1 Insch Flood Study

How is flood risk managed by the Aberdeenshire 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 and the Local Flood Risk Management Plan for the North East Local Plan District developed by Aberdeenshire Council.

Study objectives

1. Develop a better understanding of flood risk in the community

- Create, update or develop a new flood model for flood mapping.
- Determine existing flood risk.

2. Engage partners and stakeholders

- Present the study to SEPA, Scottish Water and the Council.
- Present the study and the preferred option to the local community – the purpose of today's exhibition.

3. Develop recommendations for management of flood risk

- Appraise options to manage flood risk (consider the pros, cons and economic viability of the proposed options).
- Recommend options for the future management of flood risk.

4. Select a preferred approach that the Council can take forward

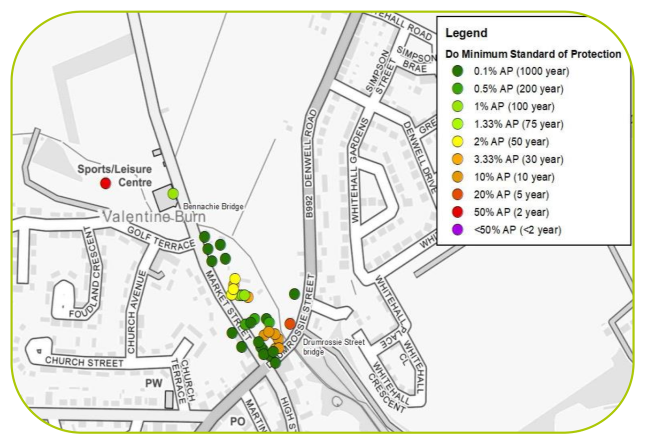
- SEPA (on behalf of Scottish Government) will prioritise nationally where funding should be allocated.
- The reports and findings of our study will inform this process. Preferred option from this report must be submitted by 31st Dec 2019.

What has been done so far?

