

Comments for Oxford City Council on **issue 4** of the ‘Technical Note’, prepared by Atkins Ltd for Network Rail, and forwarded to Oxford City Council in support of the Vibration Scheme of Assessment for East-West Rail

To: Fiona Bartholomew

From: Paul Buckley

6 March, 2015

These are my comments on the amended (issue 4) version of the Technical Note. My conclusions are unchanged from those given in my comments on the previous version. A reasonable expectation is that EWR, as currently proposed, will breach Condition 19 with respect to vibration.

The substantive changes from the version of the Technical Note issued on 17 December 2014 are: (i) small changes to the EWR scheme in Wolvercote; (ii) a proposal that ‘frequency based’ building transfer functions should be considered, in addition to the ‘single figure’ values proposed previously; (iii) partial inclusion of the effects of the Bladon Close points (ignored completely in the previous version).

### **1. Changes to the EWR scheme**

Issue 4 of the Technical Note contains two changes to the proposed EWR scheme, relative to the case modelled in the original VSoA.

- (a) The set of points at Bladon Close has changed. Specifically, the associated crossings (discontinuities in the track) have moved (see p.13).
- (b) The design train speed is said to have been increased from 70 to 75mph (see p.14). But there is some ambiguity about this. E.g. on p.10 in a section copied from the first version of the Technical Note, a design train speed of 70mph is mentioned. This needs clarifying.

## 2. Revised vibration predictions

The above changes to the proposed scheme have small consequences for the vibration predictions.

- (a) The change to track layout causes a small increase in vibration level at 4 Bladon Close, since it is now adjacent to both crossings. It also causes a small reduction in vibration at 3 Bladon Close, as it is now much further from the crossing on the furthest line than it was (approximately 40m instead of 15m). However it remains at approximately 25m from the crossing on the nearest line. **Note: the effect of the crossings on 3 Bladon Close is ignored in both the VSoA and in the current and previous versions of the Technical Note.** I see no justification for this.
- (b) The effect of the increase in design speed of the trains to 75mph is to cause a small increase in vibration level at all receptors. I assume this would not apply to the stone train, whose speed I assume remains at 60mph.

I have applied these small changes to Open Ground VDV<sub>s</sub>, computed using Approach 1 of the VSoA, with data from the VSoA. I have then combined them with either the ‘reasonable worst case’ *single figure* amplification factors suggested in Table 5 of the new version of the Technical Note, or (in view of (ii) above) the ‘reasonable worst case’ *frequency based* amplification factors suggested in Tables 7 and 9, to produce the revised table of predicted VDV<sub>s</sub> below (in units of  $\text{ms}^{-1.75}$ ). Recall, for comparison, that Arup had suggested a universal amplification factor of 4.

	Open ground VDV		With factor from Technical Note Table 5			With factor from Technical Note Tables 7/9		
	day	night	factor	day	night	factor	day	night
Quadrangle	.149	.097	1.0	.149	.097	1.6	.238	.155
4 Bladon Close	.182	.101	3.16	.575	.319	3	.546	.303
3 Bladon Close	.185	.107	3.16	.585	.338	3	.555	.321
2B Bladon Close	.114	.065	5.01	.58	.32	3*	.342*	.195*

Key to compliance with

Condition 19:

***	Compliance	***	Non-compliance
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\*These figures for 2B Bladon Close are probably too small. The Technical Note itself (p.4) acknowledges that a timber-framed building, of the type 2B Bladon Close is believed by Atkins to be, is the type believed most vulnerable to vibration amplification. A factor higher than the 3 suggested for a conventional family residence would be more appropriate, but apparently a suitable frequency based amplification factor was not available.

The Table shows: three of these four buildings are predicted to suffer vibration substantially above the NVMP thresholds when using one set of factors, and at least two (probably three) when using the other set of factors.

The new version of the Technical Note *agrees* (see Tables 6,8,10) that using these input data: Quadrangle is predicted to be below the thresholds, and 4 and 2B Bladon Close are predicted to exceed the thresholds. But the Technical Note *disagrees* in claiming 3 Bladon Close will *not* exceed the thresholds. The reason is the error in the

Technical Note's Open Ground VDV's predicted for 3 Bladon Close: they ignore amplification from the crossings, especially the crossing on the nearest line.

### **3. Are the predictions for 4 Bladon Close unreasonably cautious?**

The revised Technical Note claims that the predictions for 4 Bladon Close are “overly conservative” and therefore its “marginal exceedance” of the vibration thresholds can be ignored. The basis for this judgement is that above-average measured VDV's were used as baseline values in the predictions, and these were combined with above-average values for S&C amplification factors. However, this argument is fallacious. In both cases, the use of above-average values is *required*, to take into account: (1) uncertainty in the average values of the whole populations of vibration levels and amplification factors, because of the relatively small number of measurements made, and their large scatter, and (2) the fact that a single VDV used to accurately represent a population of VDV's must be higher than the average value, by an amount that depends on the scatter (because of the 4<sup>th</sup> power averaging involved). (1) is well-known; (2) is less well-known, but can be quantified analytically. In no sense does this use of above-average values correspond to a “*safety margin*” in the usual sense of the term. As an example, consider the graph on p.12 of the Technical Note: to take into account (1) and (2) accurately would require use of amplification factors at the four distances 3,5,7,9m, of 12.4dB, 14.3dB, 14.3dB, 13.4dB respectively – i.e. very close to those actually used. For these reasons, the VDV predictions for 4 Bladon Close in the Table above are *not* overly cautious.

