

How is flood risk managed by the Scottish Borders Council?

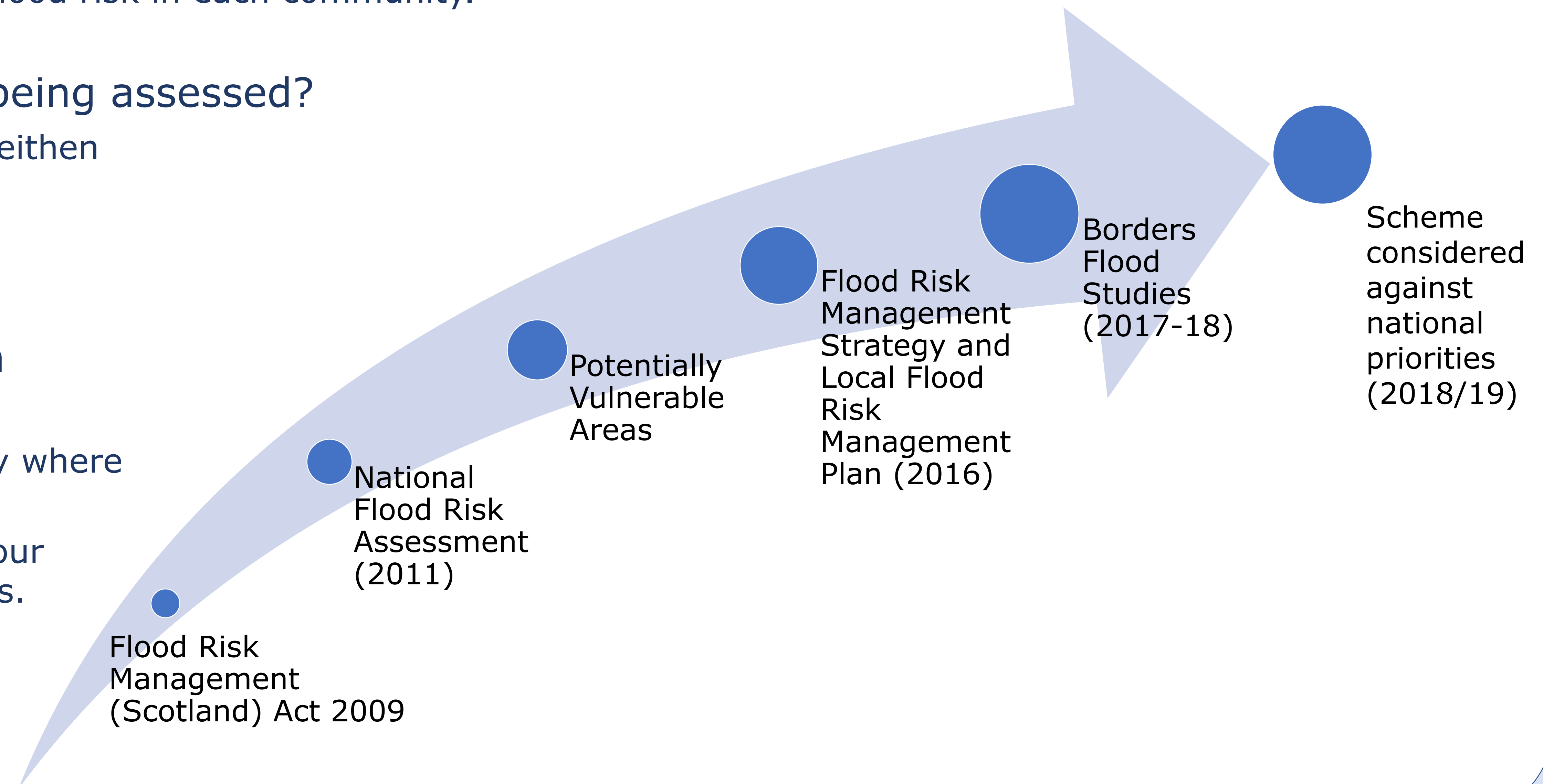
- The Flood Risk Management (Scotland) Act 2009 aims to prioritise flood mitigation across Scotland using a proactive and risk based process for assessing flood risk.
- This approach led to the preparation of SEPA's Flood Risk Management Strategies by SEPA and the Tweed Local Flood Risk Management Plan developed by the Scottish Borders Council as the Lead Local Authority for the Tweed Local Plan District.
- These plans identified specific communities as being at risk and in need of a detailed flood study to help inform the management of flood risk in each community.

Which communities are being assessed?

- Broughton, Peebles & Innerleithen
- Newcastleton
- Earlston

How will Flood Protection Schemes be prioritised?

- SEPA will prioritise nationally where funding should be allocated.
- The reports and findings of our study will inform this process.



What are the study objectives?

1) Develop better understanding of flood risk in the community

- Create, update or develop new/existing flood model information;
- Determine existing flood risk;
- Develop improved flood mapping;

2) Develop recommendations for management of flood risk

- Develop a range of options to manage flood risk, including structural and non-structural options;
- Appraise actions to manage flood risk (consider the pros and cons and economic viability for all proposed options);
- Recommend options for the future management of flood risk;

3) Select a preferred approach to manage flood risk in each community and identify recommendations that the Council will take forward

- SEPA will prioritise nationally where funding should be allocated;
- The reports and findings of our study will inform this process.

4) Engage partners and stakeholders

- Today's consultation.

What has been done so far?

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Flood Review



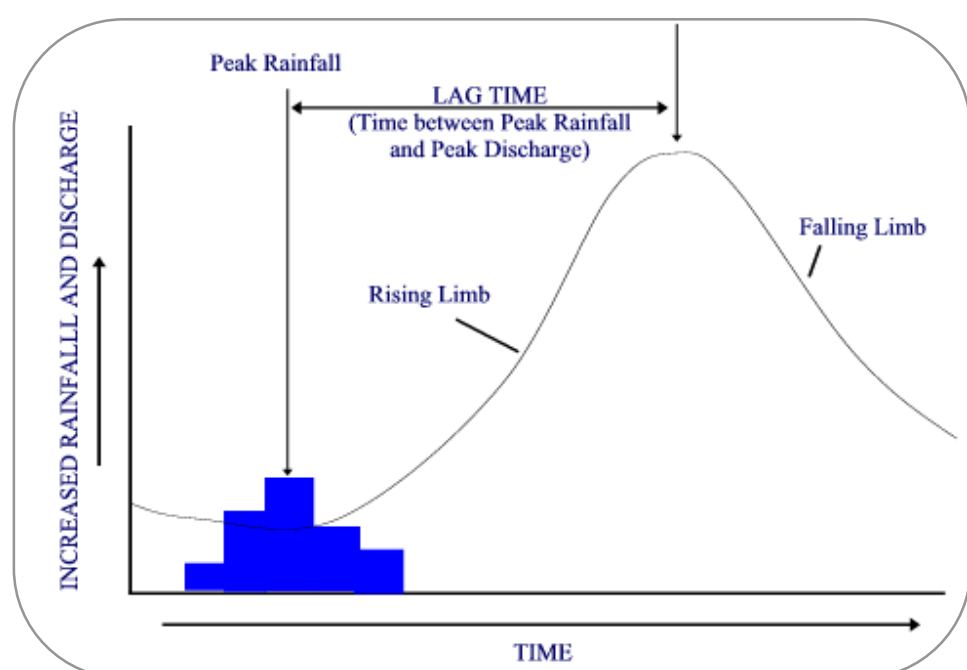
Topographic
surveys



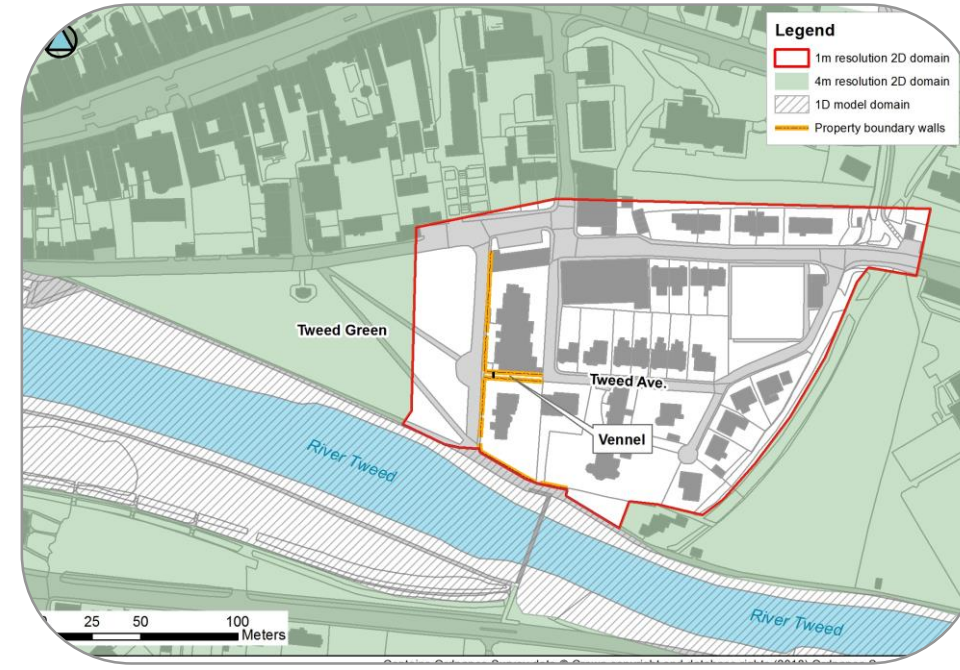
Asset
inspections

The studies aim to better assess current flood risks in the community by undertaking a review of past flood events; generating updated and detailed flood maps, determining the likely risk to different properties; and to propose a set of mitigation measures to reduce the flood risk to an acceptable level.

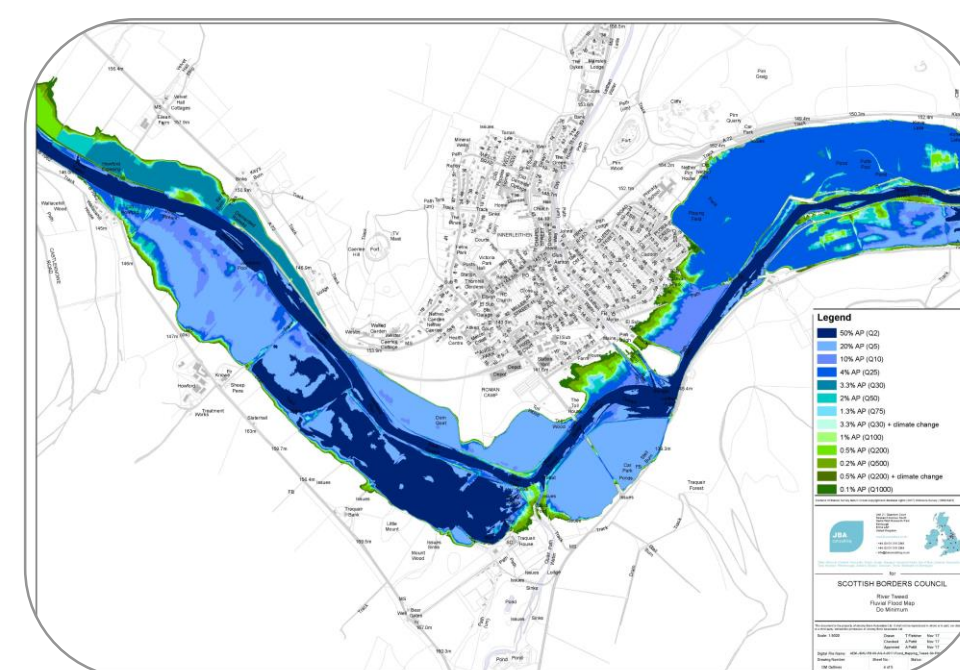
The models developed form a basis for assessing future flood levels, flood mitigation options, detailed design of schemes and the costs to deliver.



