NOTE TO FILE

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Contract	Solihull Level 2 SFRA
Client	Faithful & Gould
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Author	Andrew Waite
Reviewer / Sign-off	David Kearney
Subject	Strategic modelling report

1 Introduction

1.1 Terms of reference

In May 2020 JBA Consulting were commissioned to produce a Level 2 Strategic Flood Risk Assessment (SFRA) for several proposed development sites within Solihull Metropolitan Borough Council's (SMBC) administrative boundary. For several of the development sites, flood risk had not previously been assessed relating to the Ordinary Watercourses in their vicinity. This document summarises the approach of the strategic modelling undertaken to provide flood risk data for the following development sites:

- SMBC01 – Barrett's Farm, Balsall Common
- SMBC06 – Meriden Road, Hampton-in-Arden
- SMBC08 – Hampton Road, Knowle
- SMBC09 – Station Road, Knowle
- SMBC10 – Birmingham Road, Meriden
- SMBC18 – Sharman's Cross Road, Solihull
- SMBC20 – Damson Parkway, Bickenhill
- SMBC26 – Whitlock's End Farm, South of Shirley

2 Data Management

The following data has been provided for this study by the Client and associated stakeholders:

- LIDAR Digital Terrain Model (DTM). This dataset has a 2m resolution with the majority of the Solihull Borough covered by data typically flown between 2007-2008.
- Integrated Height Model (IHM) DTM provided by the Environment Agency for the entire Solihull Borough. This dataset is to provide topographic data where there is no LIDAR coverage.
- OS Mastermap data providing coverage for the entire Solihull Borough.
- Key structure survey data collected by Grantham Coates Surveys (GCS) in May 2020 at selected locations. The survey data provided can be found in Appendix A.
- Site boundaries provided by SMBC.
- Flood Risk Assessment (FRA) for the Birmingham International Airport proposed runway extension produced by Scott Wilson in December 2007. This document was provided by SMBC however, the hydraulic model for the FRA was not supplied.

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3 Approach

3.1 General Modelling Approach

A 2D modelling approach has been adopted for the strategic modelling of the proposed development sites using TUFLOW HPC. To allow flexibility in the modelling approach, individual domains have been created for each site with their own boundary files which are selected using different scenario commands. The topography has been informed using DTM data with a preference of using LIDAR where available over the IHM DTM due to its improved resolution and accuracy. A 2m grid cell resolution has been utilised for all model domains given the sizes of the watercourses of interest. The channels have been stamped into the DTM where possible using the DTM data to ensure they are adequately represented when the model grid is generated. In locations where the IHM DTM is the only available source of topographic information, this approach has still been utilised but 0.5m has been removed from the elevation to form a channel. This approach has been adopted due to the channels not being distinctly represented within the IHM dataset due to its resolution.

