Briefing Note 07

Project:	**National Highways Spatial Planning Arrangement**	Job No:	**60659714 Q14DN063.006**
Subject:	**Dudgeon Sheringham Offshore Wind Farm – DCO Support**		
Prepared by:	**Amy Findlay**	Date:	**16th June 2023**
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1. Introduction

1.1. AECOM have prepared this Briefing Note (BN07) on behalf of National Highways to document a review of Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects – Junction Modelling Clarifications (dated 18th May 2023) issued to National Highways (NH) by Equinor, prepared for the Dudgeon and Sheringham Shoal Extension Projects DCO.

1.2. The Junction Modelling Clarifications technical note is intended to address comments within this topic area that AECOM raised earlier in the examination period. AECOM received this document on 22nd May 2023.

1.3. NH are responsible for the monitoring, management, and maintenance of the SRN. Within the vicinity of the DCO, the SRN consists of the A47, as well as the A11, with most relevant sections being the highways and junctions along the A47 in the vicinity of Easton and Honingham villages, to the west of Norwich.

1.4. The review against previous recommendations is set out as follows:

Table 1: AECOM Response to Applicant's Response to Junction Modelling Issues

ID	Brief Description of issue raised by AECOM on behalf of NH	Applicants Response	AECOM Response
R6	TA results tables and outputs for Junction 1 do not correlate for the 'with development scenarios'	The Applicant agrees with the findings of AECOM that the Transport Assessment (TA) results tables [APP-268] do not correlate with the junction modelling inputs and outputs contained within the Annex 7 and 32 of the TA [APP-269] respectively. The Applicant has therefore reviewed all junction modelling and made the flowing amendments: · Updates to the Annex 7 flow diagrams are provided as Appendix 1 of this note. · Updates to the Annex 32 junction modelling outputs are provided as Appendix 2 of this note. · Updates to the TA results tables [APP-268] are provided and Appendix 3 of this note. The following provides a summary of the conclusions of the TA [APP-268] in comparison to the revised junction modelling results (detailed in Appendix 3 of this note) to provide National Highways with an appraisal of any materially changes to the assessment conclusions. **Junction 1** The TA [APP-268] outlined that the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP and DEP traffic, the TA [APP-268] outlined that the B1535 arm of the junction would operate over capacity with significant queuing and delay. The updated junction modelling outputs (Appendix 3) have not resulted in a change to the baseline conditions, however the forecast performance of the junction improves in the with development scenario compared to previously reported results. Notwithstanding, Appendix 3 still shows that with the addition of SEP and DEP traffic the junction would operate over capacity and experience significant queuing and delay. The conclusions of the TA [APP-268] and mitigation strategies outlined within the OCTMP [REP1-028] for junction 1 are therefore considered to remain valid. **Junction 2, 3, 4, 6 and 8** The updated junction modelling outputs (Appendix 3) correlate with the figures presented within the TA [APP-268]. The conclusions of the TA [APP-268] for junctions 2, 3, 4, 6 and 8 are therefore considered to remain valid. **Junction 5** The TA [APP-268] outlined that the existing junction operates with spare capacity with queues of up to 17 PCUs. With the addition of the SEP and DEP traffic, the TA [APP-268] outlines that the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay. The updated junction modelling outputs (Appendix 3) have resulted in	AECOM agree that the changes made to the modelling of Junction 1 are appropriate and accurate. AECOM have carried out checks on the updated results and outputs for Junction 1. There are no differences in the 2025 Forecast Background Flow scenarios. The 2025 Forecast Background Flows + SEP or DEP in Isolation scenarios show a decrease in queuing and RFC relative to the equivalent assessment scenario within the TA, as stated within the applicant's response.
R8	TA results tables and outputs for Junction 5 do not correlate for all scenarios		AECOM agree that the changes made to the modelling of Junction 5 are appropriate and accurate. AECOM have carried out checks on the updated results and outputs for Junction 5. There are minor differences in the modelling results as stated by the applicant. The maximum predicted queue was modelled on the eastbound off-slip from the A47, at 17 PCUs. This has changed to 20 PCUs. These changes do not result in a material difference in the performance of the junction relative to the previous assessment. The data input and modelling results for Junctions 2, 3, 4, 6 and 8 are considered by AECOM in responses to ID R9, R27, R28, R29, R7 and R31