Hydrology



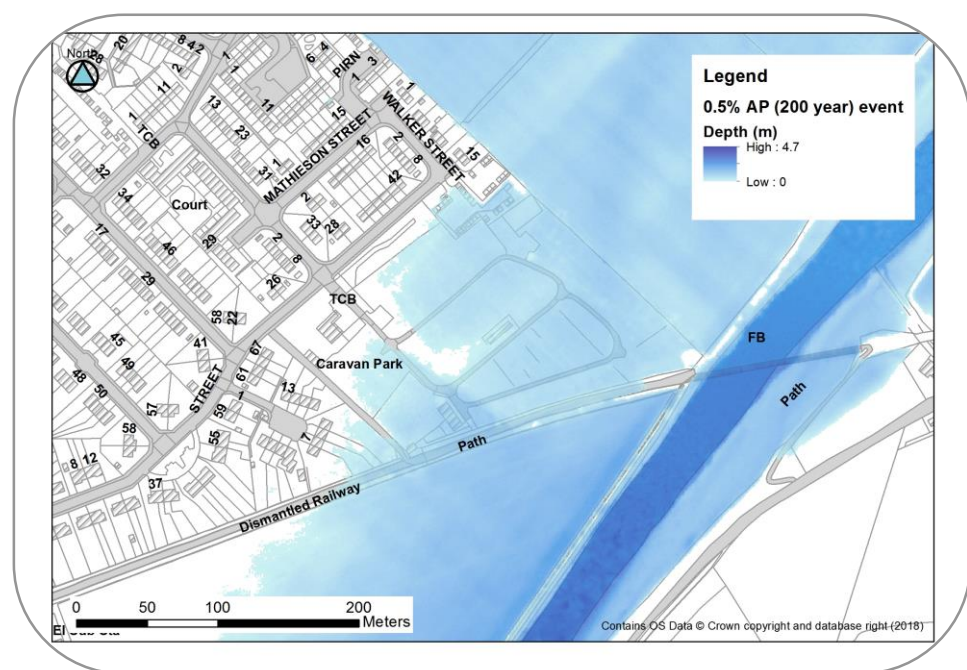
Modelling



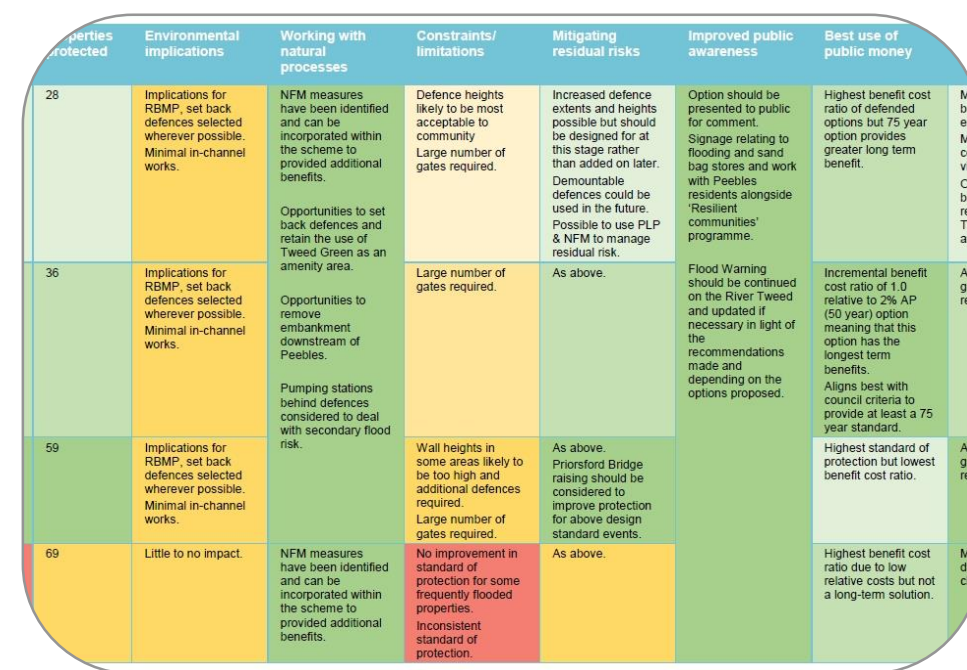
Flood Mapping

Return periods and annual probabilities

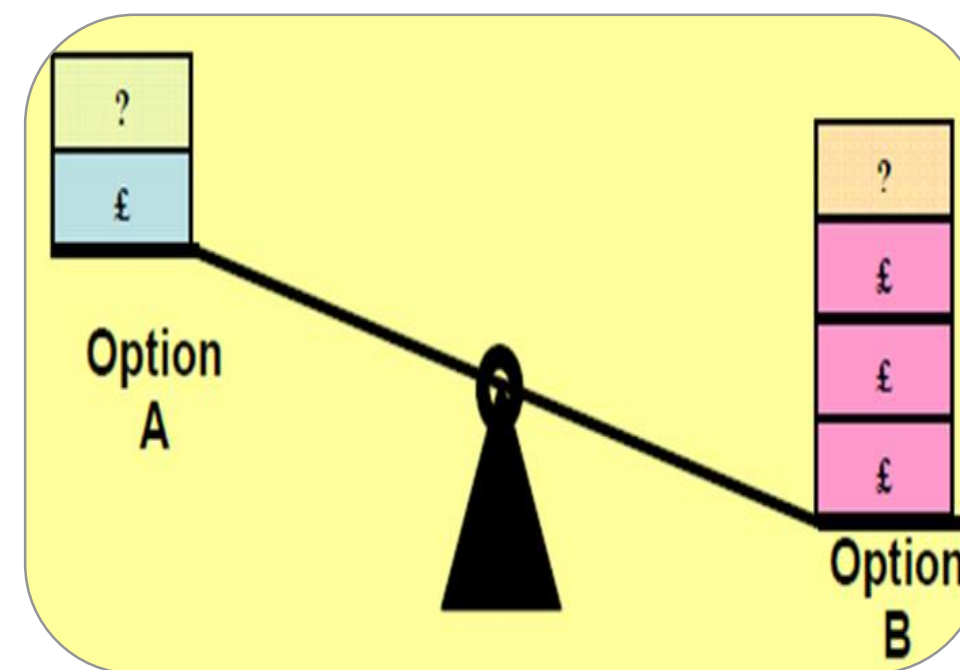
- When a river floods the severity of the flood is known as a 1 in x year flood. This terminology represents the probability of that event occurring in any year.
- For reference, the December 2015 event (Storm Frank) in Peebles had a 1 in 55 chance of occurring in any year.
- This does not mean that the flood will occur once every 55 years; it could occur tomorrow and again next week, or not for another 200 years. But on average a flood of that severity will occur once every 55 years.
- For example, there is a 1 in 100 (or 1%) chance of a flood exceeding the 100 year flood in any one year.



