WESTNEWTON BRIDGE SHEAR STRESS 'HOT SPOT', 200M UPSTREAM OF DESIGN

Technical note

Prepared for

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1. SHEAR STRESS HOT SPOT

Modelling of the College Burn at Westnewton Bridge using a 2D hydraulic model has indicated a significant 'hot spot' in shear stress for the 200year flow, approximately 200m upstream of the bridge. The maximum value of shear stress in the hot spot is approximately 190Pa, meaning that bed particles of >270mm diameter would be mobilised, assuming a critical Sheilds stress of 0.043.

There is no difference in shear stress here between existing and design conditions.

The reasons for the high shear peak here are essentially due to a localised constriction of channel geometry, causing a vertical and lateral flow convergence, and a localised increase in velocity.

The following figures are output from the 2D hydraulic (described in previous reporting).

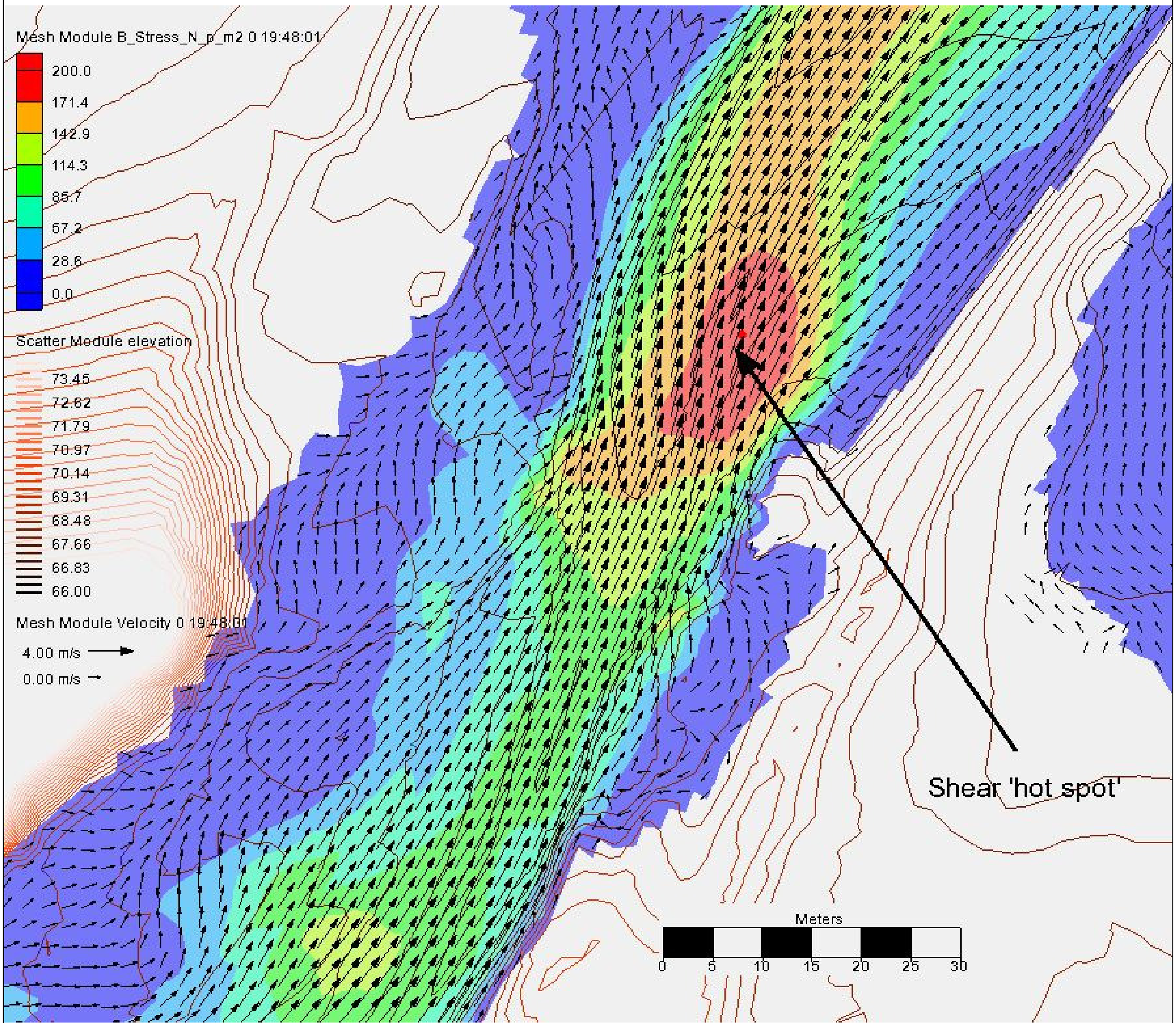
Figure 1.1 shows the shear stress contours at the hot spot for the 200 year peak flow simulation. This point is 200m upstream of the bridge, significantly upstream of the design area, and at the start of the straightened section of channel on the approach to the bridge.

