Project	Telford & Wrekin Level 2 SFRA	**Date**	May 2008
Note	Modelling Approach	**Ref**	WBTWCS
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1 Modelling Methodologies

1.1 The modelling methodology selected for this commission is a pure 2D approach, using the modelling software TUFLOW. TUFLOW is a computer program for simulating depth-averaged, 2D free-surface flows such as occurs from floods. The approach involves creating an elevation grid of the modelling area using LiDAR (ground elevation) data. Review of the LiDAR data allows determination of whether the channel has been adequately identified. The channel is appropriately represented in the grid and hydraulic structures are included to create a representative model of the hydraulic situation. This approach allows the out of bank flow paths to be easily identified and the full extents of the floodplain can be easily mapped. It also facilitates the production of hazard maps.

2 Modelled Watercourses

2.1 The commission requires the production of six separate 2D models in order to facilitate the production of improved Flood Zone maps (Flood Zones 2, 3a, 3b and 3a + 20% for climate change) for the following watercourses in Telford: Crow Brook, Hurley Brook, Hurley Brook Tributary, Wall Brook (also cited as Donnington Watercourse), Mad Brook and Tributary of Wesley Brook. Sections three to eight describe the approach taken for each.

3 Hurley Brook Tributary

3.1 The upstream extent of the model is located upstream of Wrockwardine Road (SJ 63808 11943) and the downstream extent of the model is downstream of Bratton Farm (SJ 63812 14263).

3.2 The grid resolution used for the 2D model is 4m; this grid size allows for accurate representation of the model area while keeping run times low enough to be viable.

3.3 Along the watercourse there are nine culverts. The culvert locations, type and size are tabulated overleaf.

Table 1: Hydraulic structures on the Hurley Brook Tributary

Name	Location	Type	Size	Comments
HBT01	SJ 63877 12009	Circular	1.2mØ	-
HBT02	SJ 63892 12031	Circular	1.5mØ	-
HBT03	SJ 63869 12152	Circular	1.5mØ	-
HBT04	SJ 63928 12367	Rectangular	3m x 0.75m	-
HBT05	SJ 63940 12483	Rectangular	2m x 1m	-
HBT06	SJ 63820 13341	Circular	1.5mØ	-
HBT07	SJ 63742 13704	Circular	1.5mØ	Added after model boundary revised Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
HBT08	SJ 63710 13919	Circular	1.5mØ	Added after model boundary revised Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
HBT09	SJ 63723 14175	Circular	1.5mØ	Added after model boundary revised Not visited on site visit, dimensions estimated from channel size and knowledge of culverts

3.4 Culvert dimensions were measured, wherever accessible, during site visits and where measurement was not possible the culvert sizes were estimated. Wherever possible, the level of the culvert (mAOD) was verified using a hand-held GPS system and the data was then used to QA the LiDAR data.

3.5 The channel has been represented in the 2D grid and a 'z line' has been used to reinforce the channel and eliminate any localised high points caused by inaccuracies in the LiDAR data.

3.6 The floodplain has mainly been left as it is, however where there are obvious inaccuracies in the LiDAR (such as sudden large fluctuations in ground level in a relatively flat area) these have been fixed by using 'z polygons' based on the surrounding topography to smooth them out. Similarly where there is no LiDAR data, the absence has been fixed using 'z polygons' and the surrounding topography.

3.7 There are no formal Environment Agency defences in the area.

3.8 A global value for the hydraulic roughness, based on the local land use and observations from the site visit, has been chosen this value is 0.045.

3.9 The Hurley Brook Tributary has three inflow boundaries. The first boundary (HU) goes in at the upstream extent of the model (SJ 63808 11943). The next two boundaries (HL and import) enter the model downstream of Shawbirch Road (SJ 63808 13376)

3.10 The downstream boundary of the model is represented by a normal slope calculated using the LiDAR data.

3.11 Due to the ungauged nature of the catchments and the lack of historic outlines it is not possible to calibrate or verify the model. However when results were generated for the model, flow paths were checked against LiDAR and knowledge of the local area to ensure that the results were representative of the local setting.