Properties at
risk



Options
Appraisal



Cost-Benefit

Flood Timeline

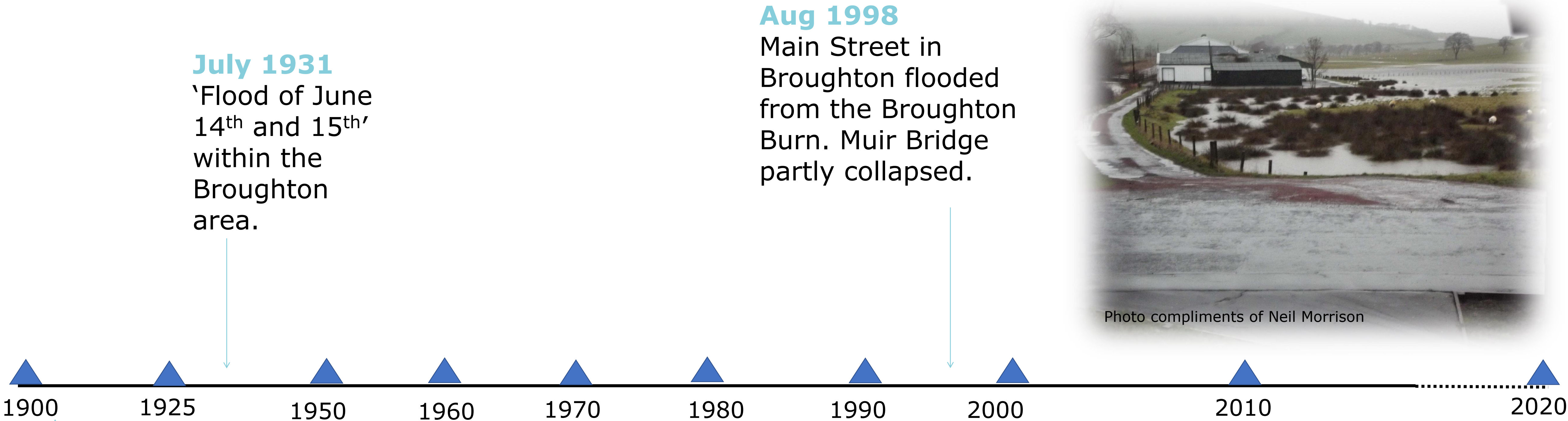


Photo compliments of Neil Morrison

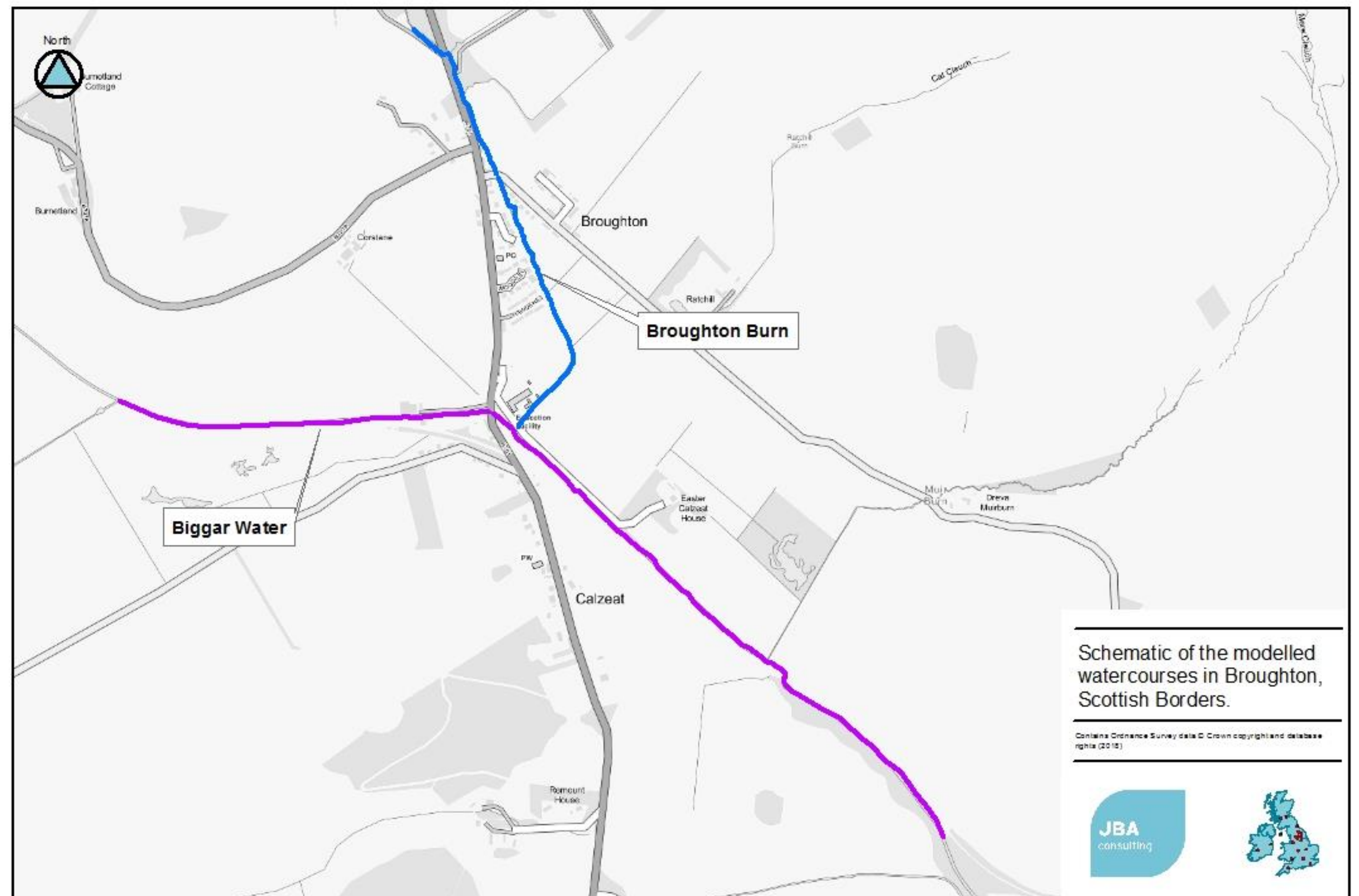
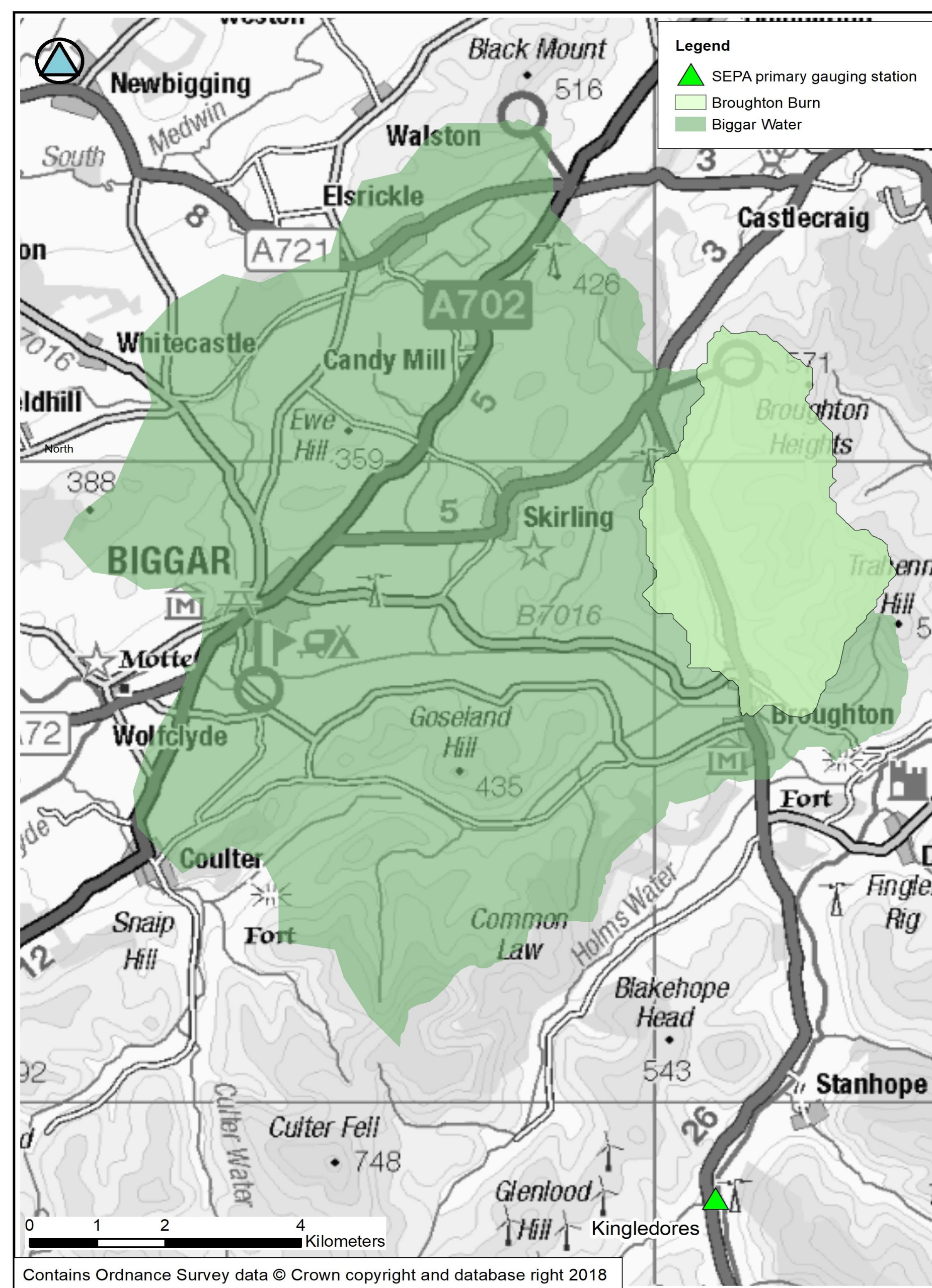
Oct 1903
Regional level flooding. Fields flooded at Broughton and Stobo.



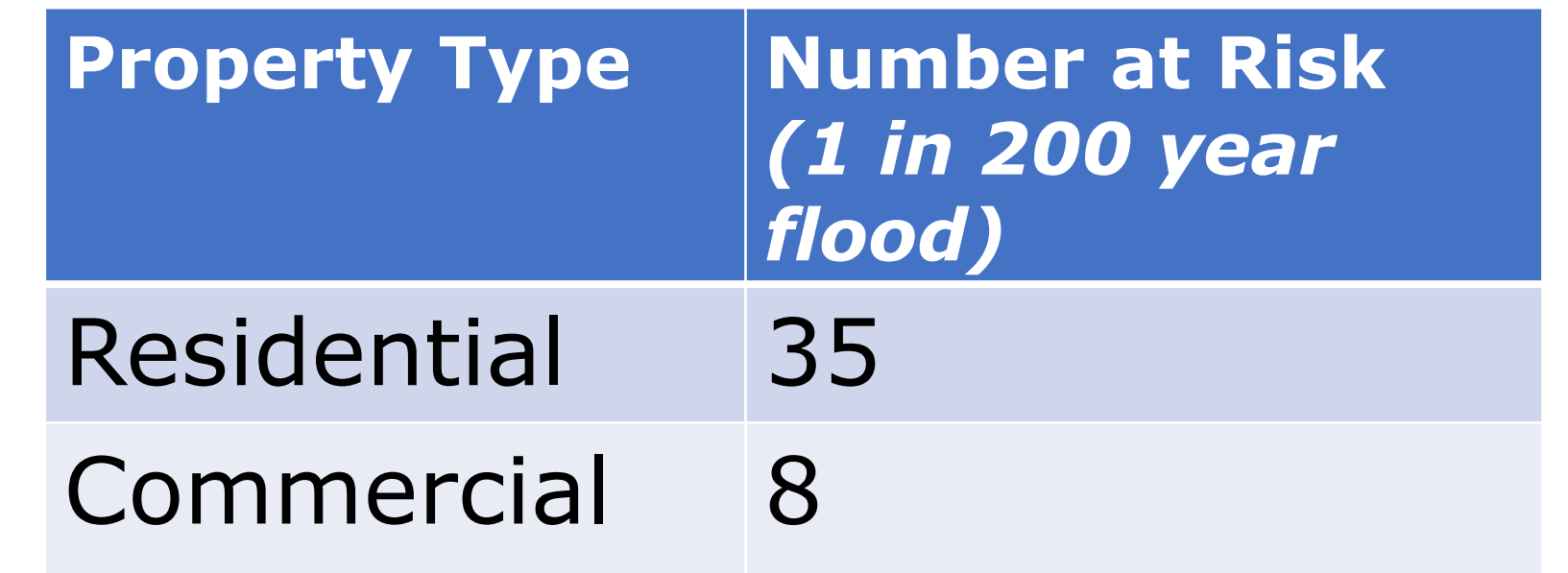
Photo compliments of Neil Morrison

Catchment & watercourses assessed

Whilst the Biggar Water is the much larger watercourse, Broughton is primarily at risk from the Broughton Burn. Broughton Ales is regularly affected by flood water from the Biggar Water, however, it is the Boughton Burn which effects residential properties. The figures below shows the watercourses catchment's and the modelled channel reach.



Biggar catchment area: 86 km²
Broughton Burn catchment area: 14 km²



- A physical survey captured the measurements of river channels, banks and structures along each watercourse.
- These measurements were input into a computer model, along with calculated river flows for a range of storm events.
- This model produced a flood level which was then applied to a 3D representation of the land surface and buildings. The outcome resulted in a detailed flood map of river flooding in Broughton

- The mapping indicates the predicted flooding for a given flood magnitude.
- The 1 in 10 year map shows what is expected to be inundated for a flood that is likely to occur once every 10 years (or with a probability of 10% in any one year).
- The 1 in 200 year represents a flood event with a probability of 0.5% in any year.

Flood mechanisms & key constraints

Out of bank flow paths, key structures and constraints were identified. Flood flow from the Broughton Burn effecting properties first exits the right bank of the channel between the Village Hall and Dreva Bridge. At almost the same time water emerges onto the playing fields downstream. As the water level continues to rise, flood water flows on to the A701 flows and south through the town. Water backs up behind the Village Hall vehicle bridge and adds further flood water to the A701.



Complex out of
bank flows



Existing
embankments



Bridges that
constrain flows

Options appraisal – process and long list of options

The process for selecting options assesses a wide range of possible options, which are narrowed down to a short list according to whether the options are technically, environmentally and socially acceptable. Those that are short listed are shown in the following posters. The full list of options assessed is provided below.

- **Relocation** - Relocation or abandonment of properties not usually socially or politically viable.
- **Flood Warning** – Rapid time to peak would give insufficient warning.
- **Resilience Measures** - Unlikely to be economically viable due to number of properties at risk.
- **Resistance Measures** - Unlikely to be accepted as the only flood protection measure.
- **Diversion channel** - A diversion channel from the Broughton Burn to the Bigger Water.
- **Watercourse Maintenance** – Council continues scheduled maintenance regime.
- **Demountable Defences** - Rapid time to peak would give insufficient time to assemble defences.
- **Storage** - Option discounted due to lack of suitable locations.
- **Natural Flood Management** – NFM opportunities throughout the catchment have been identified.
- **Structure Modification** – Bridges restrict channel flow which contributes to flood risk but removing the bridges is not sufficient to prevent flooding.
- **Direct Defences** – A combination of walls and embankments can contain flows on the Broughton Burn.
- **Channel Modification** – Channel can be widened to provide necessary conveyance.