Figure 1.2 shows the digital elevation model (DEM) used in modelling. Apparent in the DEM, which was obtained by topographic survey, is a lateral constriction of the channel just upstream and adjacent to the shear stress hot spot. This lateral constriction is especially pronounced on the right bank. Flow is constricted laterally, reducing the wetted width, and increasing flow velocity. There is an obvious convergence of velocity vectors at this flow constriction shown in Figure 1.1 and following figures.

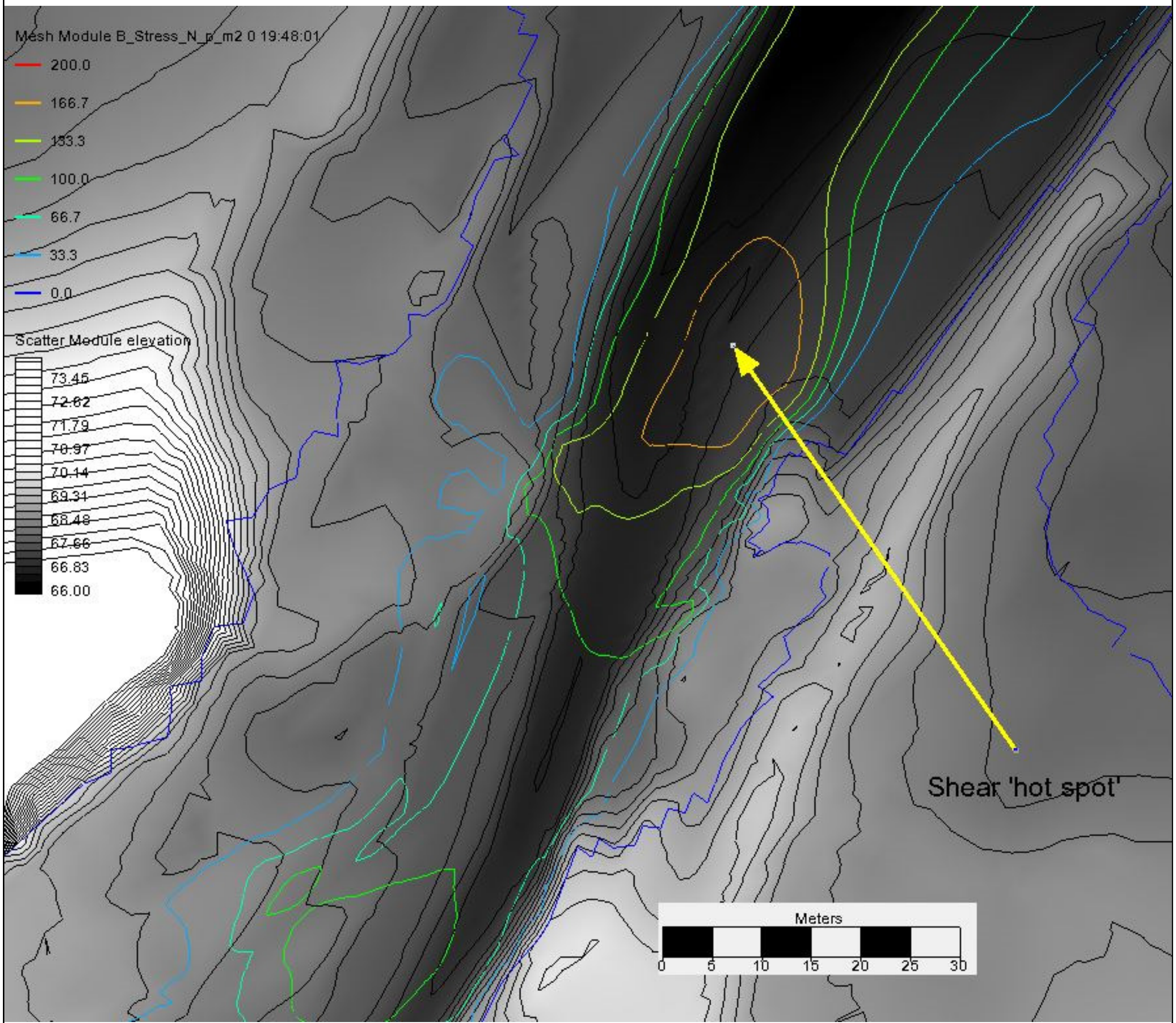
As well as the lateral constriction, caused by the locally high right (and left) bank, there is a vertical constriction obvious in Figure 1.3, which shows the depth of the water. The channel bed has a localised riffle crest at the lateral constriction, further increasing channel velocity. The increase in channel velocity is shown in Figure 1.4. The shallow depths and high velocities result in a region of supercritical flow coincident with the shear stress hot spot, shown in Figure 1.5. The critical flow region starts at a line drawn from the local obstructions on the left and right banks.