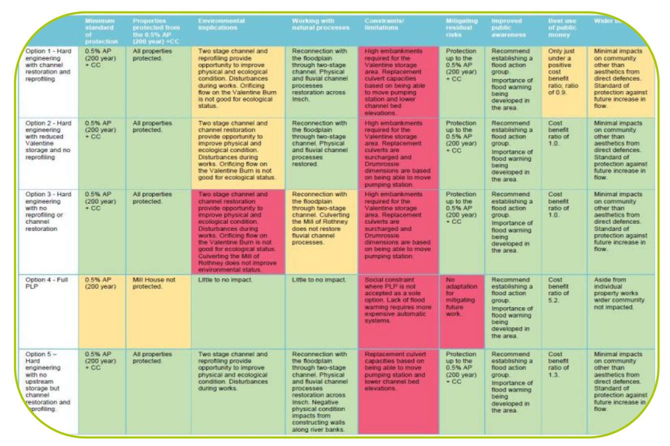
Flood review

River Surveys

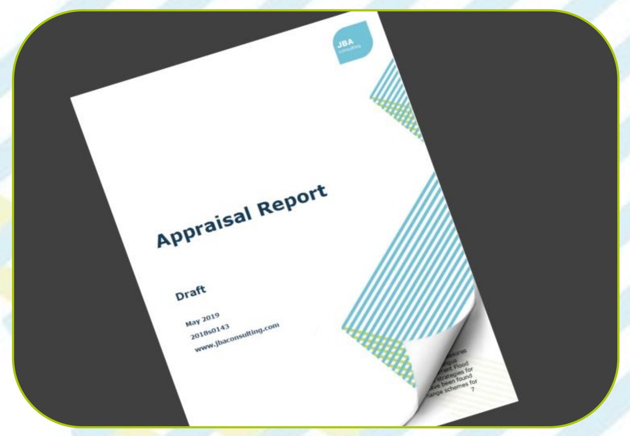
Modelling & mapping



Properties at risk and current standard of protection assessed



Options appraisal



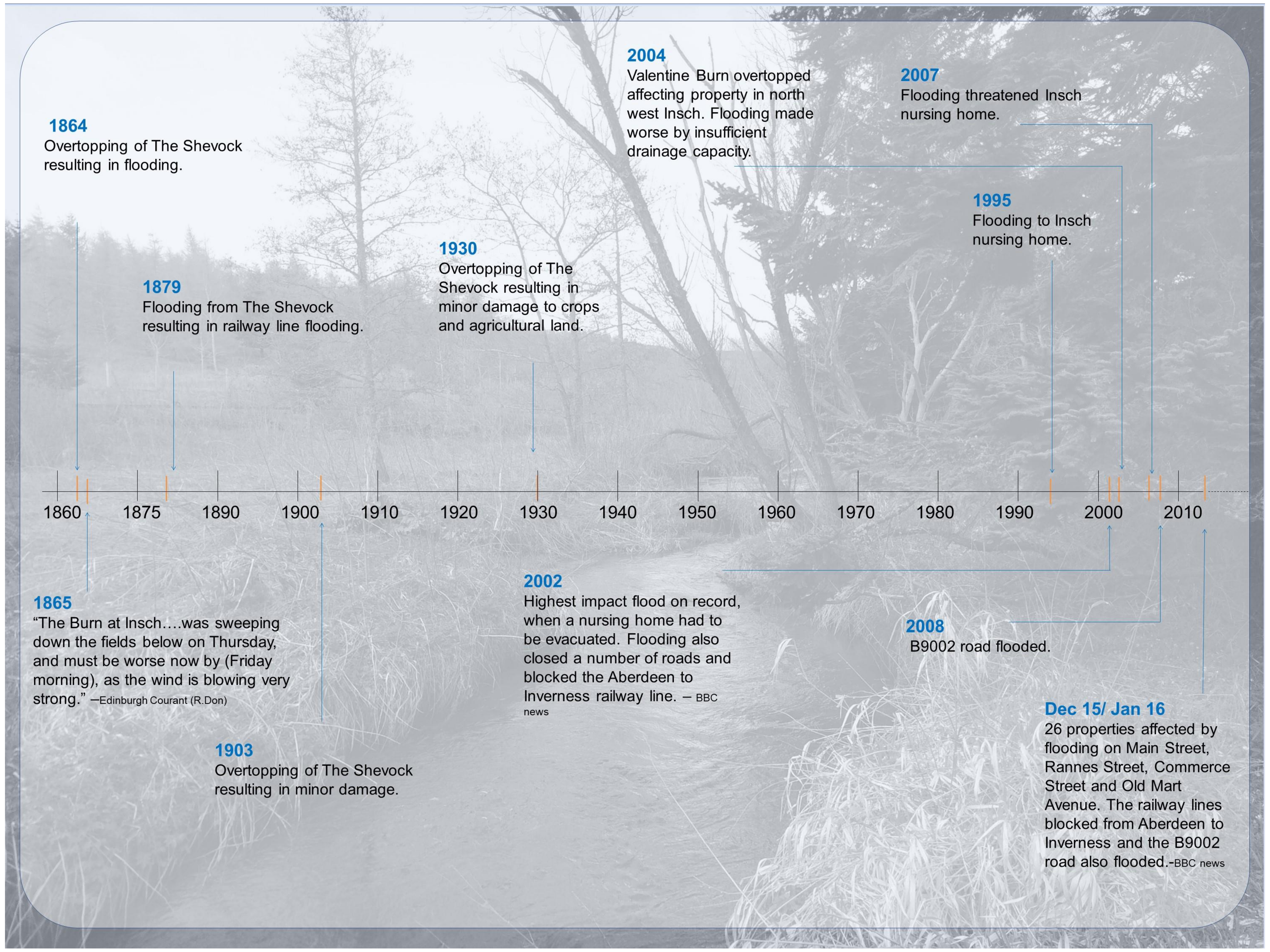
Reporting

What happens next?

Moving beyond this point is dependent on having government funding approved. At present there is no formal commitment by Scottish Government or Aberdeenshire Council for funding.

Public consultation (Today) → Council review flood study and decides strategy, Area Committee review → Schemes submitted to SEPA for prioritisation in national strategy by 31st Dec 2019 → More detailed design and consultation (e.g. site investigations) → Scheme construction

2 Insch Flood History



The goal

Protect against a 200 year plus climate change flood event. *Climate change is predicted to increase the scale of floods in Aberdeenshire by 24%.*

The long-list of options considered for appraisal to go to short list if deemed viable

Engineering solutions:

- Storage (engineering)
- Conveyance (channel modification, diversion, realignment)
- Structure modification (enlarge culvert/bridge, trash screens)
- Control structures (weir, pumping station)
- Direct defences (wall, embankment, adaptable wall)
- Property Level Protection PLP (resistance and resilience measures)
- Sediment management (online/offline pond)