Least desirable options

Good practice and partial solutions

Most desirable options

Broughton Burn– Short Listed Options

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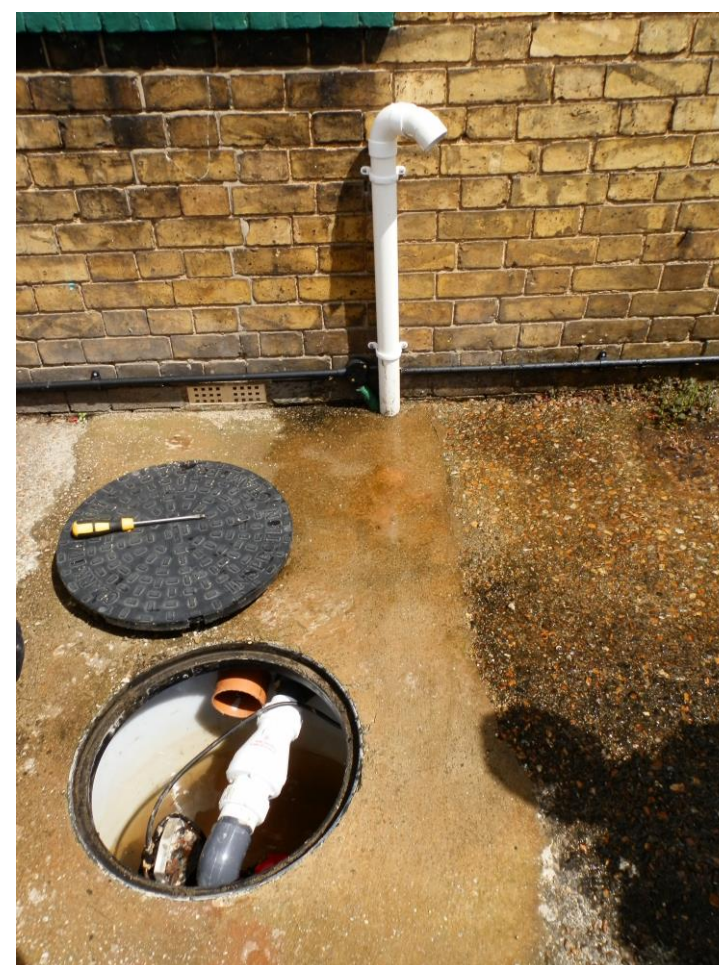
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Option 1: Property Level Protection (PLP) – 200 year standard of protection

- Automatic property level protection installed in 39 properties. PLP shall involve surveying each property to identify entry points and recommend appropriate PLP, but could include self sealing door and air vents and non return valves on plumbing.
- Estimated cost £1.2m
- Estimated damage avoided £2.5m



Typical example of PLP

Option 2: Construction of suite of direct defences along the Broughton Burn – 200 year standard of protection

- Combination of earth embankment and concrete retaining wall along right bank of Broughton Burn.
- Removal of Village Hall vehicle bridge – new access formed to the east.
- Wall height approximately 600 mm high.
- Estimated cost £3.1m
- Estimated damage avoided £2.5m

Option 3: Channel Widening – 200 year standard of protection

- Widen the Broughton Burn by approximately 3m (varies between 2 and 6m)
- Widen Dreva Bridge and the two bridges which serve the Village Hall.
- Estimated cost £0.9m
- Estimated damage avoided £2.5m

See adjacent technical drawings
for further option details



Typical example of flood wall



Typical example of channel widening

Broughton Burn– Short Listed Options

Option 4: Diversion channel with reduced direct defences – 200 year standard of protection

- Same as Option 2 (Direct defences) except the earth embankment is replaced with a diversion channel running east
- A new park land with shallow loch/wetland is proposed through which the diversion channel shall run
- Estimated cost £3.1m
- Estimated damage avoided £2.5m



Typical example of a diversion channel

Option 5: Diversion channel with Channel widening – 200 year standard of protection

- The same as Option 3 (channel widening) with the diversion channel and associated parkland of option 4.
- Estimated cost £2.6m
- Estimated damage avoided £2.5m



Typical example wetland park

See adjacent technical drawings for further option details

Option 1 - Property level Protection

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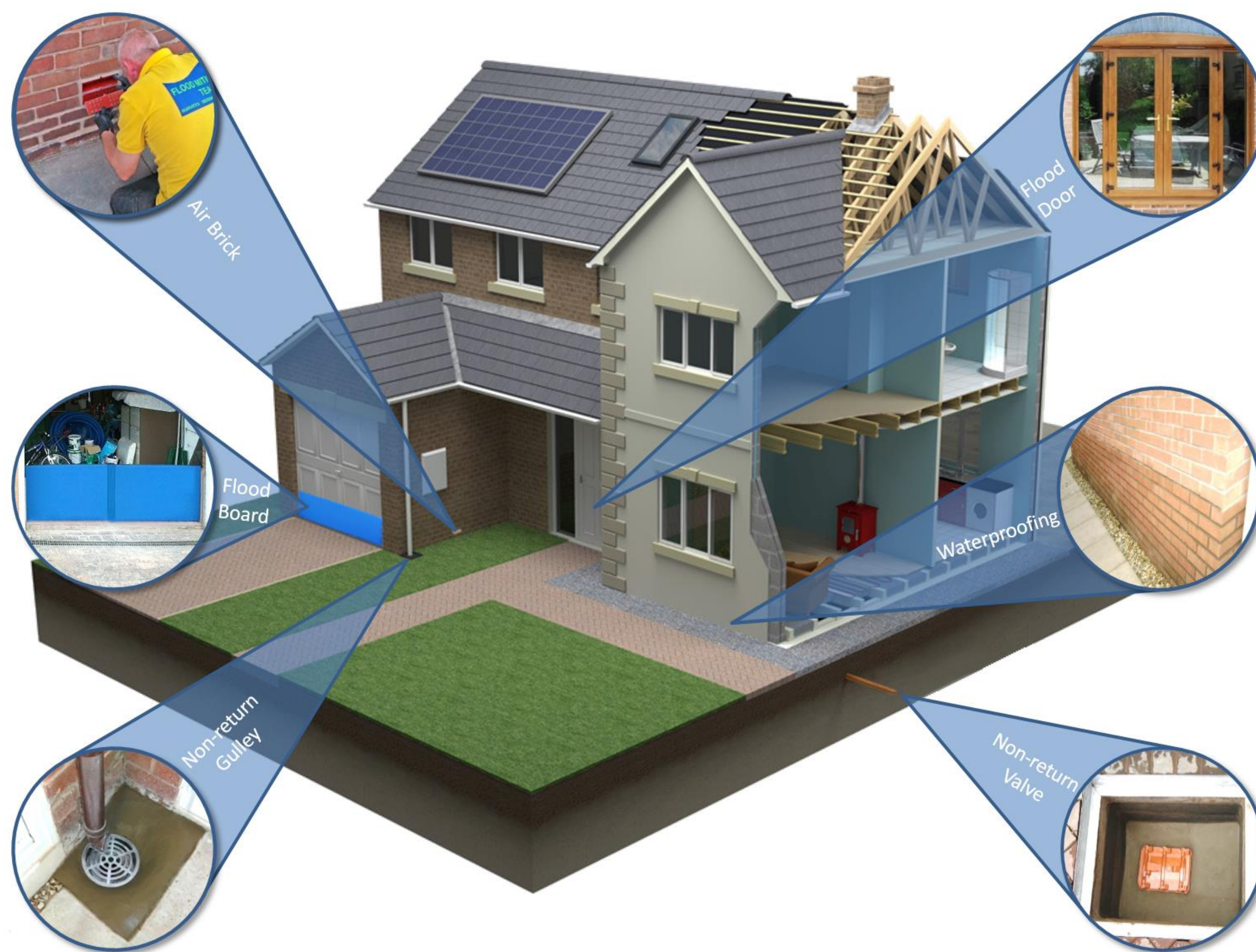
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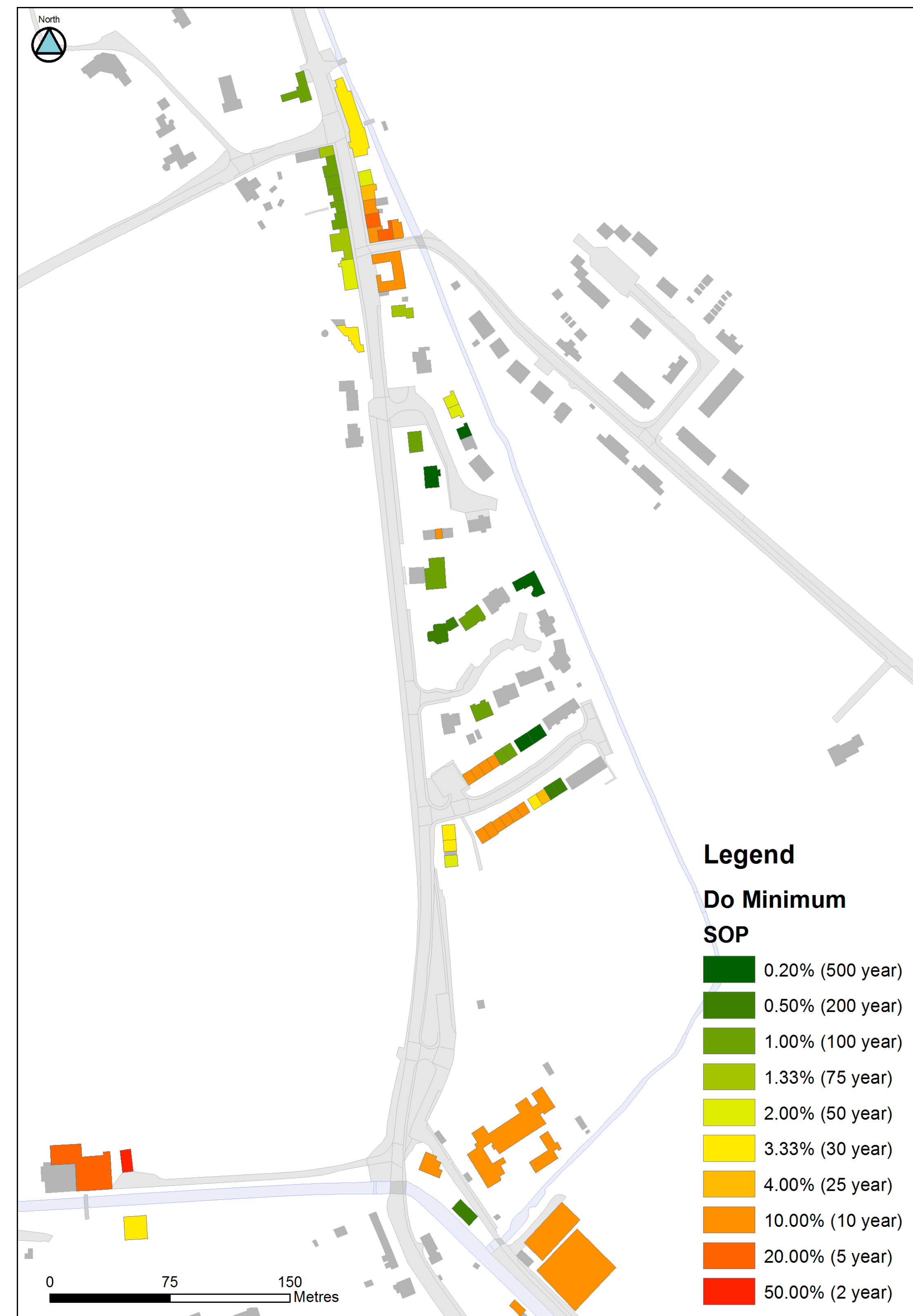
PLP is the last form of defence before water gets into the building. Automatic PLP is proposed for each residential property - 35 in total and 4 non residential properties. It can protect these properties to the 200 year flood event.

The standard of protection (SOP) map indicates the existing level of protection to each property with a SOP of less than the 500 year flood event.