The model output and DEM therefore indicate that the hot spot in shear is likely caused by the localised high flow lateral channel obstruction, combined with a vertical constriction.

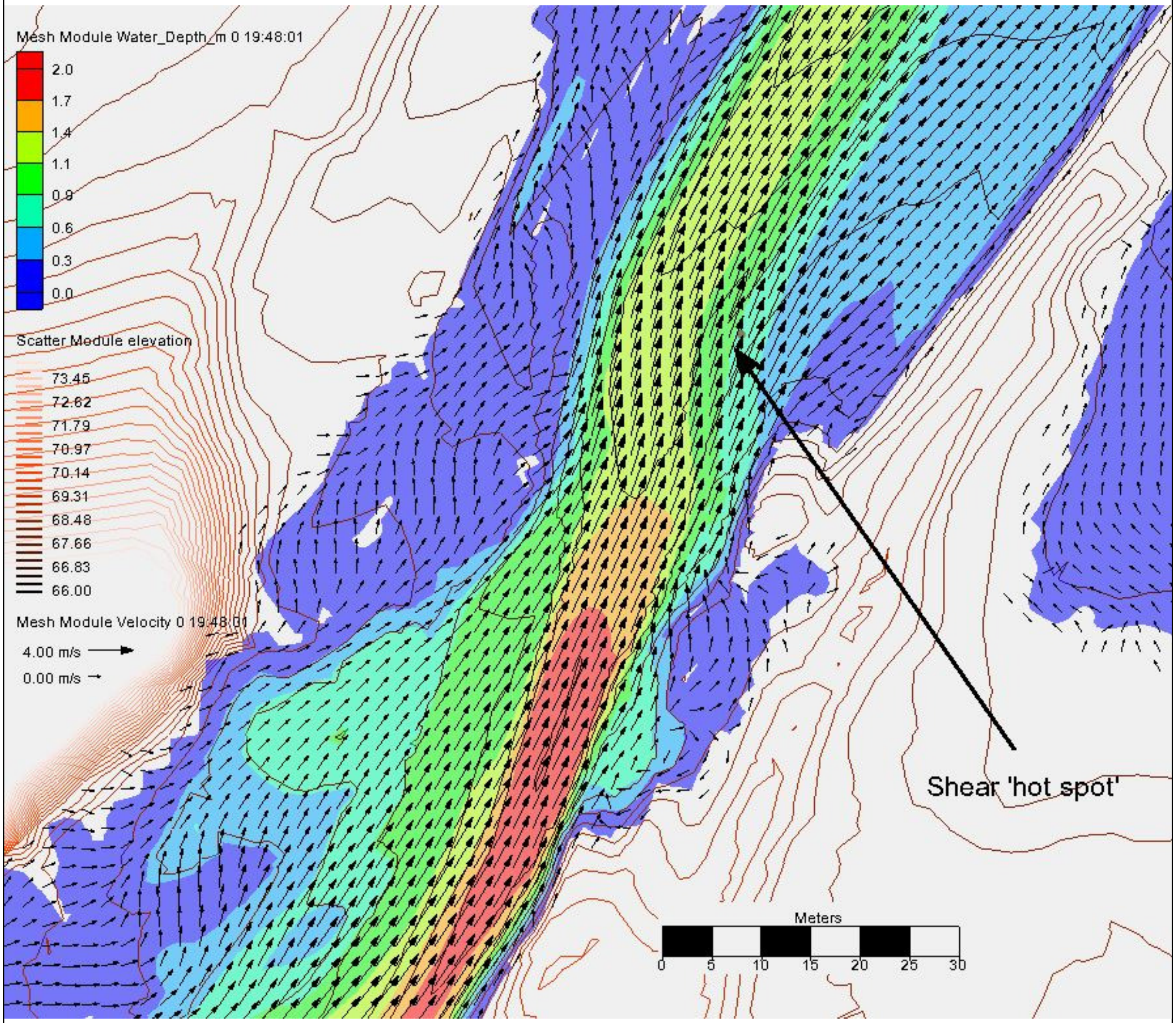
Given the high shears experienced here, it is likely that bed and bank erosion will adjust the channel geometry.



