and 100% have also been considered. The resulting period VDVs are shown in Table A2.7.

Classification of vibration predictions in relation to Cherwell policy

Cherwell DC's policy EN9, below, does not state a specific vibration criterion but refers to levels 'likely to affect the material comfort of end users' [ie, of noise sensitive buildings].

BS6472 provides the following guidance on the probability of adverse comment on vibration levels within residential buildings by reference to the period VDV in five bands the first three of which are shown below.

Period	**Adverse comment is not expected**	**Low probability of adverse comment**	**Adverse comment possible**
Day	< 0.2	0.2 to 0.4	0.4 to 0.8
Night	< 0.1	0.1 to 0.2	0.2 to 0.4

Comparing the daytime VDVs in Table A2.7 with the guidance above shows that they are all within the first category except in the case of a 100% increase in the VDV for each train type which extends into the next category – 'Low probability of adverse comment'.

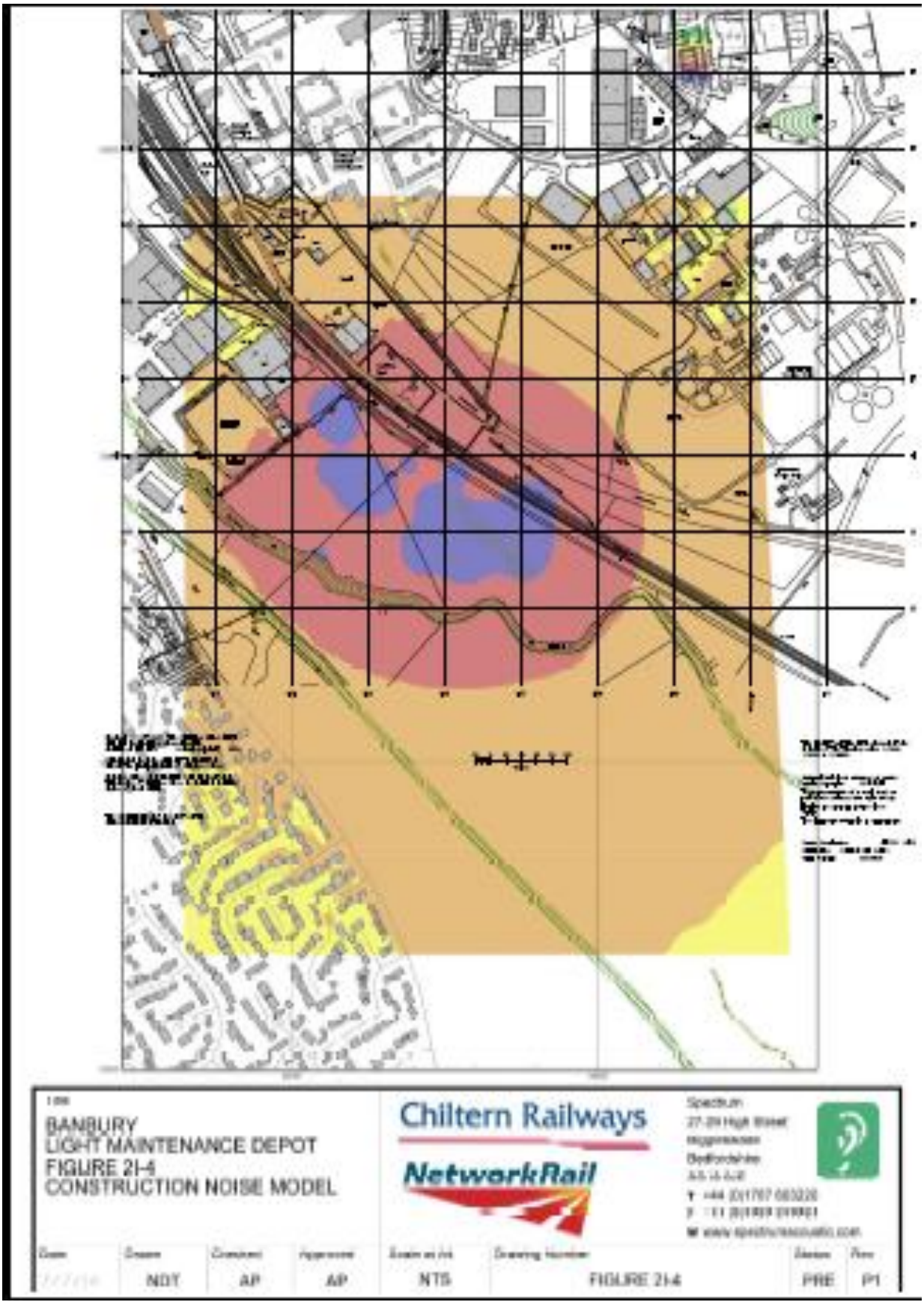
The estimated night-time VDVs in Table A2.7 extend into the second level in the above guidance – 'Low probability of adverse comment' and in the case of a 100% increase in the VDV for each train type extends into the third category – 'Adverse comment possible'.