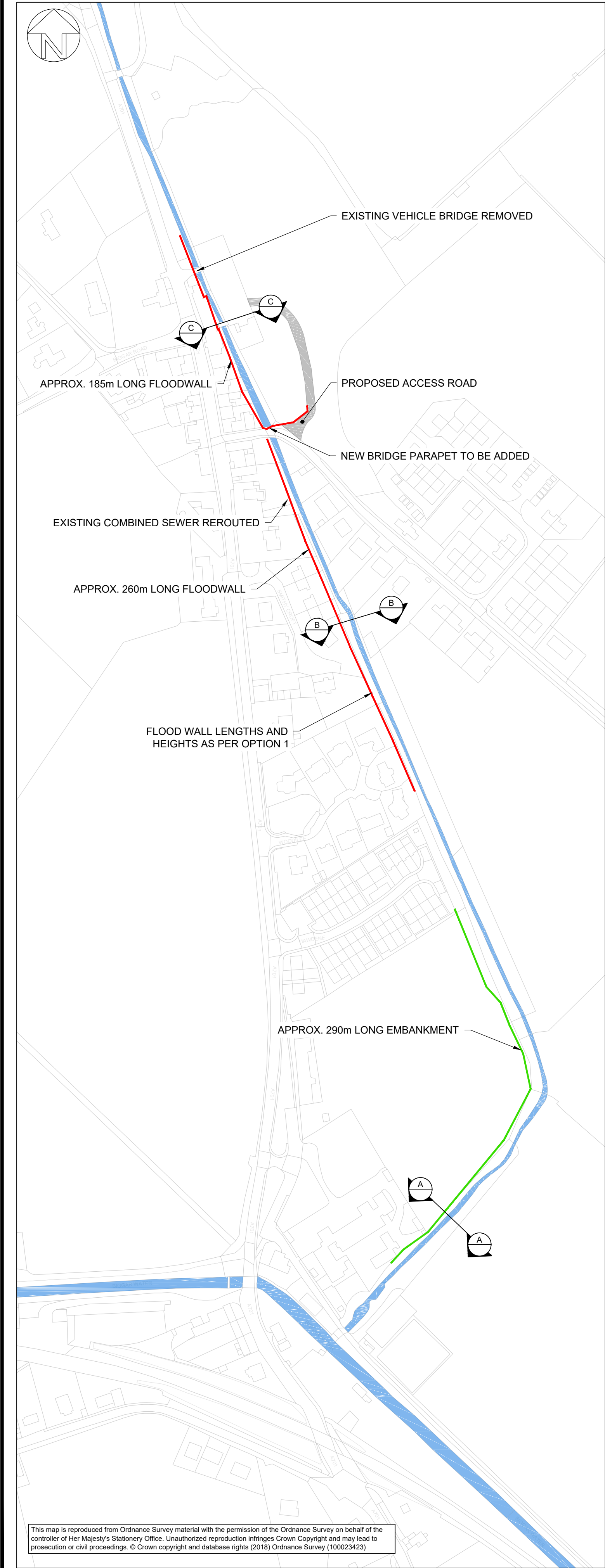


Examples of how Property Level Protection can mitigate the risks of flood inundation (image courtesy of Whitehouse Construction Co. Ltd)

Standard of protection map



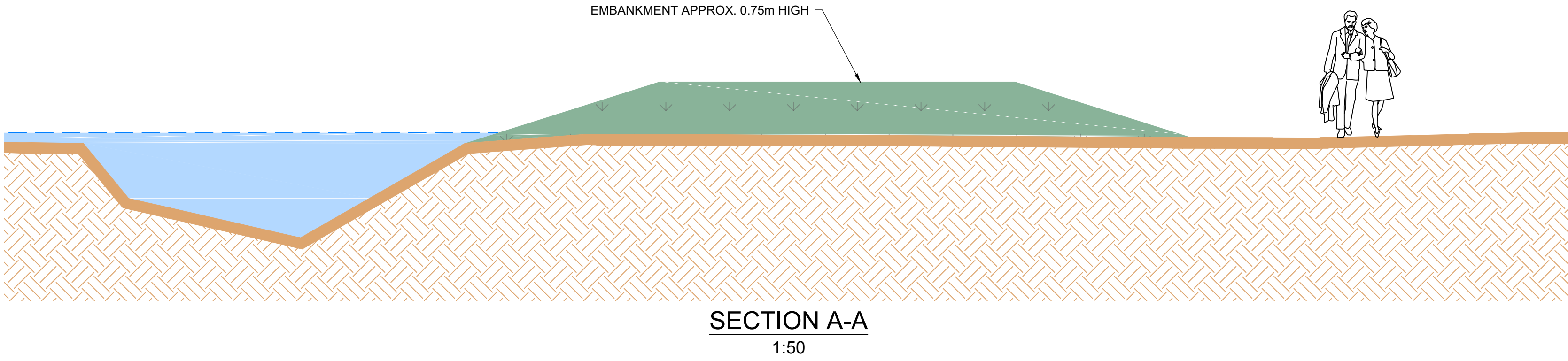
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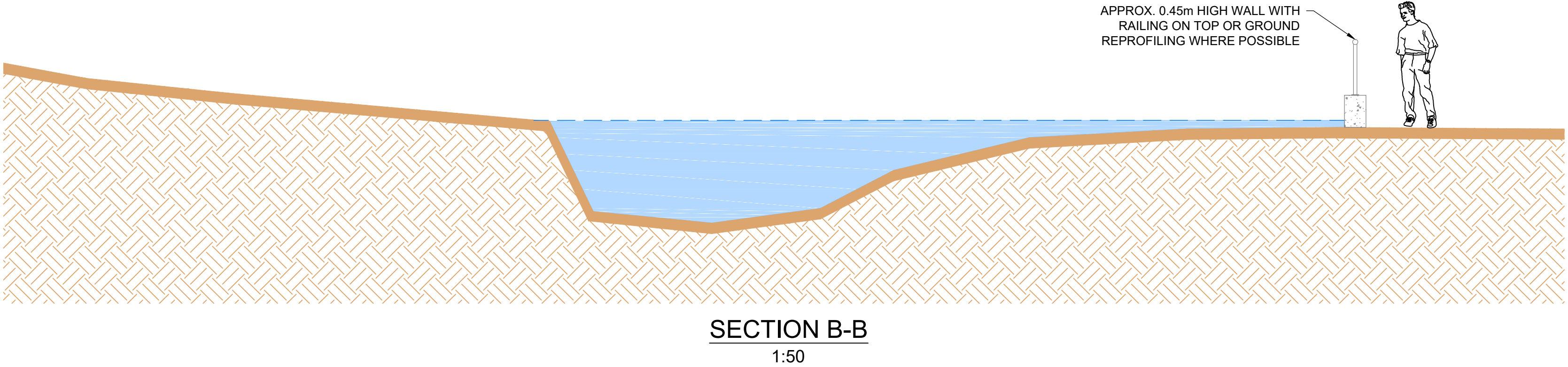
PLAN
1:2000

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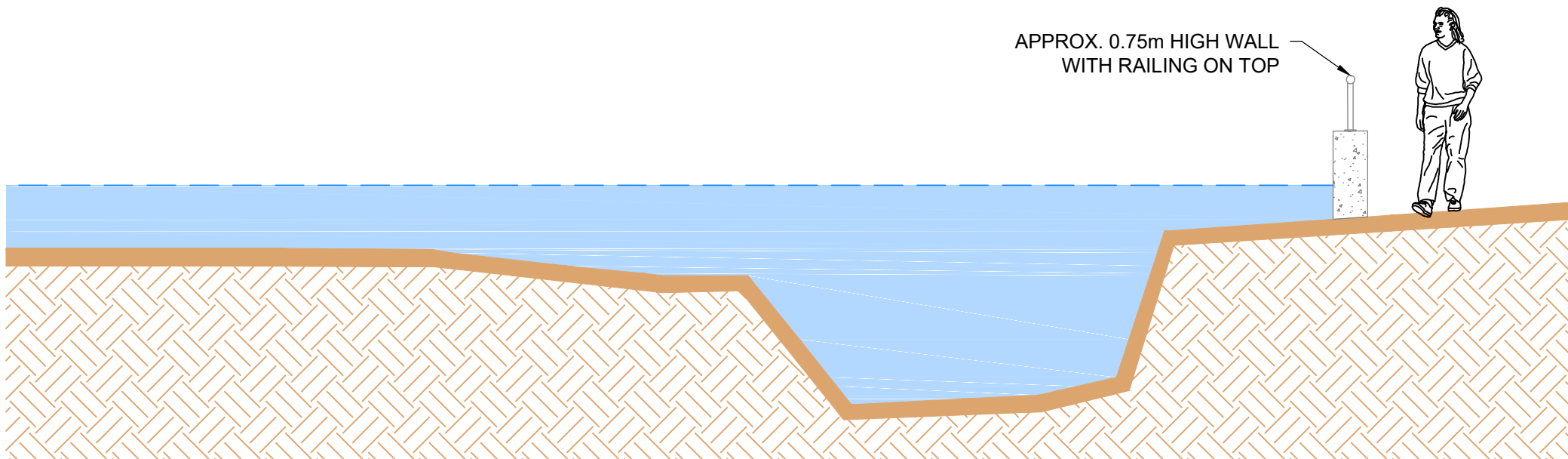
Broughton
Option 2: Broughton Burn
200 Year Direct Defences



SECTION A-A
1:50



SECTION B-B
1:50



SECTION C-C
1:50

OPTION SUMMARY. This option, if space is available would run a wall along the right bank of the Broughton Burn from the northern end of the town up to Woodilee housing estate, the defence continues as an embankment along the playing fields down to Broughton Primary School.

- LEGEND
- EMBANKMENT DEFENCE
- WALL DEFENCE
- EXISTING WATERCOURSE

Comments					
Rev.:	Date	Drawn	Designed	Checked	Approved
Client Approval					
A - Approved					
B - Approved with Revisions					
C - Do Not Use					
Purpose of Issue				Status	S1

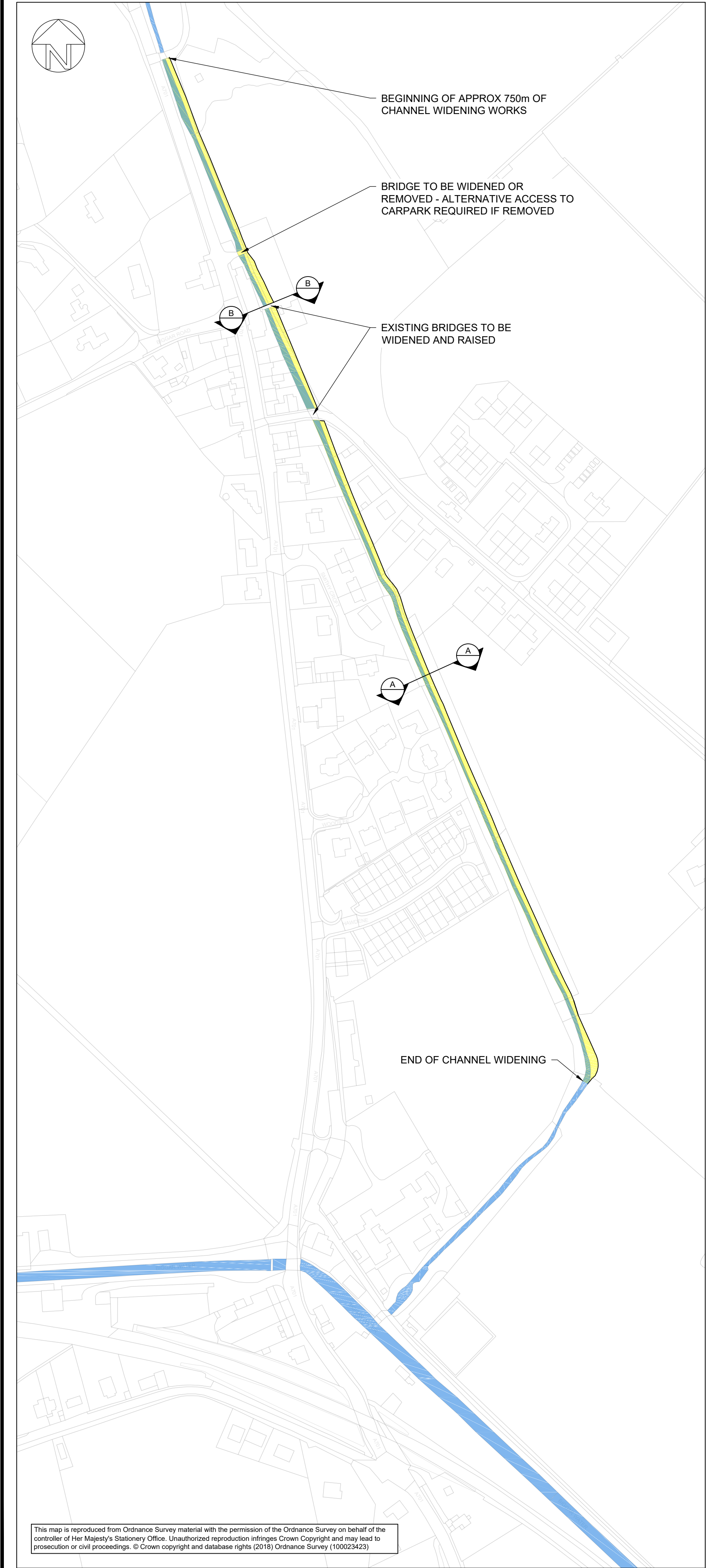
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Project	Borders Flood Studies	
Title	Broughton: Option 2 Broughton Burn 200 Year Direct Defences for	
Client	<div><div>M MOTT MACDONALD</div><div></div></div>	