4 Hurley Brook

4.1 The Hurley Brook model is formed from three watercourses the Hurley Brook, Ketley Brook and Newdale Brook. As such it has three upstream extents, the Hurley Brook downstream of Limekiln Lane (SJ 65756 10829), the Ketley Brook downstream of Ketley Dingle Interchange (SJ 67102 10382) and Newdale Brook downstream of the M54 (SJ 67306 10251). The revised downstream extent of the model is located near Eyton upon the Weald Moors (SJ 65102 15161). When creating the model it was observed that a large amount of water, during the larger flood events, was flowing down the railway line bisecting the Hurley Brook. It was found that this water eventually flowed into the Hurley Brook Tributary, as such a section of the Hurley Brook Tributary model was included in the Hurley Brook model to allow for proper mapping of the flood extents of the Hurley Brook.

4.2 The grid resolution used for the 2D model is 4m, this grid size allows for accurate representation of the model area while keeping run times low enough to be viable.

4.3 Along the watercourse there are seven culverts on the Hurley Brook and two on the Ketley Brook, with the inclusion of part of the Hurley Brook Tributary model culverts HBT03-HBT09 have been included in the model as well. The culvert locations, type and size are tabulated overleaf.

Table 2: Hydraulic structures on the Hurley Brook

Name	Location	Type	Size	Comments
HB01	SJ 68579 10926	Circular	1mØ	
HB02	SJ 66341 11441	Circular	1.2mØ	
HB03	SJ 66551 13379	Rectangular	2m x 1.2m	
HB04	SJ 66522 13449	Rectangular	1m x 1m	
HB05	SJ 66358 14499	Rectangular	2m x 1m	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
HB06	SJ 65302 15058	Rectangular	2m x 1m	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
HB07	SJ 65235 15097	Rectangular	2m x 1m	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
KB01	SJ 67104 10519	Circular	1.95mØ	
KB02	SJ 66886 11363	Circular	0.5mØ	
HBT03	SJ 63869 12152	Circular	1.5mØ	Taken from Hurley Brook Tributary model
HBT04	SJ 63928 12367	Rectangular	3m x 0.75m	Taken from Hurley Brook Tributary model
HBT05	SJ 63940 12483	Rectangular	2m x 1m	Taken from Hurley Brook Tributary model
HBT06	SJ 63820 13341	Circular	1.5mØ	Taken from Hurley Brook Tributary model
HBT07	SJ 63742 13704	Circular	1.5mØ	Taken from Hurley Brook Tributary model
HBT08	SJ 63710 13919	Circular	1.5mØ	Taken from Hurley Brook Tributary model
HBT09	SJ 63723 14175	Circular	1.5mØ	Taken from Hurley Brook Tributary model

4.4 The channel has been represented in the 2D grid, a z line has been used to reinforce the channel and eliminate any localised high points caused by inaccuracies in the LiDAR data. There are two weirs along the watercourse one at Wappenshall Bridge and the other at Eyton Lock; these have been well represented in the LiDAR and do not have z lines over them.

4.5 The floodplain has mainly been left as it is, however where there are obvious inaccuracies in the LiDAR (such as sudden large fluctuations in ground level in a relatively flat area) these have been fixed by using z polygons based on the surrounding topography to smooth them out. Similarly where there is no LiDAR data the absence has been fixed using z polygons and the surrounding topography.

4.6 There are no formal Environment Agency defences in the area.

4.7 A global value for the hydraulic roughness, based on the local land use and observations from the site visit, has been chosen this value is 0.045. Based on observations of the culverts a Manning's 'n' value 0.025 has been chosen for the culverts. A short section of the Ketley Brook is comprised of an artificial concrete channel, this section has been given a roughness value of 0.02.

4.8 The Hurley Brook model has six inflow boundaries two (UW, L1) located at the upstream extent of Hurley Brook (SJ 65756 10829), two (UE2, L2) at the

upstream extent of Ketley Brook (SJ 67102 10382), one (UE1) at the upstream extent of Newdale Brook and the sixth (L3) near Leegomery Roundabout (SJ 66640 13621).

4.9 The downstream boundary of the model is represented by a normal slope calculated using the LiDAR data, the downstream boundary of the Hurley Brook Tributary has also been included in the model.