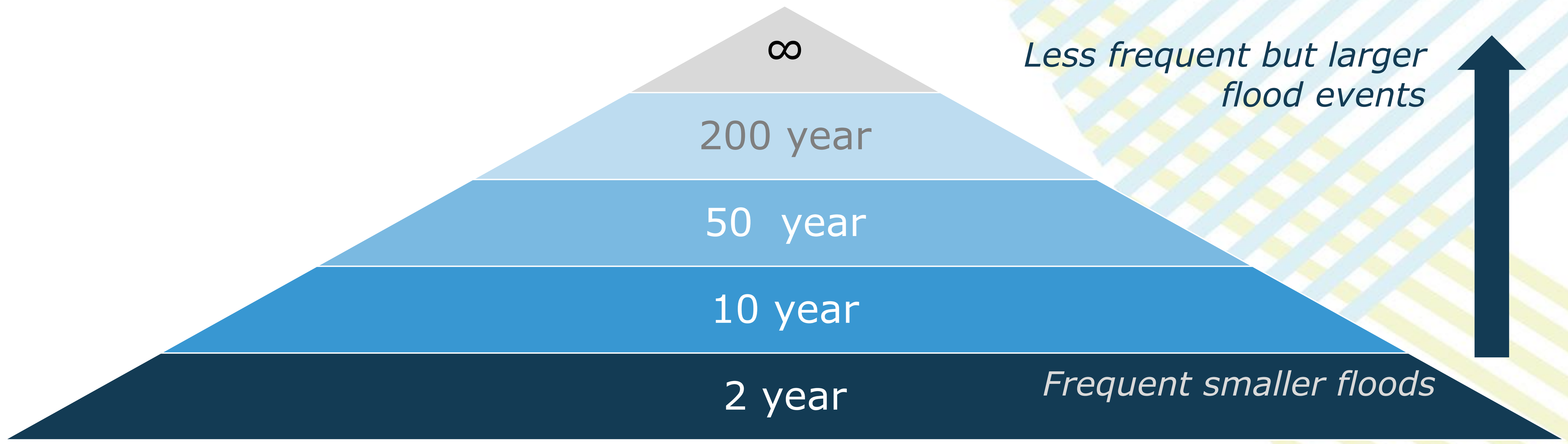
Non-structural options:

- Natural Flood Management NFM (runoff, sediment, floodplain)
- Watercourse maintenance
- Flood forecasting and warning
- Emergency planning & Local planning policies
- Self help

Non-structural options are expected to be carried forward alongside the engineering options.

