

How is flood risk managed by the Scottish Borders Council?

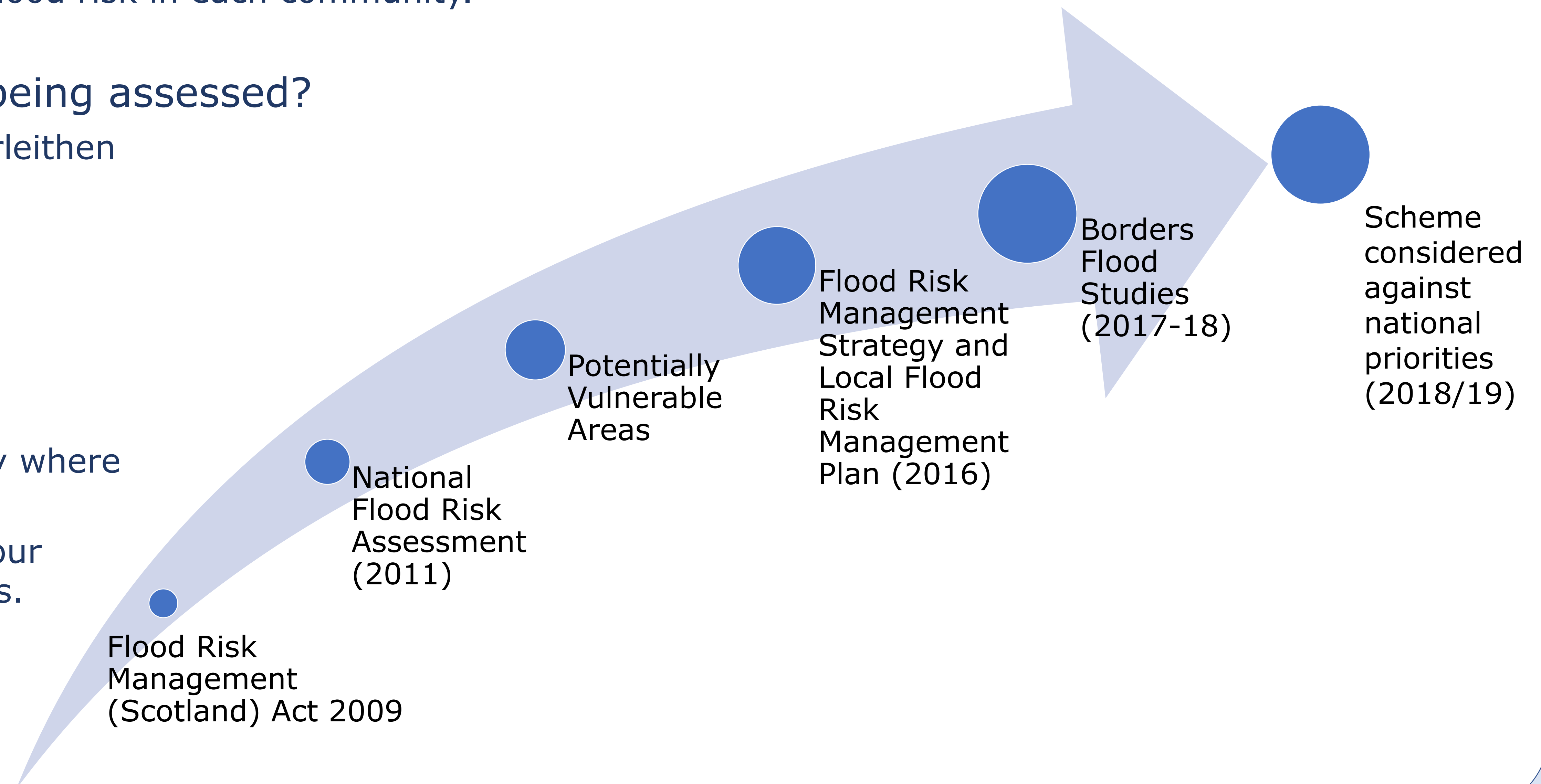
- The Flood Risk Management (Scotland) Act 2009 aims to prioritise flood mitigation across Scotland using a proactive and risk based process for assessing flood risk.
- This approach led to the preparation of SEPA's Flood Risk Management Strategies by SEPA and the Tweed Local Flood Risk Management Plan 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?

- **Peebles**, Broughton & 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

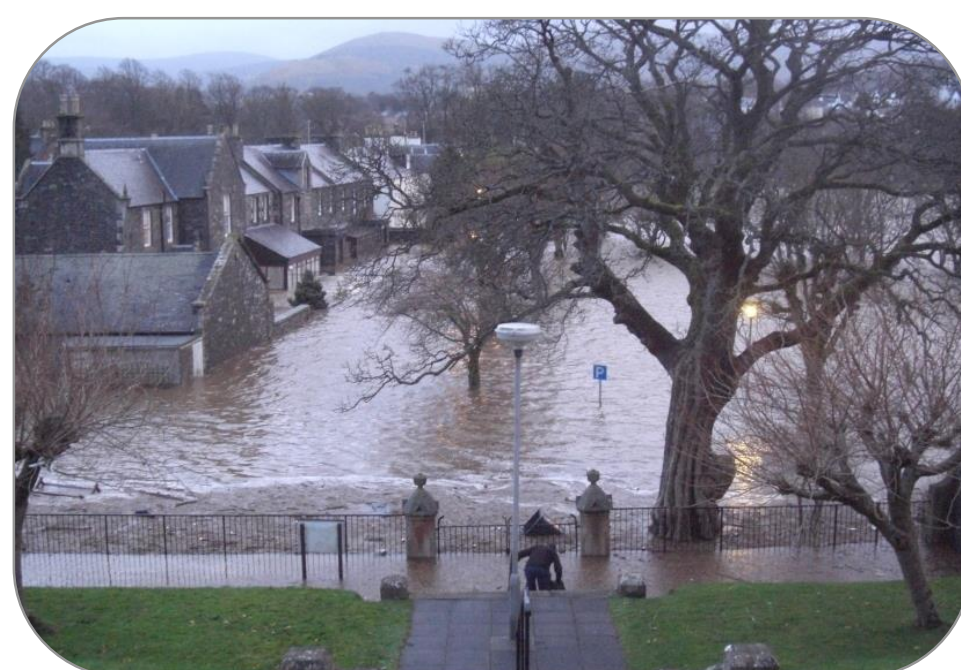
- SEPA will prioritise nationally where funding should be allocated;
- The reports and findings of our study will inform this process.

4) Engage partners and stakeholders

- **Today's consultation.**

Why choose a 200 year standard of protection?

- Scottish Planning Policy requires new build properties to have a 200 year standard of protection
- This standard is accepted as low risk by the flood insurance companies.
- A higher standard of protection will mean the scheme will be considered more favourably by SEPA's scheme prioritisation making funding more likely



Flood Review



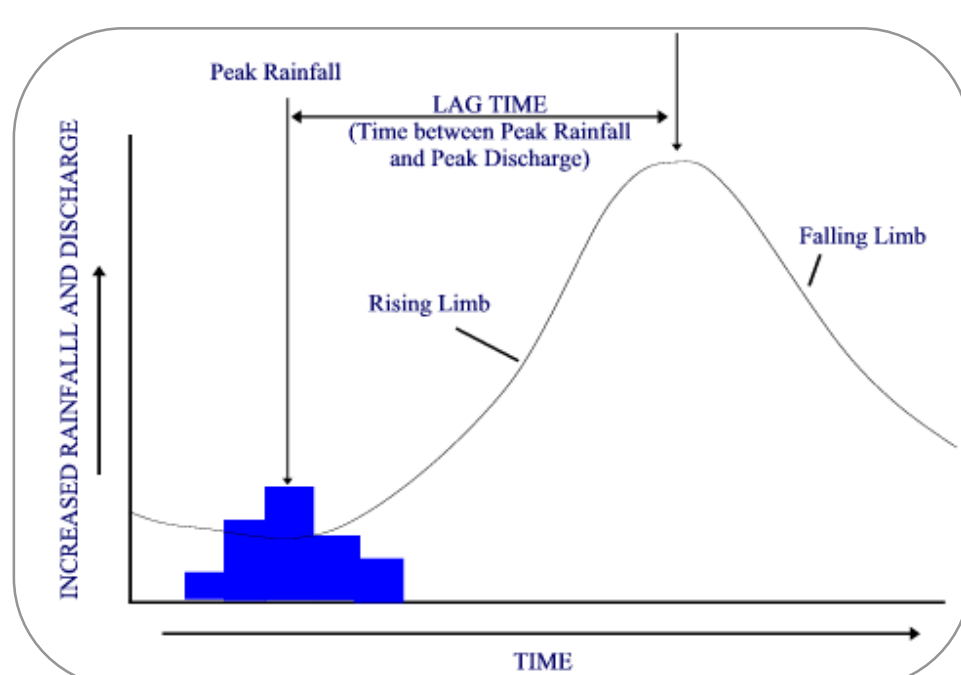
Topographic surveys



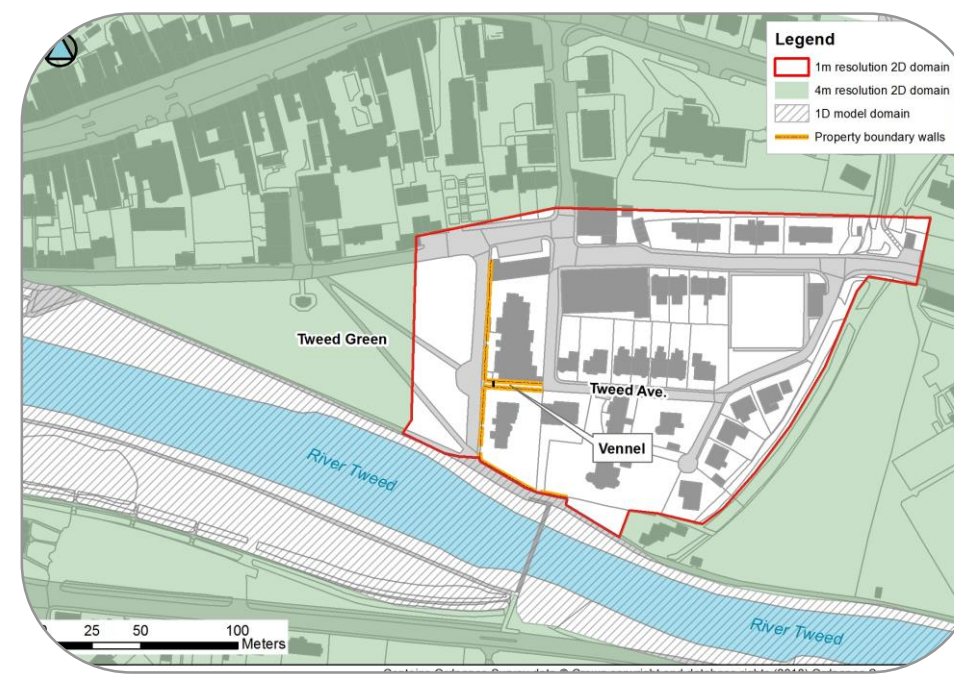
Asset inspections

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.

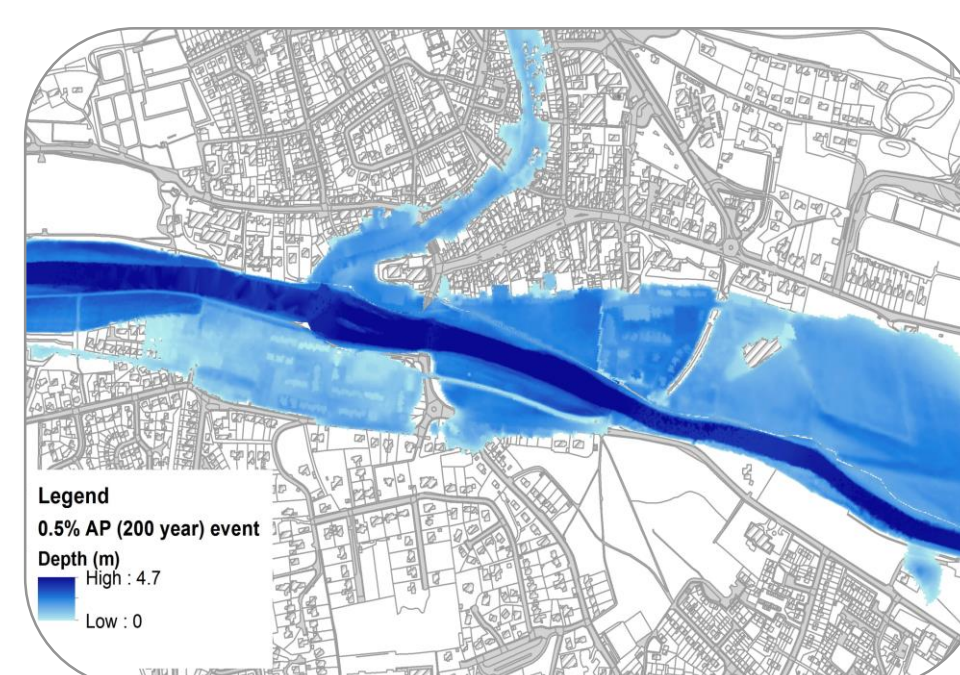
The models developed form a basis for assessing future flood levels, flood mitigation options, detailed design of schemes and the costs to deliver.



