Executive Summary for Burniston, Cloughton and Quarry Becks

A phase 1 (scoping report) on the flooding issues was undertaken in 2002 for Burniston Beck. During this study a flood event occurred in August 2002 that affected several properties outside the original study reach. At that stage it was determined that a more detailed options phase 2 study was justified.

For this current assessment the study reach has been extended to include Cloughton Beck, Quarry Beck and Burniston Beck, to the confluence with Sea Cut (Burniston Beck changes its name to Cow Wath from Cow Wath Bridge to the confluence with Sea Cut). This, current report represents a detailed mathematical modelling exercise that has been undertaken to determine the causes, extents and frequency of flooding. Mitigation options have also been assessed and costed.

Consideration of risks

Flooding to properties around the West Lane area of Cloughton Beck and the Bridge Close area of Burniston Beck is frequent, therefore justifying their designation as Critical Ordinary Watercourses. The most recent severe flood occurred in August 2002 when flooding was experienced at a number of locations in the catchment. These areas included the West Lane area, Becks Lane, Bridge Close and the caravan park.

Hydrological assessments have determined that the peak flow for the entire Burniston Beck catchment is 19m^3/s, with the sub-catchments of Cloughton and Quarry Beck being 3m^3/s and 16m^3/s respectively for the 1 in 100 year event. For the 1 in 50 year event the peak flow for Burniston is 17m^3/s.

Hydraulic modelling predicts that flooding is first experienced by 8 properties in the West Lane area at a return period of 1 in 10 years. The flooding is a result of culvert incapacity under West Lane. This rises to 63 properties for the 50 year event and 69 properties for 100 year event. Flood depths of up to 600mm are predicted for some properties for the 1 in 100 year event.

Specific Causes of Flooding

The hydraulic analyses have revealed that there are a number of contributing factors to flooding in the area caused by various mechanisms. The table below summarises the causes, extents and locations of the flooding and these are described in more detail in subsequent paragraphs.

Location	No. of Properties affected (100 yr event)	Causes	Return Period for Start of flooding
West Lane Culvert	27	Incapacity of culvert	10 years
Becks Lane	19	Incapacity of channel	50 years
Rocks Lane Bridge	14	Upstream incapacity of channel and bridge Downstream incapacity of channel and Bridge Close Bridge	U/S 100 years D/S 50 years
Bridge Close Bridge	9	Incapacity of bridge and channel	25 years
Caravan Park	N/A	Incapacity of channel	25 years

The capacity of key structures is the direct cause of flooding at a number of locations. The culvert under West Lane is undersized and causes backing up of the flow, which spills across West Lane flooding properties on West Lane and Little Moor Close. The Bridge at Bridge Close causes backing up and the low right bank causes floodwaters to bypass the bridge, flooding properties on Bridge Close and Willymath Bridge (Coastal Rd). The incapacity of Rocks Lane Bridge in combination with the incapacity of the river channel causes the floodwaters to reach such a level that flooding of properties upstream of bridge is observed.

In the Beck Lane area flooding is caused by the lack of capacity in the river channel, therefore causing floodwater to flow over land and flood properties along Beck Lane and Church Beck cottages. Due to the natural topography in the caravan park area once the channel capacity has been reached the only route for the floodwater to take is in to the caravan park area.

Mitigation Measures Proposed

Some of mitigation measures, such as flood storage, were dismissed as there were no suitable areas available for flood storage before costing. However, a number of mitigation measures were assessed tested and costed as summarised in the table below. (Options 1 and 2 represent do nothing and do minimum but have been rejected.) A range of return periods were also assessed and the 50 year standard of protection was considered to be the most cost-beneficial for the preferred scheme.

Summary of mitigation measures and cost benefit assessment.

	Option 3	Option 4
Protecting properties West Lane and Little Moor Driver Area	Improve West Lane culvert to a box culvert 1 m by 1.2m	
Protecting Properties Church Beck Cottages and Beck Lane Area	Construction a flood embankment average height 750mm for 500m	
Protecting properties Rocks Lane and Bridge Close	(i) Embankment downstream Rocks Lane Bridge average height 400mm, right bank 150m and left bank 75m (ii) Floodwall upstream of Bridge Close average height 850mm for 60m	
Protecting Caravan Park	Flood embankment average height 750mm for 450m	Raise Caravans above 1 in 50 year flood event
Maintenance Measures	(i) The structures are frequently inspected for debris and any trash screens cleaned along the watercourses. These should also be designed to be accessed and cleaned during flood conditions. (ii) The channel vegetation and debris is required to be kept 'under control' to assist in maximising the channel capacity.	
Cost Benefit Ratio (50 yr SoP)	2.5	3.5
DEFRA Priority Scores (50 yr SoP)	12	16

Ecological consideration

The main ecological risks are associated with the presence of otters along Burniston Beck and the possible presence of badgers and bats. Licences, and close consultations with Defra and English Nature will be required for the development of any proposals.

Selection of Proposed Scheme

The cost difference between option 3 and 4 is due to the proposed construction of a bund to protect the caravan park or raising the floor level of the caravans to stop internal flooding. This is reflected in the benefit cost ratio. Therefore the cost benefit ratios, a consideration of risks associated with the schemes and the LDW 11 score have been considered in order to make a decision on the preferred option.

In conclusion, option 4 is the preferred scheme based on the low costs, higher cost benefit ratio and favourable LDW11 score. The risk and ecological benefits are similar for each of the options. This scheme designs flooding out of the system by several localised flood defence structures, replacement of the West Lane culvert and channel widening downstream of the culvert. It is recommended that a 200 year standard of protection is adopted throughout this scheme.

Recommendations

(i) Burniston and Cloughton Becks are considered to be critical ordinary watercourses and this status should be maintained.

(ii) In terms of the selection of freeboard and factors of safety regarding channel design, a manning's n of 0.08 (to simulate a highly vegetated channel) increased water levels of 100-200mm for the 100 year design event. It is recommended that this robustness should be accommodated for in the design as freeboard and a minimum 300mm should be allowed for.

(iii) This Phase 2 Report has revealed that there is a strong economic case to advance this project and present it to DEFRA for grant aid assistance with a benefit cost ratio of 3.5.

(iv) As part of the detailed design phase, a comprehensive site investigation would be required. This will consist of a full services search, and relevant boreholes to determine ground conditions. This will enable a greater level of confidence to be placed in the scheme costs which could then be revisited. The issue of permission to do works on land will also need to be further investigated.

(v) The progression of this study will need to incorporate a carefully designed consultation strategy to ensure that all stakeholder comments, aspirations and opportunities are maximised.

(vi) It is recommended that consideration be given to local rainfall and water level monitoring such that a calibration of the hydraulic model can be undertaken at a future date. However, it is not suggested that the project is delayed for this requirement.

(vii) It is recommended that the area be flown to obtain LiDAR data. This will help improve the accuracy of the flood outlines.