4.10 Due to the ungauged nature of the catchments and the lack of historic outlines it is not possible to calibrate or verify the model. However when results were generated for the model, flow paths were checked against LiDAR and knowledge of the local area to ensure that the results were representative of the local setting.

5 Crow Brook

5.1 Near Trench Pool the Crow Brook has, at some time in the past, been diverted from its natural course. Examining the LiDAR data, OS tiles and existing Flood Zone information indicates that the Crow Brook originally flowed in a northerly direction from the Trench Pool area. Currently the existing Flood Zones for Crow Brook follow the natural drainage path and ignore the diversion, giving an unrepresentative account of flood risk. However in reality water flows from Trench pool in a North-North-Westerly direction into the new Crow Brook channel.

5.2 The upstream extent of the Crow Brook model is located downstream of Hadley Road (SJ 68592 11510). However, there is a second upstream extent, where the original channel resumes drainage, located downstream of Horton Lane (SJ 68807 14387). The downstream extent of the model is located near Oxmoor (SJ 67761 14889).

5.3 The grid resolution used for the 2D model is 4m. This grid size allows accurate representation of the model area while keeping run times low enough to be viable.

5.4 Along the new channel of the Crow Brook there are five culverts and a further two culverts along the old channel. Table 3 gives details of the hydraulic structures in the model

Table 3: Hydraulic structures on Crow Brook

Name	Location	Type	Size	Comments
CB01	SJ 68722 11757	Circular	0.3mØ	Culvert from Crow Brook to Middle Pool
CB02	SJ 68891 12004	Circular	1.2mØ	Culvert from Middle Pool to Trench Pool
CB03	SJ 68502 12482	Rectangular	2.4m x 1.6m	Culvert from Trench Pool to Crow Brook
CB04	SJ 68058 13325	Rectangular	5m x 1.2m	Culvert under Hadley Park Roundabout Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
CB05	SJ 67858 14316	Rectangular	5m x 2m	Road bridge Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
CB06	SJ 68218 14859	Rectangular	1m x 1m	Culvert on old Crow Brook channel
CB07	SJ 67847 14837	Rectangular	1m x 1m	Culvert on old Crow Brook channel Not visited on site visit, dimensions estimated from channel size and knowledge of culverts

5.5 The channel has been represented in the 2D grid, a z line has been used to reinforce the channel and eliminate any localised high points caused by inaccuracies in the LiDAR data. There are two weirs which have been left in the channel and do not have z lines over them as they are represented in the LiDAR.

5.6 The floodplain has mainly been left as it is, however where there are obvious inaccuracies in the LiDAR (such as sudden large fluctuations in ground level in a relatively flat area) these have been fixed by using z polygons based on the surrounding topography to smooth them out. Similarly where there is no LiDAR data the absence has been fixed using z polygons and the surrounding topography.

5.7 There are no formal Environment Agency defences in the area.

5.8 A global value for the hydraulic roughness, based on the local land use and observations from the site visit, has been chosen this value is 0.045. Based on observations of the culverts a Manning's 'n' value 0.025 has been chosen for the culverts.

5.9 The Crow Brook has four inflow boundary conditions, one at the upstream extent of the model (CU20) one at Middle Pool (CU80), one just downstream of where the watercourse reappears at Trench Lock Interchange (Crow) and one where the old alignment of the watercourse appears (CE).

5.10 The downstream boundary of the model is represented by a normal slope calculated using the LiDAR data.

5.11 Due to the ungauged nature of the catchments and the lack of historic outlines it is not possible to calibrate or verify the model. However when results were generated for the model, flow paths were checked against LiDAR and knowledge of the local area to ensure that the results were representative of the local setting.

6 Mad Brook

6.1 The upstream extent of the model is located near Grange Farm View (SJ 70023 07039) and the downstream extent of the model is located downstream of Halesfield Industrial Estate (SJ 71433 03675).

6.2 The grid resolution used for the 2D model is 4m; this grid size allows for accurate representation of the model area while keeping run times low enough to be viable.

