

Smart Motorways Programme

M23 Junction 8 to 10 Smart Motorway Environmental Study Report: Addendum Noise and Vibration Chapter

February 2018

Notice

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Executive summary

Noise and vibration

This addendum has been provided to set out the effect of changes to the design of the Proposed Scheme during DF4 and DF5 on the noise and vibration assessment presented in the Environmental Study Report.

Construction noise and vibration impacts are not considered to differ from those detailed in the Environmental Study Report and are therefore not detailed in this addendum.

In the short term, during the operational phase with the Proposed Scheme (with design changes) in place, the majority of noise sensitive receptors are expected to experience a decrease in noise level with minor decreases for 632 properties and even greater decreases for 154 properties. This decrease is due to the inclusion of a new low noise surface on Lanes 1 and 4 of the motorway and the installation of noise barriers, as part of the Proposed Scheme (with design changes). The four noise barriers proposed between Junctions 8 and 10 will help to enhance the noise environment in the vicinity of the Proposed Scheme.

In the long-term, during the operational phase with the Proposed Scheme (with design changes) in place, two noise sensitive receptors are predicted to experience a perceptible increase in noise level (although this is due to traffic increases on a local road in the future assessment year and is not due to the Proposed Scheme), whilst 124 noise sensitive receptors are predicted to experience minor or moderate decreases in noise, which would be perceptible to residents.

During the operational phase no significant effects are predicted. The Proposed Scheme (with design changes) is considered to result in an overall beneficial effect during the operational phase.

1. Introduction

1.1.1. The Environmental Study Report (ESR) for the M23 Junction 8 to 10 Smart Motorway project (the Proposed Scheme) was produced in early 2017 using the best available information and understanding at the time of writing. Through 2017, the design of the Proposed Scheme was refined and was subject to a detailed target cost exercise undertaken by the Delivery Partner. As a result of this exercise, the design of the Proposed Scheme has changed. There are two changes which have the potential to affect the findings presented in the noise and vibration chapter (Chapter 8) of the ESR. These changes are summarised as:

- The provision of a new Low Noise Road Surfacing (LNRS) to lanes 1 and 4 only (the existing hard shoulder and the lane closest to the existing central reserve). This change means that upon opening of the Proposed Scheme, lanes 1 and 4 would have a new LNRS in place, whilst lanes 2 and 3 would retain the existing road surfacing currently in position. The assessment presented in Chapter 8 of the ESR was undertaken assuming that all 4 running lanes would be resurfaced with a new LNRS, hence this design change has the potential to adversely affect the assessment presented in Chapter 8 of the ESR. A technical note was produced to detail the likely noise changes as a result of this design change (HA549337-JAJV-ENV-SG_ASSESS-RP-EN-0001)
- The number of proposed noise barriers has been reduced from that presented in Chapter 8 of the ESR, from seven to three. The design change resulted from more detailed cost information becoming available from the Delivery Partner. This detailed cost information was used to reanalyse the value for money ratio of each of the seven noise barriers proposed in Chapter 8 of the ESR. The results illustrated that only three of the seven barriers proposed in Chapter 8 of the ESR remained value for money; therefore, only these three barriers were retained as part of the Proposed Scheme design, whilst the other four were removed from the design. A technical note was produced to illustrate this analysis (HA549337-JAJV-ENV-SG_ASSESS-RP-EN-0002)

1.1.2. In addition to the two changes detailed above, an additional noise barrier was identified through DF4 stage as a result of detailed design activity. NB22a was added to compensate for the loss of a small embankment which is proposed to be removed to make space for the construction of an Emergency Refuge Area. NB22a has not been included within the noise modelling, nor is it subject to the value for money process, as it is provided in exchange for an existing embankment which is required to be removed as part of the proposed scheme. Hence the number of new noise barriers provided as part of the Proposed Scheme (with design changes) is four in total.

1.1.3. In addition to the information presented in the technical notes referenced above, this addendum has been provided to illustrate the combined impact of these two design changes, in terms of how the change affects the assessment presented in Chapter 8 of the ESR.