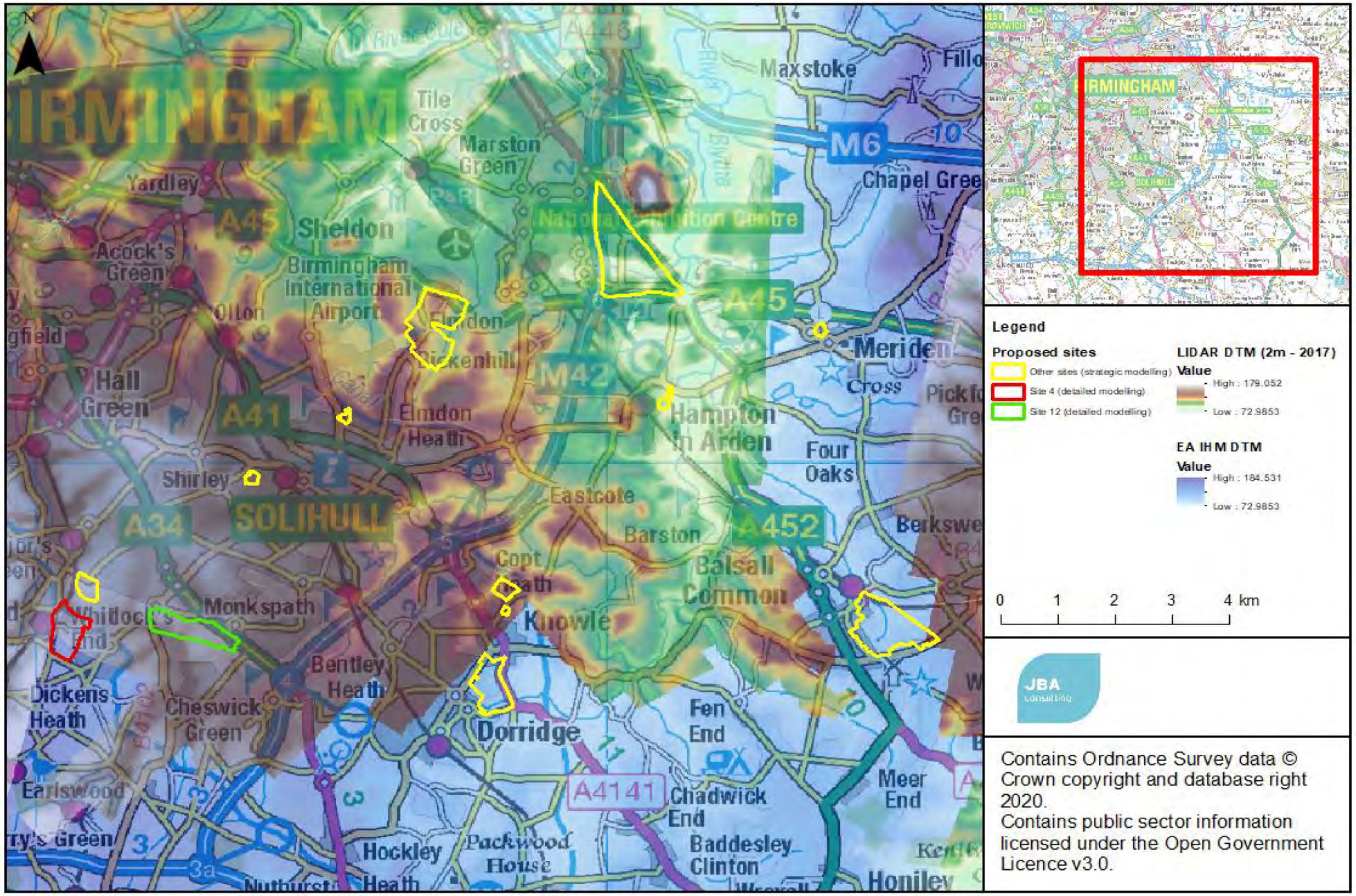
Land use and associated roughness coefficients have been attributed to the model using OS Mastermap data. Values for different land uses are based on typical values which would be utilised in flood mapping studies for clients such as the Environment Agency (see Section 3.3).

Only selected structures have been included within the hydraulic models which are based on GCS survey data collected in May 2020. The structures have been modelled using ESTRY. Where survey has not been collected (typically for structures outside of the proposed boundaries) assumptions have been made for structures or simple cut throughs have been applied through embankments/raised areas in the DTM, following the methodology the Environment Agency use to deliver Flood Zone improvement studies using strategic modelling methods.

3.2 Topographic Data

Figure 3-1 shows the coverage of DTM data within the Solihull Borough. This shows that the majority of the modelled sites are covered by 2m LIDAR data. As sites SMBC01, SMBC09 and SMBC10 have no LIDAR coverage, levels have been represented using the IHM dataset. This dataset is based on a comprises LIDAR data (where available), followed by photogrammetry data (5m resampled to 2m) Photogrammetry data can have a larger level of inaccuracy than LIDAR data and as such, it can have a reduced level of detail when used to pick out topographic features in the floodplain. As such, there may be instances where features such as the ordinary watercourses or road embankments are not represented to their full extent. As discussed in Section 3.1, efforts have been made to account for this with additional topographic edits using basic assumptions. Unfortunately, without further information on the channel and surrounding features, additional quality assurance cannot be performed. This information should be considered when interpreting the model results for these locations.

Figure 3-1: DTM Coverage



3.3 Manning's 'n' Coefficient

Manning's 'n' values have been used to represent hydraulic roughness in the 2D domain throughout the study extent. The roughness values recorded in were used in Table 3-1 the model and are based on land cover types recorded in the Ordnance Survey Master Map Topographic Area layer dataset.