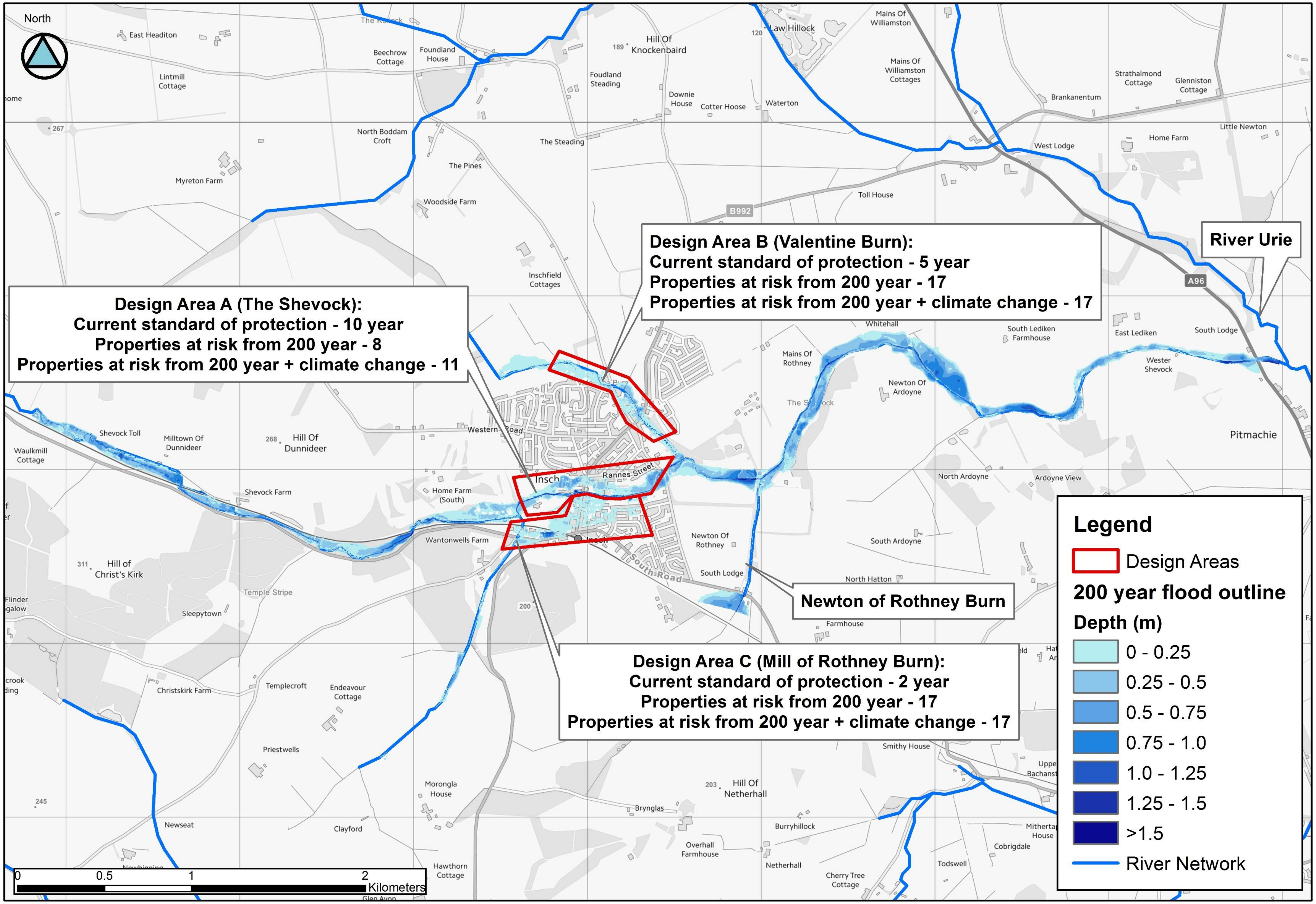
Return periods and annual probabilities

- When a river floods the severity of the flood is referred to as a '1 in *x* year' flood or as having a certain percentage chance of occurring in any one year.
- For example, a 1 in 200 year flood event is simply a flood of a size large enough that it has a probability of occurring once every 200 years, i.e. it has a 0.5% chance of occurring in any one year.
- Any given flood, such as the 1 in 200 year event, will not necessarily occur at all in a 200 year period, but a flood of this size could equally occur tomorrow and again next year - this is just statistically unlikely.



Flood return periods

3 Insch Watercourses



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Insch is at flood risk from The Shevock, Valentine Burn, Mill of Rothney Burn and Newton of Rothney Burn. Each watercourse has its own mechanism of flood risk. To assess flood risk three areas have been identified.

The model produced flood maps which help us to work out where the greatest flood risk lies and how water flows out of the burns and into properties.

These maps allowed us to plan where best to place flood defences or other solutions to reduce the flooding.

The following posters show the mitigation measures which have been considered within each design area. The best combination of options from each area is then presented and has been compared against social, environmental and economic benefits. This results in a preferred option, shown on poster 10.