1.1.4. References to the “Proposed Scheme” refer to the design at the time of writing the ESR, whilst references to the “Proposed Scheme (with design changes)” refer to the design at the current time, i.e. without LNRS to lanes 2 and 3, and only four noise barriers included.

1.1.5. The information provided in the following sections of the ESR has not changed as a result of the design changes, therefore they are not presented in this addendum:

- 8.2 Study area;
- 8.3 Methodology;
- 8.4 Baseline conditions;
- 8.5 Sensitivity of resource;

- 8.6 Assumptions and limitations; and,
- 8.8 Potential construction effects.

2. Design and mitigation measures

2.1.1. Table 2-1 below presents the noise mitigation measures included in the Proposed Scheme (with design changes), and replaces Table 8-15 of the ESR.

Table 2-1 Enhancement measures during operation

| Mitigation type | Mitigation measure | Location | Aim | Residual impact | Cost benefit analysis*/ noise changes |
|-----------------|--|---------------------------------------|--|-----------------|--|
| Lay-out | NB21: Noise barrier around 882m long and 4m high; B3 under BS 1793-2 and A3 under BS 1793-1 | Southbound M23 Ch. 40750 to Ch. 41631 | Reduce road traffic noise levels in noise Important Area no. 6066 and properties in Smallfield | N/A | Cost to benefit ratio = 2.04 In the opening year daytime the following numbers of properties are predicted to experience noise reductions in bands: 1 to 3dB = 166 3 to 5dB = 85 5 to 10dB = 6. |
| Lay-out | NB21a: Noise barrier around 65m long and 3m high; B3 under BS 1793-2 and A3 under BS 1793-1 | Southbound M23 Ch. 41862 to Ch. 41927 | Reduce road traffic noise levels in mobile home site | N/A | Cost to benefit ratio = 1.25 In the opening year daytime the following numbers of properties are predicted to experience noise reductions in bands: 1 to 3dB = 0 3 to 5dB = 0 5 to 10dB = 2. |
| Layout | NB22a: Noise barrier around 350m long and 3m high; B3 under BS 1793-2 and A3 under BS 1793-1 | Northbound M23 Ch. | Replace an existing bund which is removed to make space for Emergency Refuge Area | N/A | Not subject to cost benefit analysis |
| Lay-out | NB29: Noise barrier around 627m long and 4m high; B3 under BS 1793-2 and A3 under BS 1793-1 | Northbound M23 Ch. 45954 to Ch. 46564 | Reduce road traffic noise levels in noise Important Area no. 6079 | N/A | Cost to benefit ratio = 1.01 In the opening year daytime the following numbers of properties are predicted to experience noise reductions in bands: 1 to 3dB = 102 3 to 5dB = 55 5 to 10dB = 24. |

- 2.1.2. Provision of NB29 is subject to further design and assessment which are dependent on works being undertaken in the Junction 10 area by a property developer.
- 2.1.3. All other noise barriers considered at the scoping stage have been ruled out as not providing value-for-money. Table 2-2 below adds to Table 8-16 of the ESR and presents a summary of the analysis undertaken and justification behind the scoping out of each noise barrier during DF4/5.

Table 2-2 Scoped out enhancement measures

| Mitigation measure | Location | Justification |
|----------------------|---|---|
| NB5: Noise Barrier | Northbound M23 diverge to clockwise M25 | Discounted at DF4/5. Increased construction costs due to requirement for traffic management and other activities not provided as part of Smart Motorway construction. Discounted as the value for money ratio = 0.63. |
| NB23: Noise Barrier | Northbound M23 between Junction 9 and Perrylands Land underbridge | Discounted at DF4/5. More accurate construction costs provided by Delivery Partner indicating increase compared to that estimated in ESR. Discounted as the value for money ratio = 0.64. |
| NB25b: Noise Barrier | Northbound M23 south of Junction 9 | Discounted at DF4/5. More accurate construction costs provided by Delivery Partner indicating increase compared to that estimated in ESR. Discounted as the value for money ratio = 0.61. |
| NB26b: Noise Barrier | Southbound M23 south of Junction 9 | Discounted at DF4/5. More accurate construction costs provided by Delivery Partner indicating increase compared to that estimated in ESR. Discounted as the value for money ratio = 0.91. |

3. Potential operational effects

3.1.1. This section examines the predicted change in the operational effects detailed in the ESR, as a result of the design changes to the Proposed Scheme.

