Chiltern Railways (Bicester to Oxford improvements) Order 2012 and Deemed Planning Permissions.

Report by Dr Chris Jones (Independent Expert, Vibration) on Schemes of Assessment for Plain Line and Switches & Crossings

1. Introduction

Condition 19 of the deemed planning permission for the Bicester to Oxford railway line improvements, referred to above, requires the submission of Schemes of Assessment (SoAs) for noise (paragraphs 3 and 9) and vibration (paragraph 10) to the Local Planning Authorities (LPAs) for Cherwell District and Oxford City Councils. Condition 19 also requires that each SoA should be accompanied by a report, prepared by an independent expert previously approved by each LPA, on the robustness of the noise/ vibration-related elements of each SoA. This report of the Independent Expert on Vibration describes the work that I have carried out to review the methods of assessment and my findings. It focuses on whether (a) the estimates of vibration have been achieved by a suitably robust method and (b) that plans for mitigation and track maintenance are robust for the protection of residents from levels of vibration that might exceed the previously agreed criteria for the project.

2. General Approach

The key documentation relating to the Order and the proposal to which it relates, together with the overall methodology for prediction of vibration impacts proposed by the applicant's vibration specialists Atkins were made available to me via the Environmental Health Lead Officers for Cherwell District and Oxford City Councils. in 2013. My response to the Lead Officers, together with the outcome of subsequent discussions between them and the agents for the applicant, led to improvements and refinements in methodology and work to obtain sufficient and relevant empirical data to estimate the Vibration Dose Values (see note to 3.1 below) expected under the proposal to which the Order applies.

2.1. Plain line assessment report

I subsequently examined the Vibration SoA for the plain line in its final form in January 2014 as

1. *East-West Rail: Phase 1, Chiltern Railways Company Limited, Plain Line Vibration Assessment and Mitigation, reference 5114534-ATK-VIB-RPT-80001, revisions P07, 16 January 2014, prepared for Network Rail by Atkins.*

This report covers the plain line conditions only, *i.e.* it does not cover the cases in which switch and crossing track work may lead to increased vibration at nearby properties.

The report identifies nine receiver locations. These are properties that are either most at risk of high levels of vibration individually, or represent the "worst case" for a group of properties that may be at risk. The report estimates the level of vibration at these receiver locations using measurements made at Wolvercote, adjacent to the Oxford end of the route, from vehicles travelling on the main line so that their speeds are more representative of the upgraded line.

2.2. Switches and crossings report

In addition to the above report, I have examined the report

2. *East-West Rail: Phase 1, Chiltern Railways Company Limited, Vibration from Switches and Crossings – Assessment and Mitigation. 5114534-ATK-VIB-80003, Revisions A01 28 January 2014.*

This report uses supplementary vibration data measured at Fenny Compton Junction on the mainline between Banbury and Leamington Spa. The increase in the level of vibration adjacent to the crossing was measured in comparison to the plain line. It results from the impulsive forces as wheels pass over the crossing noses and rail joints. The method of assessment uses guidance from the recent RIVAS EU research project[1].

The report identified three properties that represent those at risk of vibration impact.

3. Results of vibration estimation

3.1. Note on terminology

Vibration is assessed in terms of the Vibration Dose Value (VDV) which is a measure defined in the standard BS 6472. It is designed to correlate with the human perception of vibration felt in multiple events over a daytime, 0700 - 2300 hrs, or night-time period, 2300 - 0700 hrs. The criteria for the East-West Rail project are that the VDV_{day} should not exceed 0.4 $ms^{-1.75}$ and that VDV_{night} should not exceed 0.2 $ms^{-1.75}$.

3.2. Predictions for plain line locations

Estimates of the Vibration Dose Values (VDV's) under the traffic conditions expected on the improved Oxford-Bicester Line were made individually for each of the nine receiver locations identified for plain line predictions in Reports 1, 3 and 5 (Section 2).

These VDV estimates were based on measured vibration for appropriate vehicle types on the main line (Didcot to Chester Line, DCL) and the existing Oxford-Bicester Line close to Oxford North Junction (Wolvercote) and on the projected traffic patterns of the upgraded Oxford-Bicester Line.