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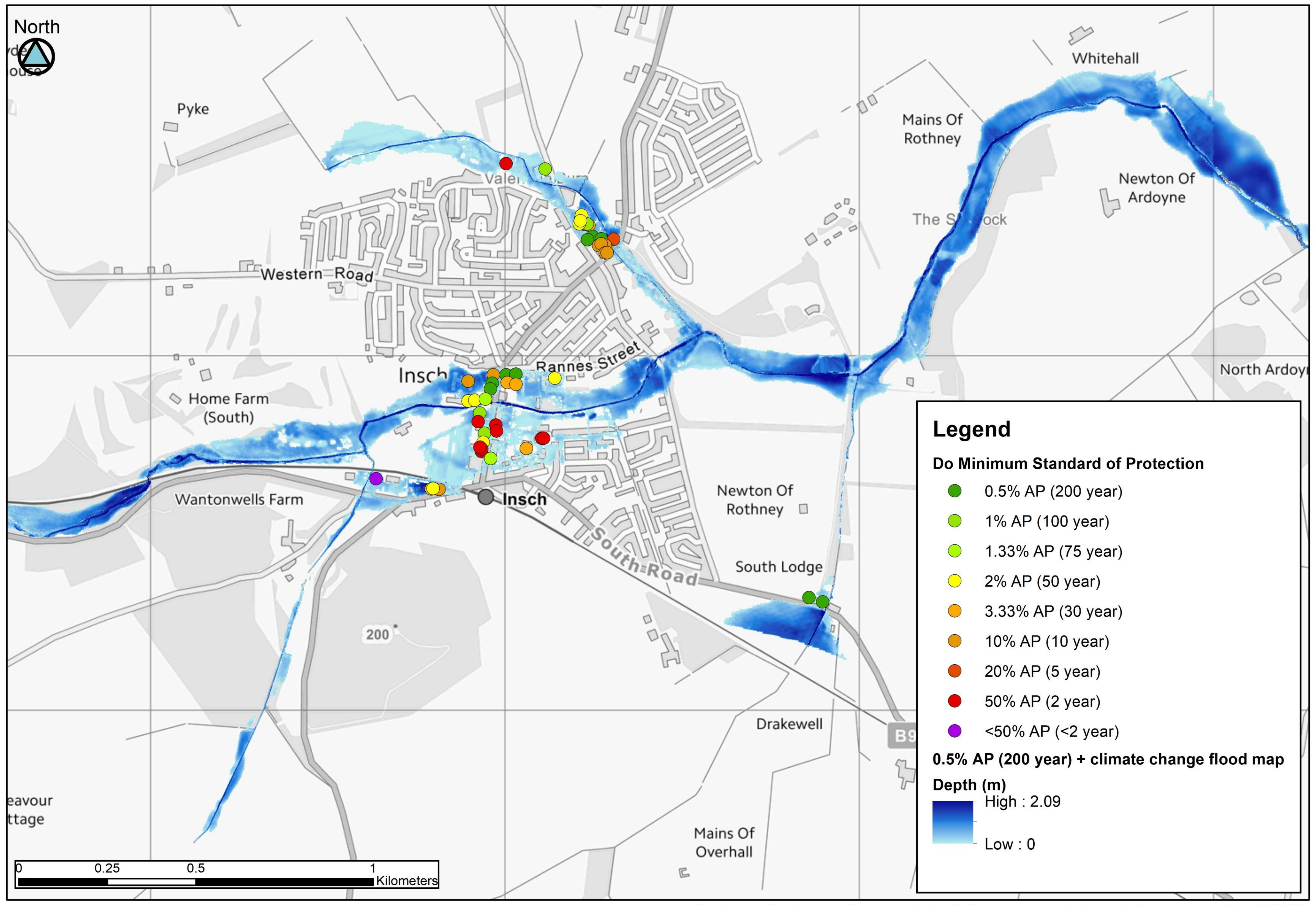
4 Coming up with the proposals

Dougall Baillie Associates DBA civil. structural. transportation. water management

JBA consulting

Standard of Protection - 200 year plus climate change flood map



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The "standard of protection" map shows the maximum flood return period that each property is currently protected against. The properties shown would be expected to flood during larger floods. E.g. if a property is shown to have a Standard of Protection of 100 years, it would be expected to flood during a 200 year flood event.

Prioritising the proposals

Option	Minimum standard of protection	Properties protected from the 0.5% AP (200 year) +CC	Environmental implications	Working with natural processes	Constraints/ limitations	Mitigating residual risks	Improved public awareness	Best use of public money	Wider benefits
Option 1 - Hard engineering with channel restoration and reprofiling	0.5% AP (200 year) + CC	All properties protected.	Two stage channel and reprofiling provide opportunity to improve physical and ecological condition. Disturbances during works. Orificing flow on the Valentine Burn is not good for ecological status.	Reconnection with the floodplain through two-stage channel. Physical and fluvial channel processes restoration across Insch.	High embankments required for the Valentine storage area. Replacement culvert capacities based on being able to move pumping station and lower channel bed elevations.	Protection up to the 0.5% AP (200 year) + CC	Recommend establishing a flood action group. Importance of flood warning being developed in the area.	Only just under a positive cost benefit ratio; ratio of 0.87.	Minimal impacts on community other than aesthetics from direct defences. Standard of protection against future increase in flow.
Option 2 - Hard engineering with reduced Valentine storage and no reprofiling	0.5% AP (200 year) + CC	All properties protected.	Two stage channel and channel restoration provide opportunity to improve physical and ecological condition. Disturbances during works. Orificing flow on the Valentine Burn is not good for ecological status.	Reconnection with the floodplain through two-stage channel. Physical and fluvial channel processes restored.	High embankments required for the Valentine storage area. Replacement culverts are surcharged and Drumrossie dimensions are based on being able to move pumping station.	Protection up to the 0.5% AP (200 year) + CC	Recommend establishing a flood action group. Importance of flood warning being developed in the area.	Cost benefit ratio of 1.01.	Minimal impacts on community other than aesthetics from direct defences. Standard of protection against future increase in flow.
Option 3 - Hard engineering with no reprofiling or channel restoration	0.5% AP (200 year) + CC	All properties protected.	Two stage channel and channel restoration provide opportunity to improve physical and ecological condition. Disturbances during works. Orificing flow on the Valentine Burn is not good for ecological status. Culverting the Mill of Rothney does not improve environmental status.	Reconnection with the floodplain through two-stage channel. Culverting the Mill of Rothney does not restore fluvial channel processes.	High embankments required for the Valentine storage area. Replacement culverts are surcharged and Drumrossie dimensions are based on being able to move pumping station.	Protection up to the 0.5% AP (200 year) + CC	Recommend establishing a flood action group. Importance of flood warning being developed in the area.	Cost benefit ratio of 1.03.	Minimal impacts on community other than aesthetics from direct defences. Standard of protection against future increase in flow.
Option 4 - Full PLP	0.5% AP (200 year)	Mill House not protected.	Little to no impact.	Little to no impact.	Social constraint where PLP is not accepted as a sole option. Lack of flood warning requires more expensive automatic systems.	No adaptation for mitigating future work.	Recommend establishing a flood action group. Importance of flood warning being developed in the area.	Cost benefit ratio of 2.07.	Aside from individual property works wider community not impacted.
Option 5 – Hard engineering with no upstream storage but channel restoration and reprofiling.	0.5% AP (200 year) + CC	All properties protected.	Two stage channel and reprofiling provide opportunity to improve physical and ecological condition. Disturbances during works.	Reconnection with the floodplain through two-stage channel. Physical and fluvial channel processes restoration across Insch. Negative physical condition impacts from constructing walls along river banks.	Replacement culvert capacities based on being able to move pumping station and lower channel bed elevations.	Protection up to the 0.5% AP (200 year) + CC	Recommend establishing a flood action group. Importance of flood warning being developed in the area.	Cost benefit ratio of 1.32.	Minimal impacts on community other than aesthetics from direct defences. Standard of protection against future increase in flow.

