

Appendix D - Breach Analysis Methodology

Overview of Flood Warning Improvements Work

The hydraulic model for the River Eden and its tributaries was updated as part of the Carlisle City and Caldew Flood Alleviation Scheme. This model update included the linking of the ISIS 1D model to a TUFLOW 2D model to better define the out of bank flow specifically from the Caldew through the city of Carlisle. The model was updated with the flood defences from the Eden Petteril and Carlisle City and Caldew Schemes. Details of the updates to the models are described in the Carlisle City and Caldew Modelling Report¹.

As part of the Carlisle City and Caldew Flood Alleviation Scheme there are a total of twenty-three floodgates. These include two that are normally closed and are only used by Environment Agency staff, thirteen used to protect property at the Maltings, one used by Network Rail to access their maintenance area, two that are normally closed at the Little Caldew pumping station and the remainder used to access public areas.

As part of the Flood Warning Improvements Project² for the River Eden and its tributaries, in order to better inform incident planning and management, inundation areas have been considered for the various failure scenarios including a 'With Scheme Condition 1:200 Year event Caldew Critical – Flood gates left open'. This scenario shows the effect of failing to close the flood gates in design events. The gates that are only opened for maintenance purposes and are normally closed are assumed to be closed in this scenario.

Breach Locations

As part of the Level 2 SFRA for Carlisle, an assessment of the risk from the breach of flood defences has been considered for the five areas of Caldewgate/Shaddongate, Denton Holme, Milbourne Street, Rickergate and Willowholme.

Following discussion with the Environment Agency Development Control in Penrith it was confirmed that the outputs of the 2D modelling undertaken for the 'With Scheme Condition 1:200 Year event Caldew Critical – Flood gates left open' is appropriate to determine the residual risk for the areas of Caldewgate/Shaddongate, Denton Holme and Milbourne Street.

The modelling undertaken as part of the Flood Warning Improvements Project did not cover the areas of Rickergate and Willowholme. Therefore, additional modelling was undertaken as part of the Level 2 SFRA. For Rickergate a low spot in the flood defence embankment along the River Eden was identified from Lidar data. At this location a 50m width of the defence was removed from the model to simulate a breach in the flood defence (see Figure D1). The Eden "Do Something" model which includes both the Eden Petteril and Carlisle City and Caldew Scheme defences was used as the basis of the breach model. The model was run for the 1% and 0.5% AEP events to derive flood hazard outputs, flood depth, velocity and rate of inundation.

For Willowholme a low spot in the flood defence embankment along the River Eden was identified from Lidar data. At this location a 50m width of the defence was removed from the model to simulate a breach in the flood defence (see Figure D2). The Eden "Do Something" model which includes both the Eden Petteril and Carlisle City and Caldew Scheme defences was used as the basis of the breach model. The model was run for the 1% and 0.5% AEP events to derive flood hazard outputs, flood depth, velocity and rate of inundation.

¹ Caldew & Carlisle City Flood Alleviation Scheme. Modelling Report. Halcrow, December 2008

² Caldew and Carlisle City Flood Alleviation Scheme Flood Warning Improvements Report. Halcrow, May 2010