Hydrology



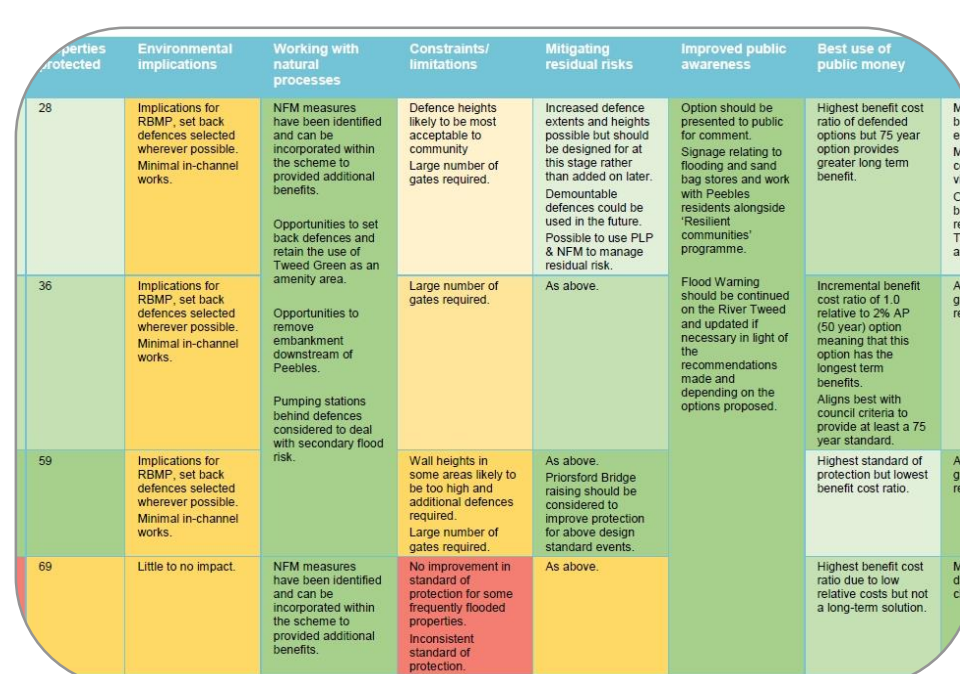
Modelling



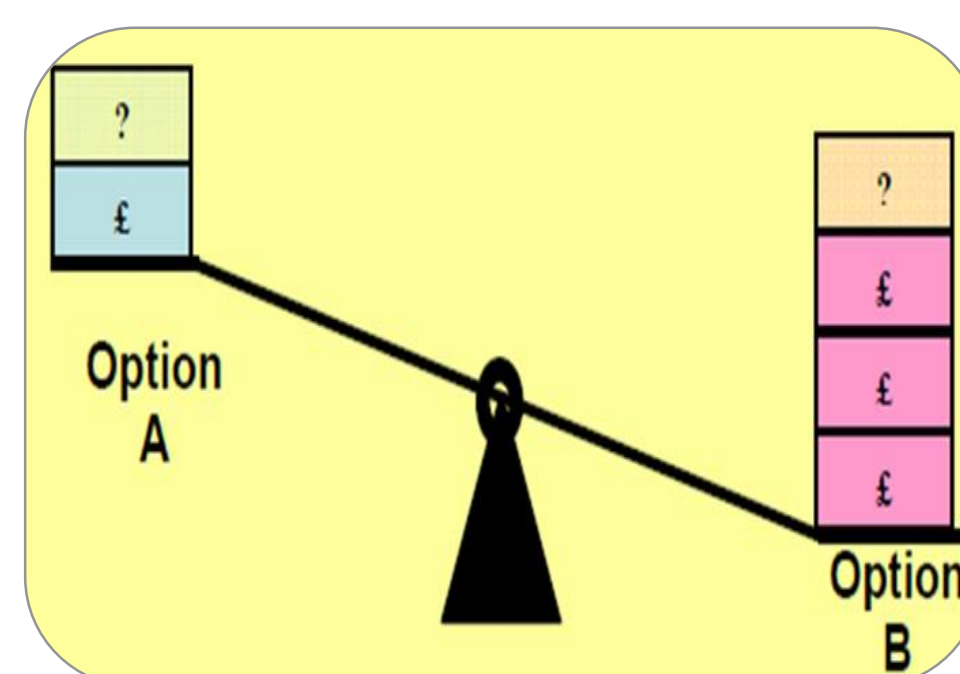
Flood Mapping



Properties at risk



Options Appraisal

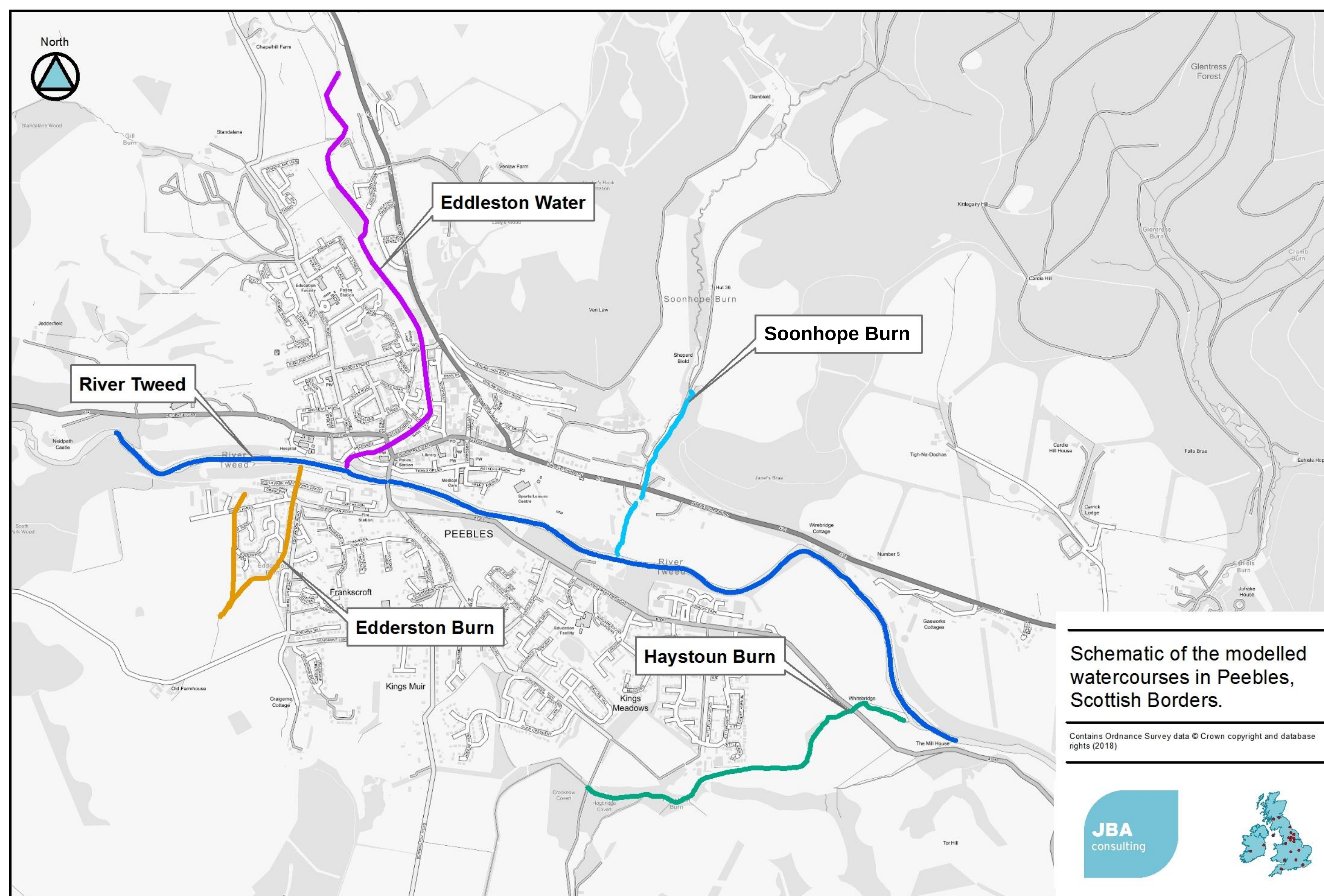


Cost-Benefit

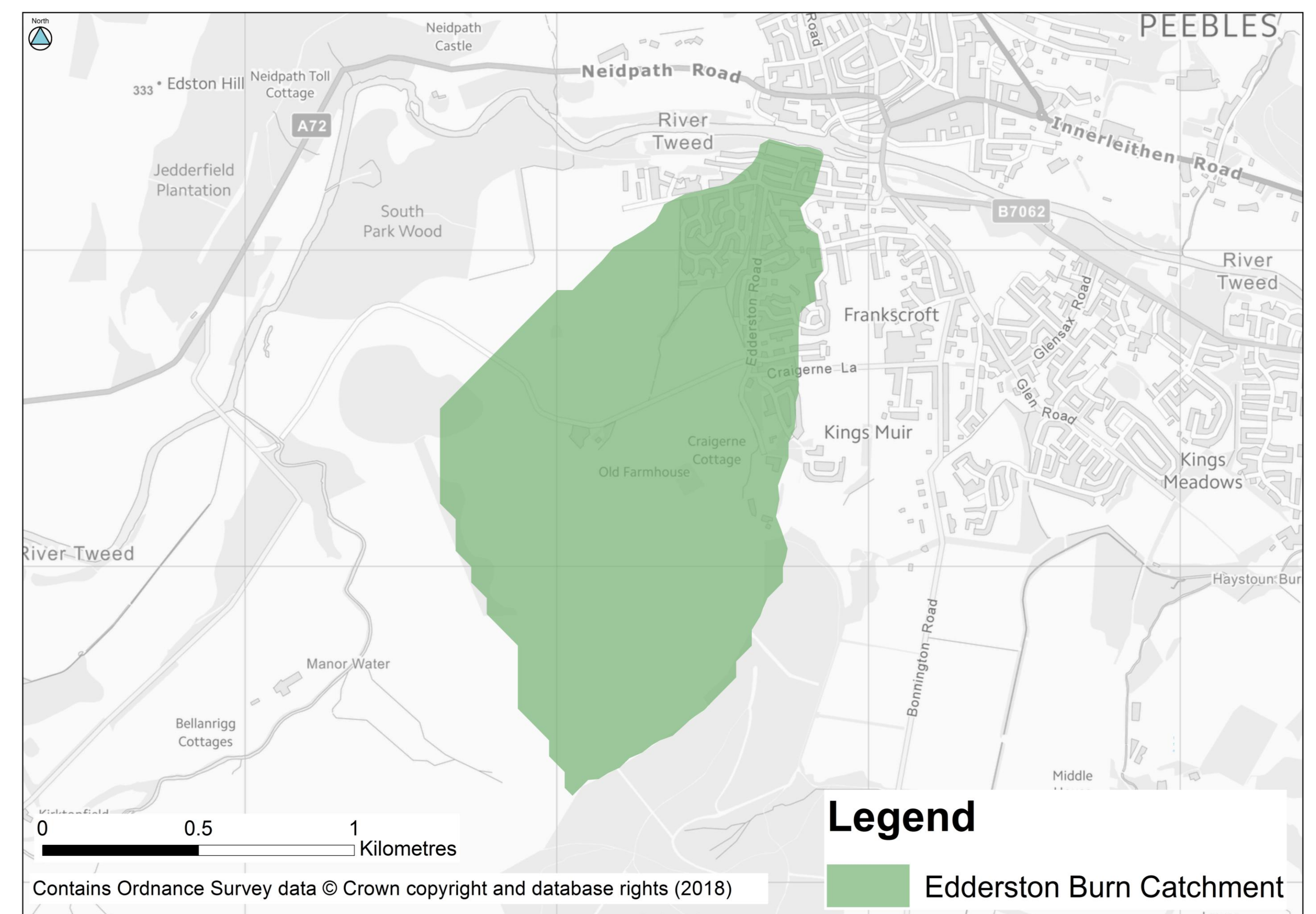
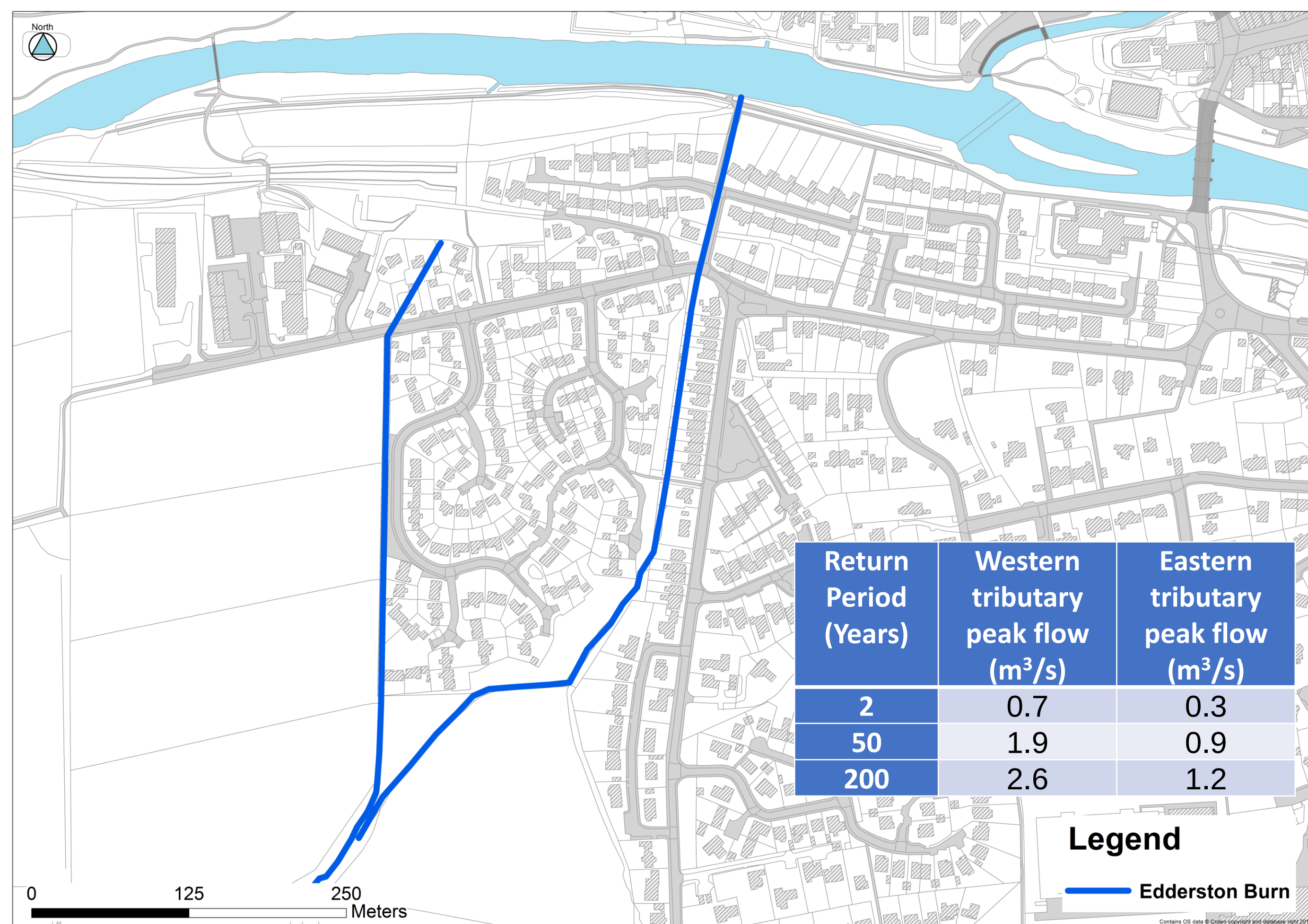
Return periods and annual probabilities

- 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) on the River Tweed 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.

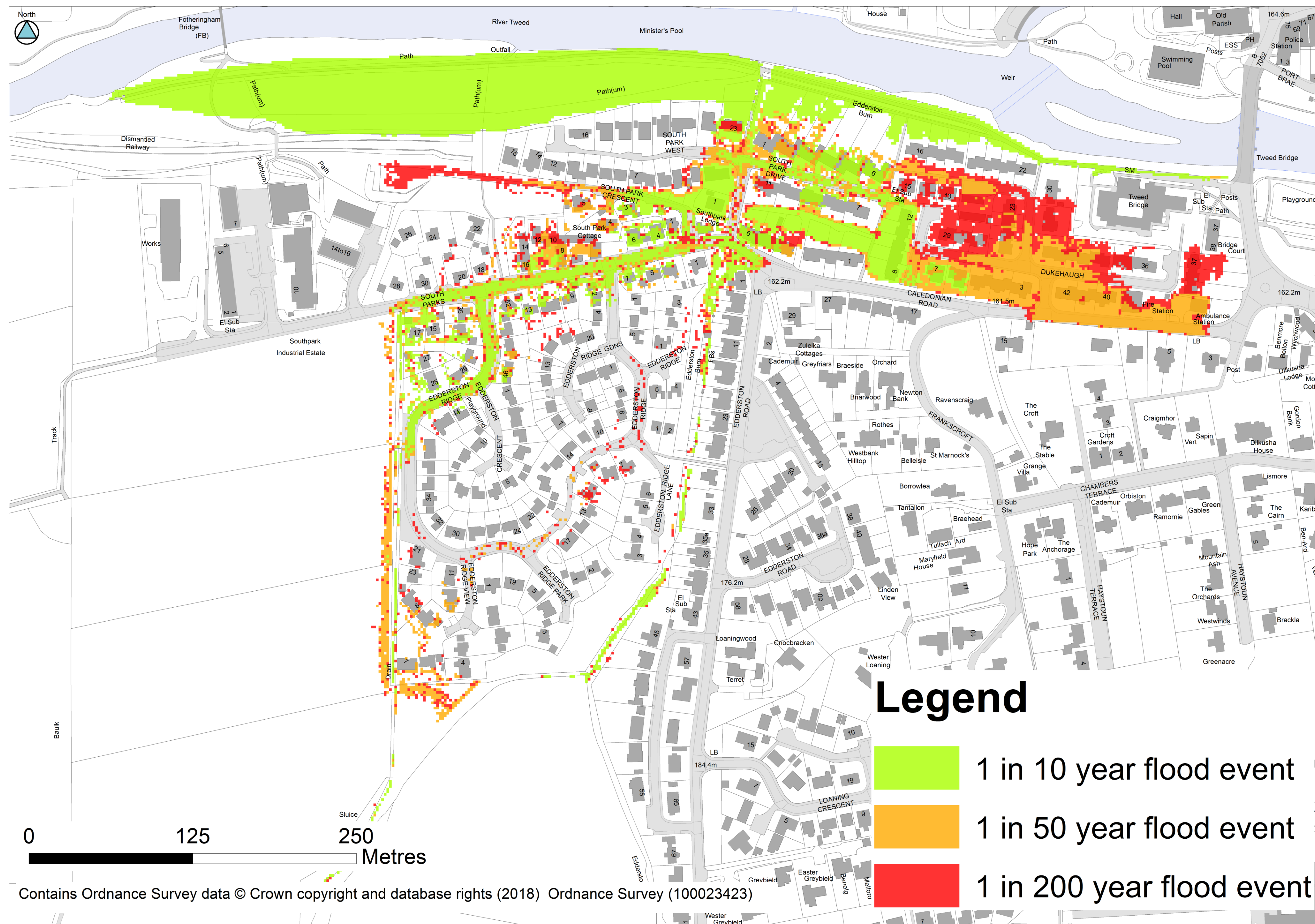
Peebles is at flood risk from the River Tweed, Edderston Burn, Eddleston Water, Soonhope Burn and Haystoun Burn. Each of the watercourses has its own mechanism of flood risk and the individual watercourses were therefore studied independently. The River Tweed is the largest of the assessed watercourses with a catchment area of 700km² followed by the Eddleston Water (70km²), Haystoun Burn (23km²), Soonhope Burn (9.5km²) and finally the Edderston Burn with a catchment area of under 2km². Some of the watercourses such as the Eddleston Water and the River Tweed have a long history of flooding whereas others have little available flood history.



The Edderston Burn is a small burn in Peebles flowing north into the River Tweed with a catchment area of 1.6 km². It consists of two main tributaries which combine to form the main Edderston Burn channel approximately 600 m upstream of its confluence with the River Tweed. As part of the South Parks Flood Prevention Scheme (FPS) in 1988 a diversion channel was built to divert flows from the west tributary of the Edderston Burn to drain directly into the River Tweed via a culvert under South Parks Road. The diversion channel consists of an overflow structure, a re-graded drainage channel and culvert extending from South Parks Road to the outfall at the River Tweed. The figures below show the length of modelled channel and the full catchment area.



Flood mapping – Edderston Burn



Property Type	Number at Risk (1 in 200 year flood)
Residential	38
Commercial	1

How do we create these flood maps?

- A physical survey captured the measurements of river channels, banks and structures along each watercourse.
- These measurements were input to 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 South Parks

What do the maps show?

- 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 on the Edderston Burn

Out of bank flow paths, key structures and constraints were identified. Water backing up behind bridges and culverts is the main source of flooding for South Parks. Flood water flowpaths have been identified on Edderston Ridge and South Parks Road with water also expected to flow into the low lying residential streets of South Park Crescent and South Park Drive.



Complex out of bank flows



Key control structures



Structures that constrain flows



Has this flow mechanism been seen before?

The only known flooding from the Edderston Burn in recent times occurred along South Parks Road due to blockage of the double barrel culvert and resulted in flooding of properties on South Park Drive and Caledonian Road.