Negative — Neutral — Positive

The "prioritising the proposals" table summarises the pros and cons of each shortlisted option. The next few posters show these options in more detail.

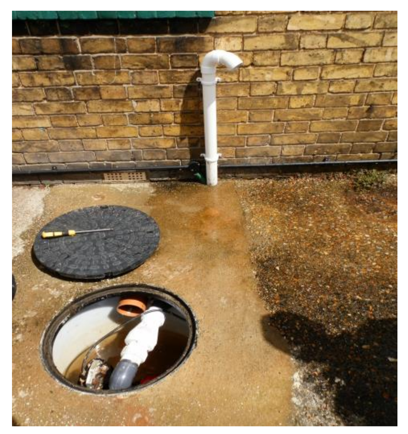
Flood walls

Flood embankments (earth)

Typical examples of direct defences

Riparian buffer strips

Typical example of Natural Flood Management



Typical examples of property level flood resilience

PLP* would involve the installation of products such as waterproof doors, self-sealing airbricks and improved render on the outside of a property. This can only protect a property against water 0.6m (2ft) deep – above this depth the pressure of the water against walls can cause damage.

Some residents may already have manually-installed door guards and air brick covers but we would recommend measures that are constantly in place, such as waterproof doors, so that a property is always protected even if nobody is at home.

