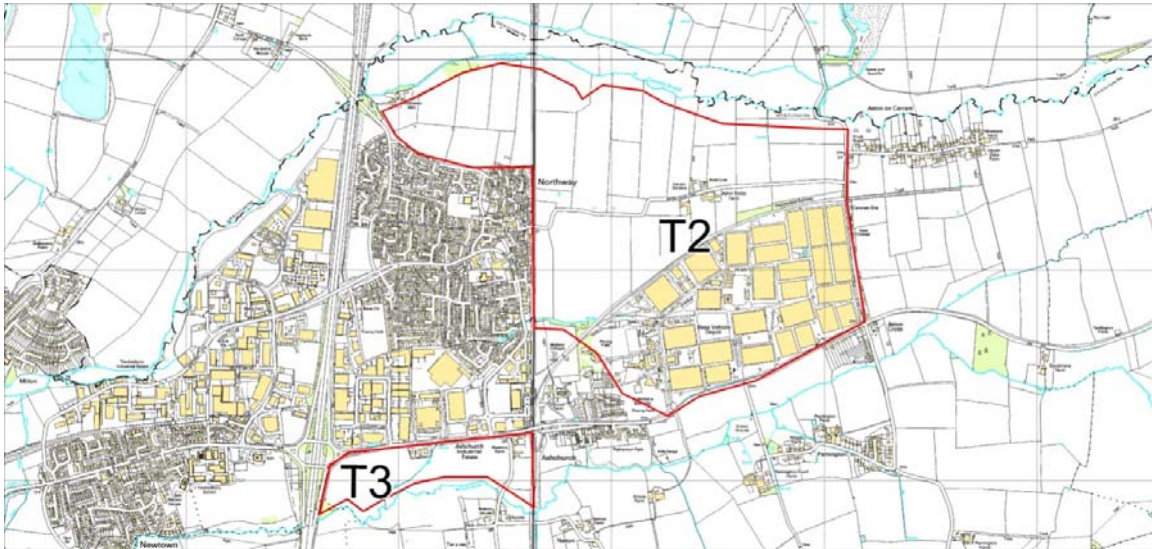


<b>Model Reference</b>	CAR
<b>Location</b>	Tewkesbury
<b>Watercourses</b>	Carrant Brook
<b>Development Sites</b>	T2 - Land at Ashchurch
<b>Objectives/Areas of interest</b>	



The Ashchurch site (T2) is located to the north east of Tewkesbury, to the east of the M5. The site spans an area made up of approximately 50% farm land and 50% industrial/military installation. The main West coast main railway line also cuts through the site in the north of the site, forming the western boundary in the southern area. The area of the site is approximately 2.12km<sup>2</sup>.

The Carrant Brook flows east to west along the northern boundary of site T2 passing under the railway before passing under the M5 motorway at the western extent of the development site. A tributary of the Carrant Brook runs parallel to the brook from the B4704 before the confluence immediately upstream of the motorway culvert. Both the Carrant Brook and the tributary will be considered in this assessment.

#### Previous Models

Title	Watercourse(s)	Notes
Tewkesbury confluence ISIS-TUFLOW model	River Severn, Carrant Brook, River Swilgate, Tirlle Brook and Tirlle Brook Tributary.	Model US extent is at downstream end of both sites therefore these sites are not covered by this model sufficiently.

#### Survey Data

Title	Type	Notes
Tewkesbury confluence ISIS-TUFLOW model.	Cross sections and structures	Structure and channel data will be used where available.
Site walkover observations (June 2012), Capita Symonds	Approximate structure dimensions	Dimensions taken through combination of measurements and visual inspections (when access to the structure face was not possible).

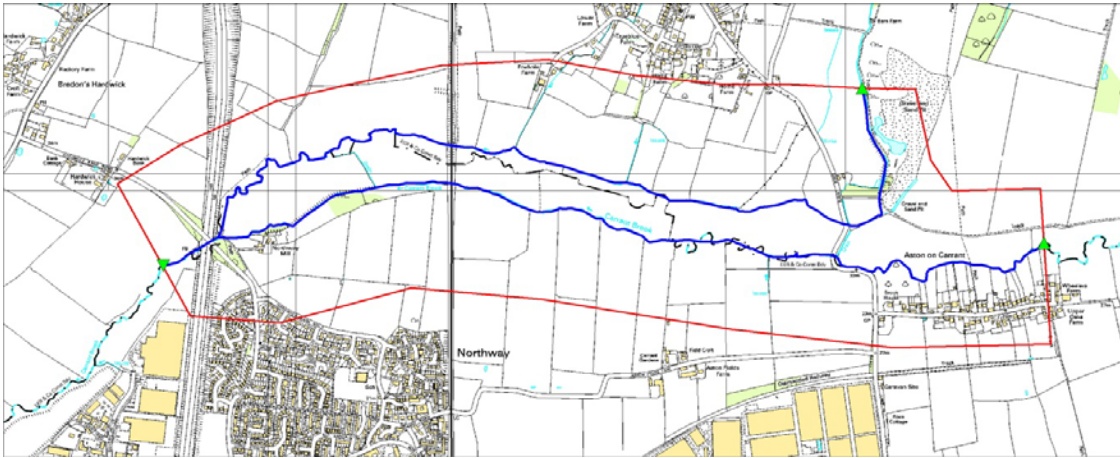
## GIS Data

**OS Tiles -** 10k: SO93NW, SO93NE, SO93SW, SO93SE  
50k: SO82

**LIDAR -** Resolution: 1m  
Flown Date: July 2011

## Modelling Approach

A new 2D model of the Carrant Brook has been created for this assessment using TUFLOW. Hydraulically important structures are represented in 1D using ESTRY. The existing Tewkesbury confluence ISIS-TUFLOW model extends up to the Railway embankment; through this overlapping reach the existing model data will be used to inform the new model. Data for the upstream section the Carrant Brook and the Kinsham stream has been taken LIDAR data and site observations.



