M4 Junctions 3 to 12 smart motorway

Risk Management in response to the LMVR ACO Minute

1. Background

1.1. This Technical Note provides details of the measures taken to address the risks highlighted in the Appraisal Certifying Officer's ("ACO") Minute of the 18th September 2013 in respect of the Local Model Validation Report ("LMVR") for M3M4 Model. The model submitted for appraisal in 2013 reflected the status of the base traffic model at the end of its development and prior to its subsequent use as a basis for the development of the traffic forecasts, which commenced shortly afterwards. The traffic forecasts were completed by July 2014 to allow the subsequent assessments in preparation for the Environmental Statement to be undertaken in 2014-2015.

1.2. Due to the inherent risks (in the nature of uncertainties) associated with any form of modelling, as part of the Highways England governance regime it is the role of the Traffic Appraisal Modelling and Economics ("TAME") ACO to scrutinise traffic models developed for use on Highways England projects. TAME's role is to ensure that, when approved, such models provide a sufficiently robust basis for subsequent scheme assessment. This is a requirement for all schemes being promoted by Highways England. As a result of the TAME ACO process most traffic models will carry some form of qualification which identifies particular risks. As such, the M3M4 traffic model is no different in this respect to most Highways England projects.

1.3. The ACO Minute concludes that in general, the modelled flows and journey times are similar to those observed through surveys undertaken in 2009 for the model development. The level of network change as a result of the Scheme will be small in comparison to the whole model study area. Therefore it would be reasonable to assume that the journey pattern across the whole model area is not likely to change significantly. In summary, the overall performance of the model on the Scheme links was found to be acceptable and the ACO minute acknowledges that to improve compliance would be both costly and time consuming.

1.4. However, the minute also identifies the following items:

1. In general, less confidence can be placed in the modelled outputs and in turn on the dependent assessments than would be the case with a fully TAG compliant model;
2. The effects of the Scheme on the operation of the M25 will be difficult to assess;
3. The robustness of air quality assessments may be compromised by the modelled speeds being higher than observed; and
4. The basis for HGV flows is compromised by the application of a correction factor of two to the base year matrices.

2. Actions Taken in response to highlighted uncertainties

2.1. As with any identified risks, the appropriate response is to manage the relevant risks. This means that where possible, they are eliminated. Where that is not possible, the risks should be mitigated to an acceptable residual level. Where mitigation is not possible or effective, it may be necessary to tolerate them. Accordingly, on receipt of the ACO Minute and prior to using the model for the Scheme forecasts (and EIA), the risks

were reviewed. As stated in the ACO Minute, it was recognised that further model development work to eliminate the risks would be costly and time consuming.

2.2. The risks fell into two broad categories – traffic flows and speeds. Accordingly, as it was already four years beyond the validated base year of 2009, the decision was taken to undertake a validation check for the M4 against 2013 traffic data. This would mitigate the concerns over the model outputs in terms of flows. These checks were undertaken in the spring of 2014 prior to the traffic model data being issued for the environmental evaluations published in the Environmental Statement, and the results are described below in paragraphs 2.4 to 2.6.

2.3. The second category relates to the ability of the model to provide sufficiently accurate speed data for air quality assessment. This issue is not confined to the M3M4 model; it is common to many 'strategic' models, particularly in congested traffic conditions. Appropriate methods to 'post-process' the model outputs for better representation in air quality modelling have been developed on other Highways England projects and it was decided to employ these techniques at the appropriate stage as part of the later assessments. This would mitigate the concerns over the model outputs in terms of speeds. Each of these measures is described in more detail below in paragraphs 2.7 to 2.13.

Risks 1 and 4 - Validation of model traffic flow outputs

2.4. As noted in the ACO minute, the model performance on the links is acceptable. Modelled journey times were within 12% of those recorded from surveys of journey times in 2009. This is better than the level that WebTAG sets as a benchmark is that 85% of modelled journey time routes are within +/- 15% or 1 minute (if higher). The journey time validation for each total route is met in all but the PM peak period, where 96% of the times meet the criterion. The modelled flows were also close to those surveyed. However, further work was carried out to address the risk of less than robust assessments associated with the model outputs by comparing forecast outputs from the model with the recorded traffic flow in 2013 on the M4 from the Highways Agency Traffic Information System ("HATRIS"). HATRIS is a database that holds details of traffic flows downloaded primarily from loops installed in the carriageways of trunk roads. It also holds a journey time database collated from speed data recorded from vehicles passing over the counting loops.

2.5. The comparison concluded that the percentage difference between the HATRIS and model flows remained consistent between 2009 and 2013. This demonstrated that the underlying level of validation had remained constant over time. Whilst the match remained good for the modelled time periods, the 2013 forecasts were on average 10% lower at the Annual Average Daily Traffic ("AADT") level. This pointed to a need to revise the factors used to convert modelled period flows to AADT equivalent flows for subsequent environmental assessments.

