

TECHNICAL NOTE

DATE:	06 October 2022	CONFIDENTIALITY:	Public
SUBJECT:	WSP Response to EA Comments		
PROJECT:	Bognor Golf Course Hydraulic Model	AUTHOR:	Andy Smith

INTRODUCTION

This Technical Note has been produced to provide a detailed response to the Environment Agency's comments on the hydraulic model which was developed to support the Hallam Land Management Ltd planning application for the redevelopment and relocation of the existing Golf Course (HA/2022/124003/01 and HA/2022/124004/01).

The Environment Agency provided comments on 7th September 2022 via email, with further context within the model review spreadsheets (NRT_2nd_follow_on_Bognor_Regis_Golf_Club_070929 and Bognor_Regis_Hydrology_Follow_On_080929), this note should be read in conjunction with the responses provided in the model review spreadsheets.

The comments from the Environment Agency are in italics below.

HYDRAULIC MODEL KEY COMMENTS

This section should be read in conjunction with the attached hydraulic model review workbook (NRT_2nd_follow_on_Bognor_Regis_Golf_Club_061029).

1. *Only the design event (100+25%CC AEP) has been included in the Infoworks Transferable database. Results for other AEP scenarios are not included within the supplied model. Site A contains residential land use (more vulnerable development) and Site B contains water compatible development (golf course). The central uplift allowance for the 2080s epoch (+25%) is the correct uplift to use based on the site vulnerability classification. Would it not be sensible to also test a 20 year scenario to check that the proposed development (particularly Site A) does not sit within functional floodplain?*

The model has been run for additional AEP scenarios, these are now provided within the ICMT. The AEP scenarios which are now provided are the 30yr+25%CC AEP, 50+25%CC AEP, 75+25%CC AEP and the 100+25%CC AEP. In line with the updates made to the Flood Risk and Coastal Change PPG in August 2022, we have not run the 20 year scenario, but the 30 year scenario. The appended flood maps demonstrate that the proposed developments are outside of the functional and design (1 in 100 year plus climate change) floodplains. With regard to the design floodplain there are minor areas where the modelled floodplain clips a couple of the proposed units, the reasons for this are two fold (dependent upon the location):

- this is considered to be an inherent part of the modelling, where the ground model is approximated into triangles to represent the ground surface
- The ground model / layout for the proposed development is subject to detailed design and modifications will be made during detailed design / RMA stage

In light of these points it is considered that these minor overlaps are addressed as part of the detailed design, once the final layout / platform locations / size is confirmed and are then tested in the hydraulic model for approval by the Environment Agency, this can be secured by an appropriately worded condition.

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2. *2 DTMS included within the model network; Updated GM 01022022.asc and Baseline GM.asc. The reporting mentions that the model used the most recent Lidar at the time of the model build. Comparisons were undertaken with EA composite 2020 Lidar DTM data. There are differences although these are generally not significant. There are differences between the Baseline Ground Model (Baseline GM.asc) and the Updated Ground model (Updated GM 01022022.asc) which extend outside of the proposed redevelopment areas (see worksheet Updated_GM_Minus_Baseline_GM within the attached workbook). It would be expected that ground levels should be consistent outside of the areas to be redeveloped? Please ensure ground models (and hence the resultant meshes) are consistent in areas where no changes are proposed.*

The model was developed using the 2020 Environment Agency LiDAR, which was the latest available at the time of the model build. However, the differences observed by the reviewer are a result of the processing of the LiDAR to convert it into a format suitable for use in ICM. This led to a marginally different co-efficient being used in the export, hence the differences observed. Whilst these differences were not sufficient to impact the findings of the flood model, they have been addressed. The comparison of the DTM now shows consistent levels outside of the areas to be redeveloped. Please see the appended figure.

3. *Some of the differences between the baseline and proposed model results could be driven by the difference between the baseline ground model and the updated ground model as noted in item 7.3 (worksheet 2D Model Build) of this model review. Please investigate this. It would also be prudent to assess detriment across a wider range of AEP scenarios and present the results in the reporting.*

In line with the comments provided for point 2, the ground models have been updated, this now demonstrates that there are no detrimental impacts outside of the red line boundaries, across the range of AEP scenarios. Please see the appended maps.

4. *A check run was undertaken as part of this follow on review using Infoworks ICM version 2021.9 for the 100 year +25% baseline scenario (100yr 10.25mm/hr +25%CC). This results in slightly more extensive flooding when considering the submitted results (see worksheet Model_Run_Sensitivity_Test within the attached workbook). Please check these differences. Are they likely to have any influence on the proposed development? Please find the following 2d results:*

The model was originally run in the same version of ICM as it was provided by the Environment Agency for consistency, however, in light of the comment, it has now been re-run in the latest version (2023.1), as detailed in the responses above this does not have any influence on the proposed development or impacts on third party land.

5. *The reporting mentions that the 27.5hr storm duration was also tested. This is referenced in the reporting but it is not clear whether this is referring to the JBA original modelling (2014) or this modelling? Please make this clear as results for the 27.5hr storm duration test have not been provided within the ICMT and are not shown in the modelling report. The reporting suggests that both the 27.5hr and 10.25hr storm durations have been used.*

To aid the reviewer, the 10.25hr and 27.5hr storm duration events have been run for a range of AEPs, with the results provided within the ICMT. As detailed in previous sections, they do not have any influence on the proposed development or impacts on third party land. Although it is recognised

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that in the 27.5hr event, some of the flood depths do increase, although these are limited to areas which are already wet in the 10.25hr event.

HYDROLOGY REPORT KEY COMMENTS

This section should be read in conjunction with the attached hydrology model review workbook (Bognor_Regis_Hydrology_Follow_On_061022).