3.2. Operational road traffic noise – HD 213/11 assessment

3.2.1. Table 3-1 below presents the short-term traffic noise changes, and replaces Table 8-23 of The ESR.

Table 3-1 Short-term traffic noise changes (DMRB HD213/11 Table A1.1)

| Change in noise level | | Number of dwellings | Number of other sensitive receptors |
|---|-----------|---------------------|-------------------------------------|
| Increase in noise level, L _{A10,18h} | 0.1 - 0.9 | 1,138 | 23 |
| | 1 - 2.9 | 20 | 0 |
| | 3 - 4.9 | 0 | 0 |
| | >=5 | 0 | 0 |
| No change | = 0 | 605 | 5 |
| Decrease in noise level, L _{A10,18h} | 0.1 - 0.9 | 1,724 | 41 |
| | 1 - 2.9 | 632 | 4 |
| | 3 - 4.9 | 100 | 0 |
| | >=5 | 54 | 0 |

3.2.2. As a result of the design changes, the number of dwellings and other sensitive receptors experiencing perceptible decreases in noise has reduced from 2,722 to 790. There are also an additional seven dwellings, making 20 in total, that are predicted to experience perceptible increases in noise; however, as previously detailed in paragraph 8.9.9 of the ESR, these additional seven are due to a limitation within the Calculation of Road Traffic Noise and HD 213/11 whereby absorptive barriers can only be modelled as reflective. Further analysis has been undertaken to confirm that these 20 receptors would not experience perceptible increases in noise level with the Proposed Scheme (with design changes) and absorptive barriers in place.

3.2.3. In summary, in the short-term, the Proposed Scheme (with design changes) does not result in any perceptible increases in noise; however, the numbers of receptors experiencing perceptible benefits has reduced substantially compared to the ESR. The Proposed Scheme (with design changes) is therefore still considered beneficial; albeit less beneficial than was presented in the ESR.

3.2.4. Table 3-2 below presents the long-term traffic noise changes, and replaces Table 8-24 of the ESR.

Table 3-2 Long-term traffic noise changes (DMRB HD213/11 Table A1.1)

| Change in noise level | | Daytime | | Night-time |
|---|-----------|---------------------|-------------------------------------|---------------------|
| | | Number of dwellings | Number of other sensitive receptors | Number of dwellings |
| Increase in noise level, L _{A10,18h} | 0.1 - 2.9 | 1,047 | 23 | 208 |
| | 3 - 4.9 | 2 | 0 | 0 |
| | 5 - 9.9 | 0 | 0 | 0 |
| | >=10 | 0 | 0 | 0 |
| No change | = 0 | 112 | 2 | 7 |
| Decrease in noise level, L _{A10,18h} | 0.1 - 2.9 | 2,988 | 48 | 705 |
| | 3 - 4.9 | 64 | 0 | 78 |
| | 5 - 9.9 | 60 | 0 | 60 |
| | >=10 | 0 | 0 | 0 |

- 3.2.5. As a result of the design changes, there are no additional dwellings or other sensitive receptors that are predicted to experience perceptible noise increases during either the daytime or night-time period. However, the design changes have reduced the number of dwellings and other sensitive receptors experiencing perceptible decreases from 1,292 to 124 during the daytime, and from 381 to 138 during the night-time.
- 3.2.6. In summary, in the long-term, the Proposed Scheme (with design changes) does not result in any perceptible increases in noise; however, the numbers of receptors experiencing perceptible benefits has reduced substantially compared to the ESR. The Proposed Scheme (with design changes) is therefore still considered beneficial; albeit less beneficial than was presented in the ESR.
- 3.2.7. Table 3-3 below presents the traffic noise nuisance changes, and replaces Table 8-25 of the ESR.