Edderston Burn Options appraisal

– 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 is not usually socially or politically acceptable.
- **Flood Warning** – The existing level gauge on the Edderston Burn could be calibrated to a send flood alerts.
- **Resistance Measures** – Property level protection is well suited to defend against shallow flood depths experienced in South Parks.
- **Resilience Measures** – Unlikely to be economically or socially viable.
- **Diversion channel** – There is potential to install a diversion channel on the western branch of the Edderston Burn.
- **Watercourse Maintenance** – The Council should continue the scheduled maintenance regime.
- **Demountable Defences** – A permanent wall is more suitable due to limited warning time.
- **Storage** – Online storage could be built at the confluence of the Edderston Burn's east and west tributary.
- **Natural Flood Management** – NFM opportunities throughout the Edderston Burn catchment have been identified.
- **Structure Modification** – Bridges or culverts restrict flow on both watercourses which contributes to flood risk but removing the bridge or upgrading the culvert is not sufficient to prevent flooding by itself.
- **Direct Defences** – A combination of walls could contribute to containing flow in the watercourse.
- **Channel Modification** – Channel deepening or widening could contribute to containing the flow in the channel.

Least desirable options

Good practice and partial solutions

Most desirable options

Prerequisites to formal flood protection scheme

Diversion channel improvements

- Remove two small bridges on the existing diversion channel.
- Improve the way in which the diversion culvert wingwall ties into the embankment.
- Clean the diversion structure of sediment and keep erosion damage to a minimum downstream of the structure.

Edderston Burn channel improvements

- Clean culvert of sediment
- Remove or upgrade culvert screen
- Remove weir upstream of culvert
- Remove small bridges on approach to Edderston Burn culvert



Bridge and weir on approach to Edderston Burn Culvert



Bridge on diversion channel



Diversion channel wingwall tie-in



Screen on Edderston Burn culvert



Bridge on diversion channel



Diversion structure

Edderston Burn – Short Listed Options

Option 1: Property Level Protection (PLP)

- Automatic PLP installed on 38 out of 39 properties at flood risk to protect against the 1 in 200 year flood event. PLP would involve surveying each property to identify water entry points and recommending appropriate products such as self-sealing doors and air vents as well as non-return valves on plumbing.
- Estimated cost £1.8m
- Estimated damage avoided £2.5m



Typical examples of PLP

Option 2: Online flood storage

- This option provides a 200 year standard of protection by storing large flows and releasing them at a controlled rate.
- Wall heights of up to 1.3m at street level.
- Adaptation to climate change could be via culvert replacement or enlargement of the storage area.
- Estimated cost £1.1m
- Estimated damage avoided £3.2m



Typical example of on-line storage

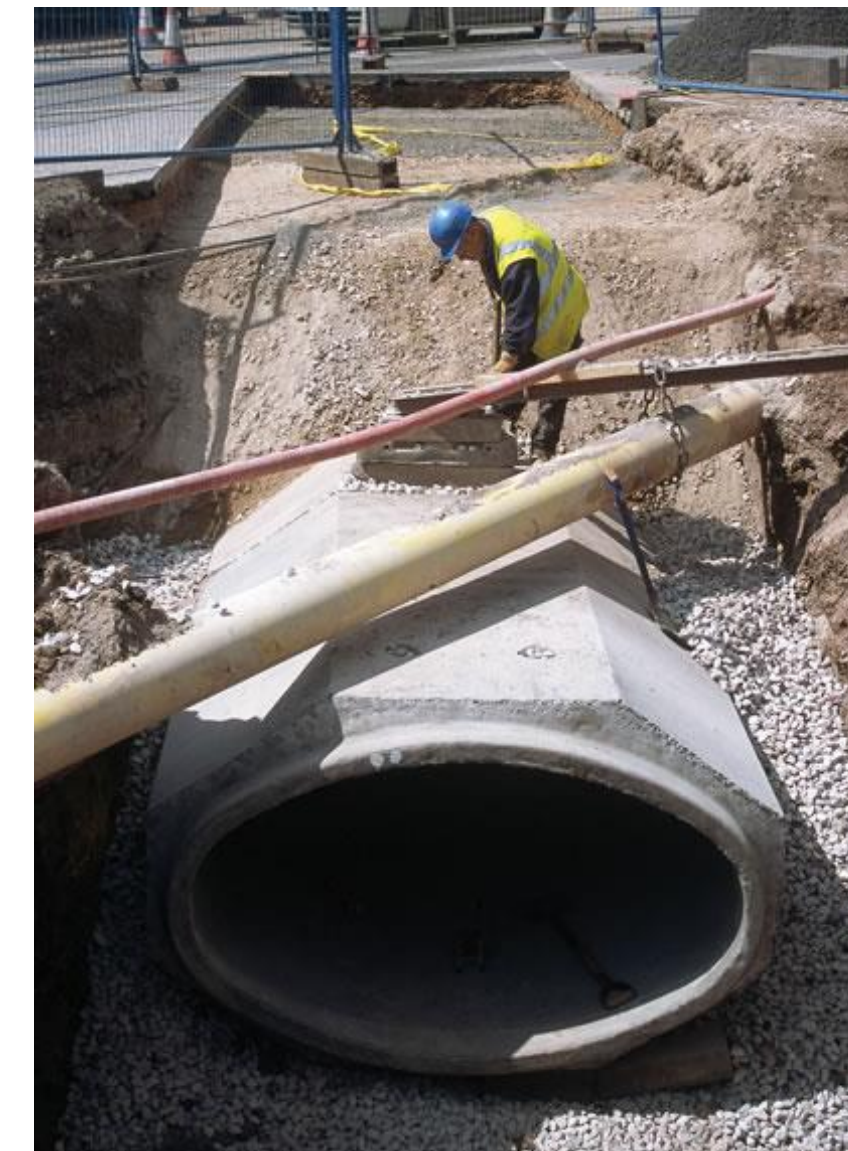
See adjacent
technical drawings
for further details
for these options

Edderston Burn – Short Listed Options

Option 3a:

Culvert upgrade with bed lowering

- Increase the diameter of the Diversion Channel culvert and the Edderston Burn culvert under South Parks.
- Lower the channel bed of both watercourses on approach to the culverts.
- Climate change could be catered for by sizing the culverts appropriately and increasing bed depth appropriately.
- Estimated cost £2.0 m
- Estimated damage avoided £3.2 m



Typical example of a new culvert



Typical example of channel deepening

See adjacent technical drawings for further details for these options

Option 3b:

Culvert upgrade with channel widening

- Increase the diameter of the Diversion Channel culvert and the Edderston Burn culvert under South Parks.
- Increase the channel width by 2.5m and 3.5m respectively to increase channel conveyance.
- Estimated cost £3.5m
- Estimated damage avoided £3.2m



Typical example of channel widening



Typical example of a flood wall

Image compliments of Flood Control International

Option 3c:

Culvert upgrade with flood walls

- Increase the diameter of the Diversion Channel culvert and the Edderston Burn culvert under South Parks.
- Construct low walls approximately half a metre high along each channel at key locations.
- Estimated cost £2.3m
- Estimated damage avoided £3.2m

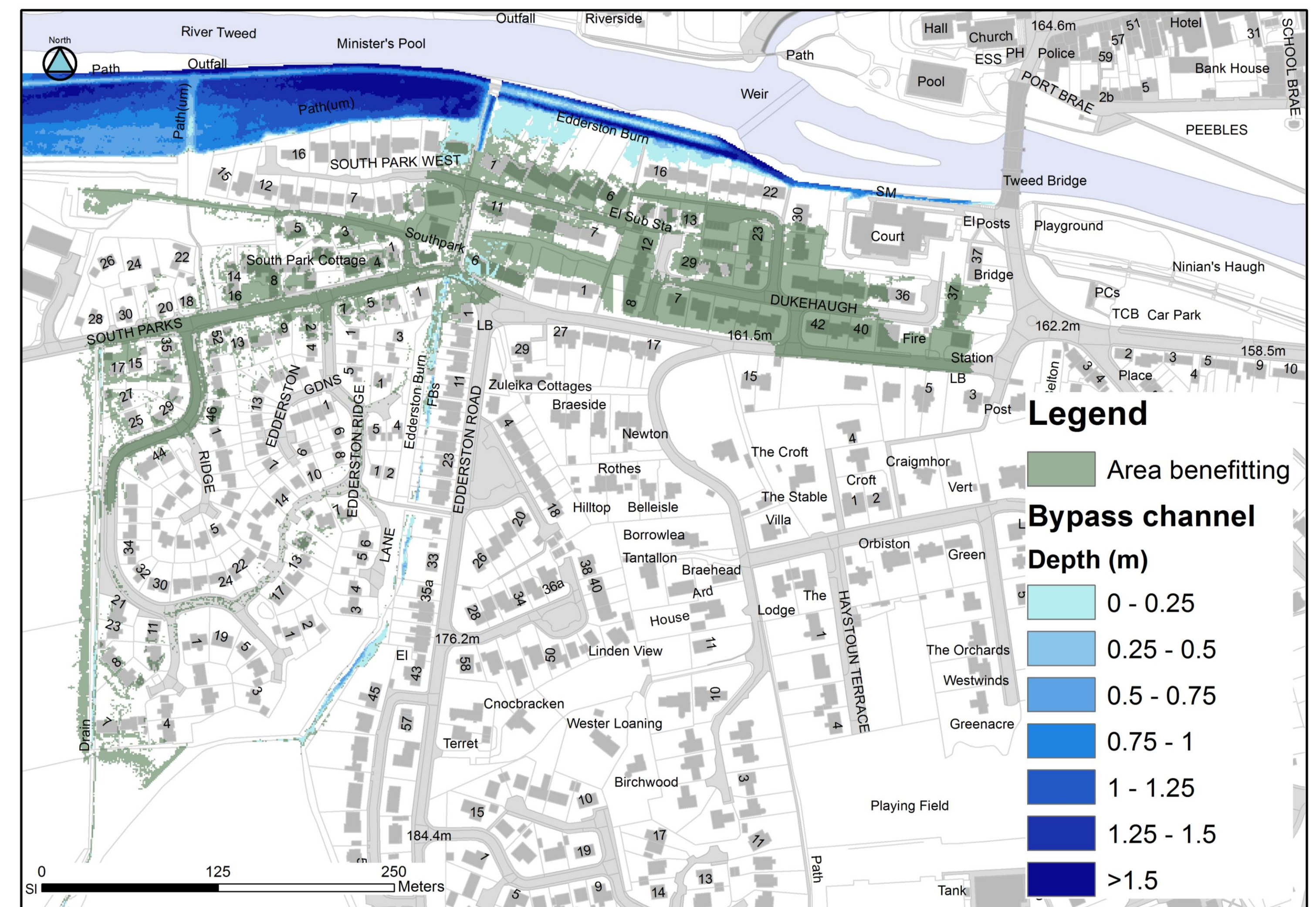
Edderston Burn – Short Listed Options

Option 4: Bypass Channel

- A meandering bypass channel could be constructed to carry excess flow from the western tributary into the River Tweed.
- The existing diversion channel could be abandoned since it does not reduce flows on the eastern tributary so some flood risk remains.
- Estimated cost £1.1 m
- Estimated damage avoided £3.1m



Typical example of a bypass channel

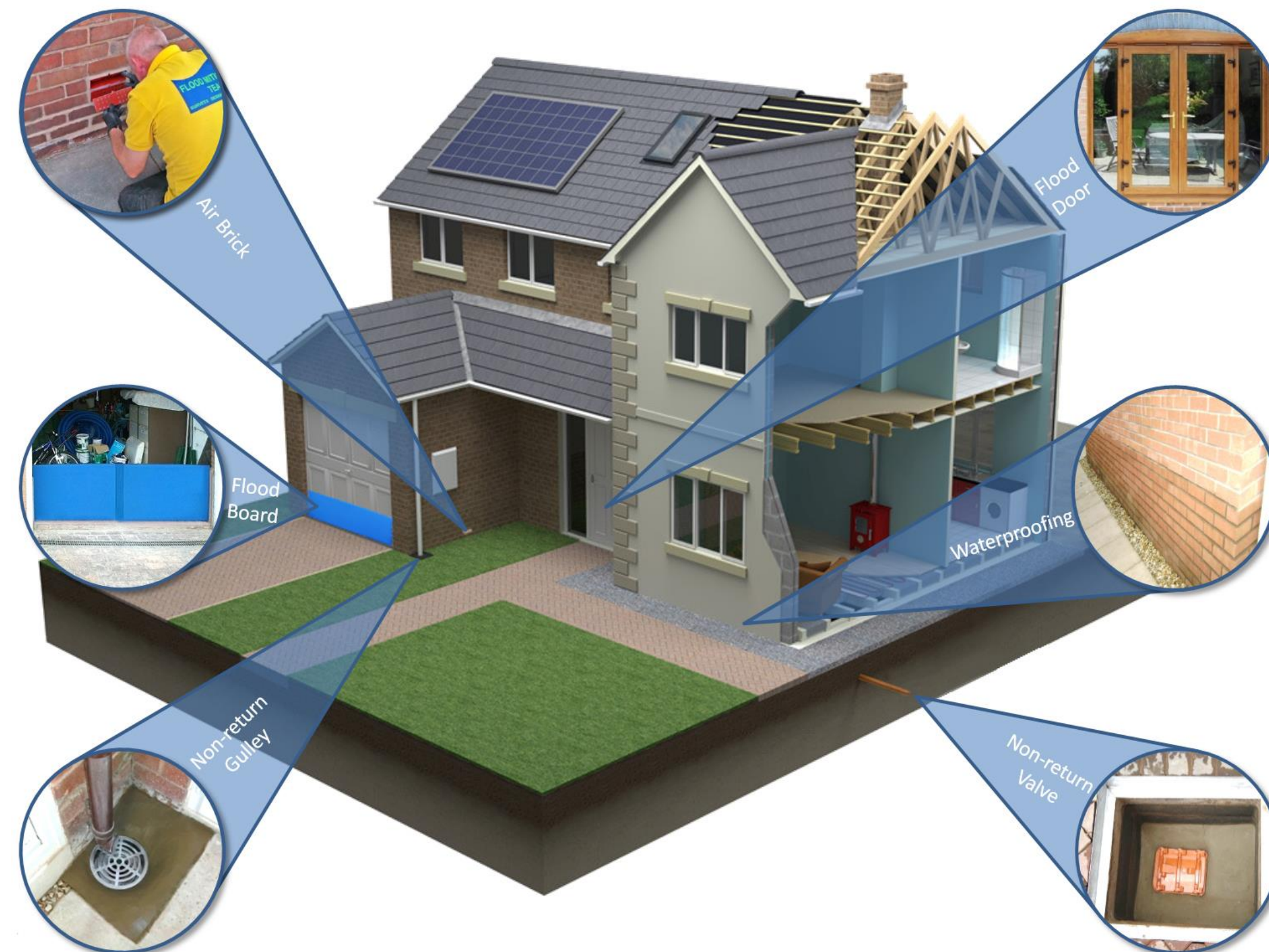


See adjacent technical drawings for further details for these options

Option 1 – Property Level Protection

PLP is the last form of defence before water gets into a property. Automatic PLP measures mean that the property is always protected by, for example, watertight doors rather than having to insert waterproof door guards when floods are forecast. PLP can protect 38 out of 39 properties in South Parks up to the 1 in 200 year flood event.

The standard of protection (SOP) map indicates the existing level of protection each property in the flood study has.



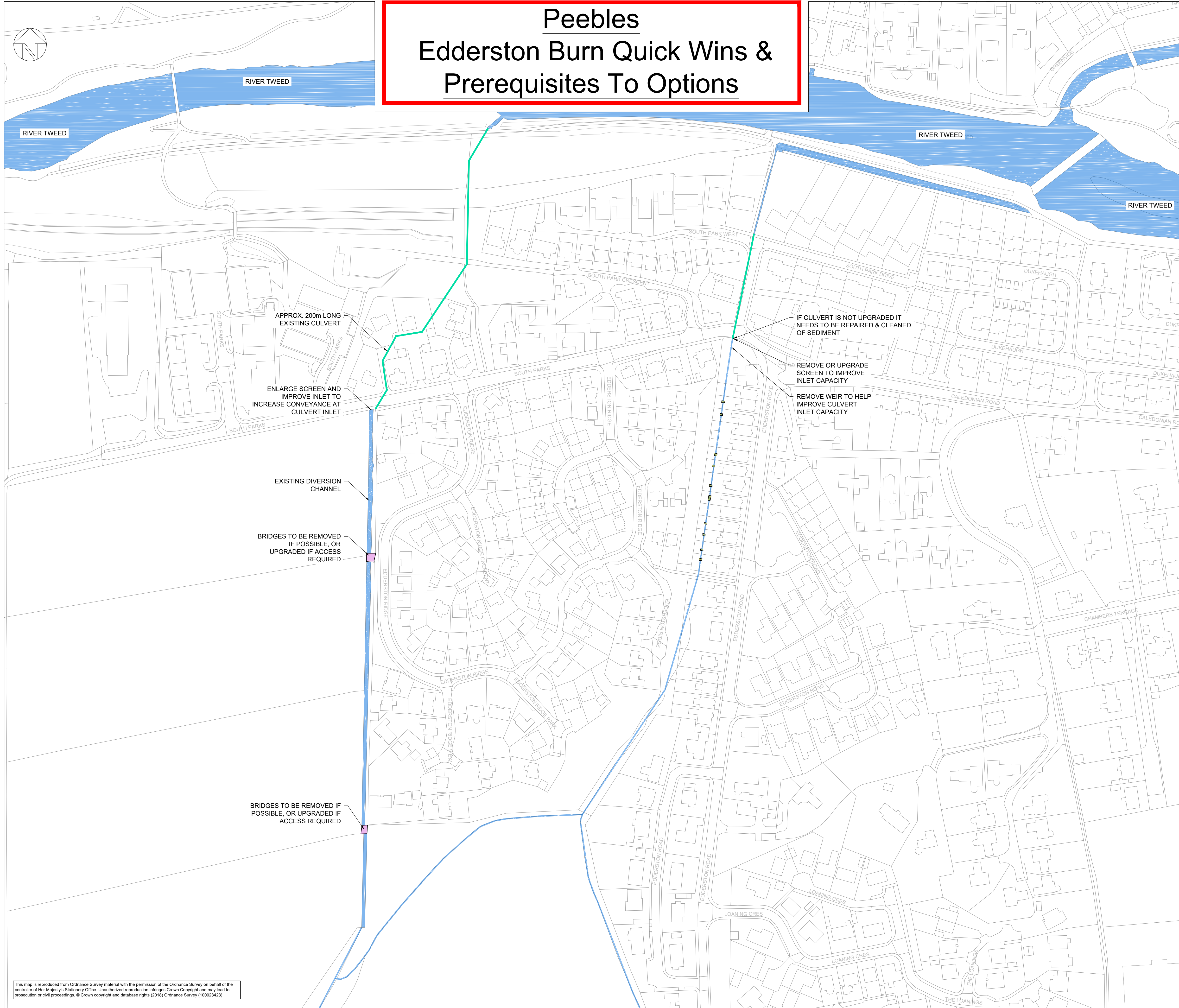
Examples of how Property Level Protection can mitigate the risks of flood inundation (image courtesy of Whitehouse Construction Co. Ltd)

Standard of protection map



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The standard of protection (SOP) map indicates the existing level of protection for each property in the flood study.