6.3 The Mad Brook flows through several pools and culverts before entering Holmer Lake, a reservoir. The reservoir has a large dam at the downstream end with an overflow structure which allows water to spill under the dam. This overflow structure also has an inlet pipe to allow water through during low flow conditions and two siphons to allow more water through as the level in the reservoir rises towards flood levels. In low flow conditions once water has passed under the dam it then flows through a smaller culvert and emerges downstream of Halesfield Industrial Estate. In flood flow conditions water flows through this culvert and any surcharged water flows down a spillway under the railway into a flood storage area downstream of the railway.

6.4 Along the watercourse there are thirteen culverts. The culvert locations, type and size are tabulated in Table 4 overleaf.

Table 4: Hydraulic structures on Mad Brook

Name	Location	Type	Size	Comments
MB01	SJ 70191 06967	Circular	1mØ	
MB02	SJ 70382 06863	Circular	0.5mØ	
MB03	SJ 70476 06723	Circular	0.5mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
MB04	SJ 70483 06602	Circular	0.5mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
MB05	SJ 70501 06434	Circular	0.3mØ	
MB06	SJ 70902 05761	Circular	5mØ	
MB07	SJ 07936 05733	Rectangular	0.75m x 0.3m	
MB08	SJ 70590 06348	Circular	0.5mØ	Floodplain culvert
MB09	SJ 70742 06281	Circular	0.5mØ	Floodplain culvert
MB10	SJ 70978 05699	Circular	3mØ	
MB11	SJ 71004 05670	Circular	0.3mØ	
MB12	SJ 70882 05762	Circular	0.61mØ	Pipe through overflow structure
MB13	SJ 70886 05759	Rectangular	0.838m x 1.264m x2	Siphons through overflow structure Culverts sized to be hydraulically similar to siphons

6.5 The channel has been represented in the 2D grid, the Mad Brook has very little open channel and after examining the LiDAR it was deemed unnecessary to reinforce the channel with a z line.

6.6 The floodplain has mainly been left as it is, however where there are obvious inaccuracies in the LiDAR (such as sudden large fluctuations in ground level in a relatively flat area) these have been fixed by using z polygons based on the surrounding topography to smooth them out. Similarly where there is no LiDAR data the absence has been fixed using z polygons and the surrounding topography.

6.7 The reservoir and associated dam and overflow are considered to be defences.

6.8 A global value for the hydraulic roughness, based on the local land use and observations from the site visit, has been chosen this value is 0.045. Based on observations of the culverts a Manning's 'n' value 0.025 has been chosen for the culverts. The spill between the dam and the railway line is constructed from concrete and has been given a roughness value of 0.02.

6.9 The Mad Brook model has three inflow boundaries one (MU) at the upstream extent of the model (SJ 70023 07039) and one (MLH) at the upstream end of Holmer Lake (SJ 70857 06167). The third inflow boundary (MLL) represents the water not accommodated by the surface water drains in Halesfield Industrial Estate, as such there is no flow for a 20yr event and all the other

events have had their flows reduced by the equivalent of a 20yr event (it has been assumed that the surface water drains can accommodate up to a 20yr event). This inflow enters the model on Halesfield 21 (SJ 71215 05434).

6.10 The downstream boundary of the model is represented by a normal slope calculated using the LiDAR data.

6.11 Due to the ungauged nature of the catchments and the lack of historic outlines it is not possible to calibrate or verify the model. However when results were generated for the model, flow paths were checked against LiDAR and knowledge of the local area to ensure that the results were representative of the local setting.

7 Wall Brook (also cited as Donnington Watercourse)

7.1 The model extends from SJ 71188 14077, just downstream of Fieldhouse Drive, to SJ 70031 15619, just upstream of the sewage works on Donnington Drive.

7.2 The grid resolution used for the 2D model is 4m, this grid size allows for accurate representation of the model area while keeping run times low enough to be viable.

7.3 Along the watercourse there are eight culverts and a further two culverts on the floodplain. The culvert locations, type and size are tabulated in the Table 5 below.