Table 3-3 Traffic noise nuisance changes (DMRB HD 213/11 Table A1.3)

| Change in nuisance level | | Do Minimum (DM) | Do Something (DS) |
|----------------------------|-----------|---------------------|---------------------|
| | | Number of dwellings | Number of dwellings |
| Increase in nuisance level | >0 - <10% | 1,343 | 691 |
| | 10 - <20% | 1 | 1,128 |
| | 20 - <30% | 0 | 30 |
| | 30 - <40% | 0 | 0 |
| | >40% | 0 | 0 |
| No change | = 0% | 168 | 554 |
| Decrease in nuisance level | >0 - <10% | 2,761 | 1,800 |
| | 10 - <20% | 0 | 64 |
| | 20 - <30% | 0 | 6 |
| | 30 - <40% | 0 | 0 |
| | >40% | 0 | 0 |

- 3.2.8. The Proposed Scheme (with design changes) results in more properties experiencing increases in nuisance level of 10% or more than there were for the Proposed Scheme. Additionally, there are less properties that experience reductions in noise nuisance with the Proposed Scheme (with design changes) than there were for the Proposed Scheme. However, it should be noted that there are still more properties experiencing reductions in nuisance level than there are experiencing increases in nuisance level. Therefore, the Proposed Scheme (with design changes) is considered less beneficial than reported in the ESR, but does not result in the Proposed Scheme (with design changes) being considered adverse in noise nuisance terms.
- 3.2.9. Table 3-4 below presents the traffic airborne vibration nuisance changes, and replaces Table 8-26 of the ESR.

Table 3-4 Traffic airborne vibration nuisance changes (DMRB HD 213/11 Table A1.4)

| Change in nuisance level | | Do Minimum (DM) | Do Something (DS) |
|----------------------------|-----------|---------------------|---------------------|
| | | Number of dwellings | Number of dwellings |
| Increase in nuisance level | >0 - <10% | 615 | 529 |
| | 10 - <20% | 1 | 0 |
| | 20 - <30% | 0 | 0 |
| | 30 - <40% | 0 | 0 |
| | >40% | 0 | 0 |
| No change | = 0% | 128 | 123 |
| Decrease in nuisance level | >0 - <10% | 277 | 352 |
| | 10 - <20% | 0 | 11 |
| | 20 - <30% | 0 | 6 |
| | 30 - <40% | 0 | 0 |
| | >40% | 0 | 0 |

3.2.10. Table 3-4 largely correlates with Table 8-26 in the ESR 8; therefore, the design changes do not materially change the airborne vibration nuisance assessment presented in the ESR.

3.3. Comparison of the operational noise effects to the aims of the Noise Policy Statement for England

3.3.1. The Proposed Scheme (with design changes) does not give rise to any significant noise increases, therefore the first and second aims of the Noise Policy Statement for England (NPSE) are met.

3.3.2. Tables 3-5 and 3-6 below present the updated versions of Tables 8-27 and 8-28 from the ESR, for the Proposed Scheme (with design changes).

Table 3-5 Short-term NPSE significance summary

| Noise level | Daytime (population) | | | Night (population) | | |
|-------------------------|----------------------|---------|------------|--------------------|---------|------------|
| | DM 2020 | DS 2020 | Difference | DM 2020 | DS 2020 | Difference |
| Above SOAEL | 497 | 359 | -138 | 2,698 | 2,256 | -442 |
| Between LOAEL and SOAEL | 8,931 | 8,917 | -14 | 7,130 | 7,572 | 442 |
| Below LOAEL | 400 | 552 | 152 | - | - | - |

Notes SOAEL = Significant Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level