Table 3-1: 2D Hydraulic Roughness

Land Use	TMF Code	Roughness coefficient
General land use	1	0.060
Boulders	2	0.065
Coniferous trees	3	0.120
Coniferous trees – scattered	4	0.070
Coppice or osiers	5	0.090
Marshes	6	0.060
Non-coniferous trees	7	0.090
Non-coniferous trees – scattered	8	0.060
Rough grassland	9	0.060
Scrub	10	0.070
Rock	11	0.070
Heath	12	0.090
Buildings	10021	0.300
Inland water	10089	0.045
Path	10119	0.050
Rail	10167	0.045
Road	10172	0.035
Roadside	10183	0.050
Roadside	10123	0.050

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3.4 Boundaries

3.4.1 Inflows

Inflows have been applied to the model using 2D Flow-Time (QT) boundaries points. Each point has a series of Excel CSV inflow tables attributed to it via a unique name. Typically, a flow point has been applied at the upstream of the model representing the upstream catchment, with other points uses to represent lateral catchments where appropriate. Flows have been generated for the following AEP events:

- 5% AEP event
- 1% AEP event
- 1% AEP plus climate change (+20%) event
- 1% AEP plus climate change (+30%) event
- 1% AEP plus climate change (+50%) event
- 0.1% AEP event

For further information the hydrological assessment please refer to the hydrological calculation record provided in Appendix B.

3.4.2 Downstream Boundaries

Downstream boundaries have been applied to all model domains to ensure that the models do not have flood water glass walling against the edge of the domain which can lead to artificially elevated water levels. Typically, Stage-Flow boundaries (HQ) representing the gradient of the land at the boundary location have been used to allow water to exit the model domains. These boundaries have been located a significant distance from the proposed development site to ensure that they do not influence water levels around the area of interest.

3.4.3 Other Boundaries

Other boundaries used with the model relate to the representation of structures and allow flow to move from the 2D domain representing the floodplain to the 1D ESTRY structures and vis versa. These boundaries have been applied at the upstream and downstream of any modelled structure using "SX" type boundaries.

3.5 Structures

In total 9 structures have been represented using 1D ESTRY units within the model domains. Details of these structures and any assumptions are shown in Table 3-2. Other structures within the modelling domain have not explicitly been represented but rather have modifications applied to the original DTM or topographic edits applied within the model. This is a similar approach to that applied by the Environment Agency when undertaking broadscale modelling for Flood Zones.

Table 3-2: Modelled Structures

Structure ID	Site	Type	Comment
SMBC01_1	SMBC01	Irregular culvert	Culvert based on GCS Survey data. Invert levels have been applied in strategic z-shape for the channel.
SMBC01_2	SMBC01	Circular culvert	Estimated culvert dimensions. Invert levels are based on the IHM dataset minus 0.5m as per the assumption for the channel in this area. No survey was available for these areas at the time of the study therefore the structures representation should be improved for more detailed assessments in the future.
SMBC01_3	SMBC01	Circular culvert	Estimated culvert dimensions. Invert levels are based on the IHM dataset minus 0.5m as per the assumption for the channel in this area. No survey was available for these areas at the time of the study therefore the structures representation should be improved for more detailed assessments in the future.
SMBC08_1a SMBC08_1b	SMBC08	Circular culvert	Culvert based on GCS Survey data. The downstream invert level is based on the similar differences between the bed level and culvert invert levels at the upstream face. Invert levels have been applied in strategic z-shape for the channel.
SMBC08_2	SMBC08	Circular culvert	Culvert based on GCS Survey data. The downstream invert levels are estimated. Invert levels have been applied in strategic z-shape for the channel.
SMBC10_1	SMBC10	Irregular culvert	Culvert based on GCS Survey data. The downstream invert levels are estimated. Invert levels have been applied in strategic z-shape for the channel.
SMBC10_2	SMBC10	Circular culvert	Culvert based on GCS Survey data. The downstream invert levels are estimated. Invert levels have been applied in strategic z-shape for the channel.
SMBC18_1	SMBC18	Circular culvert	Culvert based on GCS Survey data. Based on available data the downstream outlet of the culvert is unknown. As such the culvert is estimated to discharge at the closest open channel reach approximately 794m downstream. The downstream invert levels are estimated using LIDAR levels. Invert levels have been applied in strategic z-shape for the channel.
SMBC20_1	SMBC20	Rectangular Culvert	Based on information within the Flood Risk Assessment (FRA) for the Birmingham International Airport proposed runway extension (Scott Wilson, December 2007) regarding the proposed culverts and channel aligned.