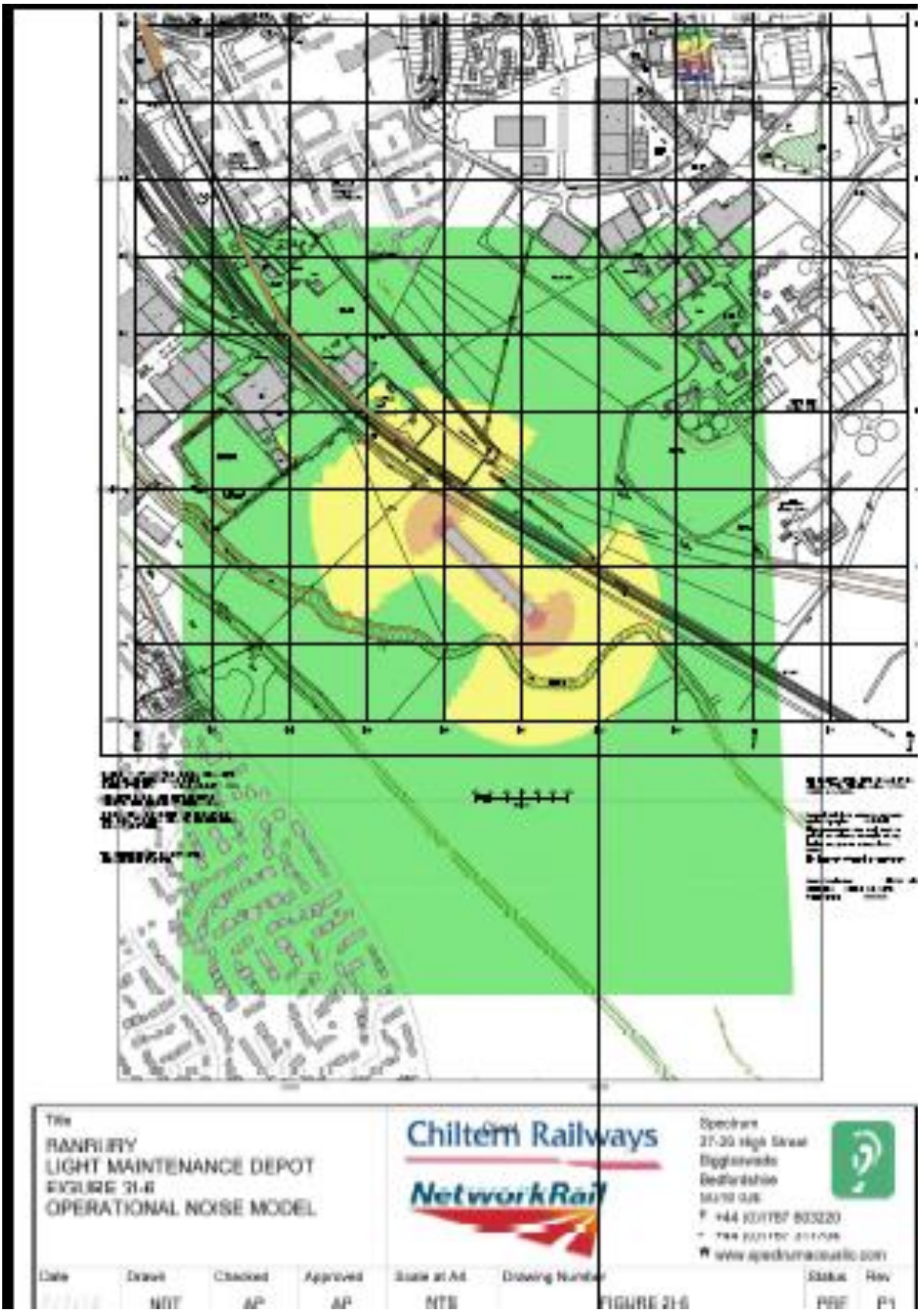
The situation can be summarised as follows: 'based on current investigations the site is not subject to high levels of vibration but that at the detailed design stage further studies should be undertaken to determine whether any mitigation is required as part of the design'.

APPENDIX 3

Noise contours for Construction and Operation of Proposed Light Rail Depot for Maintenance of Rail Vehicles

Plots of Predicted Construction and Operating Noises extracted from ES for the above scheme overlaid on plans showing the outline of the Grundon/CEMEX Application Site


BANBURY
LIGHT MAINTENANCE DEPOT
FIGURE 21-4
CONSTRUCTION NOISE MODEL
Chiltern Railways
NetworkRail
NDT
AP
AP
NTS
FIGURE 21-4
PRE
P1


Title
RANRIGRY
LIGHT MAINTENANCE DEPOT
FIGURE 31-6
OPERATIONAL NOISE MODEL
Chiltern Railways
NetworkRail
Spectrum
27-33 High Street
Biggleswade
Bedfordshire
Date
Drawn
Checked
Approved
Scale at A4
Drawing Number
Status
Rev
NTS
FIGURE 31-6
P1