Peebles

Edderston Burn Quick Wins & Prerequisites To Options

Option Summary: There are a number of small improvement works required on the Edderston Burn that will be required prior to development of the flood protection scheme. These works will help to increase the conveyance of the channels and culverts present but do not provide a satisfactory level of protection.

- LEGEND
- EXISTING CULVERT
 - EXISTING WATERCOURSE

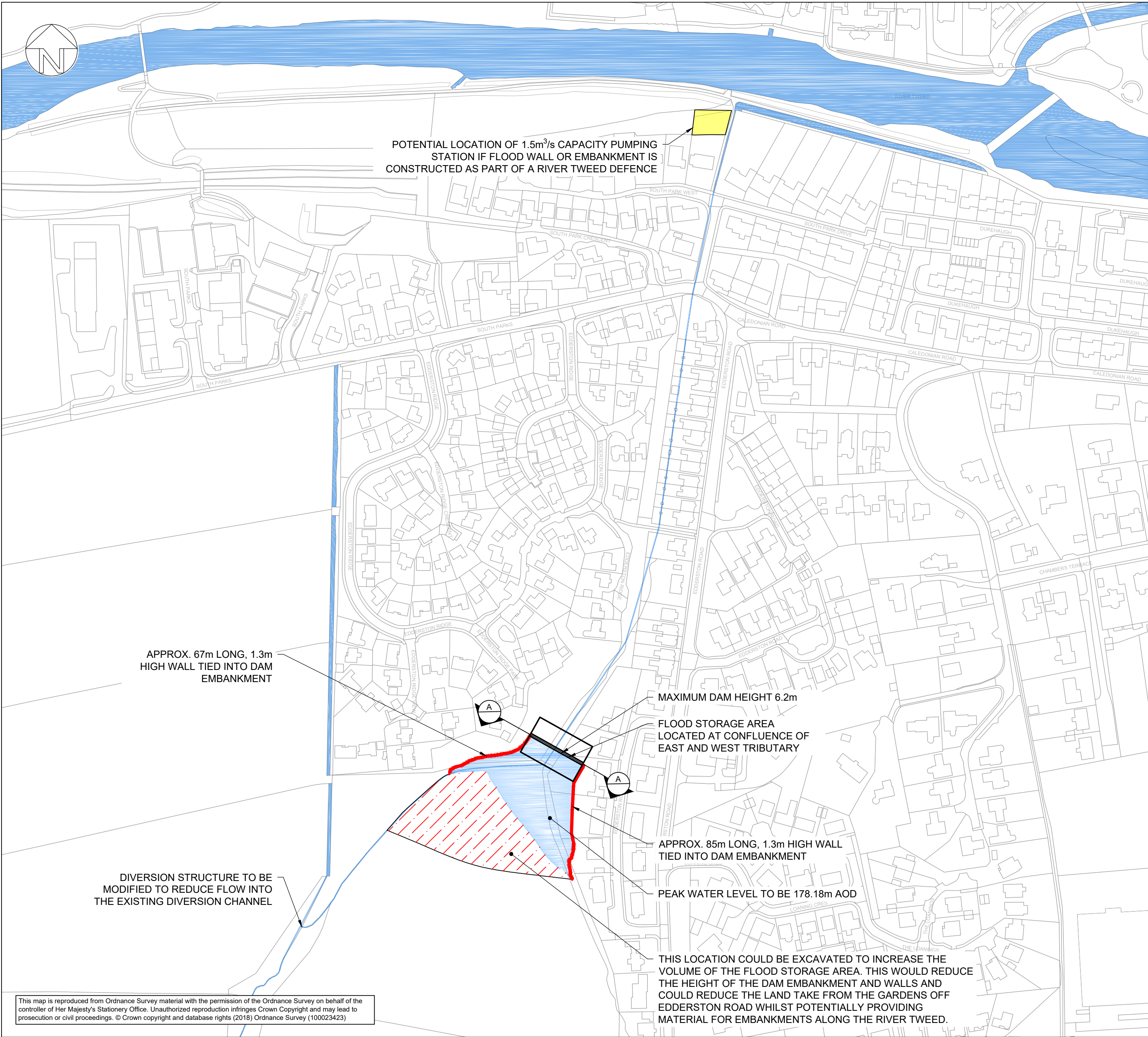
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Client Approval					
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Purpose of Issue				Status	S1

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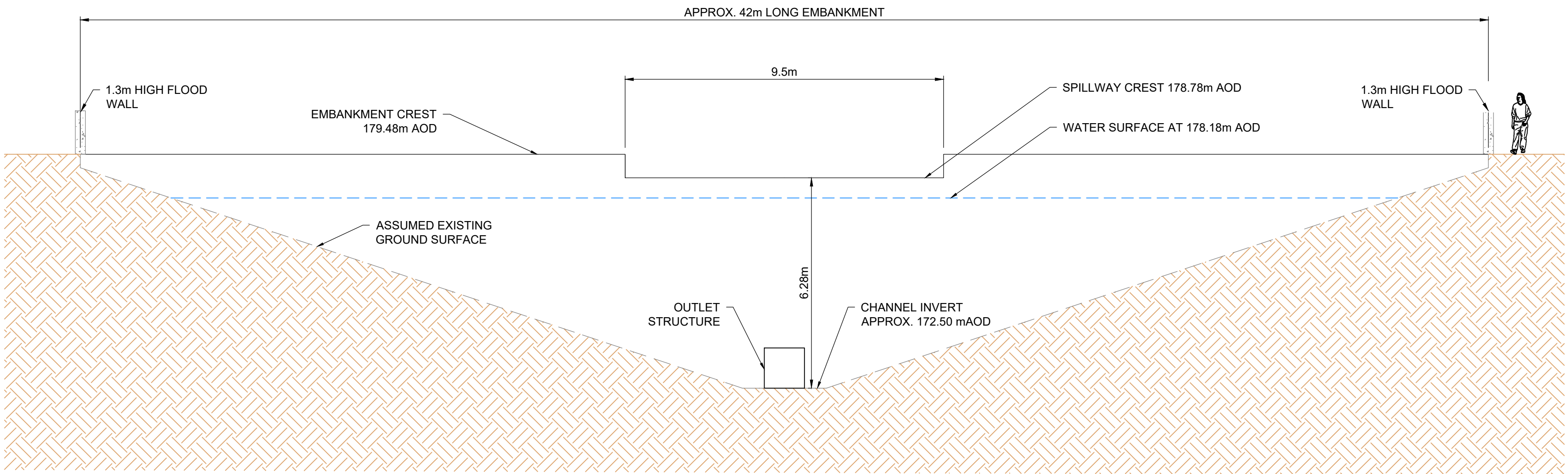
Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
t +44 (0)131 3192940
f +44 (0)845 8627772
e info@jbaconsulting.com

Offices at Colleshill, Doncaster, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle upon Tyne, Newport, Peterborough, Saltair, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

Project		Borders Flood Studies													
Title		Peebles Edderston Burn Quick Wins & Prerequisites To Options for													
Client		M M MOTT MACDONALD 													
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Project Number:		2017s5526													
Drawing Number		Revision													
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PLAN
1:2000



SECTION A-A: EMBANKMENT LONG SECTION
1:100

Peebles

Option 2: 200 Year

Standard of Protection

Ederston Burn Online

Flood Storage

Option Summary: Online flood storage area located at the confluence of the east and west tributary of the Ederston Burn. This option requires the modification of the diversion structure to limit the flow into the diversion channel. A sub-option would be to provide a smaller storage area and complement this with a bypass channel or upgrading of the Ederston Burn Culvert.

LEGEND	
---	EXISTING GROUND LEVEL
---	FINISHED GROUND
---	200 YEAR FLOOD LEVEL
---	CONCRETE FLOOD WALL
---	EXISTING WATERCOURSE
---	STORAGE AREA

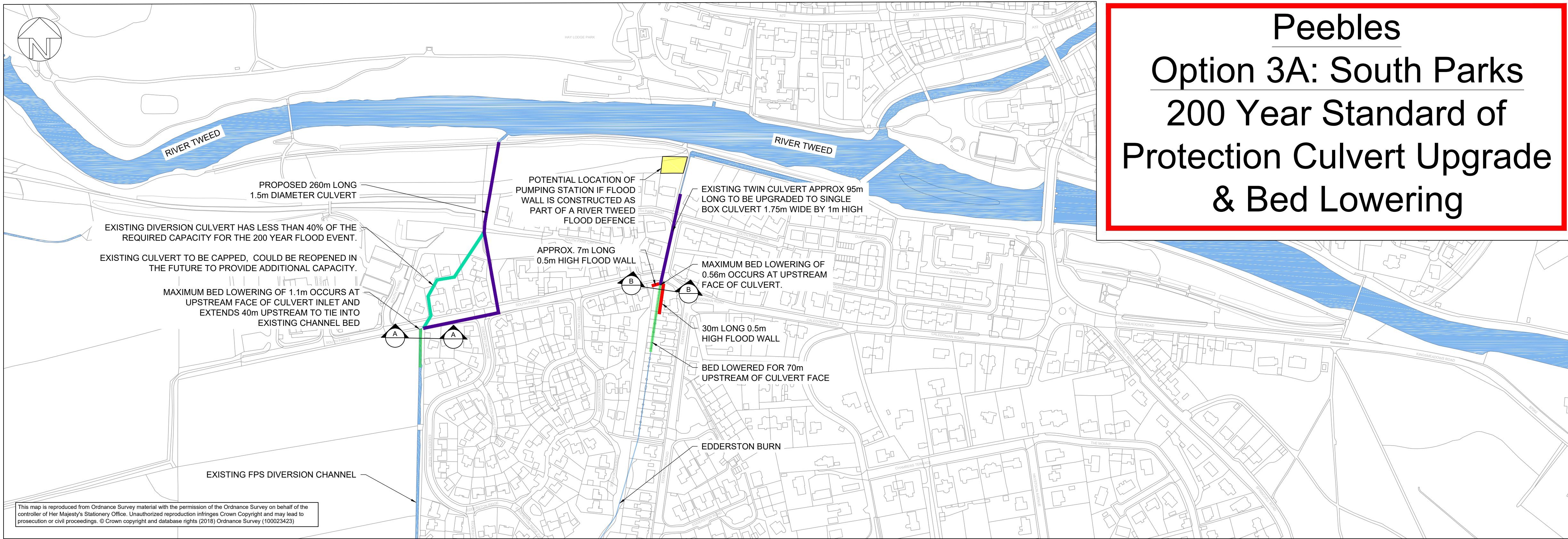
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Purpose of Issue					Status
Suitable for Coordination					S1

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
t +44 (0)131 3192940
f +44 (0)845 8627772
e info@jbaconsulting.com

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Project	Borders Flood Studies	
Title	Peebles Ederston Burn: Option 2 (200 Year SoP) Online Flood Storage for	
Client		

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Project Number:	2017s5526	
Drawing Number	AEM-JBAU-PB-EB-IM-C-1500	
		Revision P02

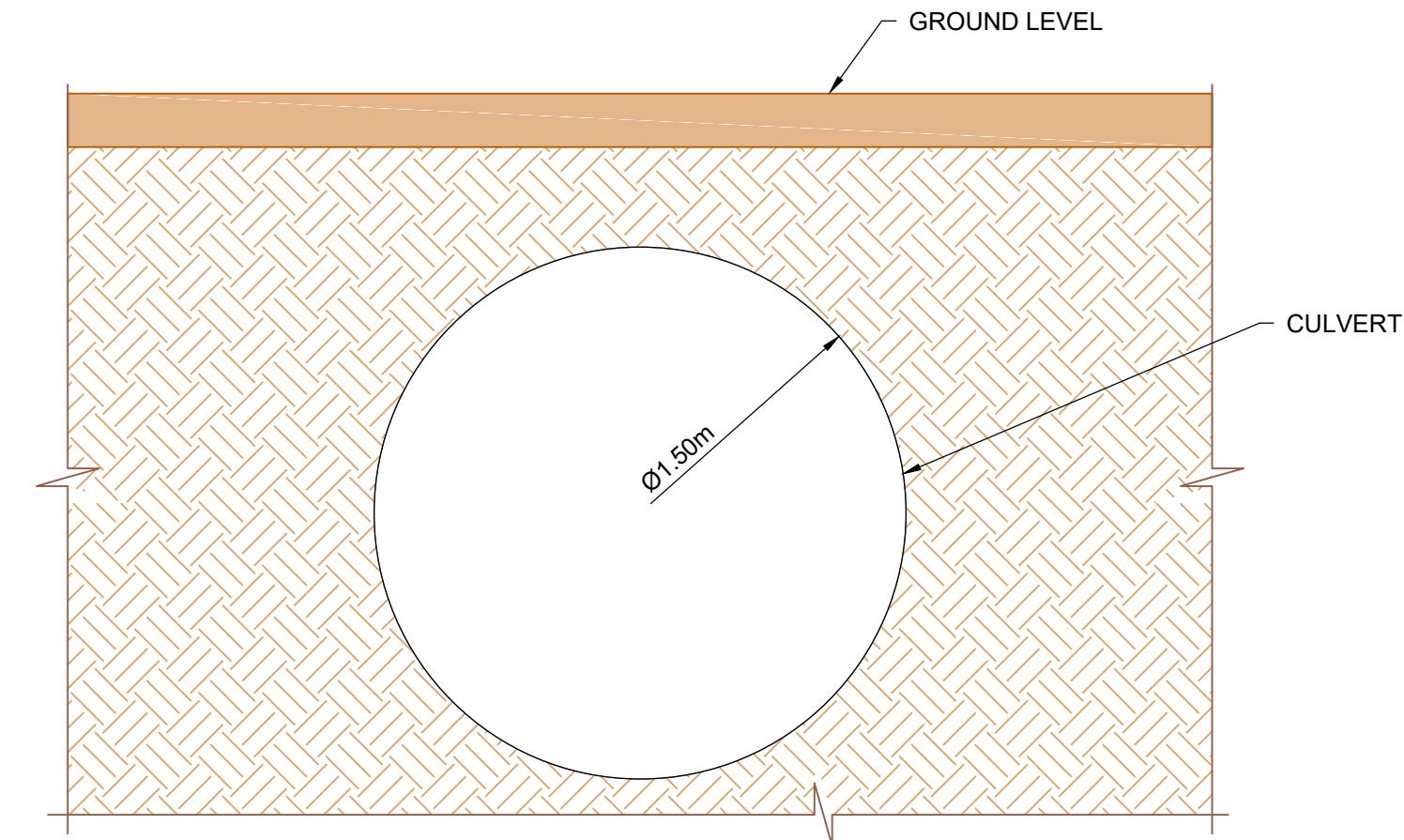


Peebles
Option 3A: South Parks
200 Year Standard of
Protection Culvert Upgrade
& Bed Lowering