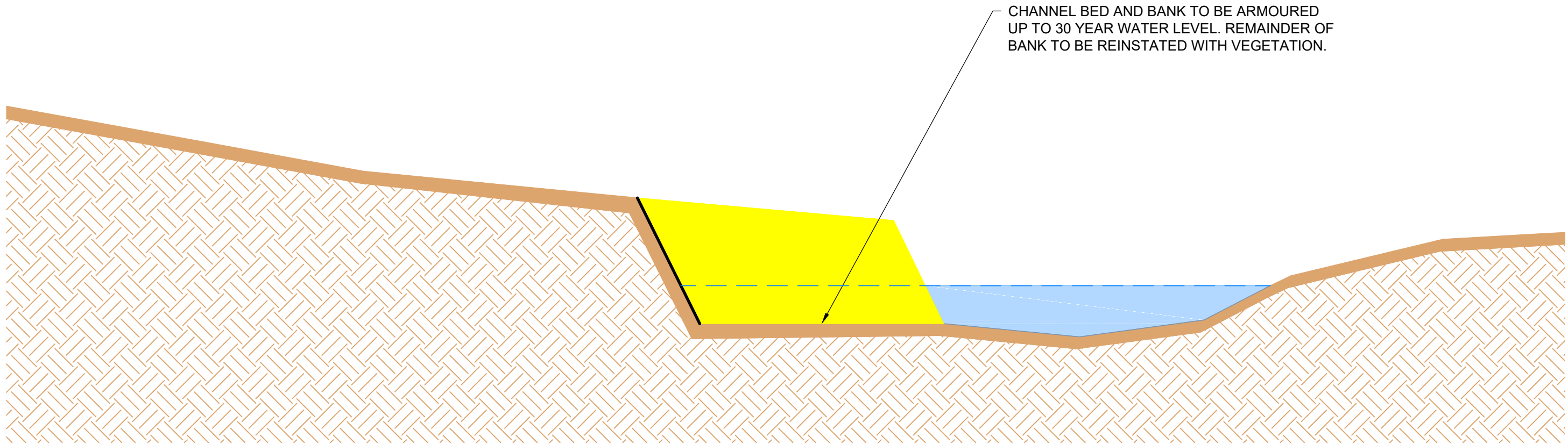
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Project Number: 2017s5526			
Drawing Number AEM-JBAU-BR-BB-IM-C-1200		Revision	P01



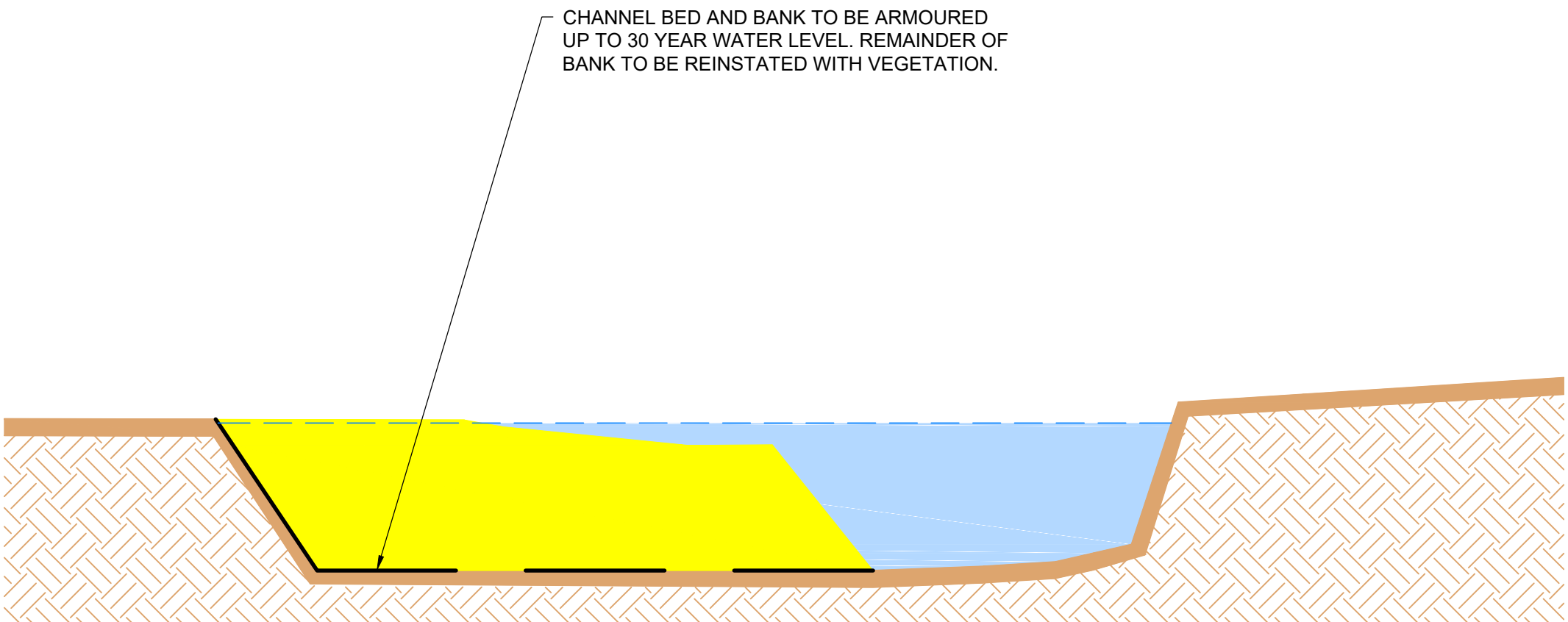
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Option 3: Broughton Burn 200 Year Channel Widening



SECTION A-A
1:50



SECTION B-B
1:50

OPTION SUMMARY. Channel widening aims to reduce flood levels and the need for flood defences. This option would work by widening the left bank of the channel by between 0.5m to 6m. Bridge modifications/replacement may also be required to ensure sufficient conveyance of flood flows through the structures.

LEGEND	
	200 YEAR LEVEL AFTER CHANNEL WIDENING
	EXISTING WATERCOURSE
	WIDENED WATERCOURSE

Comments					
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Suitable for Coordination					

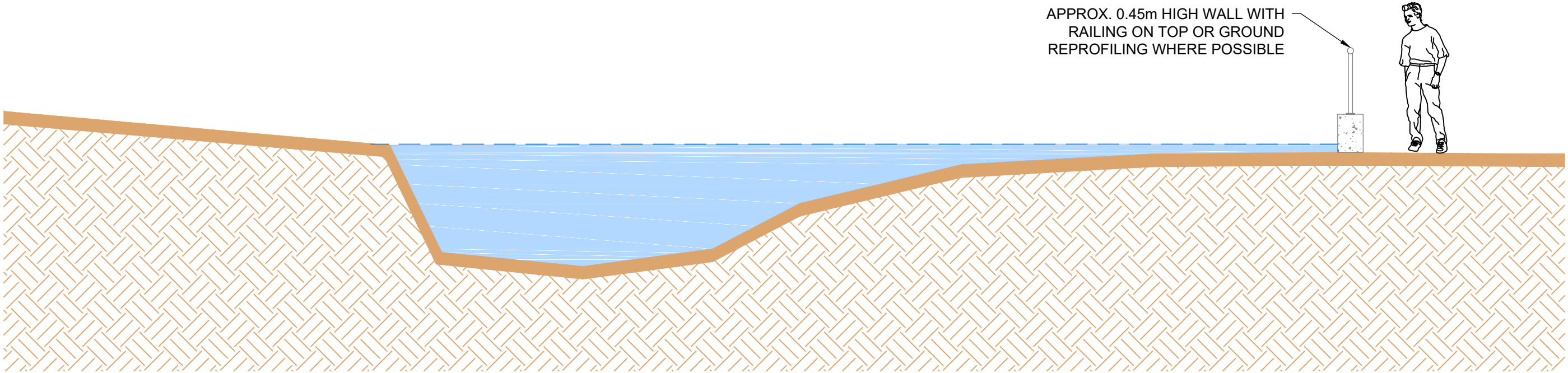
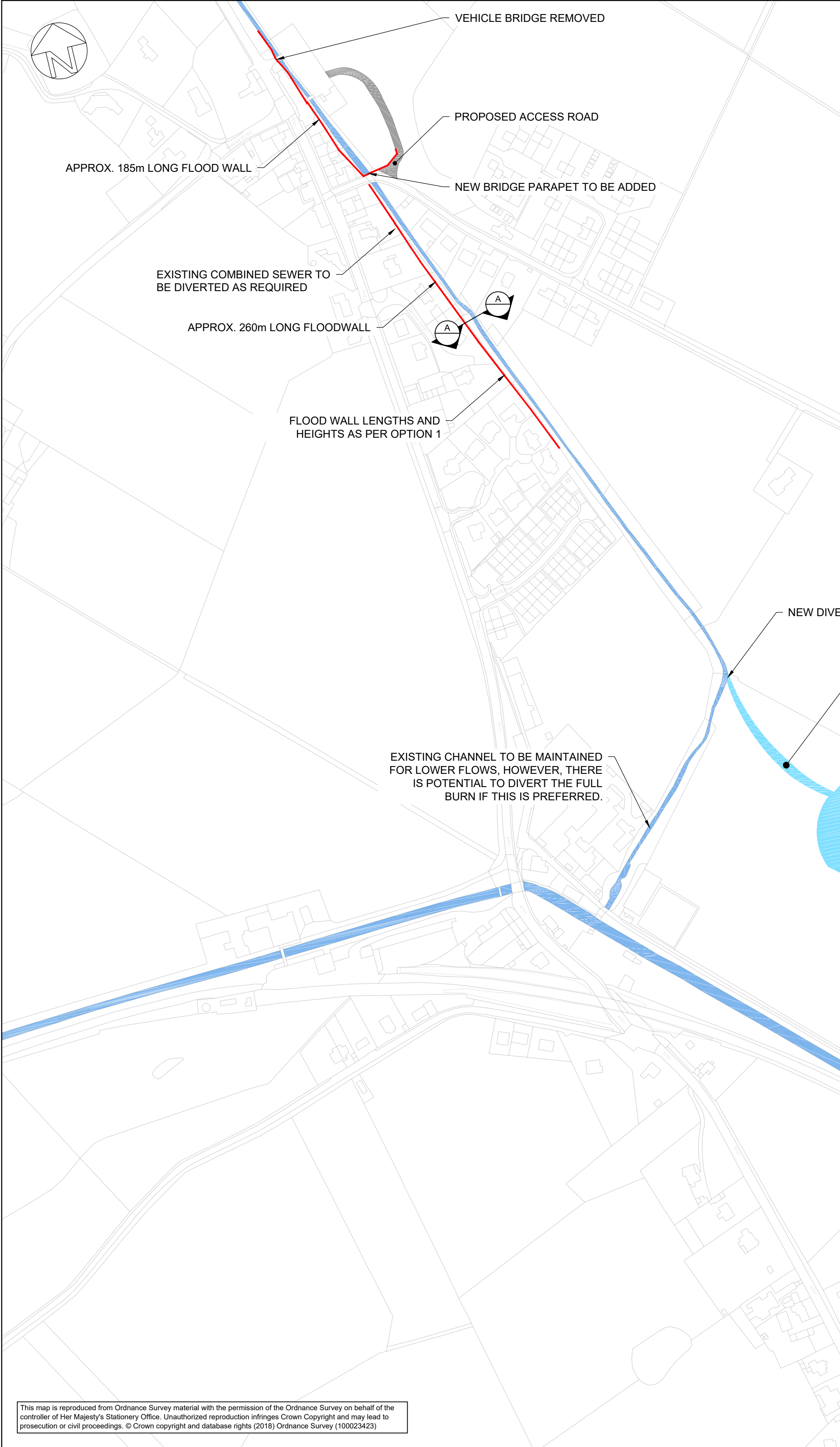
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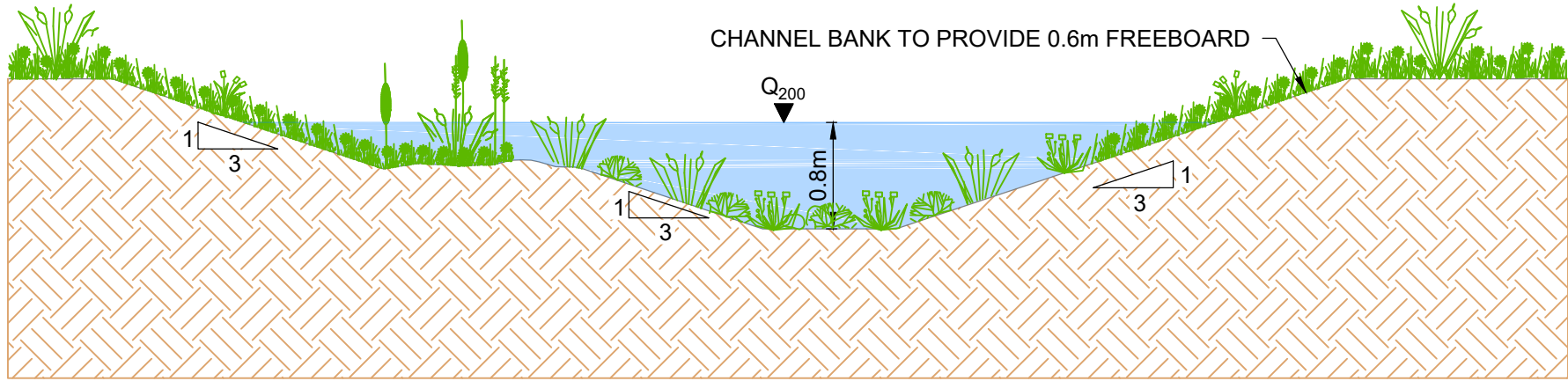
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Title	Broughton Broughton Burn : Option 3 200 Year Channel Widening for	
Client		

