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A303 Amesbury to Berwick Down (Stonehenge) Wiltshire TR010025

Addendum to Wiltshire Council's Written Representation

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I. Introduction

1. The A303 Amesbury to Berwick Down (Stonehenge) Road Improvement Scheme Examination timetable as set out in the Rule 8 letter, permitted Interested Parties to submit Written Representations relating to any environmental information submitted by the Applicant at Deadline 1 for Deadline 2a (10th May).

2. Wiltshire Council has prepared this document as an Addendum to its Written Representation and it relates solely to Flood and Drainage matters.

3. This Written Representation is made in accordance with the Infrastructure Planning (Examination Procedure) Rules 2010 rule 10. It should be read in conjunction with the April 2019 Local Impact Report (submitted on 18th April 2019), Written Representation and Initial Statement of Common Ground, which were both submitted on 3rd May 2019.

II. Flood and Drainage Considerations

4. As explained (and included at Appendices A1-4) within Wiltshire Council's Written Representation, the Council commissioned Atkins to undertake a peer review of Highways England's (HE's) approach to flood risk for the Scheme in respect of surface water (pluvial) including ordinary watercourses, groundwater and the road drainage strategy.

5. HE submitted four further reports into Examination, which were published on 10th April, and comprised:

    - Stonehenge Area Pumping Test 2018 Interpretative Report
    - Stage 4 – Implications of 2018 Ground Investigations to the Groundwater Risk Assessment
    - Stage 4 – Supplementary Groundwater Model Runs to Annex 1 Numerical Model Report
    - Stage 4 – Groundwater Monitoring 2018-19 Conceptual Model Review.

6. Atkins, as Wiltshire Council's framework consultants, reviewed these reports to provide an updated review of the groundwater related risks for the Scheme. Atkins were also asked to consider whether the issues raised within the original peer review have now been addressed.

7. In summary, the review found:

    - The additional data collection and interpretation has improved the understanding of the hydrogeology of the area and highlighted the heterogeneity in the aquifer system.
    - The additional modelling runs and presentation of calibration data have provided reassurance on the validity of the approach to the qualitative risk assessment.
    - Presentation of calibration data for additional locations, including those with longer groundwater level records, and flows in the river would provide further confidence.
    - The additional documents do not address the concerns raised previously regarding the consistency between the groundwater flood risk assessment and the pluvial and fluvial flood risk assessments nor those regarding caveats on how modelled groundwater levels should be used in flood levels or Scheme design.

8. The full report has been attached at Appendix A to this document and contains further detailed explanation on the conclusions reached above.

9. A further report, Blick Mead Monitoring to March 2019, was submitted by HE into Examination (published on 10th May). This report was submitted in response to a specific data request, and did not provide clarification on the approach to the quantitative risk assessment, therefore it has not been included within the list of documents reviewed by Atkins.

III. Conclusions

10. The Council's assessment of the newly provided flood and drainage reports for the Scheme is contained herein. There are a number of issues which still require resolution and / or clarification and discussions with HE will continue in an attempt to resolve them. The progress / outcome of these discussions will be captured in the Council's Statement of Common Ground with HE.

11. The Council reserves the right to make further comments on the DCO application throughout the Examination process and to modify its position in view of any additional information, which is presented to the Examination. This will be via additional representations, submissions at Issue Specific Hearings and through the Council's Statement of Common Ground with HE. This Addendum to the Council's Written Representation has therefore been submitted on a "without prejudice" basis.

12. This Addendum to Wiltshire Council's Written Representation should be read in conjunction with the Council's Written Representation and Initial Statement of Common Ground submitted for Deadline 2 (3rd May) and its Local Impact Report submitted for Deadline 1 (18th April).

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Appendices

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Appendix A

Update of Peer Review of Groundwater Risk Assessment

Memo

To:	Carli VanNiekerk, Danny Everett, Wiltshire Council		
From:	Lesley McWilliam	Email:	lesley.mcwilliam@atkinsglobal.com
Date:	8 May 2019	Phone:	01372 756162
Ref:	5157973-ATK-ABD-ZZ-RP-EN-026	cc:	
Subject:	A303 Amesbury to Berwick Down Update of peer review of Groundwater Risk Assessment		

1. Introduction

This note provides an updated review of the groundwater-related risks for the A303 Amesbury to Berwick Down scheme. A peer review of the initial groundwater reports was issued in November 2018 (ref: 5157973-ATK-ABD-ZZ-RP-EN-022). This note considers four recently released documents and whether the issues raised in the November 2018 review have now been addressed.

The following documents have been reviewed:

- Stonehenge Area Pumping Test 2018 Interpretative Report *(note: appendices not available)*
- Stage 4 – Implications of 2018 Ground Investigations to the Groundwater Risk Assessment
- Stage 4 – Supplementary Groundwater Model Runs to Annex 1 Numerical Model Report
- Stage 4 – Groundwater Monitoring 2018-19 Conceptual Model Review

2. Summary comments on the additional documents

The Stonehenge pumping test report presents the results of three sets of tests carried out in summer 2018 at boreholes in contrasting hydrogeological settings. Data were collected at multiple observation boreholes and detailed analysis of the results is provided.