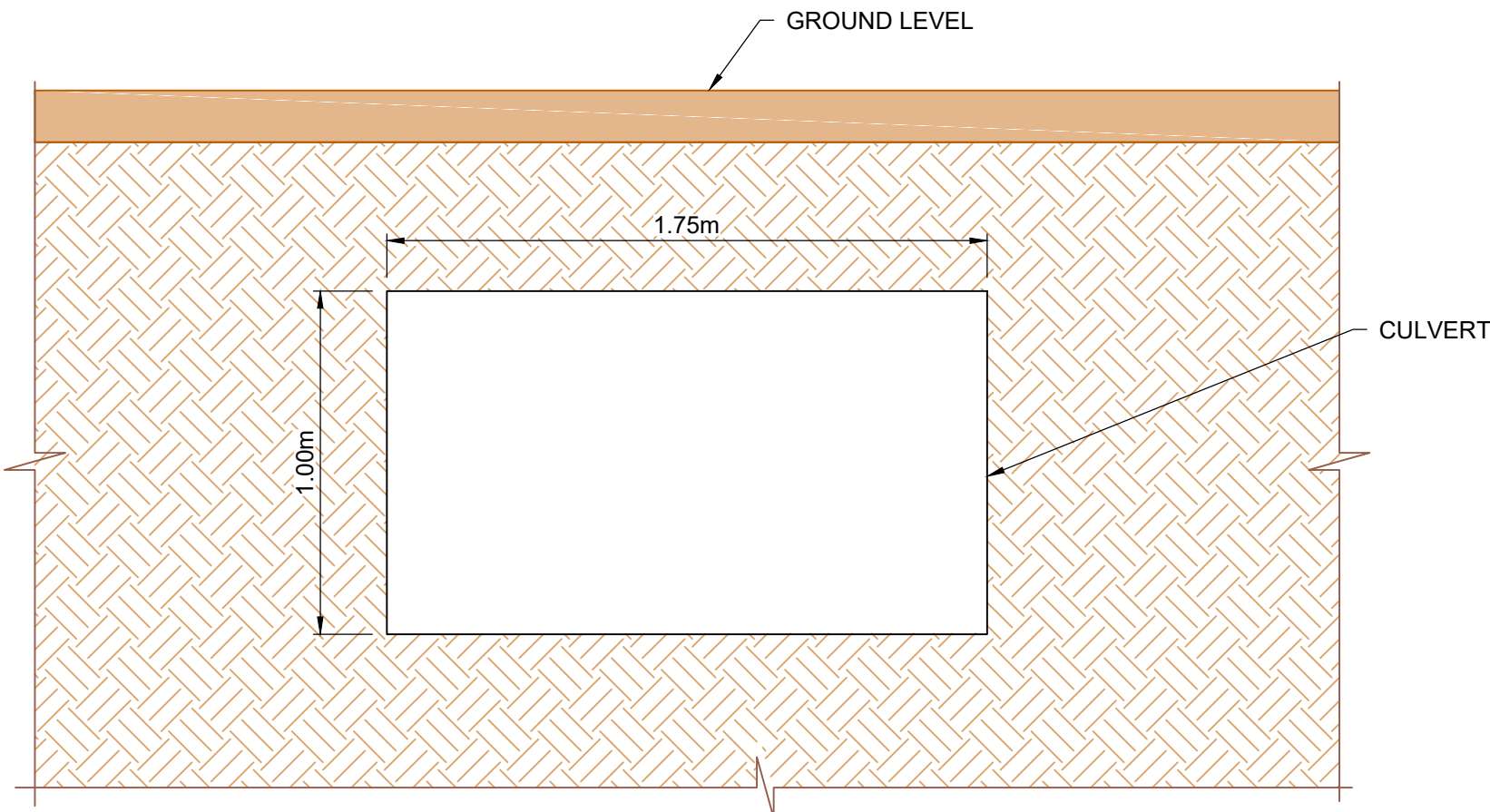
OPTION SUMMARY: Upgrade of diversion channel culvert and Edderston Burn culvert with reprofiled channels upstream to improve inlet conveyance. Culverts have been sized to cater for the 200 year plus climate change event with at least a 300mm barrel clearance to soffit. The diversion channel culvert currently runs under a housing estate, as part of the culvert upgrade the culvert will be laid along a new path as shown in purple. The residual flood risk is mitigated by deepening of the channels upstream of each culvert. Options to meander the diversion channel could also provide wider aesthetic and environmental benefits.

- LEGEND
- EXISTING GROUND
 - EXISTING GROUND LEVEL
 - 200 YEAR WATER LEVEL
 - ABANDONED CULVERT
 - OPEN CHANNEL BED LOWERING
 - NEW CULVERT
 - WALL DEFENCE
 - EXISTING WATERCOURSE

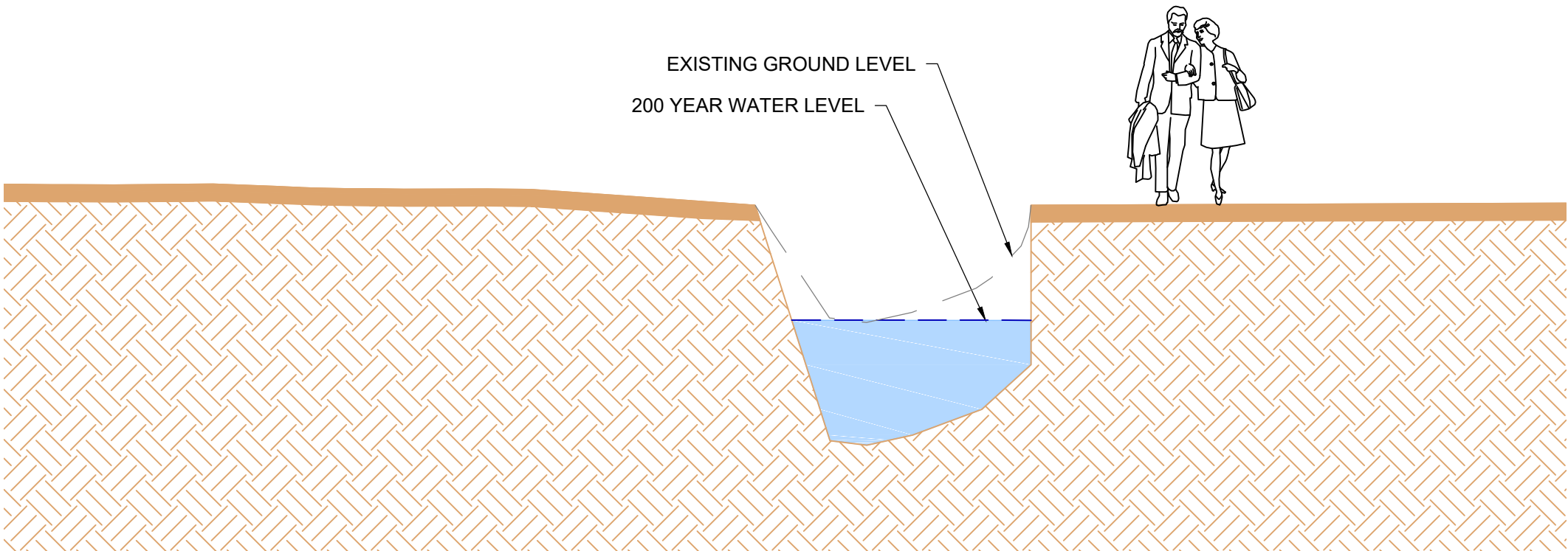
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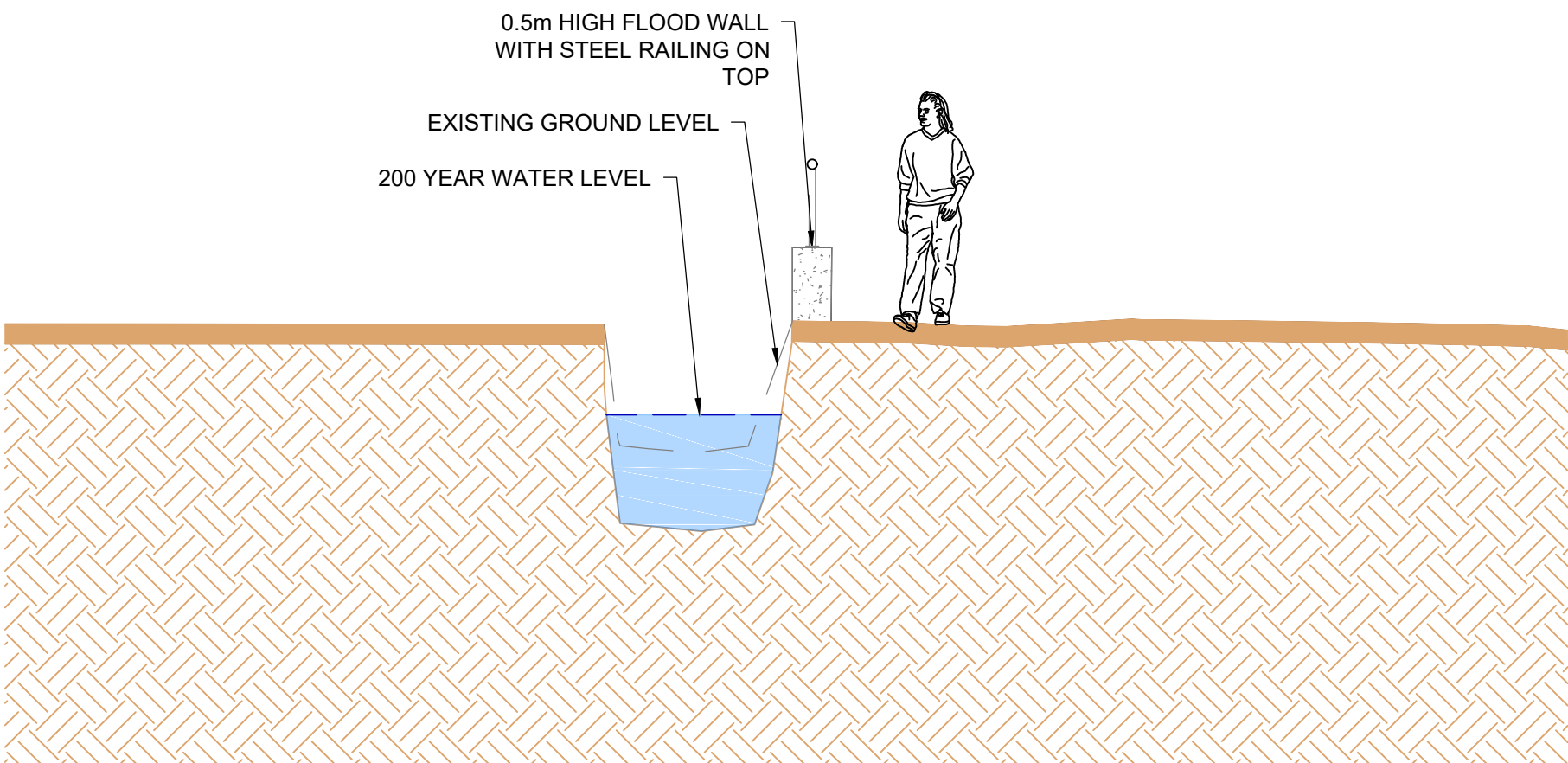
PROPOSED DIVERSION CULVERT TYPICAL SECTION
1:20



EDDERSTON BURN PROPOSED BOX CULVERT TYPICAL SECTION
1:20



SECTION A-A
1:50



SECTION B-B
1:50

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Purpose of Issue				Status	S1
Suitable for Coordination					

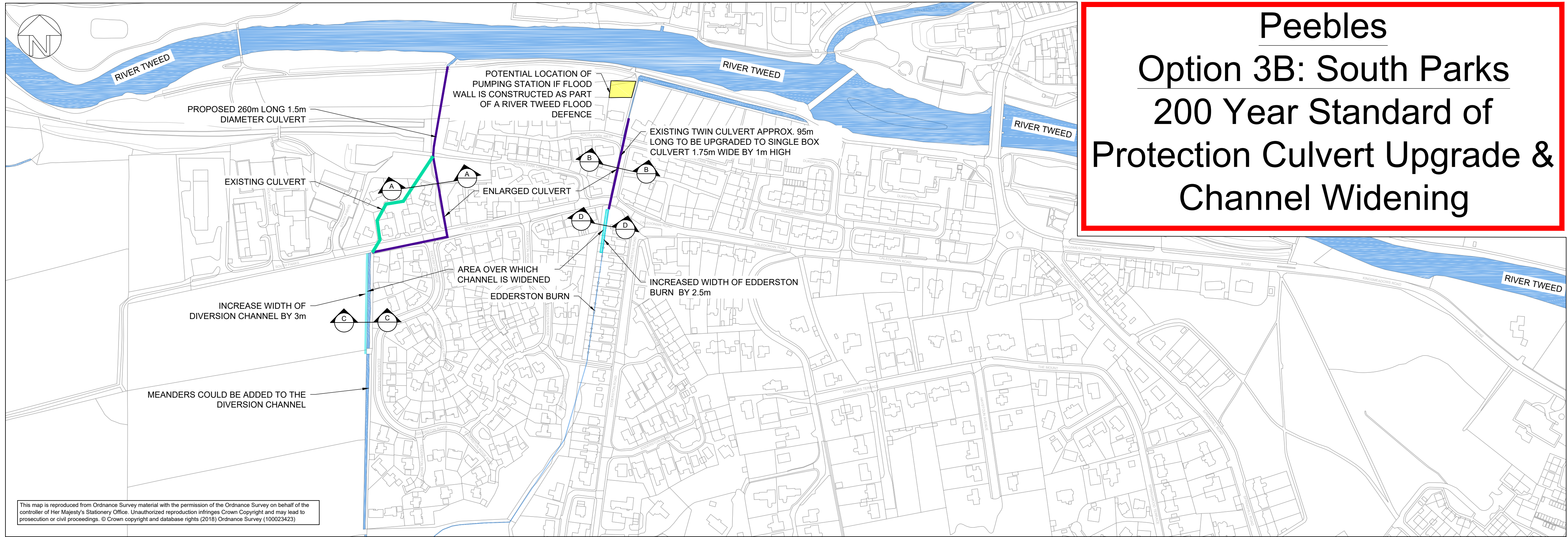
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Research Avenue South
Heriot Watt University
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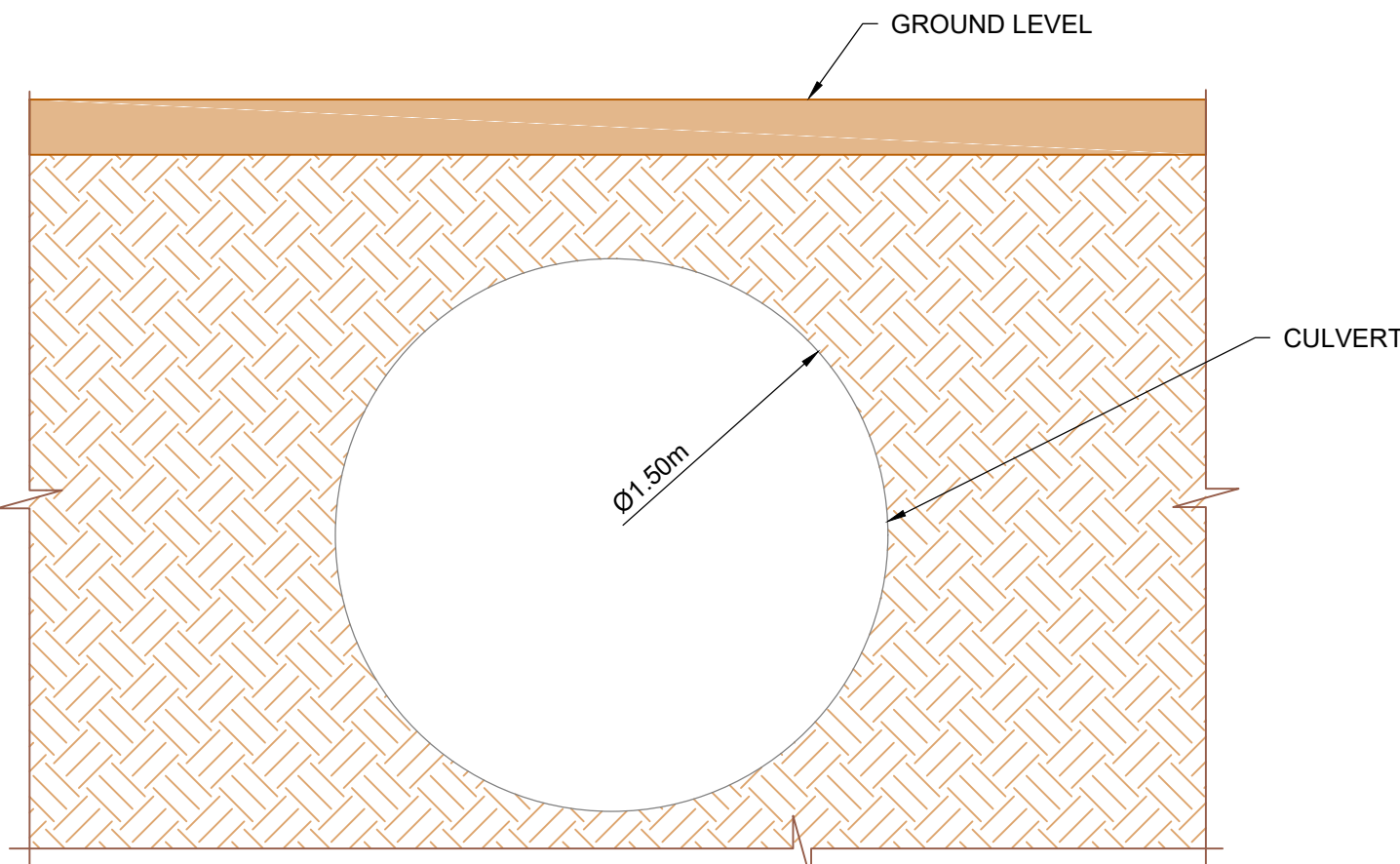
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Project	Borders Flood Studies	
Title	Peebles Edderston Burn: Option 3A 200 Year Culvert Upgrade With Bed Lowering for	
Client	M MOTT MACDONALD	

