

Table D.1 Summary of Hydrological Analysis Hydraulic Modelling

Local Authority Area	Location	Watercourse(s) Modelled	Upstream Extent (NGR)	Downstream Extent (NGR)	Existing Model Available?	Summary of updates to model / Software	Summary of amendments to hydrological analysis	Additional Model Runs Undertaken (blockage, defence breach/overtopping, canal breach)	Sites adjacent to modelled extents
Gloucester City	Gloucester City Urban Area	River Severn	Western Branch - SO 8166 1969 Eastern Branch – SO 8217 1968	SO 8009 1518	✓	Right bank floodplain of the River Severn was left as 1D storage units. Left floodplain for the full extent of the study (between cross-section OVERDS to MC129B was stripped and replaced by TUFLOW domain. No New survey was obtained and ISIS v3.4 TUFLOW v2009-07-DB-ISP was used for the simulation.	Hydrology from Severn Estuary model adopted using the 12 hour tidal period near the fluvial peak. The resulting flood outline corresponded well with the July 2007 flood outline.	No blockage analysis required	G2
		Gloucester & Sharpness Canal	SO 8269 1847	SO 8056 1507	✓	Original model retained and linked to TUFLOW for the study area	Hydrology from BW Gloucester & Sharpness Canal adopted	No blockage analysis required	
		River Twyver	SO 8446 1747	SO 8240 1949	✓	Original model retained however the flood plain component downstream of the cross-section CO34 was stripped and replaced with TUFLOW domain and simulation was carried out with ISIS v3.4 TUFLOW v2009-07-DB-ISP	Hydrology from 2007 SFRM study adopted, extracted from the model node corresponding with the model upstream extent	Rose Cottages Culvert SO 8405 1806	
		Sud Brook	SO 8416 1687	SO 8452 1788	✓	Original model retained however the flood plain component downstream of the cross-section SB02025 up to canal confluence was stripped and replaced with TUFLOW domain and simulation was carried out with ISIS v3.4 TUFLOW v2009-07-DB-ISP	Hydrology from 2007 SFRM study adopted, extracted from the model node corresponding with the model upstream extent	Trier Way SO 8313 1768	
Cheltenham Borough	Cheltenham Town	River Chelt	SO 9520 220	SO 9090 2450	✓	2 additional areas of 1D-2D linked modelling. Section 5325 to 4587 converted to 1D-2D. Section 2556 to 1260 converted to 1D-2D. ISIS v3.4 TUFLOW v2009-07-DB-ISP	None	Rodney Road – SO 9489 2212 (adjacent to Site C7) St Peter's Railway – SO 9359 2318 (adjacent to Site C2)	C2, C3, C7, C8, C9, C11, C15 & C16.
Tewkesbury BC/ Cheltenham BC	Leckhampton & Shurdington	Hatherley Brook Eastern Channel	SO 9442 1970	SO 9399 2052	✓	Converted entire length of existing model to 1D-2D. ISIS v3.4 TUFLOW v2009-07-DB-ISP	2007 SFRM hydrology adopted with the following additional analysis: The catchment was further schematised to provide flows for all upstream model extents by rescaling existing hydrology; An error was found in the calculation of flows from the 2007 study for this Eastern Channel. Flow sensitivity runs were therefore undertaken which indicated that flood extents are not sensitive to flows, hence the existing hydrological analysis could be adopted; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for Leckhampton & Shurdington.	Shurdington Road (SO 9398 2053)	C17 & T10
		Hatherley Brook Western Channel	SO 9397 1841	SO 9373 2047	X	Modelled in 2D with 1D structures Two culverts, under Kidnappers Lane and Church Road, have been estimated based on observations during the site visit. Culverts have been assumed to have the same capacity as a circular culvert 0.6m in diameter. (SO 9388 1928 and SO 9378 1996) TUFLOW v2009-07-DB-ISP	2007 SFRM hydrology adopted with the following additional analysis: The catchment was further schematised to provide flows for all upstream model extents by rescaling existing hydrology; There was some discrepancy between reported flows and those found in the model boundaries. Flow sensitivity runs were therefore undertaken which indicated that flood extents are not sensitive to flows, hence the existing hydrological analysis could be adopted; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for Leckhampton & Shurdington.	Church Road (SO 9388 1928) Kidnappers Lane (SO 9378 1967) Shurdington Road (SO 9376 2037)	