The empirical method of prediction was validated by testing against the measurements that were made during the Environmental Impact Assessment work at a few of the same

1 EU research project, RIVAS, 'Railway Induced Vibration Abatement Solutions', Deliverable D3.6 entitled 'Description of the vibration generation mechanism of turnouts and the development of cost effective mitigation measures' dated 28/02/2013, downloadable at www.rivas-project.eu.

properties. This showed that the assessment method produced an over-estimate of the VDV's in line with the deliberate choice of 'worst case' assumptions. This was the case at all properties for which VDV measurements are available except Oddington Crossing. This was discounted from the comparison because of the position of the property with respect to the track, particular track conditions and the road crossing.

Although the VDV's at each of the nine locations were predicted to be below the thresholds, two receiver locations were worthy of some concern. The first (Kareol, at Islip Crossing) because the predicted VDV's were close to the thresholds and the second (Oddington Crossing) because VDV's measured in the Environmental Impact Assessment work were higher than the empirical estimation predicted for the existing traffic. If, in the latter case, the factor of the discrepancy were to be applied to the predictions for the future traffic, the scheme limits would be significantly exceeded. The higher levels of vibration at Oddington Crossing are judged, both by Network Rail's consultant and myself, the Independent Expert, to be due to particular conditions at this property. Note that both crossing properties are extremely close to the track and therefore the vibration depends more on track/formation conditions than propagation through any significant distance in the ground.

It can be judged additionally that any high levels of vibration encountered at these sites in the future would be due to deterioration of the track bed and/or 'track top' quality condition. Such deterioration is accelerated by poor track formation condition.

3.3. Predictions for Switch and Crossing locations

Estimates of the projected VDV's at the locations adjacent to switch and crossing track work were made on the basis of the measured amplification factors from the Fenny Compton measurements and the predictions from the Wolvercote measurements. The results show that the VDVs at 16 Whimbrel Close and 21 London Road are only just below the limits. However, since the predictions are based on measurements of a crossing nose in less than perfect condition and the crossing affecting Whimbrel Close has a longer radius than that of the measurement (shown in the RIVAS document to lead to significantly lower vibration), it is accepted that a conservative over-estimate of vibration has been made. The second crossing nose at the measurement site showed lower amplification of vibration.

4. Mitigation

As a practical measure to reduce the risk of unacceptable levels of vibration at each of these two locations, Network Rail has undertaken to replace the low embankment and track formation at each of the two crossing locations. Track formations designed to modern standards are much stiffer and more stable than historical formations and the risk of future higher levels of vibration will be significantly reduced by this measure.

Although as a mitigation measure, this cannot be quantified in terms of a reduction of vibration, given that no exceedance of the vibration criteria has been predicted, I regard this measure as an effective method of protecting these properties from high VDVs in the future.

5. Review of submissions from residents

A number of submissions were received by the LPAs from residents. I reviewed these where they contained technical content and/or challenged the content of the Atkins/NR reports and gave advice to the lead officers at the LPAs. I found that none of the submissions contained substantive technical arguments that would cause a revision of my conclusions set out below.

6. Summary of Findings

As the approved Independent Expert on railway-induced vibration, I have examined the finalised Schemes of Assessment for vibration and find that:

1. The properties selected for predictions have been correctly selected as those with, or representing, the highest risk from Vibration Dose Values exceeding the criteria of the project.
2. The vibration predictions have been made based on appropriate measurement data, relevant to the local soil conditions, the expected traffic types and traffic speeds.
3. The empirical method of predicting Vibration Dose Values at the receiver properties adjacent to plain line is appropriately robust for the scheme and the levels of vibration measured. The judgement applies both the calculation method and its cautious approach in deliberately choosing to predict for the worst case. The cautious approach is demonstrated quantitatively by comparison of predicted VDV's with measurements of the existing traffic at some of the properties.
4. Two properties required further consideration. The risk of VDV's exceeding the criteria in the future at these locations has been reduced by an undertaking from Network Rail to replace the track formation at these two locations.
5. Three properties have correctly been selected as being at risk of high VDV's for locations adjacent to the switch and crossing work of the upgraded line.
6. Measurement data used in the prediction of vibration from switches and crossings showed a worse amplification of vibration than other typical published data on one crossing nose and a better value on the other. The VDV predictions from the worse data still just showed compliance with the project criteria.
7. The renewal of the formation at the crossing locations is appropriate to ensure an acceptably low risk of vibration at line side properties on the upgraded Bicester to Oxford line.

Considering the above findings, my opinion is that robust methods of vibration prediction and mitigation have been used, as set out in the key documents referred to in this report and that these may be relied upon.

Chris Jones, PhD, MIOA, 15 May 2014