### **4. Inter-train variability**

The revised Technical Note copies the section on inter-train variability (p.9) from the previous version. Again it misleadingly claims “all available trains” were monitored in the vibration monitoring survey. Evidence in the VSoA itself and provided by Atkins at the June 2014 Technical Meeting indicates that only a fraction of trains was monitored, and that the scatter in vibration measurements was extremely large. Doubts raised in the Arup Report, about whether the selection of trains was truly representative, remain. As the Arup Report suggests, a pragmatic way to make allowance for this would be to increase night-time VDV's by a further factor – the

report suggests 1.4. Such an additional factor has not been included in the Table above, but it serves to illustrate that there are reasons for considering the above Table may be under-cautious rather than over-cautious. Its demonstration, even so, that vibration levels may exceed the thresholds at some buildings in Wolvercote must be taken seriously.

Accompanying email from Professor Paul Buckley

Dear Fiona

Thank you for making public yesterday the revised (issue 4) version of the Network Rail Technical Note on the EWR scheme. I have been through it and have prepared another set of comments - see attached.

I was pleased to see that Network Rail acknowledged and corrected some errors in the previous version. However, it is disappointing to see that some errors remain.

I was also pleased to see, at last, that Network Rail acknowledge that some properties may experience vibration levels above the thresholds. To meet Condition 19 they clearly must bring vibration levels down either by mitigation at the track (as promised in the NVMP) or by reduction of speed limits.

I know that you are meeting with Arup representatives today. I also know that residents are keen that Arup get to see the points we are making, so I would be grateful if you would share the attached comments with Arup, to get their reactions. If Arup disagree with any of these comments or other points we are making, it would be very helpful all round if you could pass back their views to us.

I was pressed by residents at the Summertown meeting yesterday to remind you also of other major worries we have about the VSoA, that we have expressed many times in the past, but to which we have still not received a satisfactory reply. Here are some important outstanding issues: it would help residents enormously to have any independent advice that Arup can offer in relation to them. I am afraid confidence in Atkins and NR is waning fast.

1. Many of us remain very doubtful about the relevance and integrity of the Atkins data being used by them, and indeed by myself, in all the predictions of vibration.

(a) The geology where the measurements were made is definitely different from that of Upper Wolvercote: yet no convincing case has yet been made for why, nevertheless, they can be relied upon to predict vibration levels in Upper Wolvercote. The only attempt at a justification (at the June 2014 Technical Meeting) was vague and of the hand-waving variety. This is not acceptable to the concerned and discerning residents of Wolvercote.

(b) The topography is also very different. In particular, some houses close to the track are also near the steep cutting, and in some cases near the tunnel entrance: locations all very different in topography from the flat ground on Port Meadow where the measurements were made. There is great anxiety among some residents that these complexities could produce very high levels of vibration, unpredictable with the one-dimensional approach used in the VSoA. Could the new, higher, levels of vibration at locations such as this, even cause ground movement by triggering instability in the cutting? Residents would very much welcome an independent assessment of the situation in Wolvercote from Arup.

2. Anecdotal evidence encourages doubt about the VSoA data. There is a long history of evidence that attenuation of vibrations from the railway line in Upper Wolvercote is much less than PREDICTED with the data used in the VSoA. Even worse is the history of structural damage, apparently caused by vibrations from the railway, and yet the levels of vibration PREDICTED are said to be too low to cause structural damage. All of this arouses suspicion that the ground in Upper Wolvercote is unusually susceptible to vibrations, which therefore will not be realistically modelled using data obtained on Port Meadow. This problem has been articulated in connection with the EWR proposals at many public meetings and in writing. Keith Dancey has assembled a substantial data base of evidence. Yet this concern has never been seriously addressed by any of the railway companies. It would be very helpful to residents if Arup would offer their opinion on what causes the unusual behaviour of the ground in Wolvercote, and its likely impact on the accuracy of the predictions made by Atkins for EWR, which currently ignore it.

3. There is lingering doubt about the integrity of the data presented in the VSoA (both parts). Some information given there is obviously wrong. This casts doubt on the integrity of the rest of the two documents. It is possible that the errors are simple cases of lack of proof-reading of the manuscript. Or they could reflect deeper misunderstandings on the part of the authors, and could even have corrupted the conclusions reached in the VSoA. These concerns have never been addressed publicly. It would be very helpful indeed, and much more professional, if Atkins could acknowledge the errors that are there, and indicate what in-house quality control measures they have applied to give confidence that there are no other hidden bugs. This need is made all the more urgent by continuing errors appearing in the various versions of the recent Technical Note. It would be very helpful to residents to learn from Arup of other errors they have spotted, of which we may not yet be aware.

4. For a project on the scale of EWR, affecting hundred of homes and thousands of residents, it is very poor practice indeed for there to be no attempt at a serious validation of the methods and data used in prediction of vibration. This would have been effective in providing confidence among residents that Atkins' methods are sound. The recent Technical Note is honest in making clear that the earlier vibration measurements made by ERM inside some Wolvercote buildings do not constitute such a validation. Therefore residents find themselves left having to trust Atkins and NR that their methods are sound, in spite of all the evidence to the contrary, for example as illustrated above. In my opinion this is not satisfactory. Arup in their report already raised doubts about the integrity of the ERM data as a source of validation. It would be extremely helpful to residents to have from Arup an up-dated assessment of how confident we can be of the Atkins prediction methodology overall, now we have clarity that there has been no validation exercise at all.

Sorry to write at length. And I appreciate that this is now too late for your meeting with Arup today. But if there is Arup advice that could be made public in relation to these pressing issues, it would help the situation enormously.

Best wishes Paul