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Option 4: Broughton Burn
Direct Defences and
Diversion Channel



SECTION A-A: BROUGHTON BURN
1:50



SECTION B-B : TYPICAL CROSS SECTION
THROUGH NEW TWO STAGE CHANNEL
1:50

OPTION SUMMARY. Diversion with Direct Defences. The natural topography would allow for the creation of a diversion channel on the Broughton Burn, from the first bend in the river upstream of Broughton Primary School across the low lying agricultural land and into the Biggar Water downstream of Easter Calzeat House. The swale would be approximately 5m wide by 0.6m deep. This option needs to be carried out in combination with flood walls along the upper reach of the Broughton Burn. New wetlands and community greenspace could be provided alongside a diversion channel.

LEGEND	
	WALL DEFENCE
	EXISTING WATERCOURSE
	NEW WATERCOURSE

Comments					
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Suitable for Coordination					

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Project

Borders Flood Studies


Title

Broughton: Option 4
Broughton Burn 200 Year
Direct Defences And Diversion Channel
for

Client

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COUNCIL

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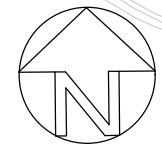
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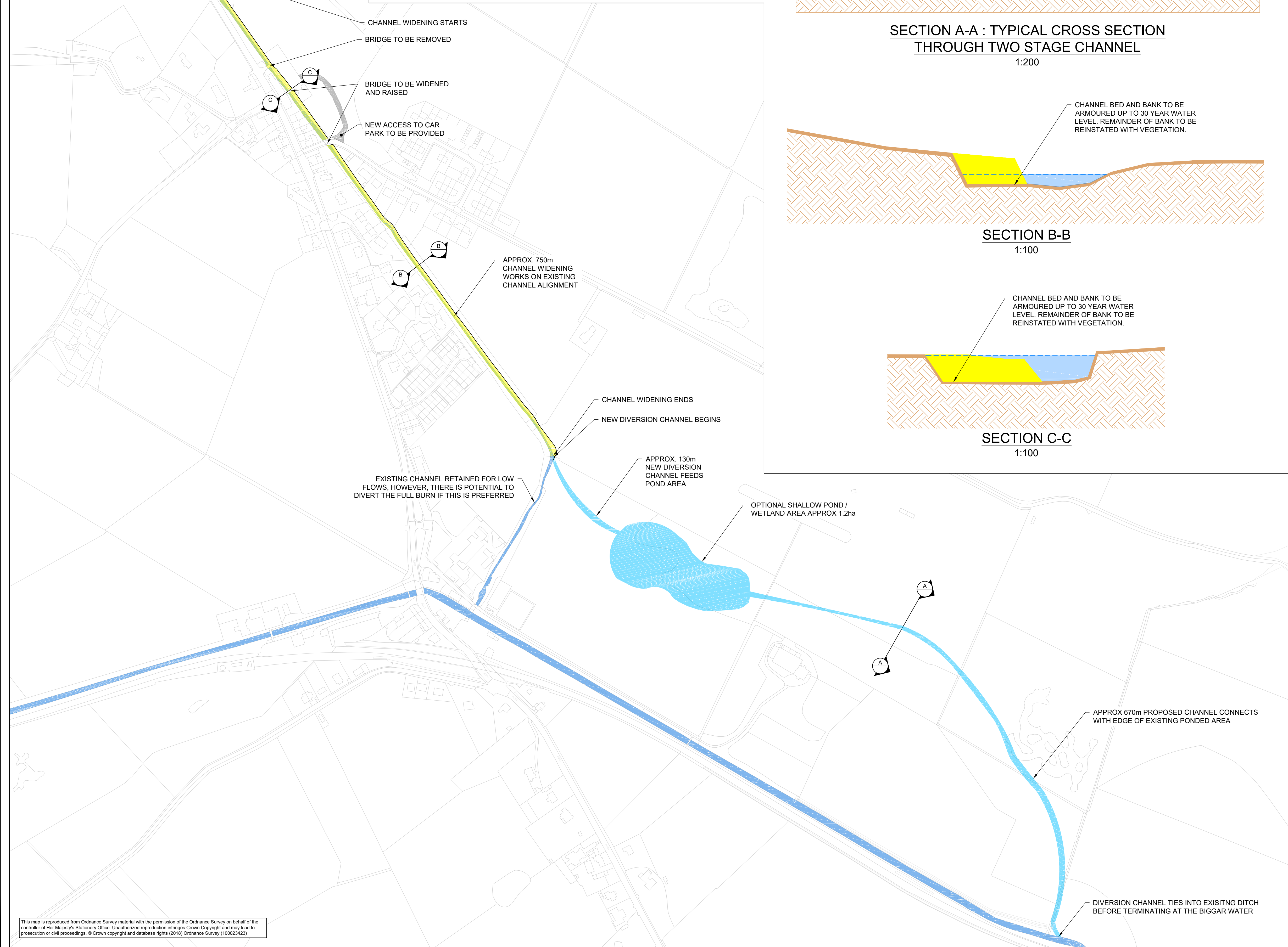
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Revision

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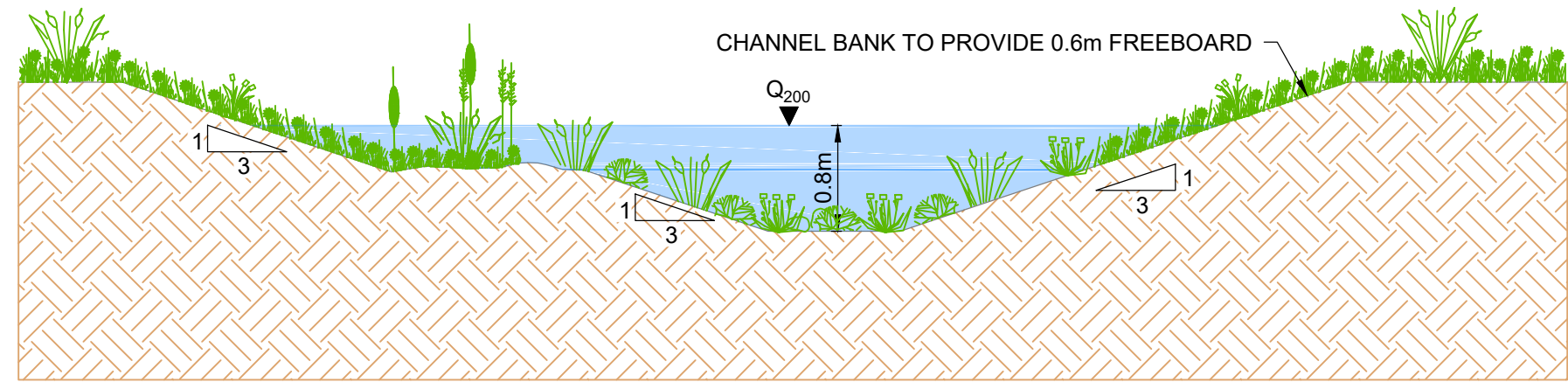