The Carrant Brook flows east to west along the northern boundary of site T2 and then under the M5. The proposed upstream extent of this watercourse is approximately 1km to the east of the site. The tributary of the Carrant (referred to as the Kinsham stream) runs parallel to the Carrant, joining it approximately 20-30m upstream of the M5 culvert. This tributary is deemed to be of less significance to flooding at the site, but will be included within the model because the interchange between the two watercourses may influence the flood mechanisms at the site.

Watercourse	Upstream	Downstream
Carrant Brook	394138, 235094	391823, 234837
Kinsham Stream	394522, 234724	391631, 239734

## Model Schematisation

<b>Model Method</b>	2D with 1D structures
<b>Software</b>	ESTRY TUFLOW (Build 2012-05-AA)
<b>Grid Size</b>	3m
<b>Mannings Values</b>	See standard Mannings values
<b>Run Settings</b>	-
<b>Channel</b>	2D model using gully line to provide flow path through model
<b>Other comments</b>	-

### Hydrology/Model inflows

ReFH derived inflow hydrographs based on catchment descriptors. Peak flow estimates obtained were compared with the existing 2007 inflow for the Carrant Brook in the Tewkesbury Confluence model assuming a return period for this event of 200 years. The ReFH inflows were scaled as necessary to achieve similar flows for an equivalent return period (scaling factor of 0.8 applied). Full hydrological assessment was not completed as it was unlikely to add value to catchments of this size.

Location and details of flows for each event are outlined in the table below;

Flow node	Grid Reference	Event period peak flow			
		20	100	100CC	1000
CB01	394690, 234810	17.3	23.6	28.4	40.1
KS01	394060, 235370	0.8	1.2	1.4	2.5

### Boundary Conditions

New inflow boundaries have been determined as detailed above. Downstream boundary was defined using a Head Flow boundary generated by TUFLOW using a user defined bed slope defined using LIDAR data.

### Model File Naming Convention

File name: CAR\_SSS\_\*\*\*\*F\_DDDhr\_YYYY\_@@@

e.g. CAR\_UND\_0100F\_8.5hr\_2012\_003

CAR	Carrant Brook hydraulic model.
SSS	The topography scenario of the model. UND - represents the undefended scenario.
****F	The return period that is being modelled.
DDD	Storm duration.
YYYY	2010 indicates current day / 2110 future (i.e. including allowance for climate change)
@@@	This will represent the version number of the model

#### Model Scenarios

BSC	Baseline Model
BL1	Blockage scenario - 50% blockage of M5 Culvert using Estry blockage function (reduces flow width and leaves invert/soffit unchanged).

### Model Runs & Mapping

Model Scenario	Return Periods
Baseline Model	20, 100, 100+CC and 1000
Blockage Scenarios	100+CC

Mapped Output	Approach
Flood Extent / Flood Zones	New model results. 3b (20 yr), 3a (100 yr), 3a + climate change (100CC), 2 (1,000 yr).
Flood Hazard	New model results (BSC) 100 year (climate change). Defra Hazard rating
Blockage (BL1)	New model results (BL1) 100 year (climate change). Defra Hazard rating

### Structures

Model Ref.	Description	Photo Ref.	Data source	Modelling Approach	Dimensions (M)	Blockage Risk
1	B4079 bridge (Kinsham Stream) - Square bridge	P102221	Site Observations	Rectangular culvert	2.0 x 1.6	-
2	B4079 bridge (Carrant Brook) - Arch bridge	P102024	Site Observations	Rectangular culvert	4.65 x 0.85	-
3	Field access - arch bridge	P102237	Site Observations	Not modelled - limited impact	-	-
4	Railway culvert (arch)	P102239	Site Observations	2D opening through embankment	Use LiDAR	-
5	Railway culvert – farm access (arch)	P102241	Site Observations	2D opening through embankment	Use LiDAR	-
6	Railway culvert (arch)	P102243	Site Observations	2D opening through embankment	Use LiDAR	-
12	Square bridge	P102269	Site Observations	Not modelled - thin deck, easily bypassed so unlikely to cause significant restriction.	-	-
13	Square bridge	P102271	Site Observations	Rectangular culvert	5.5 x 2.2	-
14	Motorway culvert	P102270	Site Observations	Rectangular culvert	5.0 x 2.5	Low

### Defences

Reference	Description	Photo Ref.	Data source	Modelling Approach
-	No Defences	-	-	

# Plan of Structure / Defence Locations