		Ham Brook	SO 9369 1831	SO 9230 1896	X	Modelled in 2D with 1D structures Two culverts, under Shurdington Road and Leckhampton Lane, have been estimated based on observations during the site visit. Culverts have been assumed to have the same capacity as a circular culvert 0.6m in diameter. (SO 9247 1892 and SO 9291 1878) TUFLOW v2009-07-DB-ISP	This catchment was very similar in terms of characteristics to the Western Channel of the Hatherley Brook. The same methodology was therefore used to derive flows for this catchment (FEH rainfall-runoff) to ensure a consistent approach within this study, and a consistency with the Hatherley Brook SFRM.	No blockage analysis required	
							Hydrological analysis from Black & Veatch 2009 study adopted with the following additional analysis: Catchment descriptors re-extracted from FEH CD ROM version 3 and checked;		

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Tewkesbury BC/ Cheltenham BC	Swindon & Uckington	Hyde Brook	SO 9389 2597	SO 9164 2773	✓	Converted entire length to 1D-2D ISIS v3.4 TUFLOW v2009-07-DB-ISP	FEH rainfall-runoff analysis re-done for new model extents; Statistical analysis repeated at downstream model extent to check the existing analysis; Time-to-peak checked against observed data; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for the site.	No blockage analysis required	C1 & T13
		River Swilgate	SO 9479 2362	SO 9129 2822	✓	Converted entire length to 1D-2D ISIS v3.4 TUFLOW v2009-07-DB-ISP	Hydrological analysis from Black & Veatch 2009 study adopted with the following additional analysis: Catchment descriptors re-extracted from FEH CD ROM version 3 and checked; FEH rainfall-runoff analysis re-done for new model extents; Statistical analysis repeated at downstream model extent to check the existing analysis; Time-to-peak checked against observed data; Storm DURATION sensitivity runs were undertaken to ensure that the critical storm DURATION was used for the site.	M5 Motorway culvert at SO 9143 2803	
		Tributary of River Swilgate	SO 9412 2507	SO 9271 2657	✓	Converted entire length to 1D-2D ISIS v3.4 TUFLOW v2009-07-DB-ISP	Hydrological analysis from Black & Veatch 2009 study adopted with the following additional analysis: Catchment descriptors re-extracted from FEH CD ROM version 3 and checked; FEH rainfall-runoff analysis re-done for new model extents; Statistical analysis repeated at downstream model extent to check the existing analysis; Time-to-peak checked against observed data; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for the site.	No blockage analysis required	
		Leigh Brook	SO 9186 2505	SO 9044 2688	✓	Converted entire length to 1D-2D ISIS v3.4 TUFLOW v2009-07-DB-ISP	Hydrological analysis from Black & Veatch 2009 study adopted with the following additional analysis: Catchment descriptors re-extracted from FEH CD ROM version 3 and checked; FEH rainfall-runoff analysis re-done for new model extents; Statistical analysis repeated at downstream model extent to check the existing analysis; Time-to-peak checked against observed data; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for the site.	M5 Motorway culvert at SO 9078 2598 Uckington Road Bridge SO 9177 2515	
Tewkesbury Borough	Brockworth	Horsbere Brook	SO 9031 1595	SO 8794 1764	X	A new 1D-2D model was build based on the survey provided for full length of the study. ISIS v3.4 TUFLOW v2009-07-DB-ISP.	2007 SFRM hydrology adopted with the following additional analysis: Flows for 5% and 0.1% AEP events derived using the same methodology as that used in 2007 study; Upstream inflow point moved 2km upstream of Brockworth site according to adjusted model extents; Lateral inflows from Hatherley Brook catchment removed to avoid double-counting flows; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for both Brockworth and Innsworth (considered in conjunction with the Hatherley Brook).	Mill Lane (SO 8956 1677) Court Road (SO 8917 1693)	T11
							2007 SFRM hydrology adopted with the following additional analysis:		