ID	Brief Description of issue raised by AECOM on behalf of NH	Applicants Response	AECOM Response
		minor changes for all scenarios. The conclusions of the TA [APP-268] for junction 5 are therefore considered to remain valid. **Junction 7** The TA [APP-268] outlined that the existing junction operates over capacity with significant queuing. With the addition of the SEP and DEP traffic, the TA [APP-268] outlined that the junction would continue to operate over capacity and users would experience an increase in queues and delays. The updated junction modelling outputs (Appendix 3) have resulted in a worsening of the baseline conditions on the A47 East arm and with the addition of the SEP and DEP traffic Appendix 3 shows that the junction would still operate over capacity and experience significant queuing and delay. The conclusions of the TA [APP-268] and mitigation strategies outlined within the OCTMP [REP1-028] for junction 7 are therefore considered to remain valid. **Junction 9** The TA [APP-268] outlined that the existing junction operates with spare capacity with queues of no more than two vehicles. With the addition of the SEP and DEP traffic, the TA [APP-268] outlines that the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay. The updated junction modelling outputs (Appendix 3) have resulted in minor improvements to junction capacity, queuing and delay for all scenarios. The conclusions of the TA [APP-268] for junction 9 are therefore considered to remain valid. **Junction 10** The TA [APP-268] outlined that the existing junction operates with spare capacity with queues of no more than one vehicle. With the addition of the SEP and DEP traffic, the TA [APP-268] outlines that the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay. The updated junction modelling outputs (Appendix 3) have resulted in very minor to improvements to junction capacity, queuing and delay for some scenarios. The conclusions of the TA [APP-268] for junction 10 are therefore considered to remain valid. **Junction 11** The TA [APP-268] outlined that the existing junction operates with spare capacity with queues of no more than one vehicle. With the addition of the SEP and DEP traffic, the TA [APP-268] outlined that the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay. The updated junction modelling outputs (Appendix 3) have resulted very minor improvements to junction capacity	

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		for one scenario only. The conclusions of the TA [APP-268] for junction 11 are therefore considered to remain valid.	
R9	Flow diagrams of traffic flow matrices should be provided for each of the SRN junction models so that these can be verified		Traffic flow matrices have been provided for every SRN junction, and it is understood that the size of the study area, including non-SRN junctions, makes a standard flow diagram not practical to produce. AECOM has checked the traffic flows as inputted into each of the junction models against the traffic flow matrices and confirm that these match.