- 3.3.3. In the short term, when compared to Table 8-27 of the ESR, the design changes have increased the number of people exposed to noise levels above the SOAEL (354 to 359 in the daytime and 1,760 to 2,256 in the night-time). However, when compared to the DM 2020 scenario, there is still an overall reduction in the number of people exposed to noise levels above the SOAEL (-138 in the daytime and -442 in the night-time). Similarly, when compared to Table 8-27, the design changes have increased the number of people exposed to noise levels between the LOAEL and the SOAEL for the daytime period (8,025 to 8,917), but again, there is still a net reduction when compared to the DM 2020 scenario (-14).
- 3.3.4. In overall terms, the Proposed Scheme (with design changes) is still considered to be beneficial, but is less beneficial than presented in the ESR.

Table 3-6 Long-term NPSE significance summary

| Noise level | Daytime (population) | | | Night (population) | | |
|-------------------------|----------------------|---------|------------|--------------------|---------|------------|
| | DM 2020 | DS 2035 | Difference | DM 2020 | DS 2035 | Difference |
| Above SOAEL | 497 | 398 | -99 | 2,698 | 1,709 | -989 |
| Between LOAEL and SOAEL | 8,931 | 7,997 | -934 | 7,130 | 8,119 | 989 |
| Below LOAEL | 400 | 1,433 | 1,033 | - | - | - |

- 3.3.5. In the long term, when compared to Table 8-28 of the ESR, the design changes have increased the number of people exposed to noise levels above the SOAEL (380 to 398 in the daytime and 1,553 to 1,709 in the night-time). However, when compared to the DM 2020 scenario, there is still an overall reduction in the number of people exposed to noise levels above the SOAEL (-99 in the daytime and -989 in the night-time). Similarly, when compared to Table 8-28, the design changes have increased the number of people exposed to noise levels between the LOAEL and the SOAEL for the daytime period (6,969 to 7,997), but again, there is still a net reduction when compared to the DM 2020 scenario (-934).
- 3.3.6. In overall terms, the Proposed Scheme (with design changes) is still considered to be beneficial, but is less beneficial than presented in the ESR.

3.4. Noise Important Areas

3.4.1. Table 3-7 below presents the long-term noise changes in Noise Important Areas (NIA) as a result of the Proposed Scheme (with design changes), and replaces Table 8-29 of the ESR.

Table 3-7 Long-term noise changes in Noise Important Areas (NIA)

| Noise Important Areas by ID number | Total Number of dwellings | Numbers of Dwellings experiencing Noise Changes between Opening Year and Design Year with Proposed Scheme (Do-Min comparison shown in brackets) | | | |
|------------------------------------|---------------------------|---|-------------------------|---------------------|-------------------------|
| | | Noise Level Increase | Noise Level Decrease | | |
| | | 0 to +3 dB (negligible) | -3 to 0 dB (negligible) | -5 to -3 dB (minor) | -10 to -5 dB (moderate) |
| From J8 to J9 | | | | | |
| 6292 | 157 | 1 (1) | 156 (156) | 0 (0) | 0 (0) |
| 5917 | 1 | 0 (0) | 1 (1) | 0 (0) | 0 (0) |
| 12417 | 4 | 3 (3) | 1 (1) | 0 (0) | 0 (0) |
| 12418 | 31 | 31 (31) | 0 (0) | 0 (0) | 0 (0) |
| 4650 | 0 | 0 | 0 | 0 | 0 |
| 6069 | 6 | 2 (0) | 4 (6) | 0 (0) | 0 (0) |
| 6070 | 2 | 2 (2) | 0 (0) | 0 (0) | 0 (0) |
| 6066 | 11 | 1 (0) | 10 (11) | 0 (0) | 0 (0) |
| 12436 | 1 | 1 (0) | 0 (1) | 0 (0) | 0 (0) |
| From J9 to J10 | | | | | |
| 4636 | 2 | 0 (0) | 2 (2) | 0 (0) | 0 (0) |
| 6067 | 10 | 0 (0) | 10 (10) | 0 (0) | 0 (0) |
| From J10 to south | | | | | |
| 6079 | 256 | 27 (35) | 114 (221) | 55 (0) | 60 (0) |
| 12589 | 22 | 22 (22) | 0 (0) | 0 (0) | 0 (0) |