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Tewkesbury Borough	Innsworth	Hatherley Brook	SO 8742 2218	SO 8258 2098	✓	Converted section to 1D-2D. Section HB-06242d to confluence with the Severn converted to 1D-2D. ISIS v3.4 TUFLOW v2009-07-DB-ISP.	There was some discrepancy between reported flows and those found in the model boundaries. Flow sensitivity runs were therefore undertaken which indicated that flood extents are not sensitive to flows, hence the existing hydrological analysis could be adopted; Upstream inflow point for the lateral inflow (near Innsworth Technology Park) moved from the 1D domain to upstream of the 2D domain to ensure that flows in this drainage path were included in the model; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for Innsworth (considered in conjunction with the Horsbere Brook).	A38 Tewkesbury Road at SO 8405 2141	T9
		Unnamed Tributary of Hatherley Brook	SO 8583 2070	SO 8452 2135	X	Modelled in 2D with 1D structures. One culverts, under Innsworth Lane, has been estimated based on observations during the site visit. Culverts have been assumed to have the same capacity as a rectangular culvert 1.8m by 1.5m. (SO 8536 2082) TUFLOW v2009-07-DB-ISP	2007 SFRM hydrology adopted with the following additional analysis: There was some discrepancy between reported flows and those found in the model boundaries. Flow sensitivity runs were therefore undertaken which indicated that flood extents are not sensitive to flows, hence the existing hydrological analysis could be adopted; Upstream inflow point for the lateral inflow (near Innsworth Technology Park) moved from the 1D domain to upstream of the 2D domain to ensure that flows in this drainage path were included in the model; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for Innsworth (considered in conjunction with the Horsbere Brook).	No blockage analysis required	
		Horsbere Brook	SO 8585 2035	SO 8279 2084	✓	Combined with Hatherley Brook 1D-2D model ISIS v3.4 TUFLOW v2009-07-DB-ISP	2007 SFRM hydrology adopted with the following additional analysis: Flows for 5% and 0.1% AEP events derived using the same methodology as that used in 2007 study; Upstream inflow point moved 2km upstream of Brockworth site according to adjusted model extents; Lateral inflows from Hatherley Brook catchment removed to avoid double-counting flows; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for both Brockworth and Innsworth (considered in conjunction with the Hatherley Brook).	A38 Tewkesbury Road at SO 8400 2121	
Tewkesbury Borough	Bishop's Cleeve	Dean Brook	SO 9695 2899	SO 9293 2874	✓	Extended the PBA model upstream with the channel modelled in 2D with 1D structures.	PBA hydrology adopted with the following additional analysis: Schematisation of catchments checked against LIDAR and Severn Trent data and found to be robust - refined for new model extents; Default catchment descriptors were checked and found to be realistic; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for the updated model extents.	Cleeve Road - SO 9637 2897 A345 at SO 9533 2862 & SO 9554 2849 Railway at SO 9302 2874	T12
			SO 9638 2865	SO 9573 2869		Two culverts under Gotherington Lane have been estimated based on the channel dimension in the LIDAR and from the survey. Culverts have been assumed to have the same capacity as a square culvert 1m by 1m. (SO 9636 2897 and SO 9622 2801)			
			SO 9666 2788	SO 9544 2857		ISIS v3.4 TUFLOW v2009-07-DB-ISP			
		Unnamed Ditch	SO 9537 2806	SO 9443 2863	✓	No changes TUFLOW v2009-07-DB-ISP	PBA hydrology adopted with the following additional analysis: Schematisation of catchments checked against LIDAR and Severn Trent data and found to be robust - refined for new model extents; Default catchment descriptors were checked and found to be realistic; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for the updated model extents.	No blockage analysis required	
		Glebe Farm Brook	SO 9543 2803	SO 9336 2871	✓	No changes ISIS v3.4 TUFLOW v2009-07-DB-ISP	PBA hydrology adopted with the following additional analysis: Schematisation of catchments checked against LIDAR and Severn Trent data and found to be robust - refined for new model extents; Default catchment descriptors were checked and found to be realistic; Storm duration sensitivity runs were undertaken to ensure that the critical storm duration was used for the updated model extents.	No blockage analysis required	