*PLP not likely to attract government grant scheme funding

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5 Area A - Options

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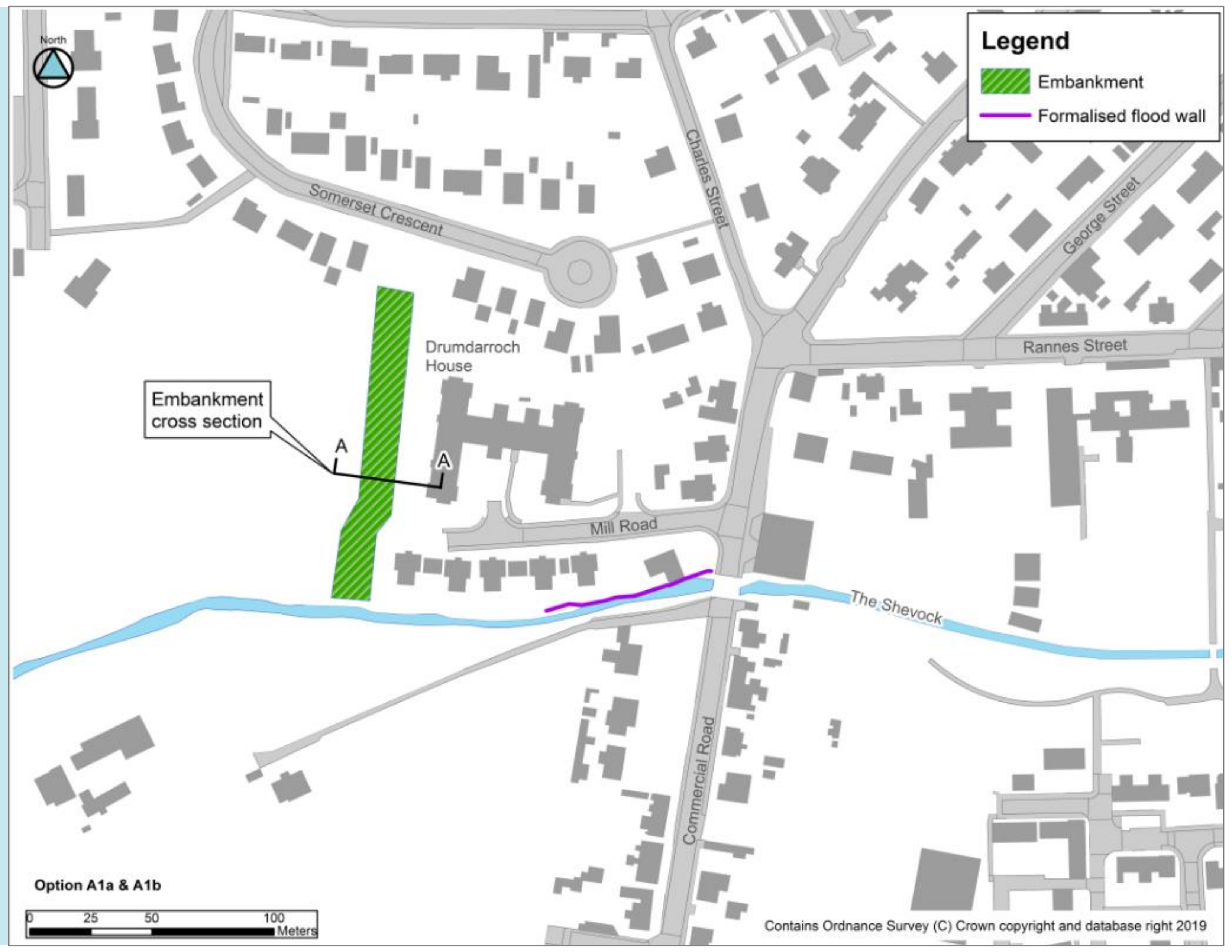
Area A (The Shevock):

- Current standard of protection - **10 year**
- Properties at risk from the 200 year event - **8**
- Properties at risk from the 200 year plus climate change event - **11**

Flood risk from The Shevock

Options A1a & b – Direct Defences

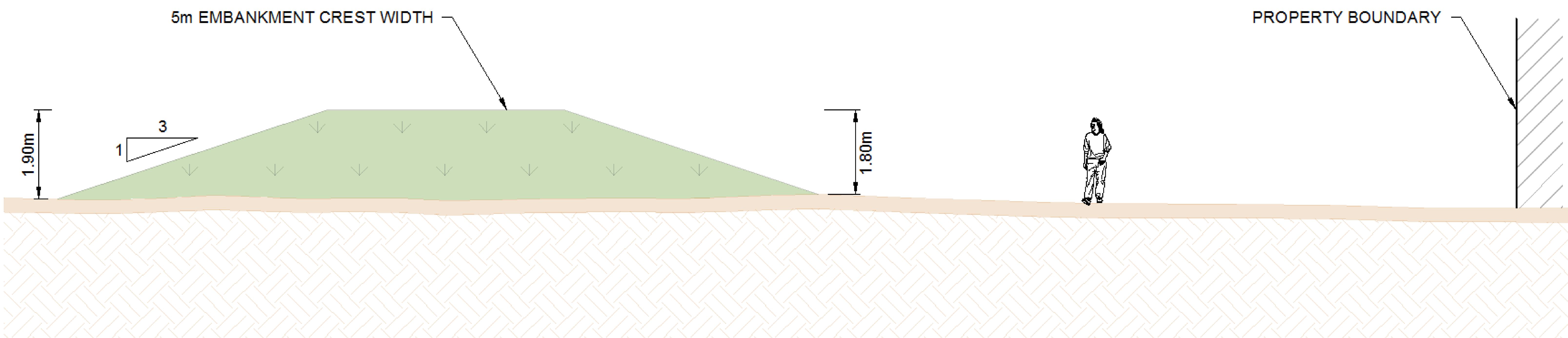


Option A1a - Standard of Protection: 200 year plus climate change

- **Embankment** west of Mill Road and Drumdarroch Residential Home.
- Maximum embankment height 1.75 m, ~15 m wide with gradual slopes.