- The reporting mentions a 10.25 hour storm duration but then goes on to say 27.5hrs was selected. It is clear that the model uses a 10.25hr storm duration so what is the reference to a 27.5 hour storm duration in the reporting? Please make this clear in the reporting as it currently implies that both 27.5hr and 10.25hrs are the preferred storm duration.*

As detailed in the response to point 5 on the hydraulic model key comments section, the model has been run for both the 10.25hr and 27.5hr duration events, 10.25hr is considered to be the design event, with the 27.5 hr event run for sensitivity purposes. However, the model demonstrates that the proposed development is not influenced by or results in impacts on third party land by either storm duration. Although it is recognised that in the 27.5hr event, some of the flood depths do increase, although these are limited to areas which are already wet in the 10.25hr event.

- An example rainfall hyetograph has been included in the hydrology report (figure 4). In addition, a table is presented in table 4 which presents the revised rainfall depths. The rainfall hyetographs and depths presented in the hydrology report were compared against the rainfall data for the 100 year 10.25 hr mm/hr+25%CC scenario included within the Infoworks Model. There appear to be differences between the rainfall applied within the hydraulic model and the rainfall rate/depths reported within the hydrology report. Please clarify why there are differences.*

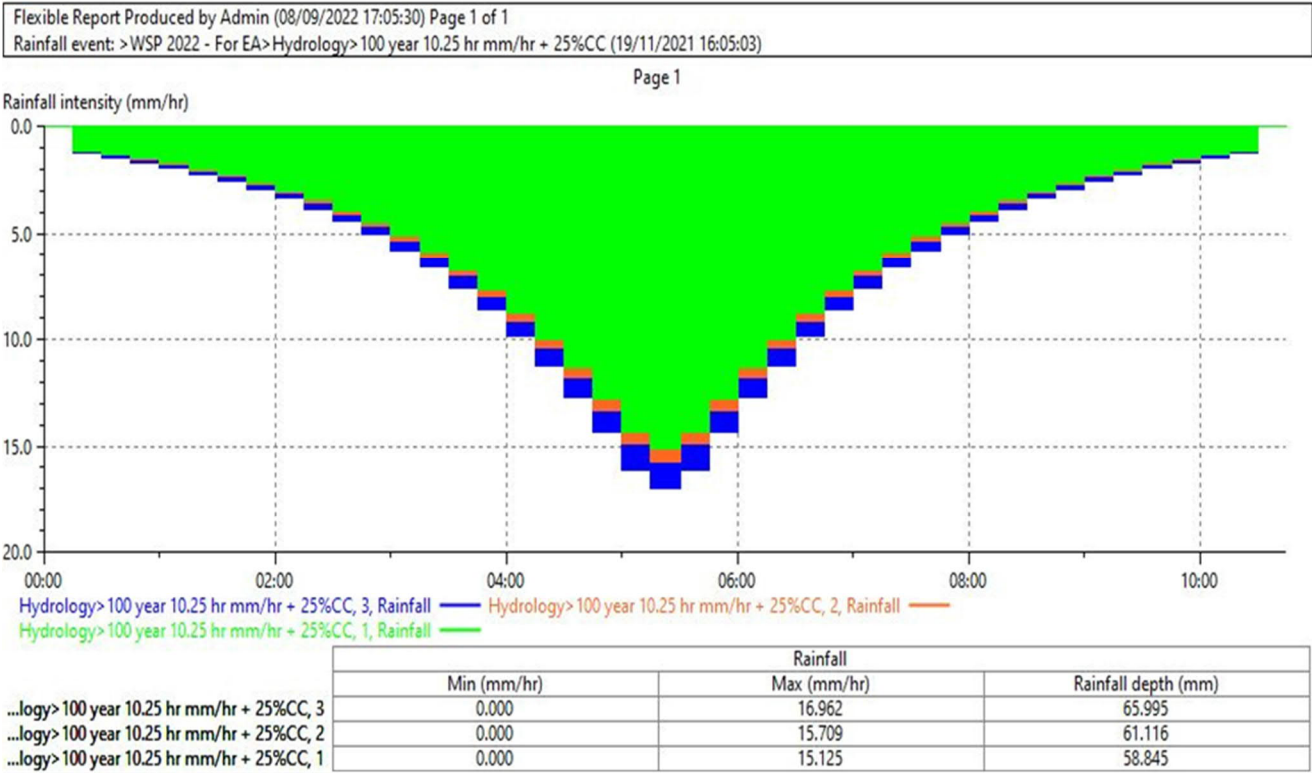
There are no differences between the rainfall within the hydraulic model and the rainfall reported within the hydrology report. The difference observed by the reviewer was caused by the data within the report being the current day scenario (i.e. no climate change allowance) and that within the model being for the future scenario (i.e. with climate change) for ease of approval the table has been updated below and the extract from the model provided by the Environment Agency reviewer is also below, noting that in the image the rainfall depths are presented in the reverse order than those in the table.

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Table 1: 10.25hr 100yr Design Rainfall Depths

Hyetograph Area	Seasonal Correction Factor	100yr 10.25hr storm event – total rainfall depth (mm)		100yr 10.25hr storm event plus 25% climate change – total rainfall depth (mm)
		Existing model hydrology	Revised Hydrology	Revised Hydrology
Low	0.713	56.40	47.08	58.85
Medium	0.727	59.74	48.89	61.11
High	0.759	65.67	52.80	66.00





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CONCLUSION

The additional model results and clarifications provided to the Environment Agency within this Technical Note and the associated model / hydrology review spreadsheets are considered to address all the outstanding issues / comments and thus the model and hydrology is suitable for approval to support the FRA and associated planning applications (FP/274/21/OUT and M/16/22/PL).