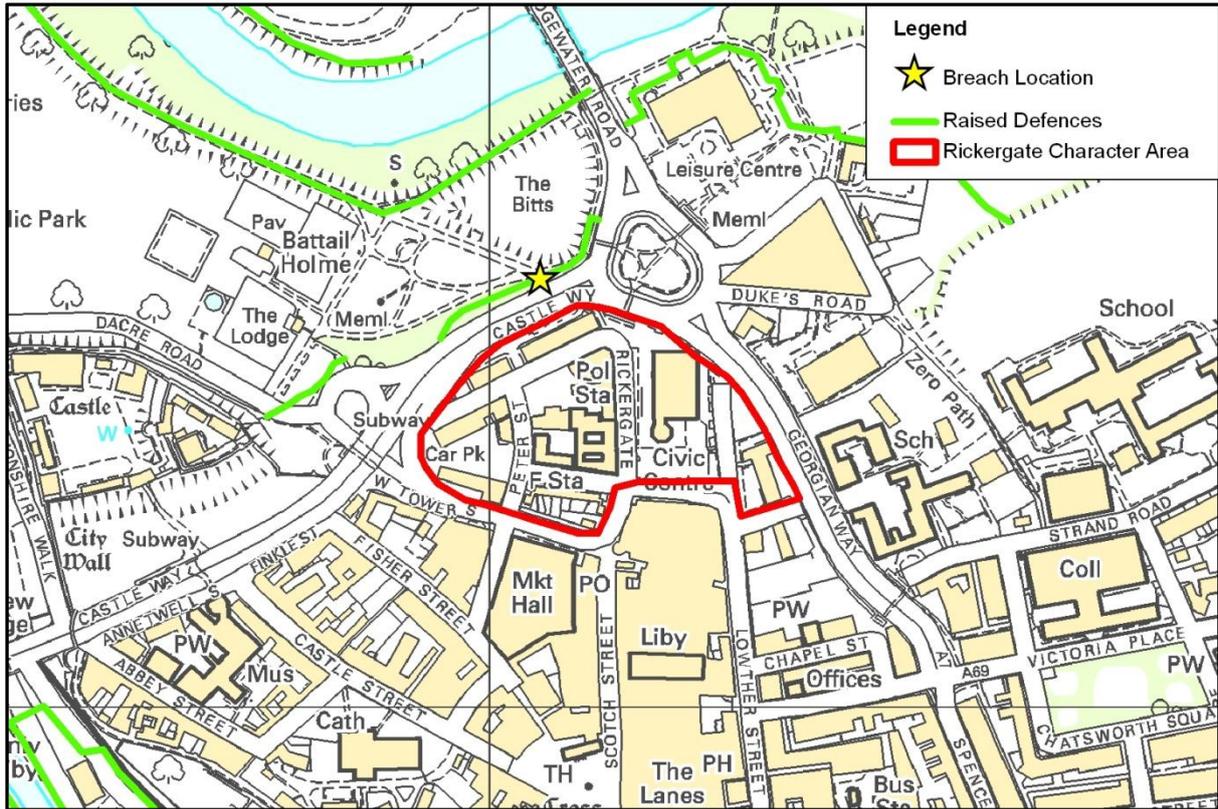


Figure D1 – Breach location for RickerGate

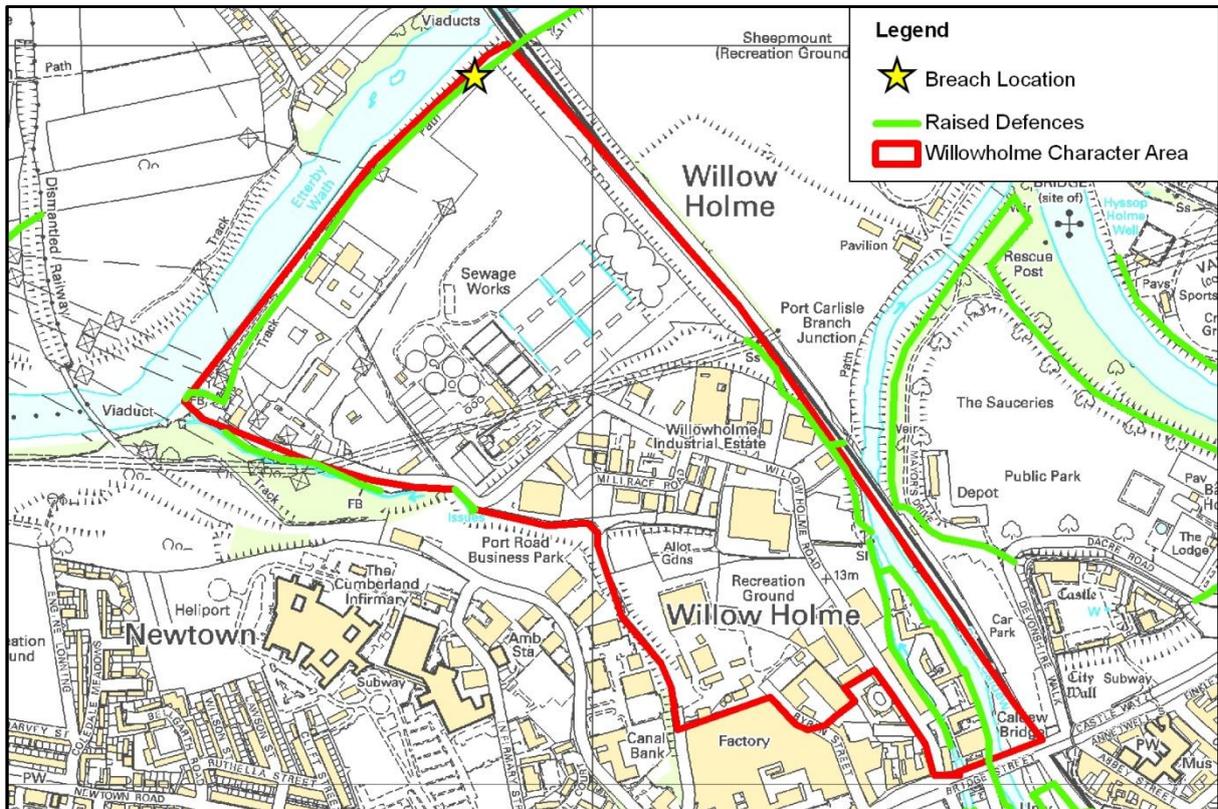