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<tr><th>ID</th><th>Brief Description of issue raised by AECOM on behalf of NH</th><th>Applicants Response</th><th>AECOM Response</th></tr>
<tr><td>R28</td><td>TA results tables and outputs for Junctions 2, 3, 4, 6, 7 & 10 do not correlate for a number of the scenarios; this should be clarified</td><td></td><td>AECOM agree that the changes made to the modelling of Junctions 7, 9, 10 and 11 are appropriate and accurate. AECOM has checked the updated traffic flow matrices and junction assessment outputs for all junctions to ensure the correct number of scenarios have been modelled and presented. The conclusions of each of the junction assessments are agreed by AECOM.</td></tr>
<tr><td>R11</td><td>The modelling for the Thickthorn Interchange Junction should be revisited as appropriate as the results showing that there are no capacity issues is surprising given that there is a RIS scheme proposed at this location to relieve congestion</td><td>The modelling scenarios presented in the TA [APP-268] represent the shoulder peak hours of 06:30 to 07:30 for the morning peak and 17:25 to 18:25. These periods were agreed with National Highways at Expert Topic Group Meeting (ETG) 5 (05 April 2022) (detailed within Evidence Plan Agreement Log [APP-030]) as a representative worst case scenario for assessing sensitive junctions when considering the periods during which the peak SEP and/or DEP traffic demand could manifest.
The following table provides a comparison of the network and shoulder peak traffic flows for Junction 5 (extrapolated from Annex 2 of the TA [APP-269]).
<table><tr><th>2021 observed vehicle movements</th><th>Junction 5</th></tr><tr><td>06:30 – 07:30 (shoulder peak)</td><td>4,625</td></tr><tr><td>07:30 – 08:30 (network peak)</td><td>6,745</td></tr><tr><td>Difference between shoulder and network peak</td><td>2,120 (~37%)</td></tr><tr><td>17:25 – 18:25 (shoulder peak)</td><td>4,976</td></tr><tr><td>16:25 – 17:25 (network peak)</td><td>6,168</td></tr><tr><td>Difference between shoulder and network peak</td><td>1,192 (~21%)</td></tr></table>It can be noted from the table above that there are significant differences between the peak and shoulder peak movements through the junction.</td><td>The approach to modelling for Thickthorn Interchange Junction appears reasonable given that shoulder peaks of 06:30-07:30 and 17:25-18:25 were used, as opposed to the network peak. The use of shoulder peak results in 37% less trips in the AM shoulder peak hour than the AM network peak hour, and 21% less trips in the PM peak hour, The explanation of the difference between the shoulder peak and the network peak is therefore accepted. In addition, the use of shoulder peaks were previously agreed by NH at an Expert Topic Group, dated 5th April 2022 so represents a previously agreed position.</td></tr>
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R26	The observed peak hour should be set out in order to identify how the shoulder peak periods relate to the prevailing peak hour.	Paragraphs 118 and 119 of the TA [APP-268] outline a summary of an agreement with National Highways (NH) in relation to the periods to be assessed: "… It has been agreed with NH (at a meeting on the 5 April 2022) that a representative worst case scenario for assessing sensitive junctions would be during the period immediately preceding the morning network peak and immediately following evening network peaks, (known as shoulder peaks). These shoulder peak periods are identified as: · 06:30 – 07:30; and · 17:25 – 18:25. The rationale for these worst-case scenarios is that it is considered representative of the time when the peak SEP and/or DEP traffic demand associated with employee trips (LVs) could manifest if there was any divergence in the working hours of 07:00 to 19:00 (e.g. administration staff arriving later or earlier shift finishes to accommodate onward travel to home). The shoulder peak periods would also contain the hourly SEP and/or DEP HGV demand as delivery to and from site would have commenced."	It is noted by AECOM that the use of shoulder peaks identified as 06:30-07:30 and 17:25-18:25 were agreed by NH in a meeting on the 5th April 2022 as a representation of when SEP and/or DEP traffic demand would likely take place. AECOM considers this approach acceptable.
R27	For junctions 2 & 7, the modelled period for the AM peak appears to be between 07:30-08:30, rather than the intended hour of 06:30-07:30.	The Applicant agrees that both the AM and PM scenarios within the Junction 2 and 7 model outputs (contained within Annex 32 of the TA [APP-269]) were incorrectly showing the network peak time periods of 07:30 to 08:30 and 16:25 to 17:25 respectively. The Applicant clarifies that data used within the models did however use the correct shoulder peak time periods. Notwithstanding, the time periods notated within the model outputs have been corrected as part of the wider amendments to the junction modelling presented within Appendix 2 of this note.	AECOM has performed checks on the peak periods modelled for all junctions within the Junction Modelling Clarification Report and confirm the peak periods used were originally correct (but had been mis-labelled) and the time period labels have been corrected and are now aligned.
R29	The 'lane simulation' function may be useful when modelling Junction 6 - if the modelling is updated, the use of this function should be considered.	The Applicant has undertaken a comparison of modelling Junction 6 using the lane simulation function for 2021 and 2025 baseline situations, the outputs of this modelling are presented in Appendix 4. It can be observed from Appendix 4 that with the exception of the A140 North during the evening periods the outputs are broadly comparable to the outputs contained within Appendix 2 (without lane simulation). With regard to the A140 North, Appendix 4 suggests that in 2021 the level of service (LOS) would be D (approaching unstable flow) and that with the application of background traffic growth, by 2025 the LOS would be F (Forced or broken down). When considering observed queue lengths in 2021 (Annex 2 of the TA [APP-269]) it can be noted that there would be an average of three vehicles and therefore LOS of D is not considered to be representative of baseline conditions. Noting that the junction modelling (Appendix 3)	Within the Junction Modelling Clarification Report 'Appendix 4 - Junction 6 Modelling Outputs (with lane simulation)' is provided. The summary provided by the Applicant in relation to this sensitivity test is accepted by AECOM and it is agreed that the use of lane simulation for Junction 6 is not necessary, notwithstanding that observed queue data was not contained within the TA.