The pumping test results, together with the ground investigation results presented in the second document, highlight the heterogeneity of the Chalk aquifer in the scheme area. Differences in groundwater level and flow are noted over short distances (laterally and vertically). The reports describe the updated aquifer understanding including of flow horizons, directional responses in groundwater behaviour and the contrasts between valley and interfluve settings; some previous assumptions have been revised or refined.

The groundwater model set up remains valid in light of the new findings. The model is in any case a simplification of the complex groundwater system. However, the additional data on aquifer transmissivity and storage and how these vary across the area underline the need to test the sensitivity of the model to these parameters.

Previous assumptions about the importance of a discrete flow horizon which have partially been dispelled by the new ground investigation data, means that the way the way the tunnel is modelled

is likely to be pessimistic i.e. perhaps overestimates the impediment to groundwater flow and backing up of water levels north of the tunnel.

The report on supplementary groundwater model runs describes additional work with the groundwater model, carried out in response to review comments and the findings of the 2018 investigations. The supplementary runs include tests of the impact of short model runs versus full length runs, sensitivity to the starting heads used in the model and sensitivity to alternative transmissivity and storage parameter distributions.

The results suggest the conclusions from the modelling work are not sensitive to the short model runs and choice of starting heads and the original approach taken with the modelling appears valid for considering peak events. However, for low flow periods where there is not a preceding recharge event to reset the system, the model results, particularly river flows, are more sensitive to the shortened run and results should be used with care.

The sensitivity runs testing alternative aquifer parameters indicate that conclusions from the modelling on the impact of the tunnel would not change under the alternative parameters. The properties originally used appear to provide the best calibration for peak groundwater levels.

Overall the supplementary runs provide reassurance in the conclusions drawn from the modelling on the impact of the tunnel on the groundwater system.

As there is no change to the assessment of the impact of the tunnel, the groundwater risk assessment tables have not been updated.

The conceptual model review document presents the most recent groundwater monitoring data for boreholes across the scheme area. Variations in seasonal groundwater levels between boreholes are noted and provide further evidence of the aquifer heterogeneity.

The document includes graphs demonstrating the groundwater model calibration against the monitoring data for selected boreholes (six site investigation boreholes and the Environment Agency (EA) observation borehole at Stoford). Although the comparison can only be approximate as there is generally no overlap between the model and monitoring periods, it provides a useful sense-check on the model output.

3. Extent to which review comments have been addressed

Comments from the November 2018 review (ref: 5157973-ATK-ABD-ZZ-RP-EN-022) are restated below, with blue text indicating whether the points have been addressed by the new documents.

Summary of review findings

1. The overall approach to groundwater risk assessment appears reasonable. The risk of the scheme inducing groundwater flooding, interfering with abstractions or impacting on flows to environmental receptors appears to be low (i.e. risks relating to quantity of groundwater flow and heads).

This point remains valid and the additional work has provided further reassurance.

2. The conceptual model of the groundwater system is presented clearly in Ref 1. Data collation has covered the usual expected data sources and reasonable interpretation and conclusions have been drawn.

The additional data collection and interpretation has enhanced the conceptual understanding.

3. Use of the Wessex Basin model for quantitative risk assessment is a sensible approach; this is the best available tool and has stakeholder acceptance. Refinements to the hydraulic conductivity (K) in the model in the study area, in keeping with local pumping test results, appears appropriate. Nevertheless, the groundwater levels and flows presented do not show a clear improvement in model calibration.

Testing of alternative parameter distributions has provided reassurance in the model setup.

4. It would be useful to see further interrogation of the model calibration, both original and refined versions, in the study area and checks on the impact of refinements to the model (both the K changes and using short model runs). This would provide additional confidence in the results and a fuller understanding of limitations.

This comparison has been provided for groundwater levels at a selection of monitoring boreholes and provides further confidence in the model. Ideally more long term groundwater level records (e.g. from EA monitoring boreholes) and flows in the rivers would have been included.

5. A more comprehensive description of the refinements made should be given e.g. the extent of the changes in K and what starting heads have been used for each run. A table of model runs (stating period, property changes, starting heads etc) with reference codes would be useful and each figure should state clearly which model run results are from.

For the supplementary runs the model refinements and starting heads have been clearly explained.

In this document, as well as in the original modelling report, a table of model runs and use of reference codes would have been valuable. It is not always clear which run is being shown on a figure.

6. The approach to modelling the tunnel structure below the water table by reducing K seems reasonable and assumptions appropriately conservative. Focusing presentation of results on changes in heads is correct: there would be more confidence in the model's ability to simulate changes in heads (and flows) than in modelling absolute levels.

No change has been made to the tunnel representation. New ground investigation results suggest the approach may be more conservative than anticipated.

7. Where the assessment relies on the modelling of absolute levels (e.g. presentation of flood risk as modelled groundwater levels compared to ground level) additional caution in use of the results should be stated. In the area north of the tunnel where the most significant rises in groundwater levels are predicted any additional information on model calibration in this area would be helpful (point 4 above).