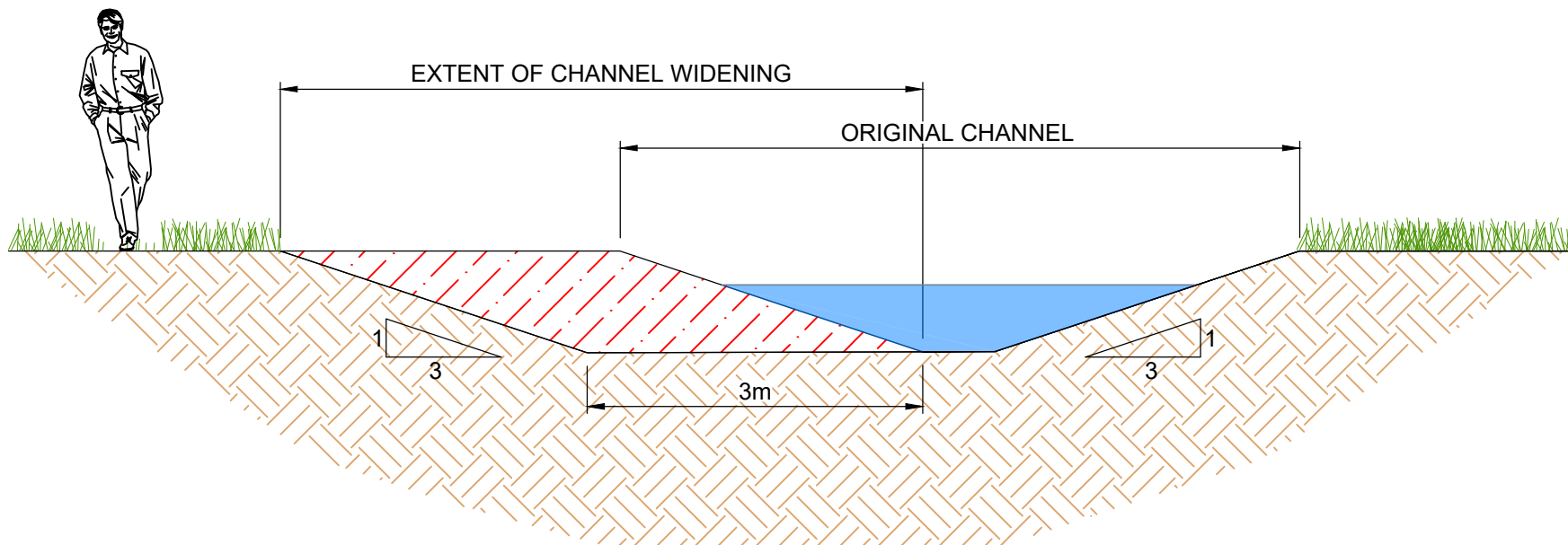
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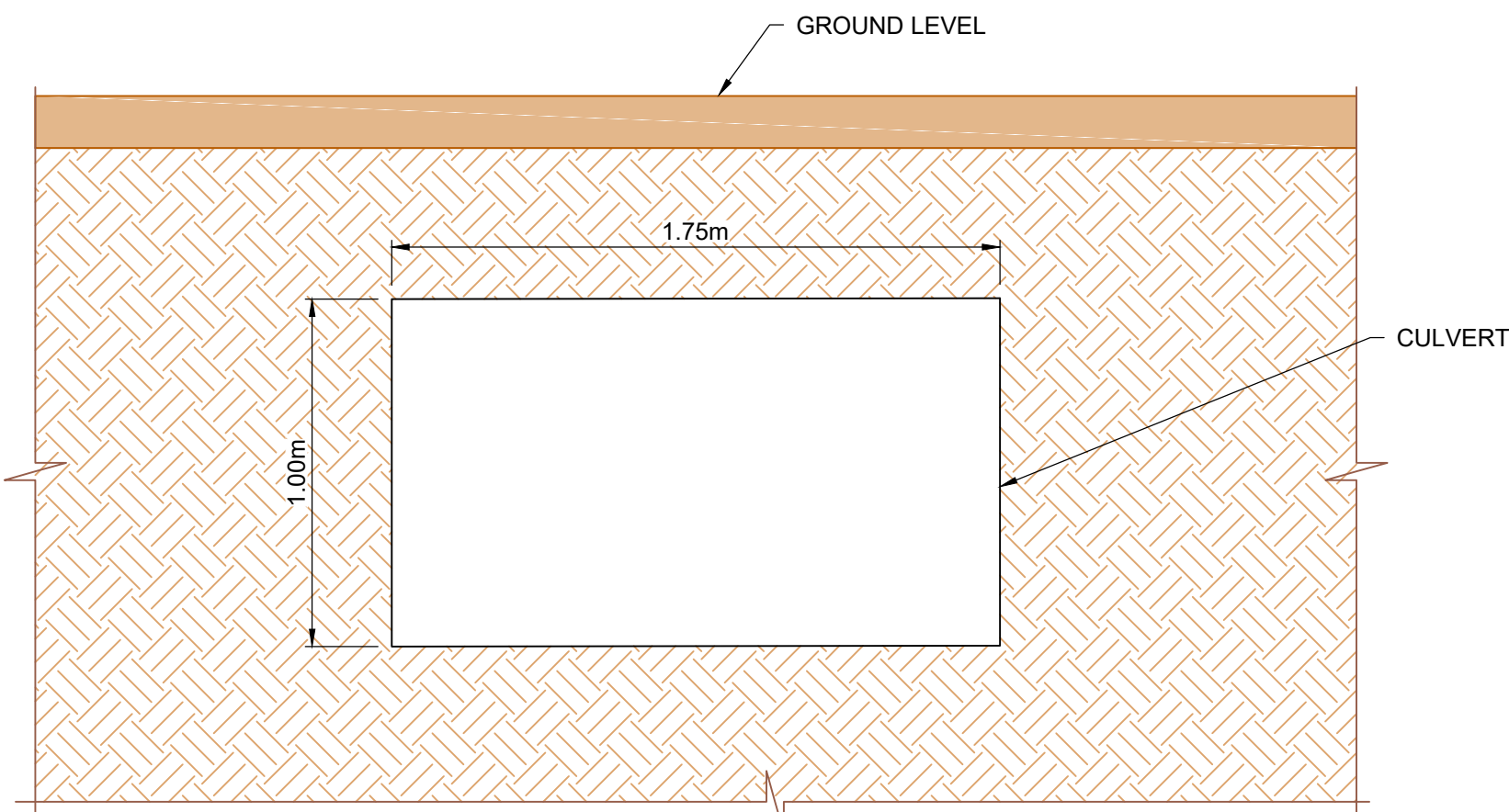
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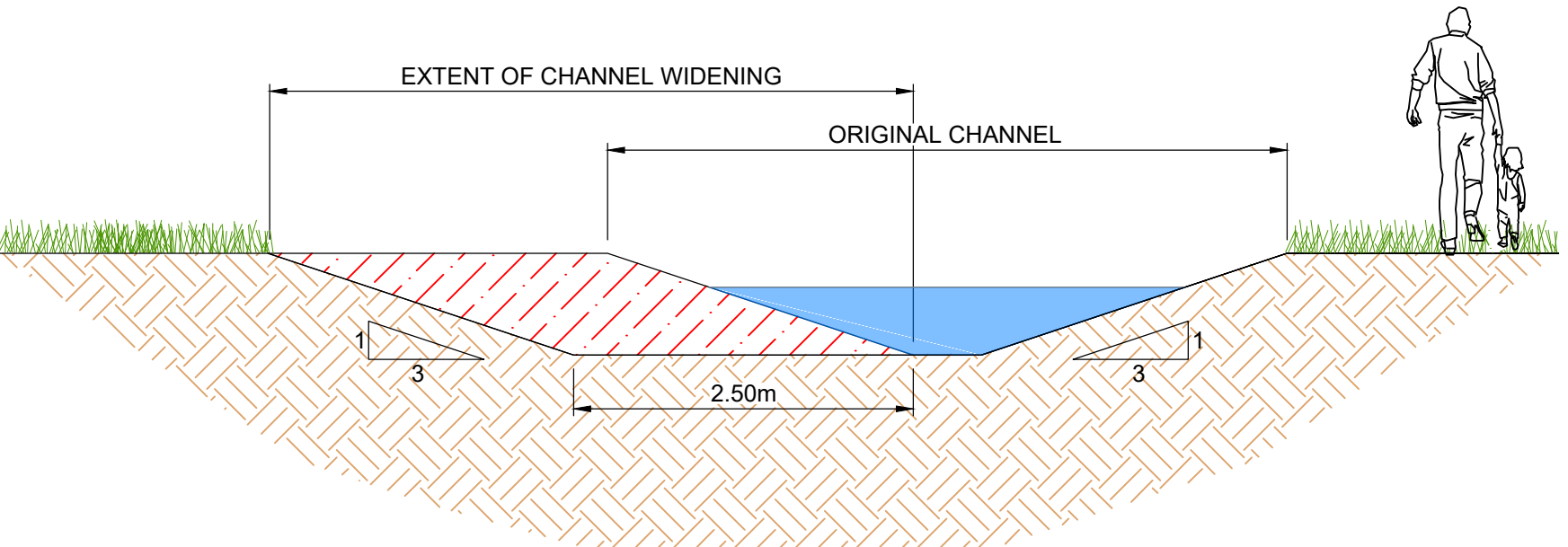
SECTION A-A
DIVERSION CULVERT TYPICAL SECTION
1:20



SECTION C-C
INDICATIVE CHANNEL WIDENING SECTION
THROUGH DIVERSION CHANNEL
1:50



SECTION B-B
EDDERSTON BURN TYPICAL BOX CULVERT SECTION
1:20



SECTION D-D
INDICATIVE CHANNEL WIDENING SECTION
THROUGH EDDERSTON BURN
1:50

Peebles

Option 3B: South Parks

200 Year Standard of Protection Culvert Upgrade & Channel Widening

OPTION SUMMARY: Upgrade of diversion channel culvert and Edderston Burn culvert with reprofiled channels upstream to improve inlet conveyance. Culverts have been sized to cater for the 200 year plus climate change event with at least a 300mm barrel clearance to soffit. The diversion channel culvert currently runs under a housing estate, as part of the culvert upgrade the culvert will be laid along a new path as shown in purple. The residual flood risk is mitigated by deepening of the channels upstream of each culvert. Options to meander the diversion channel could also provide wider aesthetic and environmental benefits.

LEGEND

- EXISTING GROUND
- NEW CULVERT
- ABANDONED CULVERT
- EXISTING WATERCOURSE
- OPEN CHANNEL WIDENING
- EXCAVATED AREA

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Purpose of Issue				Status	S1
Suitable for Coordination					

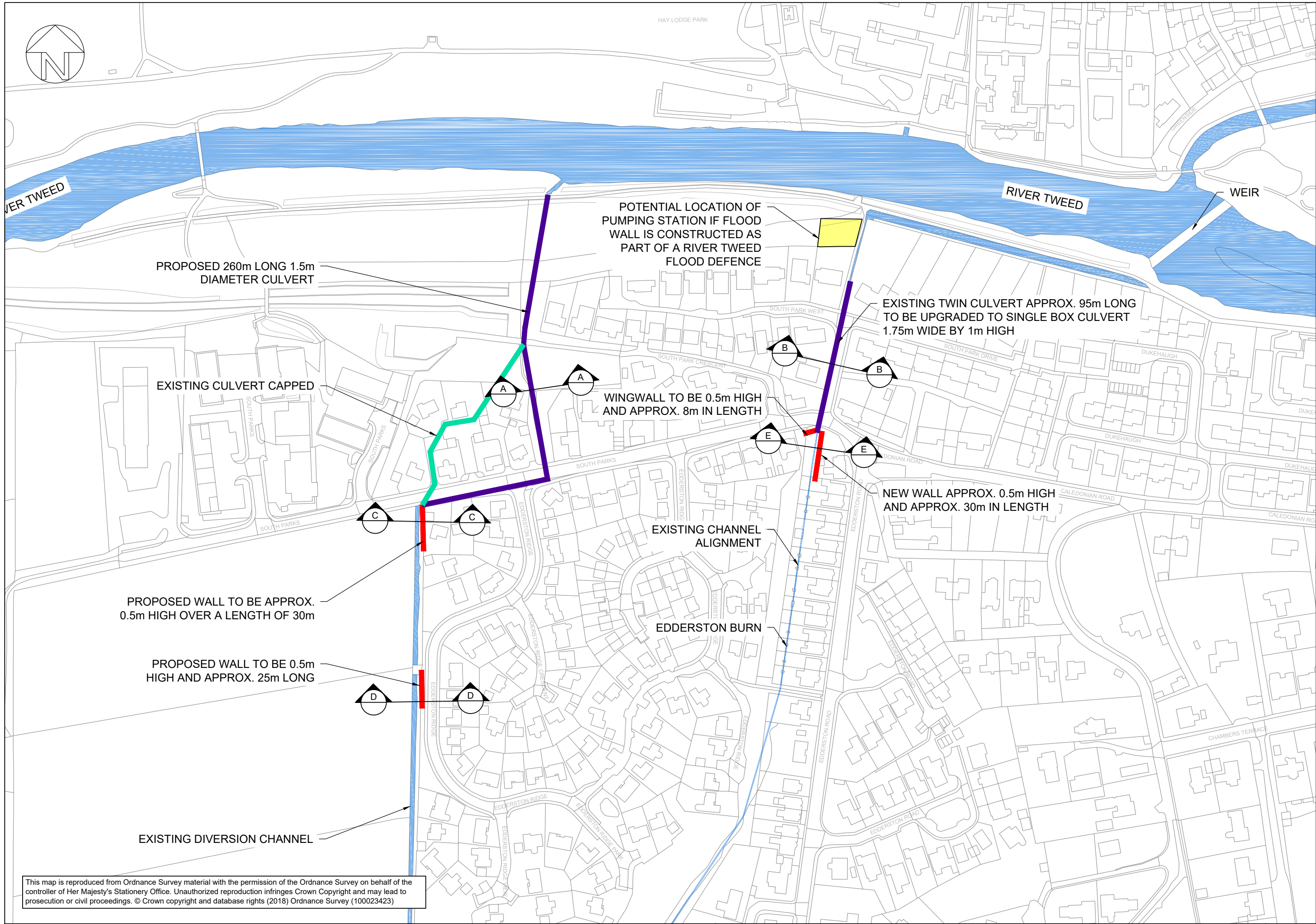
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Heriot Watt University
Edinburgh
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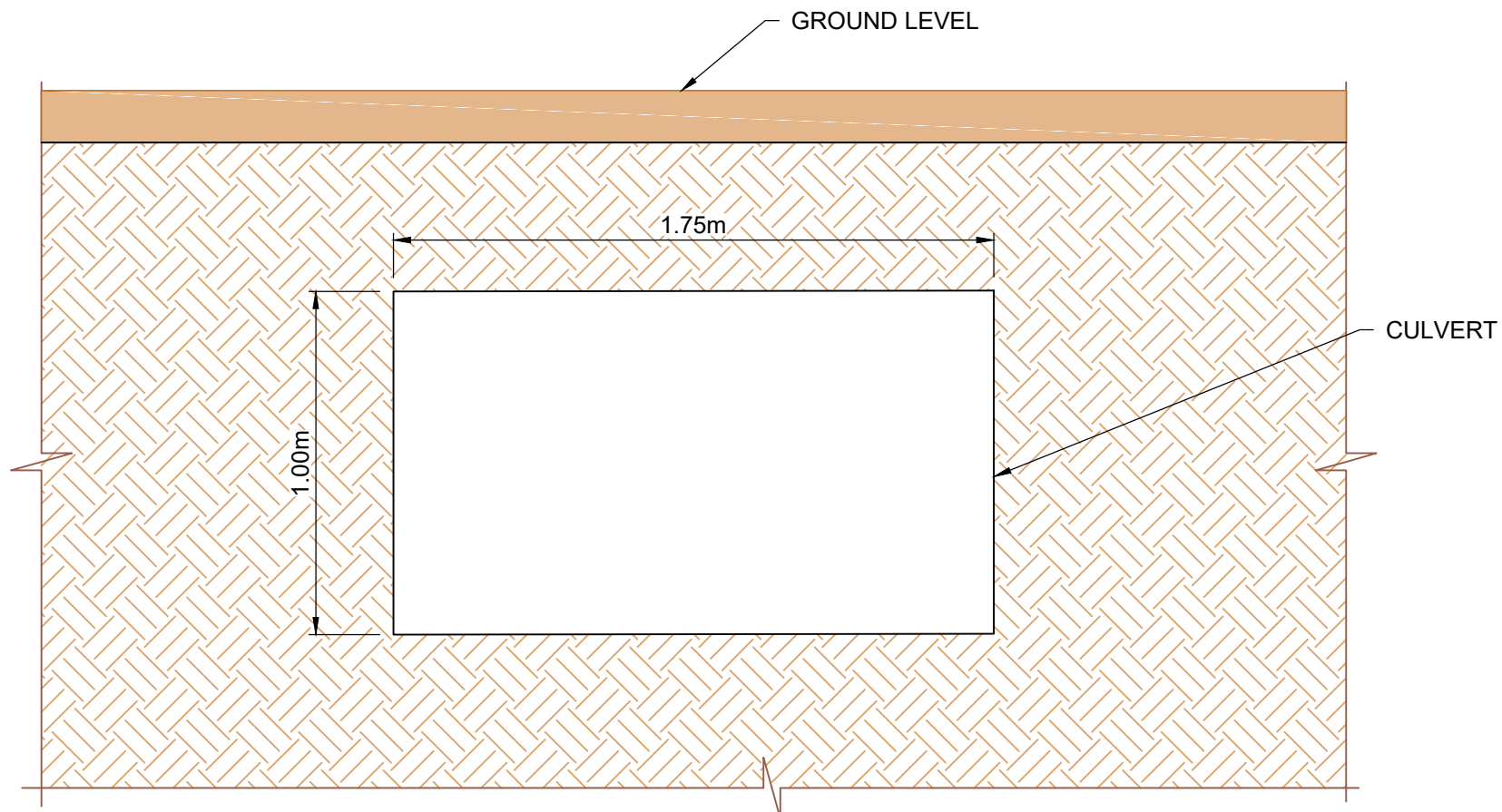
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Title	Peebles Edderston Burn: Option 3B 200 Year Culvert upgrade and channel widening	
Client		