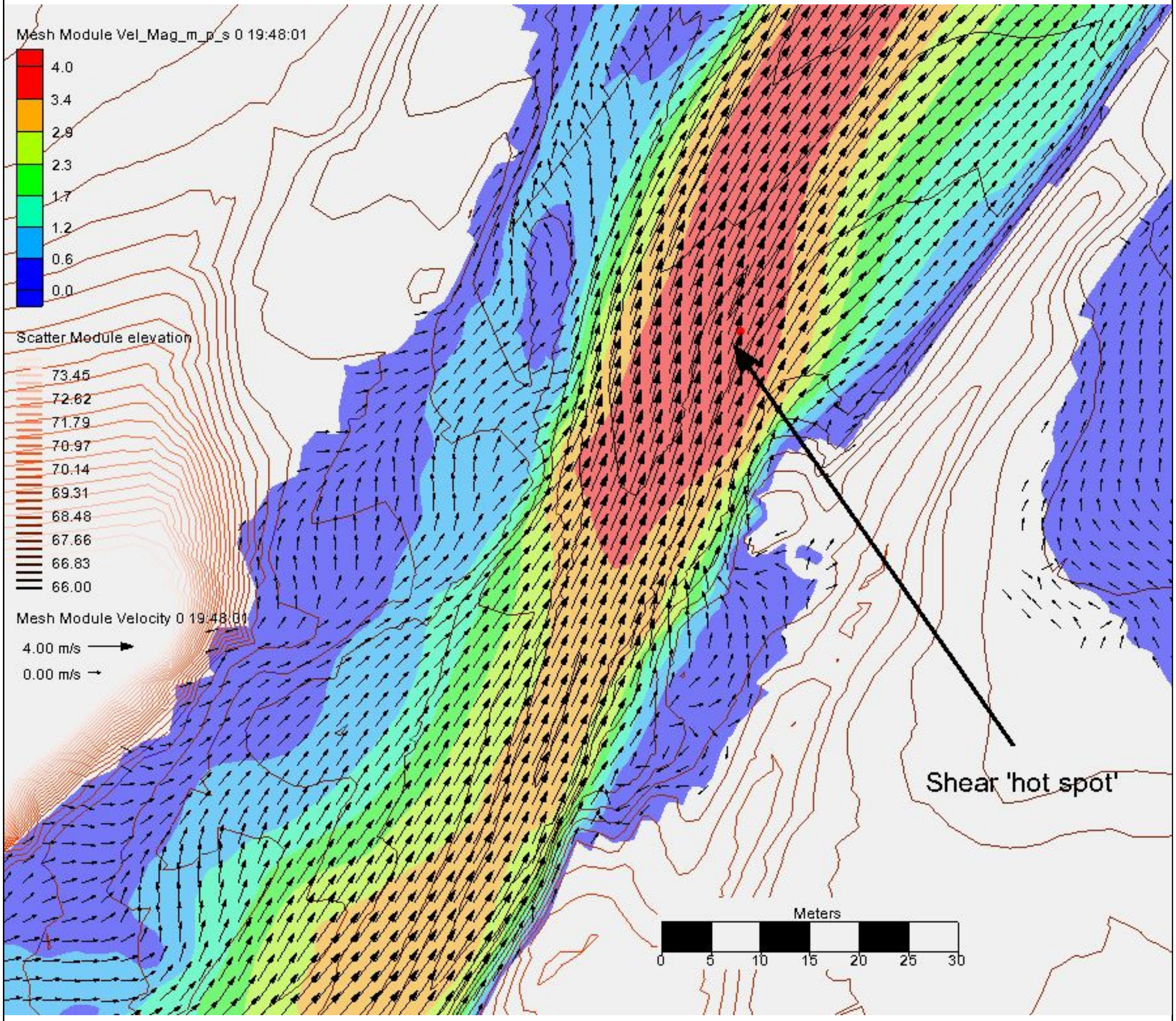
Notes: Approx 200m upstream of Westnewton Bridge	cbec eco engineering	*Project name* **Shear stress hot spot, Q200yr peak**		
		Project No.	Created By: EAG	**Figure 1.1**