The calibration figure includes two monitoring boreholes north of the tunnel. At these, and most of the other boreholes shown, the model used for the risk assessment appears to slightly overestimate groundwater levels (this is tentative as the monitoring/modelling periods do not overlap), and therefore may be pessimistic in terms of predicted flood risk. Modelled changes in level, rather than absolute level should be used wherever possible.

No comments on how the modelled groundwater levels should be used are included in the documents provided.

8. Where specific previous groundwater flooding issues have been identified, or any other areas where flooding concerns are acute, it would be useful to clearly state the modelled impact from scheme on flood levels at these locations (even if zero).

Not addressed in the documents provided

9. It is not evident whether any consideration been given to what the critical level is for groundwater interfering with drainage infrastructure or flood storage. A level of 2 m below ground has been used as an indication of risk but no explanation provided for what this is based upon. No information is given in these reports about how peak predicted groundwater levels from the modelling have been used in design of the scheme drainage infrastructure.

Not addressed in the documents provided

10. The approach to considering climate change of increasing recharge by 20% (to consider peak groundwater levels) is very simple – no allowance is made for the effect of soil zone processes or changes in starting heads (it is assumed). Clarification of how this corresponds to the approach used in fluvial/pluvial flood risk assessment (where 30% and 40% increases appear to have been used) should be provided. A 20% increase in recharge will represent <20% increase in rainfall.

Not addressed in the documents provided

11. The modelling results inevitably contain uncertainty and this should be reflected in presenting / describing results of quantitative risk assessment. Groundwater level monitoring of areas upgradient and downgradient of the tunnel will be important and as new data become available the modelling and risk assessment should be reviewed and updated.

Additional groundwater level monitoring data have been obtained but the records remain short. Monitoring should continue and the modelling and risk assessment be reviewed and updated.

12. The qualitative risk assessment concludes that almost all groundwater risks are low or very low (following embedded mitigation). These mostly refer to the use of the Construction Environment Management Plan (CEMP). Construction and operation of a scheme on the unconfined Chalk aquifer, with elements at or below the water table, presents risks particularly to water quality and the underlying vulnerability should be kept in mind in later phases (e.g. detailed design, enforcement of the CEMP).

The additional investigations and modelling do not suggest changes to the risk assessment are required.

13. It is not clear whether the potential risk that the tunnel surface acts as a preferential groundwater flow path and potential link between fissure zones has been considered.

Not addressed in the documents provided

Recommendations

- The model would preferably be run for the full 1965-2016 run time for each of the revised baseline runs (the baseline run with revised calibration, the wet climate change run and the dry climate change run) and thorough comparisons made with the original Wessex basin model output and with observation/gauge data. The short period runs would be checked against these and output from the full runs used as starting heads for the short runs.

Although not all of these specific runs have been carried out, the supplementary model runs do test the revised model over the full run period and test the sensitivity to starting heads. The results provide confidence that the modelling approach is valid.

Some additional comparison of model results with observation borehole data has been presented but, as noted above, should include more longer term groundwater level monitoring records and flows in the river.

- Provide an explicit list of the changes in the revised model compared to the original Wessex Basin model (e.g. as a table listing each model run).

Clearer descriptions of the aquifer property changes and starting heads have been provided

- Provide graphs showing comparisons between
  - the modelled groundwater heads from the short investigation runs
  - the long runs of the original Wessex basin model (and other long model runs if these are carried out)
  - observed data

  for all Environment Agency monitoring boreholes in the surrounding area and a good selection of site investigation boreholes covering the area of the scheme and areas to the north and south. This is a valuable check even where the time period of the short model does not overlap with the time period of the monitoring data.

As noted above, this has been done for some observation boreholes but nor for all locations with longer term records.

- Check the sensitivity of the model with the tunnel included and the wet climate change model to use of higher starting heads.

This has been done and raised no concerns.

- Provide clarification of how the climate change approach is consistent with that used in other flood risk assessments (and ensure they are consistent).

Not addressed in the documents provided

- Use monitoring data comparisons to inform caveats to be applied to the use of absolute levels for flood levels or in scheme design. The model is likely to be more reliable for predicting changes in heads (and flows) rather than absolute levels. Modelling absolute levels in extreme events would particularly hold uncertainty. The predicted position of the water table in terms of depth below ground should be used with a degree of caution.

Not addressed in the documents provided

4. Conclusion

- The additional data collection and interpretation has improved the understanding of the hydrogeology of the area and highlighted the heterogeneity in the aquifer system.
- The additional modelling runs and presentation of calibration data have provided reassurance on the validity of the approach to the quantitative risk assessment.
- Presentation of calibration data for additional locations, including those with longer groundwater level records, and flows in the river would provide further confidence.
- The additional documents do not address the concerns raised previously regarding the consistency between the groundwater flood risk assessment and the pluvial and fluvial flood risk assessments nor those regarding caveats on how modelled groundwater levels should be used in flood levels or scheme design.