2.6. The ACO Minute also raised a specific concern in respect of the application of an adjustment factor of 2 to the HGV matrices. The explanation for this is provided in the LMVR and relates to the data received from the Great Britain Freight Model ("GBFM") for input to the traffic model. The GBFM data is, in turn, based on Department for Transport ("DfT") data on the movement of UK-based goods vehicles. By excluding foreign-based goods vehicles and other large vehicles, both of which are necessary for forecasts of

'Heavy Duty Vehicles' required for environmental assessment, the initial sample in the model was lower than it should have been. Whilst this led to the use of the large scale adjustment, it was the limitations in the available data that compromised the modelling of HGVs, not the adjustment factor. The 2013 validation check against the recorded flow data showed that modelled HGV flows were on average 1% higher than those recorded in HATRIS. Taken together, the results for both total flow and HGV flows increased the confidence in the modelled outputs, and reduced the probability of risks 1 and 4 above occurring.

Risks 2 and 3 - potential for modelled speeds being higher than observed

2.7. The ACO Minute makes reference to the potential for the robustness of air quality assessments to be compromised by the modelled speeds being higher than observed. This appears to be a general comment, but one which is not entirely correct. It may have been the ACO's intention to comment on the implications for the M25, where modelled speeds are higher than observed in certain time periods and therefore affect the accuracy of air quality assessment on this route. However, it does not reflect the results of the overall journey time validation for the M4 which, with the exception of the PM peak, fully meet DMRB criteria. Within the key AQMA areas, the model speeds on individual links vary – some higher than recorded, others lower. However, the averaged journey times for the combined links through the AQMAs more closely match the recorded times. The details are set out in the LMVR. The result is that while average journey times through an AQMA are representative, the variation in speeds on individual links from the recorded values will affect the accuracy of the air quality assessment at individual receptors. This issue is considered in more detail below.

2.8. The issue of how speeds are represented at the individual link level within traffic models and the implications for subsequent environmental assessment has been recognised by Highways England. IAN 185/15 (Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into speed-bands' for users of DMRB Volume 11, Section 3, Part 1 'Air Quality and Volume 11, Section 3. Part 7 Noise) has been published to address this risk. The IAN draws on experience gained from the 'post-processing' of traffic model outputs referenced in paragraph 2.2 above.

2.9. IAN 185/15 recognises some of the key problems associated with trying to model air quality using traffic data, in particular the issue of speed variability at the link level. This often arises, for example, when traffic modellers introduce a delay penalty at an arbitrary point on a link between two junctions. The delay penalty replicates the disturbance to traffic flow brought about by merging, weaving and diverging traffic in congested traffic conditions and as a result achieves a journey time between junctions more representative of actual traffic conditions. Whilst this is good for model validation, it distorts modelled speeds along the link and as these are input directly into the air quality assessment, can impact upon the results. IAN 185/15 introduces a speed banding process designed specifically to deal with the issue by replacing the modelled speeds with averages that are more typical of the road type and traffic flow conditions.

2.10. This approach has been applied alongside the original M4 assessments to overcome (as far as is practical) the third highlighted risk associated with the issue of imperfect speed estimates within the M3M4 traffic model compromising the subsequent dependent assessments.

2.11. The IAN 185/15 approach was applied to the air quality assessment with the conclusion that the revised predictions for air quality following the IAN 185/15 speed banding methodology identified fewer properties that are predicted to experience a small, medium or large change in concentrations, with concentrations above the objective value. Therefore, the risk of a significant effect on air quality was unchanged from the assessment presented in the ES.

2.12. In addition, as IAN 185/15 also applies to noise, this was re-assessed from which it was concluded that employment of speed banding data in the noise assessment for the Scheme results in minimal differences in the short term and long term noise level and annoyance changes, when compared to the results using modelled speed data as reported in the ES. It was therefore concluded that there is no requirement for the provision of additional noise mitigation (beyond that specified in the ES) as a consequence of employing the speed band data in the noise assessment for the Scheme.

2.13. Finally, the ACO minute noted that journey times on the M25 were 48% and 24% faster (clockwise/anti-clockwise) in the model than observed. An explanation for why this might occur is provided in the LMVR which relates to the inability of the standard TAG compliant speed-flow relationships used in traffic models to replicate the particular highly congested conditions on the M25. Consultants working on M25 schemes have confirmed this to be the most likely reason and that by replacing the standard curves with bespoke 'M25' curves they have resolved this issue.

2.14. Whilst the modelling of speeds on the M25 is an issue for the assessment of schemes along that route, it has no material effect on the air quality assessment for the M4 as no impacts above the level of significance have been identified along the M25 arising from the M4 assessment.

3. Summary

3.1. The combination of the additional validation of the traffic model against 2013 flows and the assessments using the speed banding methodology in IAN 185/15 has addressed the risks raised in the ACO minute ensuring a sufficiently robust set of outputs for environmental assessment.