Figure D2 – Breach location for Willowholme

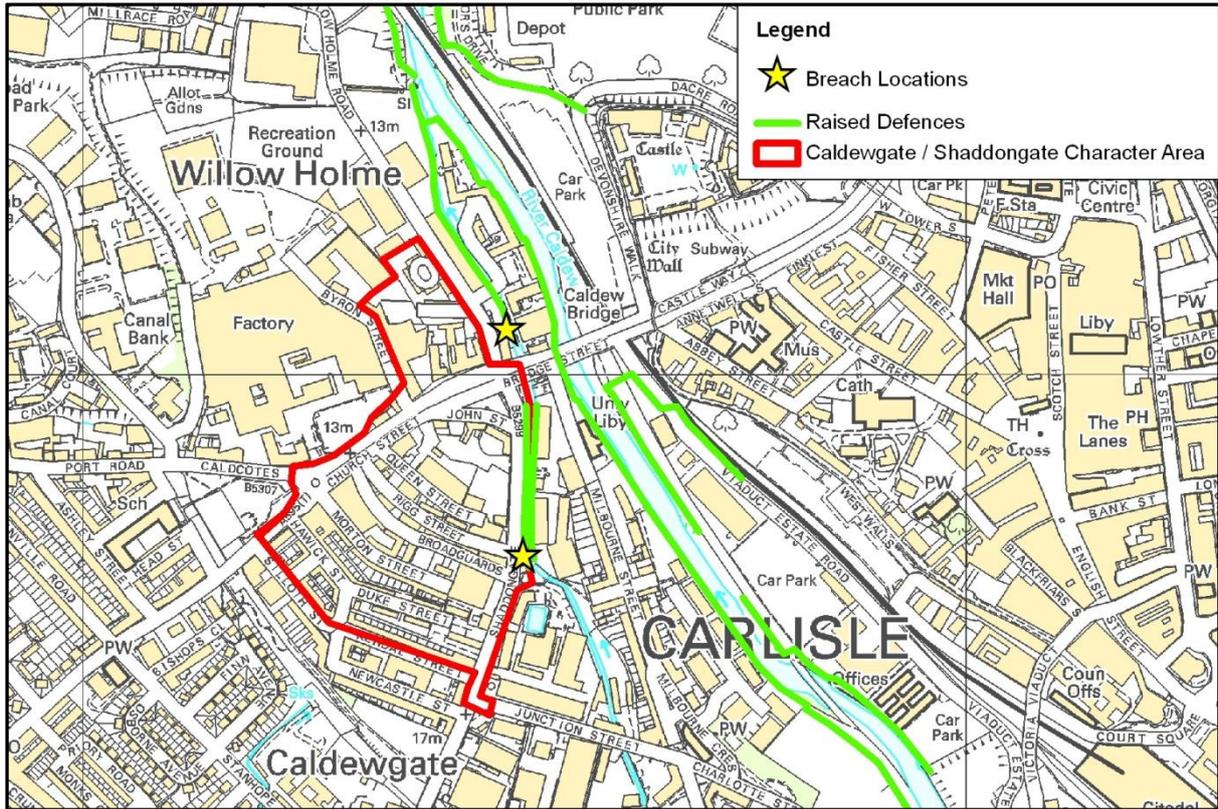