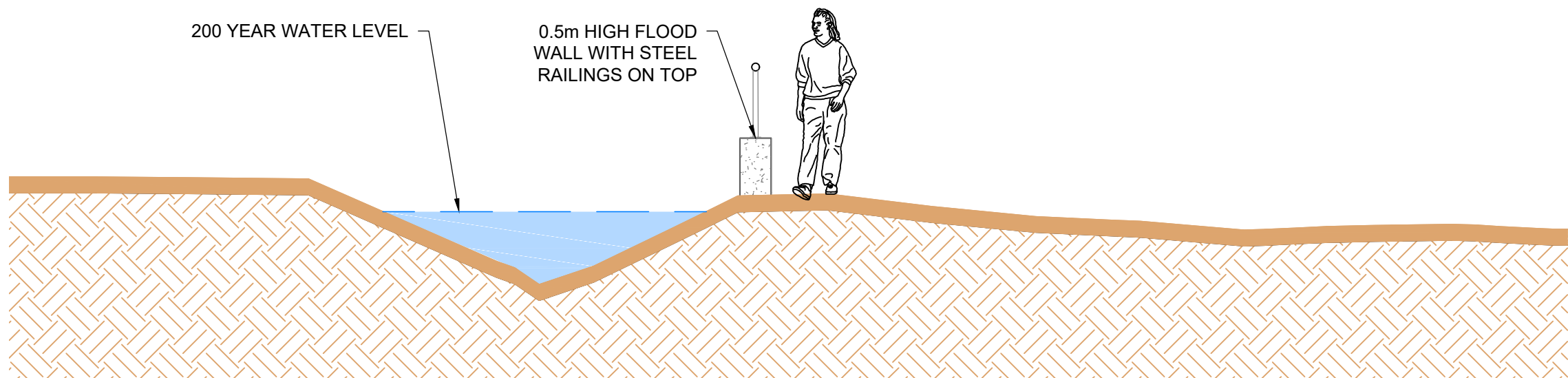
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Drawing Number	AEM-JBAU-PB-EB-IM-C-1305	Revision P02



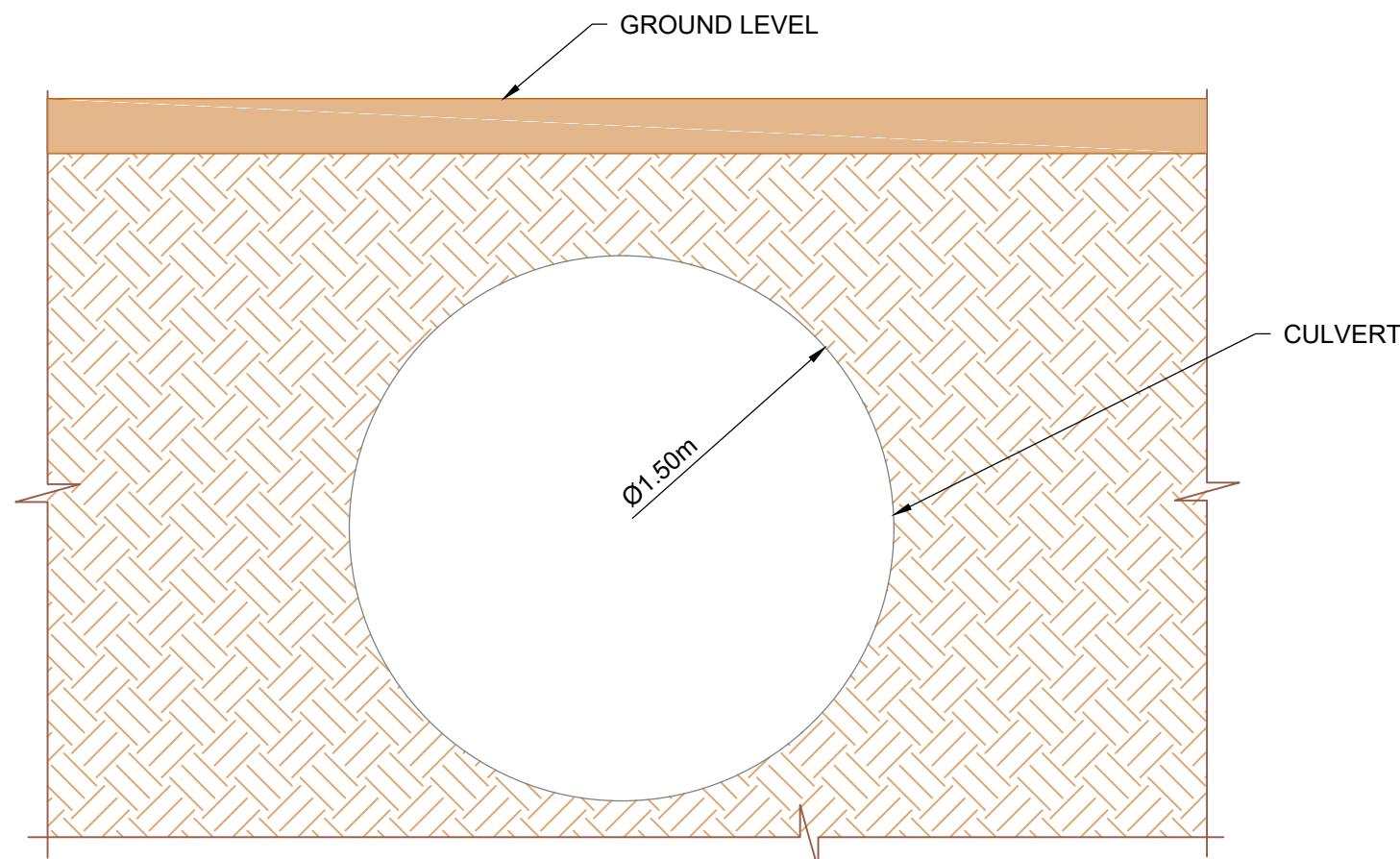
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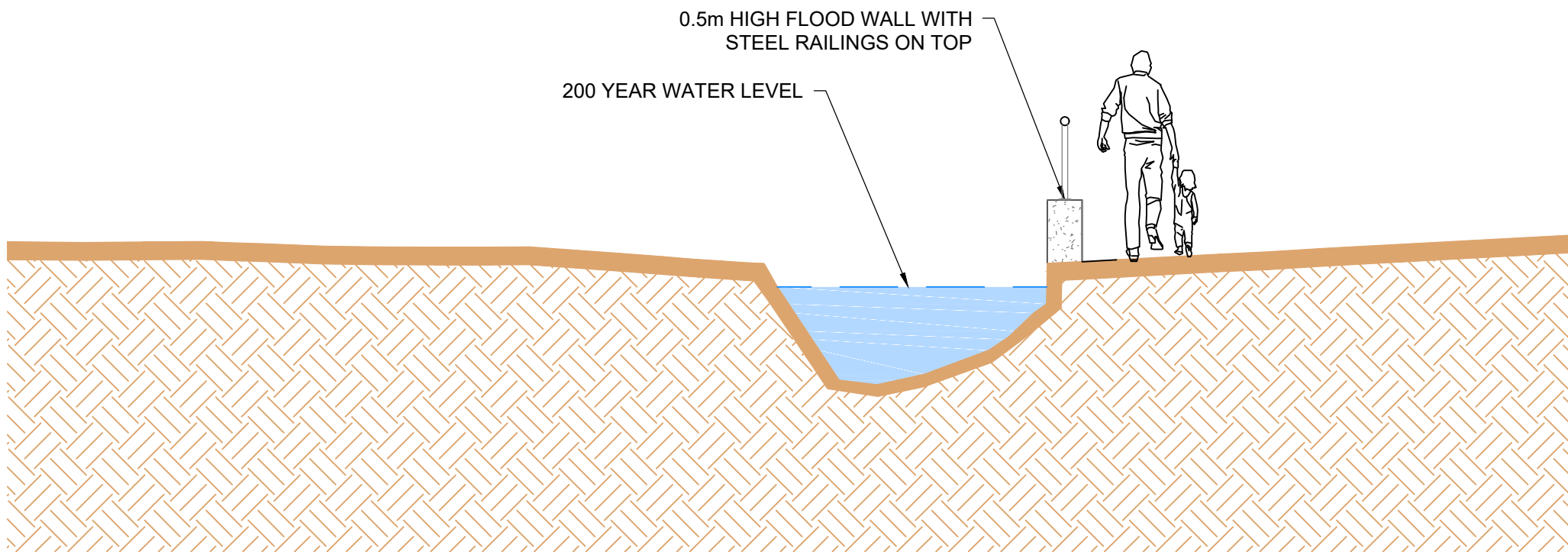
SECTION B-B
EDDERSTON BURN TYPICAL BOX CULVERT SECTION
1:20



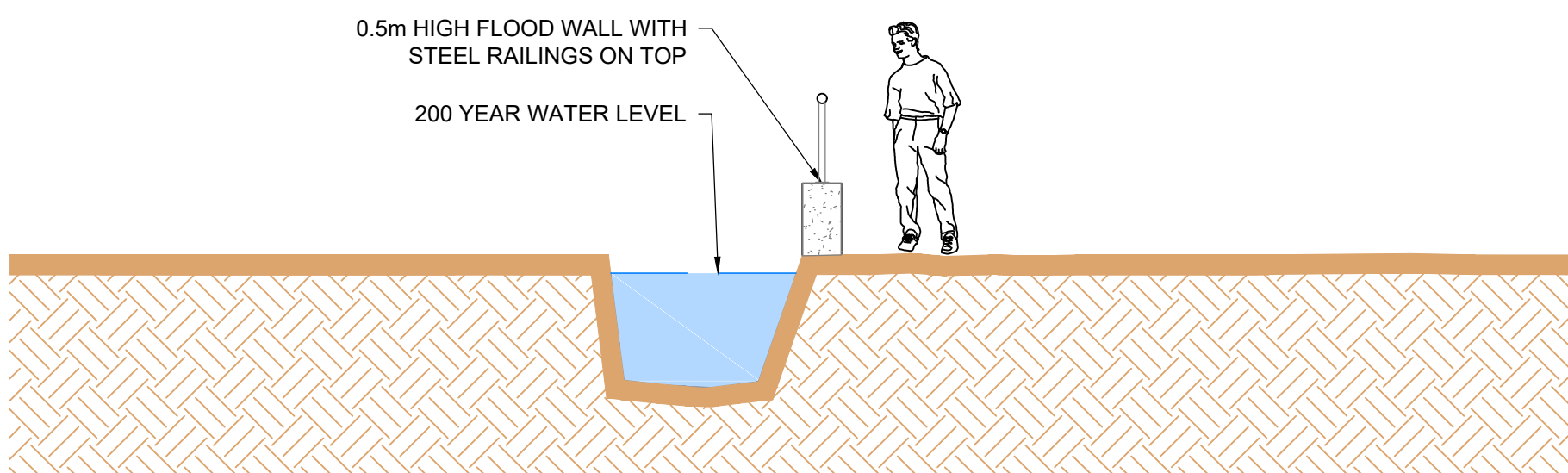
SECTION D-D
1:50



SECTION A-A
DIVERSION CULVERT TYPICAL SECTION
1:20



SECTION C-C
1:50



SECTION E-E
1:50

Peebles

Option 3C: South Parks

200 Year Standard of Protection Culvert Upgrade With Direct Defences

OPTION SUMMARY: Upgrade of diversion channel culvert and Edderston Burn culvert with flood walls upstream to improve inlet conveyance. Culverts have been sized to cater for the 200 year plus climate change event with at least a 300mm barrel clearance to soffit. The diversion channel culvert currently runs under a housing estate, as part of the culvert upgrade the culvert will be laid along a new path as shown in purple.

Note: While section data shows the water level is contained, low points between the sections allow out of bank flooding in the absence of a wall.

- LEGEND
- EXISTING GROUND
 - 200 YEAR WATER LEVEL
 - NEW CULVERT
 - ABANDONED CULVERT
 - 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

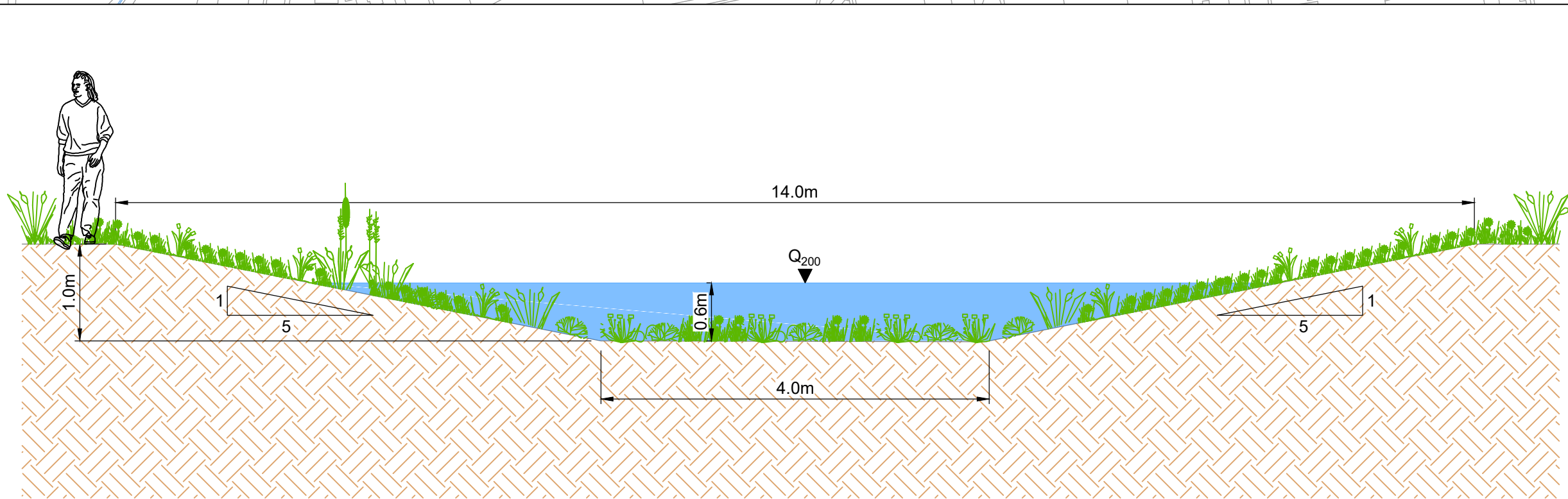
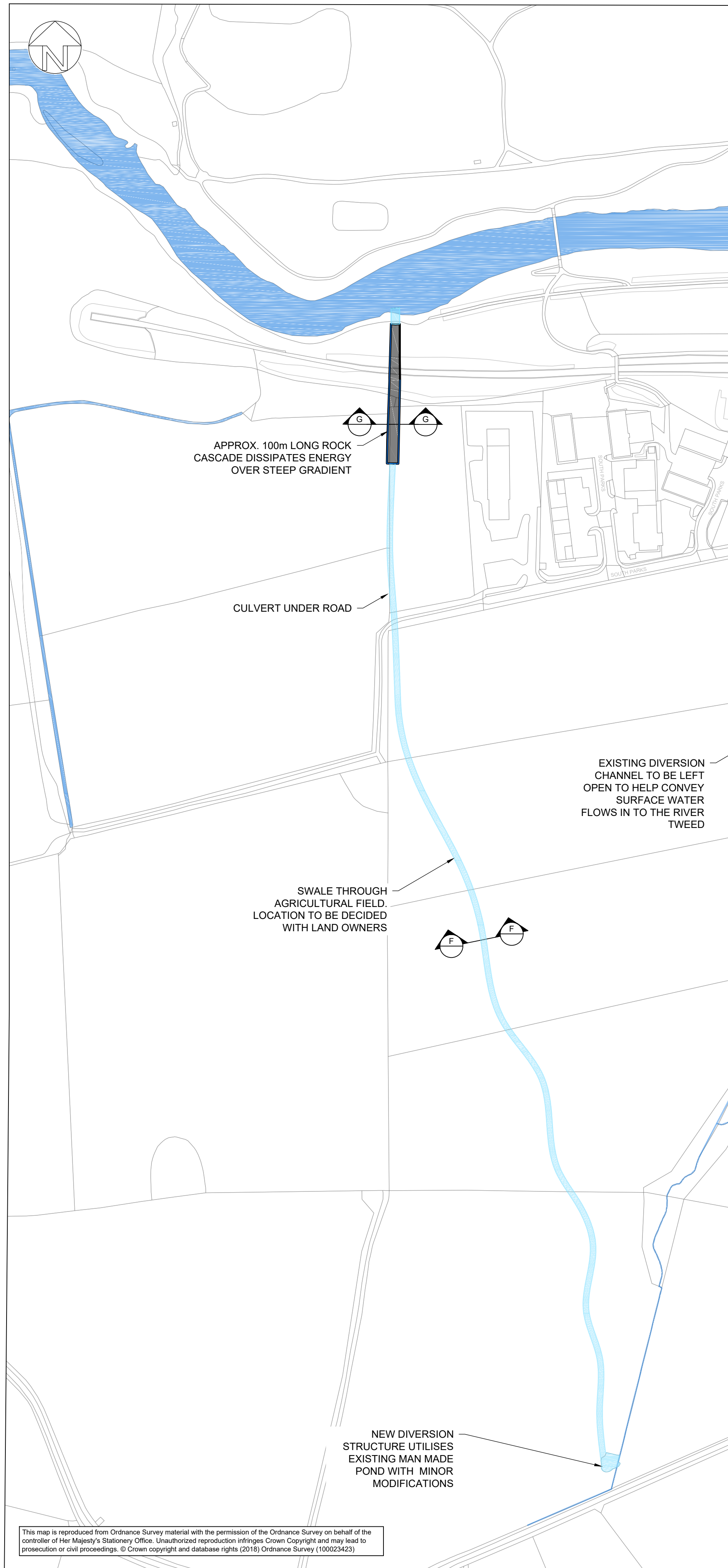
JBA
consulting