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		demonstrates that the impact of SEP and DEP traffic would not be significant and that Appendix 4 doesn't validate with observed junction performance it is reasoned that the use of lane simulation for Junction 6 is not appropriate.	
R30	For Junction 7, the flare length included within the model set up for the A47 east arm appears to be excessive.	The Applicant has revised the geometry measurements for junction 7 and 9 as suggested by AECOM. Updates to the Annex 32 junction modelling outputs are provided as Appendix 2 and updates to the TA results tables [APP-268] are provided and Appendix 3 of this note. The following provides a summary of the conclusions of the TA [APP-268] in comparison to the revised junction modelling results (detailed in Appendix 3) to provide National Highways with an appraisal of any material changes to the assessment conclusions. **Junction 7** The TA [APP-268] outlined that the existing junction operates over capacity with significant queuing. With the addition of the SEP and DEP traffic, the TA outlined that the junction would continue to operate over capacity and users would experience and increase in queues and delays. The updated junction modelling outputs (Appendix 3) have resulted in a worsening of the baseline conditions on the A47 East arm and with the addition of the SEP and DEP traffic Appendix 3 shows that (with the revised geometry) the junction would still operate over capacity and experience significant outlined within the OCTMP [REP1-028] for junction 7 are therefore considered to remain valid. **Junction 9** The TA [APP-268] outlined that the existing junction operates with spare capacity with queues of no more than two vehicles. With the addition of the SEP and DEP traffic, the TA outlines that the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay. The updated junction modelling outputs (Appendix 3) have resulted in minor improvements to junction capacity, queuing and delay for all scenarios. The conclusions of the TA [APP-268] for junction 9 are therefore considered to remain valid.	The applicant has amended the flare length of A47 East at Junction 7 from 74.0m to 10.9m which appears reasonable. Minor changes have also been made to the Approach road half-width and Entry width, which AECOM accept. It is evident that while a comparative reduction in capacity is modelled on the arm, it is evident that the difference is not significant in that the junction would operate overcapacity in any case, as stated by the Applicant.
R32	The geometry measurements for the A47 north approach to Junction 9 differ to AECOM's measurements should be revisited and the modelling results updated as appropriate.		AECOM has checked the updated geometry for Junction 9 which shows Dereham Road (Arm D) has been amended. Whilst AECOM agrees the new measurements appear reasonable, it should be noted the Effective Flare Length has increased from 18.1m to 20.3m. The change is immaterial to the junction assessment results.

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R31	The Google Maps traffic function appears to show some congestion at Junction 8, particularly during the PM peak; the modelling results appear to contradict this and further clarification should be provided with regards to this.	The Applicant has reviewed the inputs to the model and confirms that they correctly align with the observed turning counts. The Applicant would also reiterate its response to R11 which confirmed that the junction modelling is based upon shoulder rather than network peak hours.	AECOM accepts the rationale for the response and notes the difference between the PM network peak and shoulder peaks as displayed by the Google Maps traffic function.
R7	Mitigation Proposals Junction 2 (Blind Lane / Taverham Road / A47). Plans clearly showing the mitigation should be provided so that the modelling can be verified.	A plan of the mitigation measures proposed at the junction of the A47/Blind Lane and Taverham Road is provided as Appendix 5 of this note. The plan provided as Appendix 5 has informed the geometry modelling presented within Appendix 2.	The applicant has provided the proposed junction layout for Junction 2 (A47 / Taverham Road / Blind Lane junction), in Appendix 5, against which AECOM have checked the junction modelling inputs, and verifies that the Hornsea P3 mitigation is correctly set up within the junction assessment. The key features are no right turn movements from the minor arm, and the closure of Blind Lane. The mitigation is forecast to assist in the junction operating significantly within capacity. This is additional to the likely safety benefits associated with the mitigation.

2. Conclusions

2.1. AECOM have prepared this Briefing Note (BN07) on behalf of National Highways to document a review of Sheringham Shoal and Dudgeon Offshore Wind Farm Extension projects – Junction Modelling Clarifications (dated 18th May 2023), from Equinor.

2.2. Upon review of the submission, AECOM concludes that matters previously raised in relation to junction modelling have been suitably addressed.