Option 5: Broughton Burn 200 Year Channel Widening & Diversion Channel

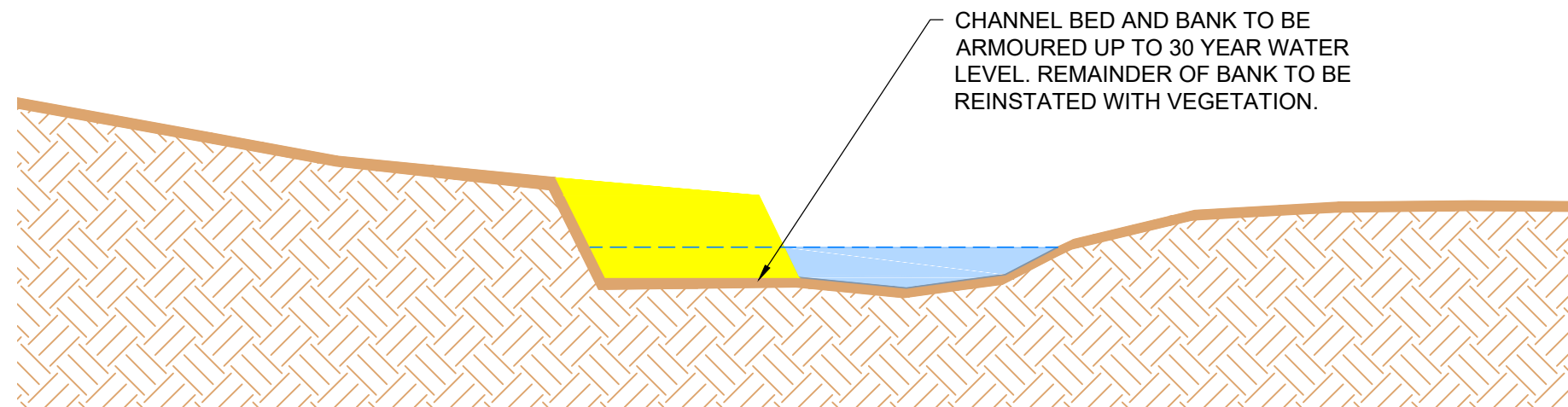


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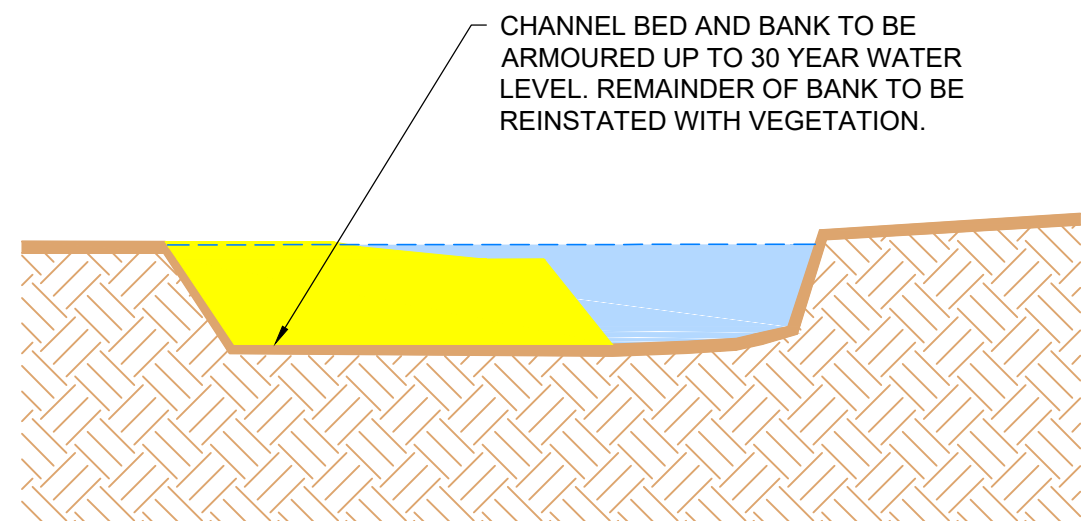
PLAN
1:2500



SECTION A-A : TYPICAL CROSS SECTION
THROUGH TWO STAGE CHANNEL
1:200



SECTION B-B
1:100



SECTION C-C
1:100

OPTION SUMMARY.
THIS IS A COMBINATION OF OPTIONS 3 AND 4.
Option 3. The natural topography would allow for the creation of a diversion channel on the Broughton Burn, from the first bend in the river upstream of Broughton Primary School across the low lying agricultural land and into the Biggar Water downstream of Easter Calzeat House. The swale would be approximately 5m wide by 0.6m deep. This option, combined with Option 4 omits the need for flood walls and may provide wider environmental benefits through the creation of new wetlands and community greenspace along the diversion channel.
Option 4. Channel widening aims to reduce flood levels and the need for flood defences. This option would work by widening the left bank of the channel by between 0.5m to 6m. Bridge modifications/replacement may also be required to ensure sufficient conveyance of flood flows through the structures.

LEGEND	
	EXISTING GROUND LEVEL
	200 YEAR LEVEL AFTER CHANNEL WIDENING
	EXISTING WATERCOURSE
	WIDENED WATERCOURSE
	DIVERSION WATERCOURSE


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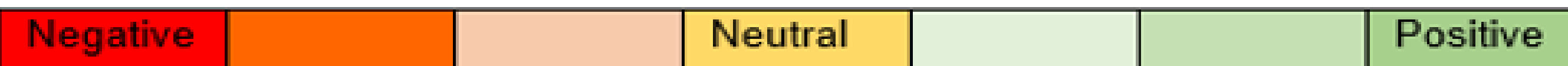
Project		Borders Flood Studies	
Title		Broughton Biggar Burn : Option 5 200 Year Channel Widening And Diversion Channel for	
Client		<div><div><div>M</div><div>M</div><div>MOTT MACDONALD</div></div><div></div></div>	
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Drawing Number		Revision	
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Summary of short listed options

Option (Standard of protection)	Properties protected	Environmental implications	Working with natural processes	Constraints/ limitations	Mitigating residual risks	Improved public awareness	Best use of public money	Wider benefits
Property Level Protection - (0.5% AP - 200 year)	39	No impact	Natural flood management measures have been identified and could be incorporated within the scheme to provided additional environmental benefits.	Intrusive into people's homes, will require reinstallation every 25 years.	Some properties will experience flood depths <u>in excess of</u> what PLP can provide, decrease in SOP of time. Additional properties will require PLP over time.	Option should be presented to public for comment. Signage relating to flooding and sand bag stores and work with Broughton residents alongside Resilient <u>communities</u> programme. Installation of a flow gauge on the Boughton Burn for flood warning, calibration and flow estimates.	Second highest benefit cost ratio of defended options. BCR 2.6	None
Direct Defences (0.5% AP - 200 year)	38	Implications for RBMP, set back defences selected wherever possible. Minimal in-channel works.	Surface water problem entering town from north along road shall be diverted to the Boughton Burn, alleviating pressure on urban drainage network.	Wall are under 1.25m so should not too much of a visual impact.	Walls could be built higher now with only a small increase in height.		BCR 0.8	None
Channel Widening (0.5% AP - 200 year)	38	Significant disruption and temporary loss of habitat during construction. Shall be undertaken at appropriate time of year. Gentle meanders added where possible.		Land take and bridge rebuilding required, shall be disruptive to community, limited alternative routes.	Channel could be made larger now to accommodate further increase in flows.		Highest benefit cost ratio of defended options. BCR 2.8	Reduced blockage risk at bridges.
Channel Widening with Diversion Channel (0.5% AP - 200 year)	38	Significant disruption caused to existing channel in the short term, however, the new wetland and naturalised channel will be created which will have long term benefits.		Land take and bridge rebuilding required, shall be disruptive to community, limited alternative routes.	Channel could be made larger now to accommodate further increase in flows.		BCR 1	Reduced blockage risk at bridges. Creation of wetland and amenity area for Broughton.
Direct Defences with Diversion Channel (0.5% AP - 200 year))	38	Minimal in-channel works. New wetland and naturalised channel will be created.		Wall are under 1.25m so should not too much of a visual impact. Land take and bridge rebuilding required, shall be disruptive to community, limited alternative routes.	Walls could be built higher now with only a small increase in height. Channel could be made larger now to accommodate further increase in flows.		BCR 0.8	Creation of wetland and amenity area for Broughton.

Preferred Option

The preferred option is channel widening with a diversion channel which is to be implemented alongside NFM



What can we do in terms of natural flood management?

What is natural flood management?

Natural flood management (NFM) is when natural processes are used to reduce the risk of flooding by slowing flows and storing water within the catchment. It is however difficult to quantify the reduction in flow that these types of measures can deliver. NFM also offers additional wider benefits by restoring habitats and improving water quality.

NFM opportunities were first identified by examination of aerial photography and was confirmed with a site visit at sample locations.

The NFM measures which have been proposed for the Broughton Burn are:

- Upland habitat restoration
- Woodland planting
- Online storage ponds and leaky barriers
- Wetland creation

The Council will need to investigate the potential benefits before working with other parties on developing these options further.



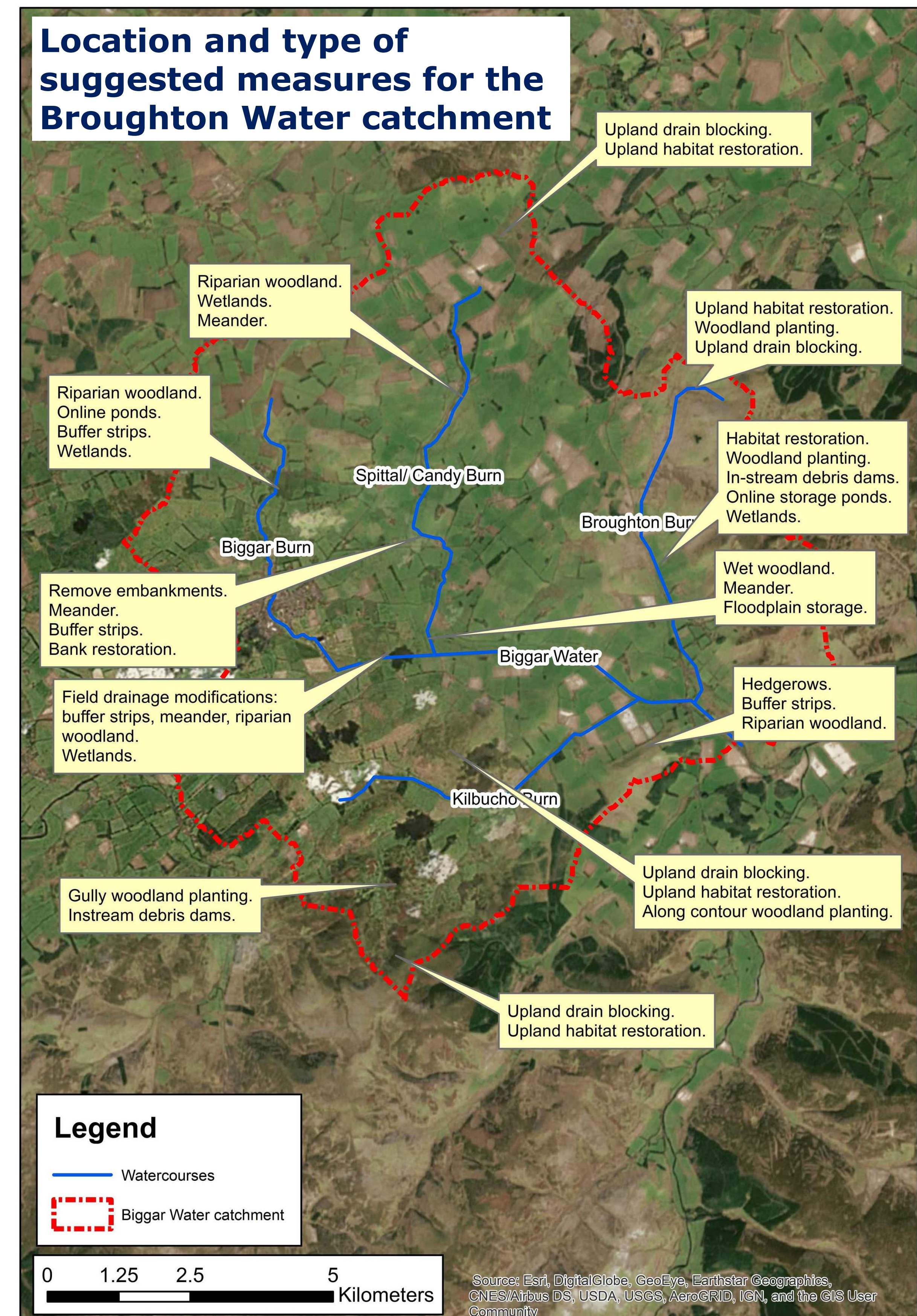
Typical example of wetland creation



Typical example of upland habitat restoration



Typical example of young woodland



What happens next?

The following sets out the Council wide steps required to progress preferred options to a Flood Protection Scheme