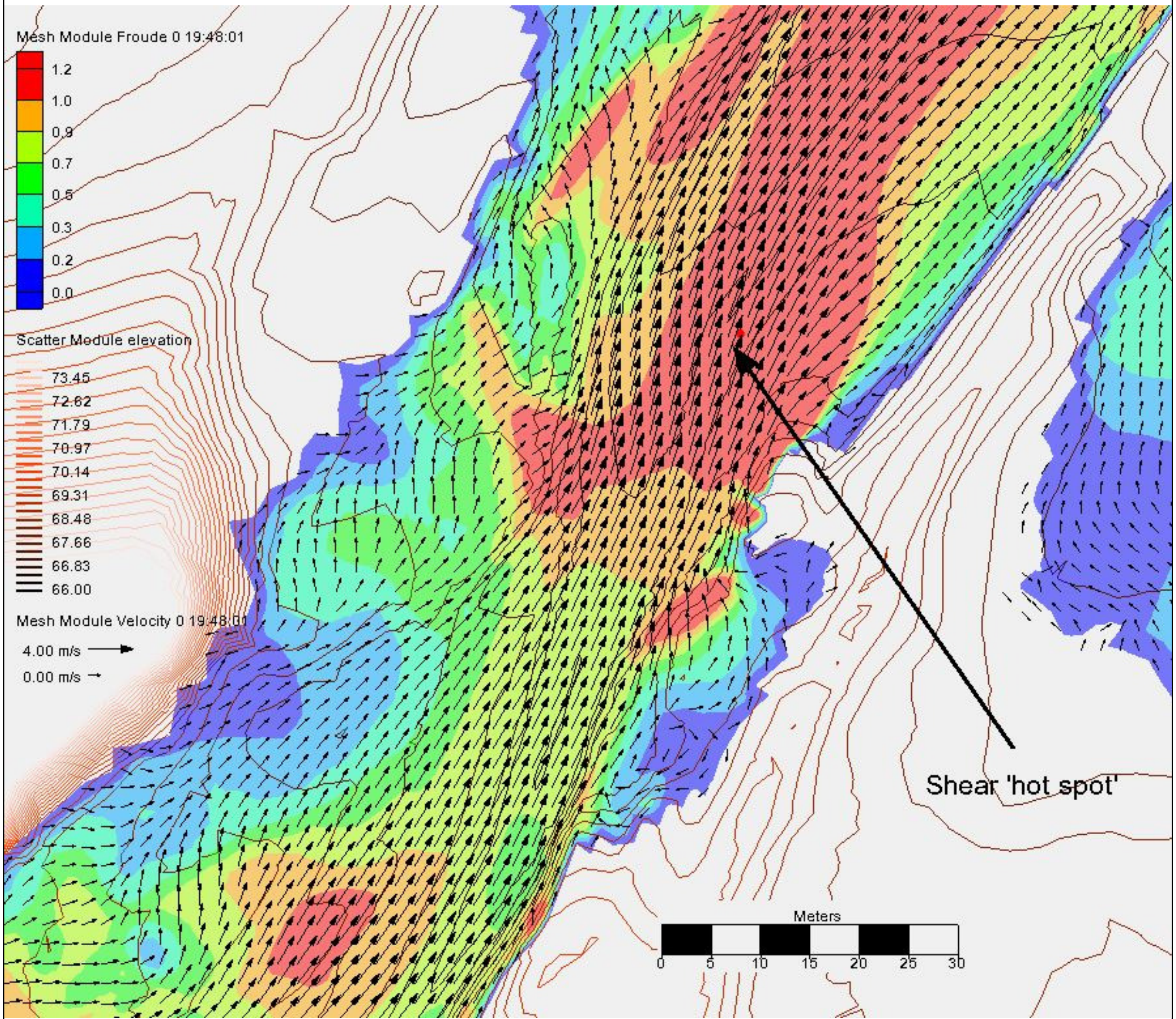
Notes: Approx 200m upstream of Westnewton Bridge	cbec eco engineering	*Project name* **DEM at shear stress hot spot**		
		Project No.	Created By: EAG	**Figure 1.2**



Notes: Approx 200m upstream of Westnewton Bridge	cbec eco engineering	*Project name* **Depth at shear stress hot spot**		
		Project No.	Created By: EAG	**Figure 1.3**



Notes: Approx 200m upstream of Westnewton Bridge	cbec eco engineering	*Project name* **Velocity at shear stress hot spot**		
		Project No.	Created By: EAG	**Figure 1.4**



Notes: Approx 200m upstream of Westnewton Bridge	cbec eco engineering	*Project name* **Froude at shear stress hot spot** Project No. | Created By: EAG | **Figure 1.5**

2. LIST OF PREPARERS

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