Table 5: Hydraulic Structures on Wall Brook

Name	Location	Type	Size	Comments
UDD01	SJ 71118 14153	Rectangular	1m x 0.4m	
UDD02	SJ 71115 14167	Rectangular	1m x 0.4m	
UDD03	SJ 71080 14216	Rectangular	1.5m x 0.5m	
UDD04	SJ 7102114254	Circular	0.8mØ	
UDD05	SJ 70863 14409	Circular	0.5mØ	
UDD06	SJ 70823 14474	Circular	0.5mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
UDD07	SJ 70423 14889	Circular	0.4mØ	
UDD08	SJ 70424 14966	Circular	0.5mØ	
UDD09	SJ 71262 14790	Circular	0.75mØ	Floodplain culvert Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
UDD10	SJ 71057 15159	Circular	0.75mØ	Floodplain culvert Not visited on site visit, dimensions estimated from channel size and knowledge of culverts

7.4 The channel has been represented in the 2D grid, a z line has been used to reinforce the channel and eliminate any localised high points caused by inaccuracies in the LiDAR data.

7.5 The floodplain has mainly been left as it is, however where there are obvious inaccuracies in the LiDAR (such as sudden large fluctuations in ground level in a relatively flat area) these have been fixed by using z polygons based on the surrounding topography to smooth them out. Similarly where there is no LiDAR data the absence has been fixed using z polygons and the surrounding topography.

7.6 There are no formal Environment Agency defences in the area.

7.7 A global value for the hydraulic roughness, based on the local land use and observations from the site visit, has been chosen this value is 0.045. Based on observations of the culverts a Manning's 'n' value 0.025 has been chosen for the culverts.

7.8 The watercourse has two upstream flow boundaries located at the same point. The boundary called "D1" represents the catchment upstream of the model, and the boundary called "import" represents the lateral inflows for the length of model.

7.9 The downstream boundary of the model is represented by a normal slope calculated using the LiDAR data.

7.10 Due to the ungauged nature of the catchments and the lack of historic outlines it is not possible to calibrate or verify the model. However when results were generated for the model, flow paths were checked against LiDAR and knowledge of the local area to ensure that the results were representative of the local setting.

8 Wesley Brook Tributary

8.1 The upstream extent of the Wesley Brook model is near St Quentins Roundabout (SJ 70388 08260) and extends to near Hem Lane at the downstream end (SJ 71950 06049).

8.2 The grid resolution used for the 2D model is 4m, this grid size allows for accurate representation of the model area while keeping run times low enough to be viable.

8.3 Along the watercourse there are eight culverts and one more on the floodplain. The culvert locations, type and size are tabulated in the Table 6 below.

Table 6: Hydraulic Structures on Wesley Brook Tributary

Name	Location	Type	Size	Comments
WBT01		Circular	0.2mØ	
WBT02		Circular	0.3mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
WBT03		Circular	0.3mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
WBT04		Circular	0.3mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
WBT05		Circular	0.5mØ	Not visited on site visit, dimensions estimated from channel size and knowledge of culverts
WBT06		Circular	1.5mØ	
WBT07		Rectangular	0.5m x 0.5m	
WBT08		Circular	0.3mØ	
WBT09		Rectangular	3m x 2m	Subway under Queen Elizabeth Avenue Not visited on site visit, dimensions estimated from LiDAR and knowledge of subways

8.4 The channel has been represented in the 2D grid, a z line has been used to reinforce the channel and eliminate any localised high points caused by inaccuracies in the LiDAR data.

8.5 The floodplain has mainly been left as it is, however the road deck of Queen Elizabeth Avenue has been recreated where the filtered LiDAR removed it at the subway.

8.6 There are no formal Environment Agency defences in the area.

8.7 A global value for the hydraulic roughness, based on the local land use and observations from the site visit, has been chosen this value is 0.045. Based on observations of the culverts a Manning's 'n' value 0.025 has been chosen for the culverts.

8.8 The Wesley Brook has two inflow boundaries, the first (W77) enters the model at the upstream extent (SJ 70390 08259) and the second (W23) enters the model downstream of Queensway (SJ 71339 07108)

8.9 The downstream boundary of the model is represented by a normal slope calculated using the LiDAR data.

8.10 Due to the ungauged nature of the catchments and the lack of historic outlines it is not possible to calibrate or verify the model. However when results were generated for the model, flow paths were checked against LiDAR and knowledge of the local area to ensure that the results were representative of the local setting.