3.4.2. For most NIA, there is very little change when compared to Table 8-29 of the ESR. NIA 6292 has seen a substantial reduction in the number of dwellings experiencing minor or moderate noise decreases with the Proposed Scheme (with design changes) in place (63 minor and 91 moderate to 0 minor and 0 moderate). This is due to the removal of NB5 from the Proposed Scheme which was generating the benefits seen in NIA 6292 in Chapter 8. Similarly, NIA 6066 and 6067 have experienced reductions in the numbers of dwellings predicted to experience minor or moderate decreases. NIA 6066 has seen a reduction from 10 dwellings to 0, whilst 6067 has seen a reduction from 8 minor/moderate to 0 as a result of the design changes. The changes for dwellings in NIA 6066 are due to the reduction in height of NB21 from 4m to 3m, whilst the changes for dwellings in NIA 6067 are due to the removal of NB25b and NB26b from the Proposed Scheme.

3.4.3. In overall terms, there are still more dwellings within NIA experiencing reductions in noise level with the Proposed Scheme (with design changes) in place (413) than there are experiencing increases (90). Conversely, without the Proposed Scheme (with design changes) in place, there are slightly less dwellings that are expected to experience a decrease in noise level (409) and slightly more dwellings that are expected to experience an increase in noise level.

4. Further mitigation

4.1. Noise Insulation Regulations

- 4.1.1. An assessment using the parameters as set out in Table 8-8 of the ESR and the methodology in Table 8-9 of the ESR indicates that with the Proposed Scheme (with design changes) in place, approximately seventeen properties may potentially qualify under the Noise Insulation Regulations.
- 4.1.2. Paragraph 8.10.1 of the ESR suggested that only seven properties would qualify for noise insulation, hence the design change has increased the number of potentially eligible dwellings by 10 properties.
- 4.1.3. This is subject to further detailed assessment in full accordance with the Regulations once the final designs are completed.

5. Residual Effects

- 5.1.1. The Proposed Scheme is not expected to give rise to significant residual effects during either the construction or operational phases. Enhancements to the noise environment will be obtained through the inclusion of four new noise barriers and provision of a new low noise road surfacing on Lanes 1 and 4 as part of the Proposed Scheme.

6. Summary

6.1.1 Table 6-1 below presents a summary of the permanent effects on noise during operational phase of the Proposed Scheme (with design changes), and replaces Table 8-31 of the ESR.

Table 6-1 Summary table of permanent effects on noise during operation

| Potential environmental Effects | Proposed mitigation, enhancement or monitoring measures | Residual impact |
|---|--|-------------------|
| Operational road traffic noise: Negligible effect. | New noise barriers: NB21 – 863m long and 3m high NB21a – 65m long and 3m high NB22a – 350m long and 3m high NB29 – 628m long and 4m high | Beneficial effect |

7. Summary

Noise and vibration:

Figure 8-1 Study Area for Construction Noise and Vibration

Figure 8-2 Operational road traffic noise. Short term comparison. Do-Something 2020 – Do-Minimum 2020. Sheets 1 to 9.

Figure 8-3 Operational road traffic noise. Long term Do-Minimum comparison daytime. Do-Minimum 2035 – Do-Minimum 2020. Sheets 1 to 9.

Figure 8-4 Operational road traffic noise. Long term Do-Minimum comparison night-time. Do-Minimum 2035 – Do-Minimum 2020. Sheets 1 to 9.

Figure 8-5 Operational road traffic noise. Long term Do-Something comparison daytime. Do-Something 2035 – Do-Minimum 2020. Sheets 1 to 9.

Figure 8-6 Operational road traffic noise. Long term Do-Something comparison night-time. Do-Something 2035 – Do-Minimum 2020. Sheets 1 to 9.