4 Deliverables

4.1 GIS Outputs

The model results are shown in the Level 2 SFRA site tables supplied as part of this study.

- Flood extents in a shapefile format
  - Cleaned shapefiles with dry islands <200m^2 removed
  - Raw shapefiles with no post processing.
- Maximum ASCII grids for the following:
  - Depth
  - Water level
  - Velocity
  - Hazard to people

4.2 Limitations / Recommendations

The following general limitations should be considered when interpreting the strategic modelling results:

- 2D modelling techniques do not explicitly represent the channel capacity or all of the hydraulic structures which influence the conveyance of water downstream. The primary purpose is to give a broadscale understanding of flood risk across each site. When a detailed site-specific assessment is required, then a more detailed hydraulic model will need to be developed. This model will need to include additional topographic survey and detail of the channel and any key structures.
- For the sites covered by the IHM dataset only, there are greater uncertainties around the elevation of floodplain features and the channel levels. Basic assumptions have been applied to stamp a channel into the DTM for this assessment, but it is recommended that this is improved if further topographic survey data or updated LIDAR becomes available or if a detailed site-specific assessment is required.
- Limited topographic survey of the ground levels within the sites was not available for the strategic modelling. It is therefore unknown if the DTM used for the study accurately represents existing ground levels. This should be investigated as part of future detailed site-specific assessments.

The following site-specific limitations should be considered when interpreting the strategic modelling results for the following sites:

- SMBC01: The majority of the site is covered by the IHM DTM dataset and as such basic assumptions have been applied to stamp features into the DTM for this strategic modelling study. There is potential that features within the floodplain are misaligned or not accurately represented by the dataset. Assumptions regarding the connectivity of the watercourse (e.g. culvert inlet levels) also have a degree of uncertainty as they are based on the IHM dataset. It is recommended that flood risk should be assessed via a detailed site-specific assessment when the site is brought forward for development.

Additional information on the channel and floodplain features should be included to help better understand the flood mechanisms of the area.

- SMBC06: The connectivity of the unnamed drain to the north west of the site is based on OS mapping and LIDAR. It is recommended that this is reviewed as part of a future detailed site-specific assessment.
- SMBC08: Although survey has been collected for the upstream face of culverts within this model domain, no information was available for their precise route. It is recommended that this is reviewed as part of a future detailed site-specific assessment.
- SMBC09: The connectivity of the unnamed drain in the northern part of the site is based on OS mapping and LIDAR. No connectively could be found linking it downstream channel. It is recommended that this is reviewed as part of a future detailed site-specific assessment.
- SMBC10: The entirety of the site is covered by the IHM DTM dataset and as such basic assumptions have been applied to stamp features into the DTM for this assessment. There is potential that features within the floodplain are misaligned or not accurately represented by the dataset. Assumptions regarding the connectivity of the watercourse (e.g. culvert inlet levels) also have a degree of uncertainty as they are based on the IHM dataset. It is recommended that flood risk should be assessed via a detailed site-specific assessment when the site is brought forward for development. Additional information on the channel and floodplain features should be included to help better understand the flood mechanisms of the area.
- SMBC18: The connectivity of the unnamed drain flowing along the southern boundary of the site is based on OS mapping and LIDAR. Although survey has been collected, there are uncertainties around the locations of both the upstream and downstream culverts. Assumptions have been made about the route of culvert, connecting the unnamed watercourse to the closest watercourse identified on OS mapping. It is recommended that this is reviewed as part of a future detailed site-specific assessment.
- SMBC20: There has been significant alterations to the Low Brook downstream of the site, where the A45 has been diverted and Birmingham City Airport extended. Unfortunately, these works have not been captured by the latest available LIDAR (collected in 2008) and as such there is uncertainty around the channel levels and invert levels of structures under the A45. Although the FRA for the works has been used during this modelling study to inform some of the assumptions made, it is recommended that this is reviewed in further detail as part of a future detailed site-specific assessment.
- SMBC26: Although survey has been collected for the informal channel within this model domain, no connections could be found which drain the site. It is recommended that this is reviewed as part of a future detailed site-specific assessment.

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Appendices

A Topographic Survey

Topographic survey collected by Grantham Coates Surveys in May 2020.

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B Hydrological Calculation Record

Hydrological calculation record documenting the method used to generate flows for the strategic modelling.