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
+44 (0)131 3192940
+44 (0)845 8627772
info@jbaconsulting.com

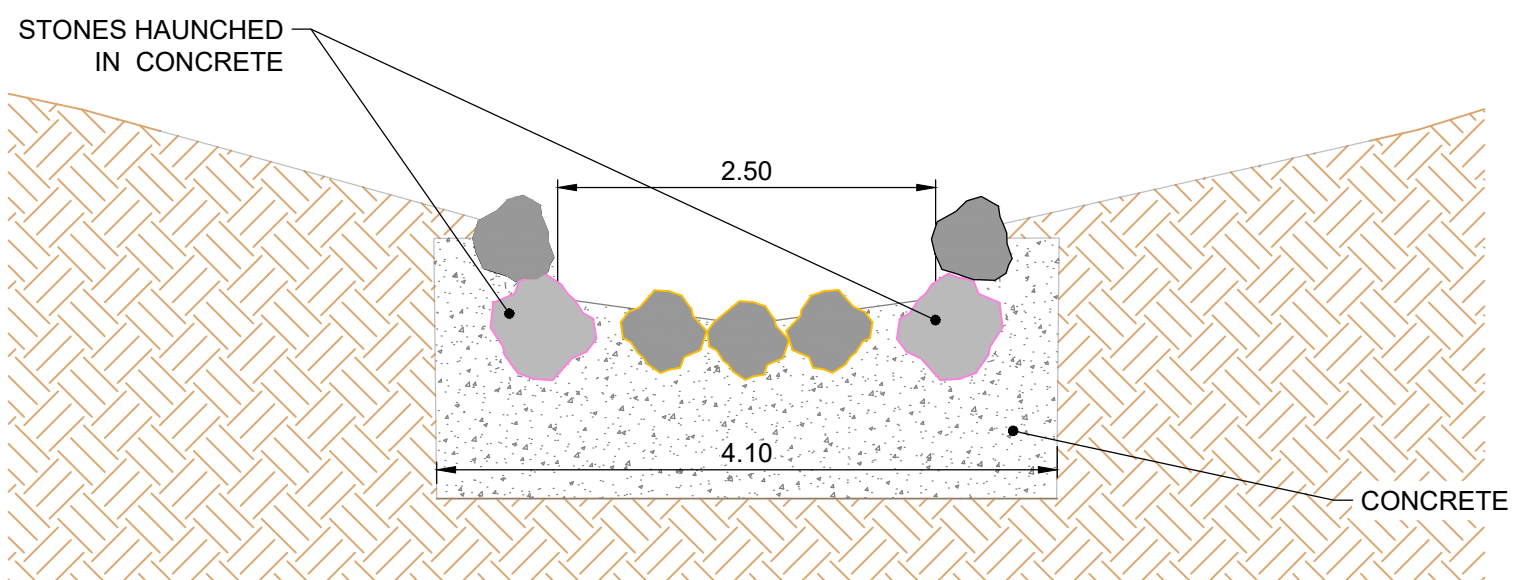
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Project		Borders Flood Studies	
Title		Peebles Edderston Burn: Option 3C 200 Year SoP Direct defences with culvert upgrade for	
Client		M M MOTT MACDONALD 	
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Project Number:		2017s5526	
Drawing Number		AEM-JBAU-PB-EB-IM-C-1306	
		Revision	
		P03	

Peebles
Option 4:
200 Year Standard of
Protection Bypass channel
on Western Tributary



SECTION F-F: TYPICAL CROSS SECTION THROUGH PROPOSED BYPASS CHANNEL
1:50



SECTION G-G: TYPICAL SECTION THROUGH ROCK CASCADE
1:50

OPTION SUMMARY. A bypass channel will convey flows from the Western tributary of the Edderston Burn directly to the River Tweed. It will be composed of a new diversion structure, swale and rock cascade. The swale will be 14m wide and 1m deep and cut into the side of the hill. This option shall only catch flow from the western tributary. This option eliminates all flooding along the Diversion Channel and significantly reduces the out of bank flooding on the Edderston Burn. Slight channel deepening or Natural Flood Management on the Edderston Burn may be enough to eliminate flooding at the 200 year event otherwise walls are needed at Edderston Burn culvert inlet.

LEGEND

- EXISTING GROUND
- EXISTING WATERCOURSE
- NEW OPEN CHANNEL

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

JBA
consulting

Unit 2.1
Quantum Court
Research Avenue South
Heriot Watt University
Edinburgh
EH14 4AP
United Kingdom
www.jbaconsulting.com
t +44 (0)131 3192940
f +44 (0)845 8627772
e info@jbaconsulting.com

Offices at Colshill, Doncaster, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle upon Tyne, Newport, Peterborough, Saltair, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

Project	Borders Flood Studies				
Title	Peebles Edderston Burn: Option 4 (200 Year) Bypass Channel for				
Client					

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Project Number:		2017s5526	
Drawing Number		Revision	
AEM-JBAU-PB-EB-IM-C-1402		P02	

Preferred Option for Edderston Burn

Summary of short listed options (Page 1 of 2)

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 (PLP) (0.5% AP - 200 year)	38	No impact	Natural Flood Management Measures have been identified and, subject to further investigation, could be incorporated within the scheme to provide additional benefits.	Intrusive into people's homes, will require reinstallation every 25 years. Some flood damages are associated with each flood event, as well as clean up cost. Roads and gardens are not protected.	All bar one property could be protected by PLP. A single property will experience flood depths in excess of what PLP can provide. Installing PLP to an additional three properties will protect properties up to the 200 year plus climate change event.	Option should be presented to public for comment. Signage relating to flooding and sand bag stores and work with South Parks residents alongside Resilient Communities programme.	Second highest benefit cost ratio of defended options. Benefit cost ratio (BCR) 3.1	None
Online Storage (0.5% AP - 200 year)	39	Implications for RBMP. Some impediment to movement of sediment and fauna but could be designed to minimise this.	Natural Flood Management Measures have been identified and, subject to further investigation, could be incorporated within the scheme to provide additional benefits. Further modelling and discussions with landowners are required to determine the most appropriate measures and locations for these works and the benefits they may provide. Surface water from the south and south west will be caught and contained by the watercourses Natural	Wall heights above bank are approximately 1.3m at street level so should not be too much of a visual impact. It requires land from peoples gardens.	Wall height would increase too much to accommodate 200 year climate change flows, but it may be possible to excavate into the hill, continue to utilise the existing diversion channel or increase the pass forward rate and protect those properties left exposed to risk as a result of the higher pass forward flow.	Installation of a flow gauge on the Edderston Burn for flood warning, calibration and flow estimates.	Highest benefit cost ratio of defended options. BCR 3.3	Could be designed to hold some water to increase the amenity value, additional storage capacity would need to be found elsewhere.
Culvert Upgrade – Channel Deepening (0.5% AP - 200 year)	39	Temporary loss of habitat during construction. Shall be undertaken at appropriate time of year. Culverts can be designed to hold a layer of sediment to simulate a more natural river bed and allow for easier movement of river fauna		Land take and bridge removal required. Replacement of culverts shall be disruptive to the community for access and noise.	Channel could be made larger now to accommodate further increase in flows. Culverts already designed for the 200 year plus climate change flow.		BCR 1.6	None

Negative

Neutral

Positive

Preferred Option for Edderston Burn

Summary of short listed options (Page 2 of 2)

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
Culvert Upgrade – Channel Widening (0.5% AP - 200 year)	39	Disruption caused to existing channel however new more naturalised channel will be created. Culverts can be designed to hold a layer of sediment to simulate a more natural river bed and allow for easier movement of river fauna	Flood Management Measures have been identified and, subject to further investigation, could be incorporated within the scheme to provide additional benefits. Further modelling and discussions with landowners are required to determine the most appropriate measures and locations for these works and the benefits they may provide. Surface water from the south and south west will be caught and contained by the watercourses			Option should be presented to public for comment. Signage relating to flooding and sand bag stores and work with South Parks residents alongside Resilient Communities programme.	BCR 0.9	
Culvert Upgrade – Direct defences (0.5% AP - 200 year))	39	Minimal in-channel works.		Walls are low so visual impact will be minimal. Replacement of culverts shall be disruptive to the community for access and noise.	Walls could be built higher now with only a small increase in height. Culverts already designed for the 200 year plus climate change flow.	Installation of a flow gauge on the Edderston Burn for flood warning, calibration and flow estimates.	BCR 1.4	
Secondary Diversion Channel	37	New naturalised river channel and rock pools created.		Land purchase agreement required. The land is steep on approach to the River Tweed so a stepped rock pools will be required. The majority of construction work will be carried out outwith the urban area of South Parks so there should be minimal disturbance to residence. .	Channel widening is an easy way to create additional capacity in the future or could be built larger now, however, there is no reduction on flows from the eastern culvert which will cause problems with climate change applied to the flows.		BCR 2.7	Possible scope to improve biodiversity and amenity value through careful design of diversion channel.
Diversion Channel and Online Storage hybrid	39	Some increase in river pressure under RBMP classification as reservoir will act as impendment sediment and fauna.			Can easily be designed to accommodate future flood flows.		Between 1.4 and 2.2	Could be designed to hold some water to increase the amenity value.

Negative Neutral Positive

Preferred Options and recommendations

The preferred option for South Parks is a hybrid of the bypass channel and the online storage option. This could be implemented alongside natural flood management.

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 were confirmed with a site visit at sample locations. The NFM measures which have been proposed for the Edderston Burn catchment include:

- Blockage of highly straightened field drainage in the upper catchment.
- Wetland creation in the upper catchment.
- Increase riparian vegetation above South Parks with 5m buffer strips.

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

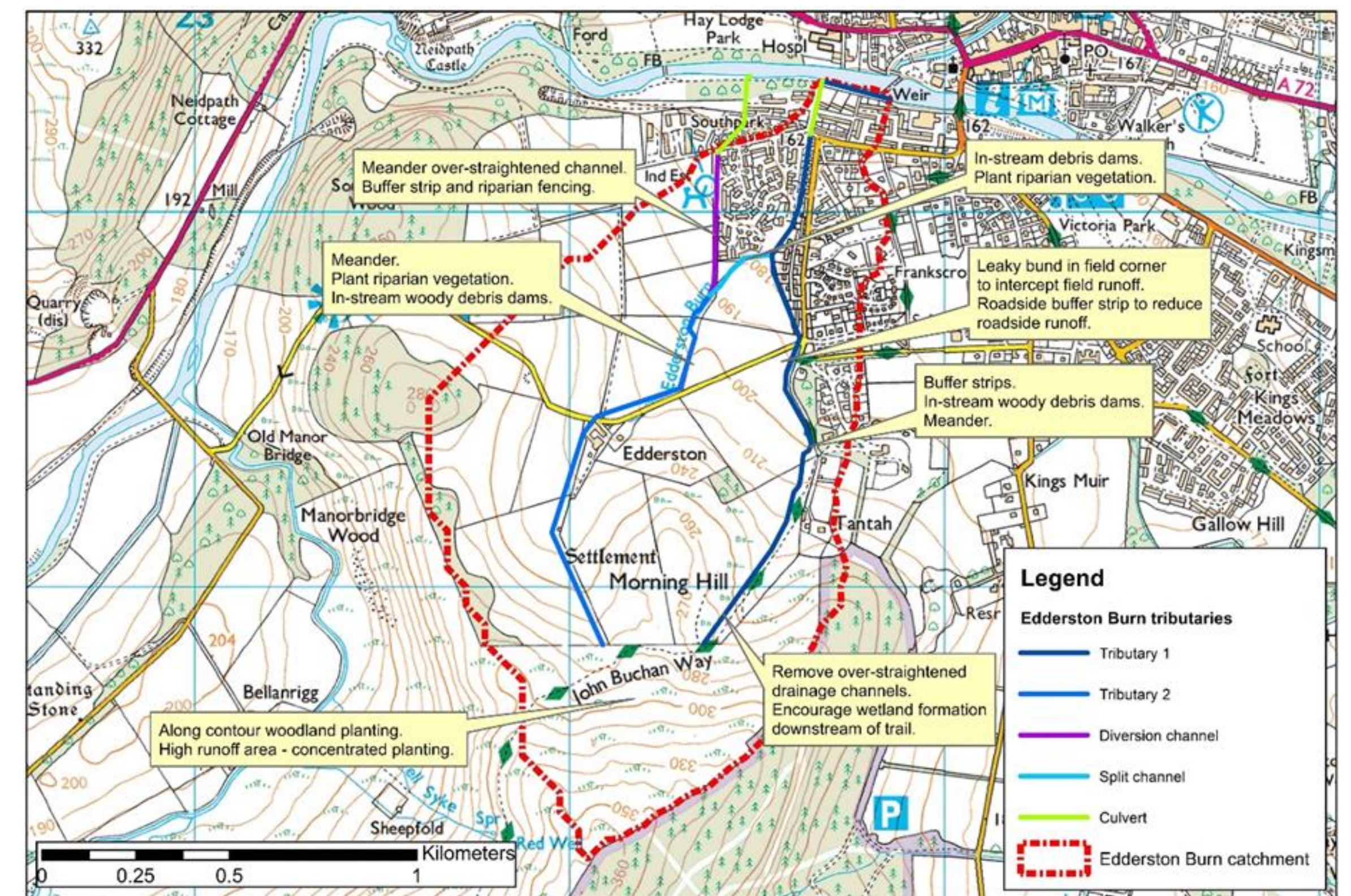


Typical example of in-channel debris barrier



Typical example of riparian planting

Location and type of measures suggested for the Edderston Burn catchment

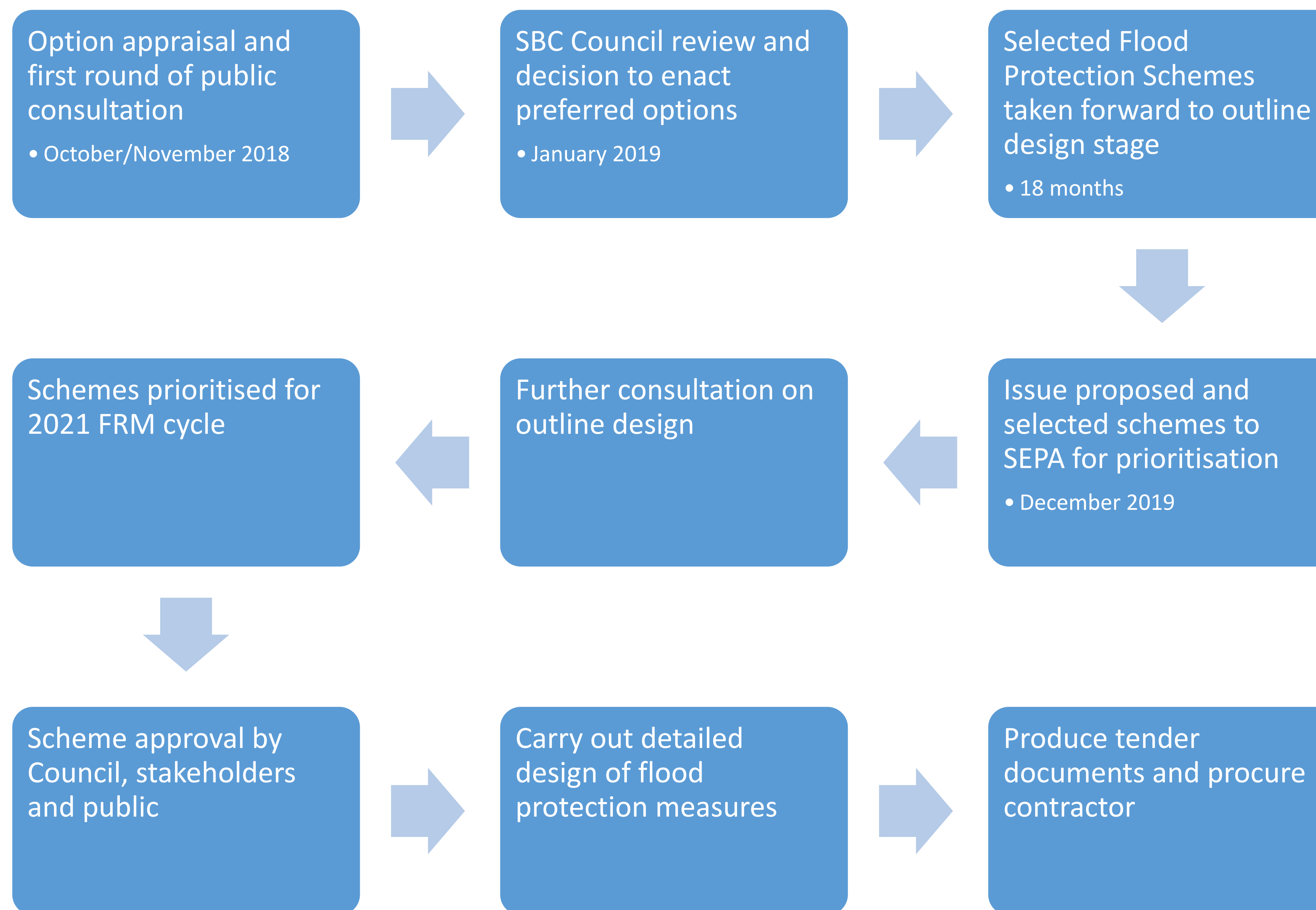


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Typical example of a wetland creation

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



These posters and further information are available at: www.bordersfloodstudies.com