Figure D3 – Breach location for Caldewgate/Shaddongate

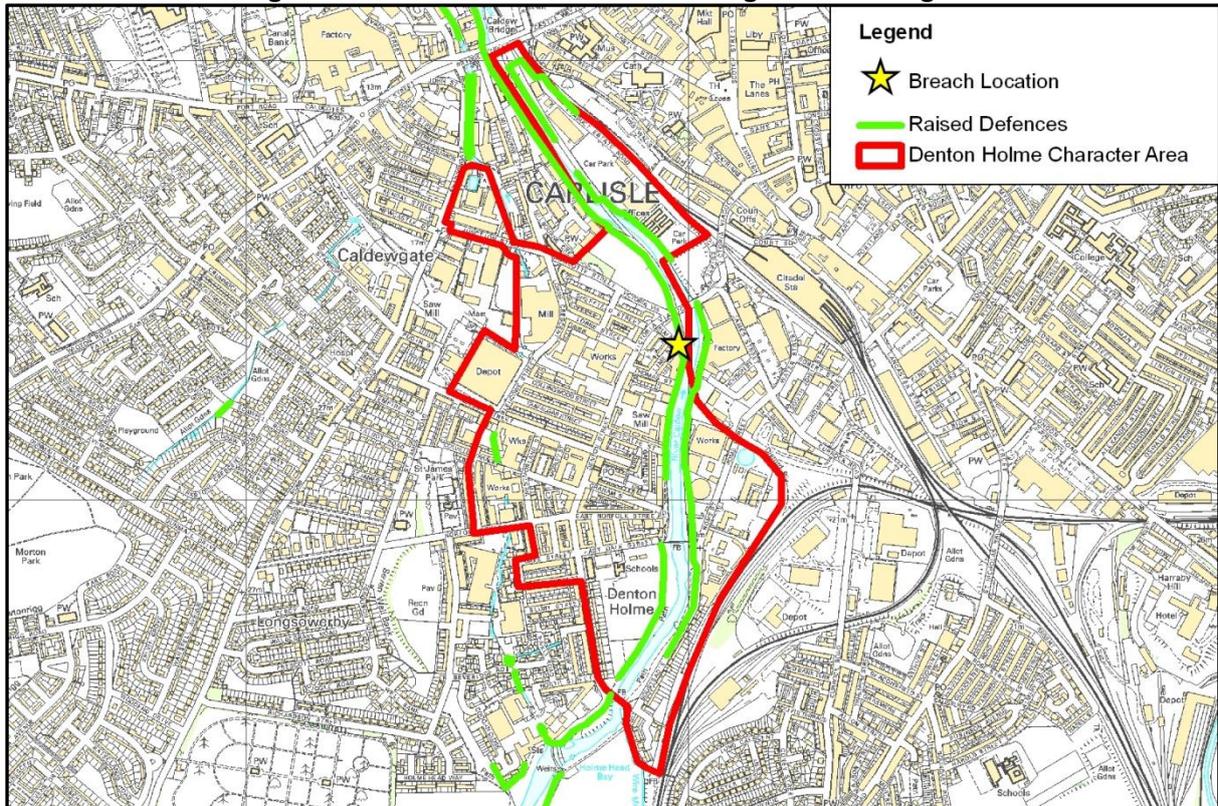


Figure D4 – Breach location for Denton Holme

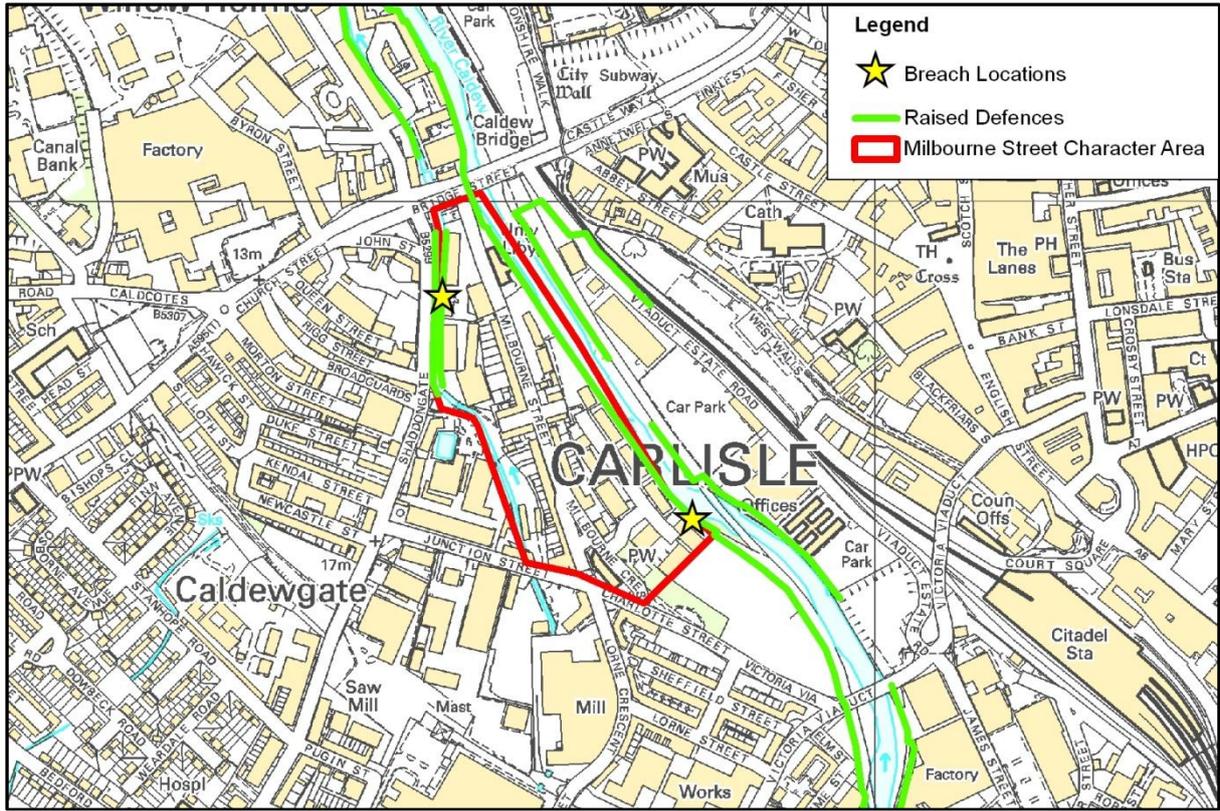


Figure D5 – Breach location for Milbourne Street