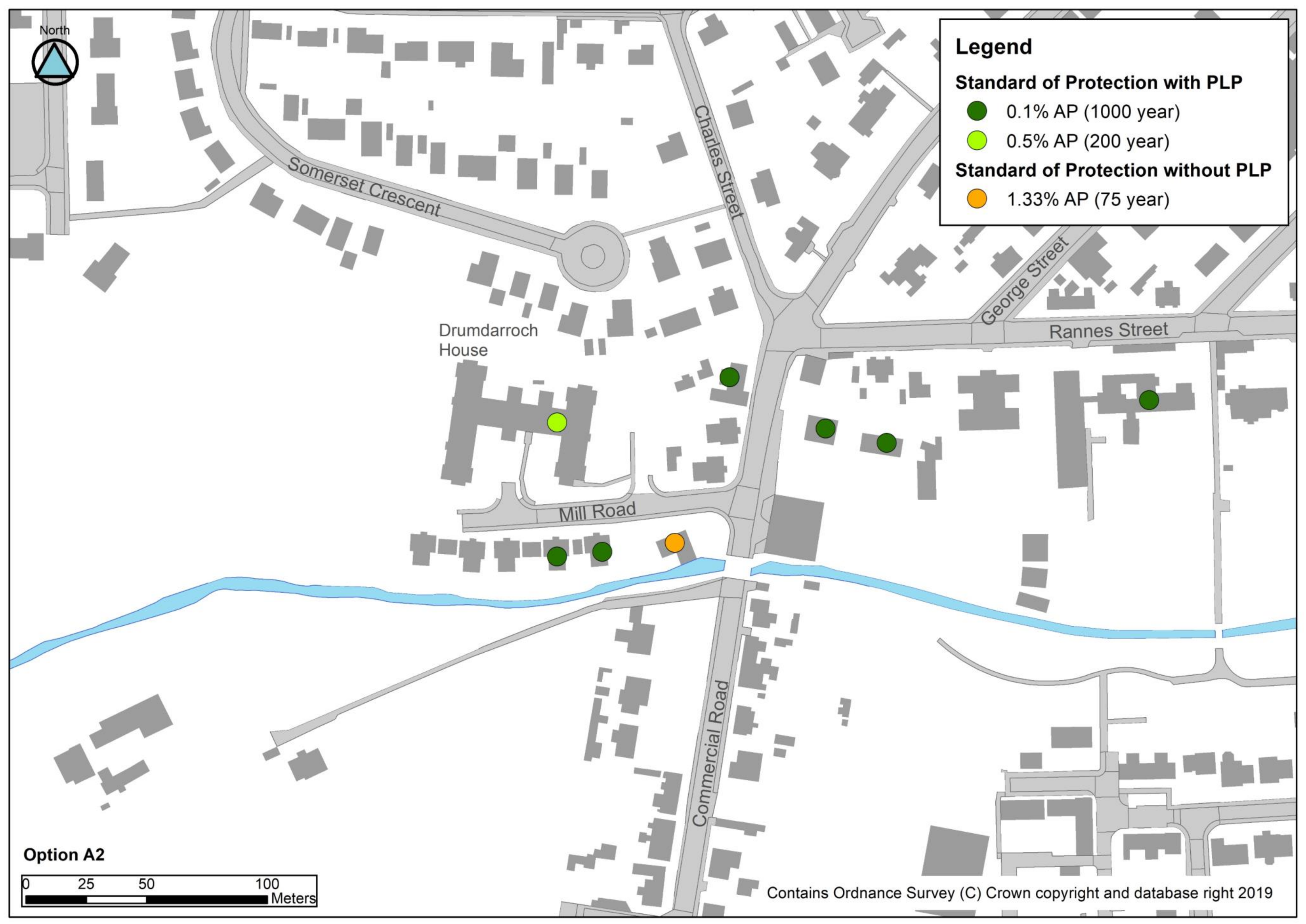
Option A1b - Standard of Protection: 200 year plus climate change

- Same as A1a but the left bank Mill wall is re-constructed as a **formalised flood wall**.
- Maximum wall height 2 m.



Section A-A: Indicative Embankment Cross Section

Option A2 – PLP



Option A2 - Standard of Protection: 200 year

- **Property level protection** (PLP).
- Mill House (in orange) does not flood until the 100 year event. At this point flooding predicted to a depth of over 0.6 m, not suitable for PLP. Therefore it remains with a Standard of Protection of 75 years.

Examples of PLP

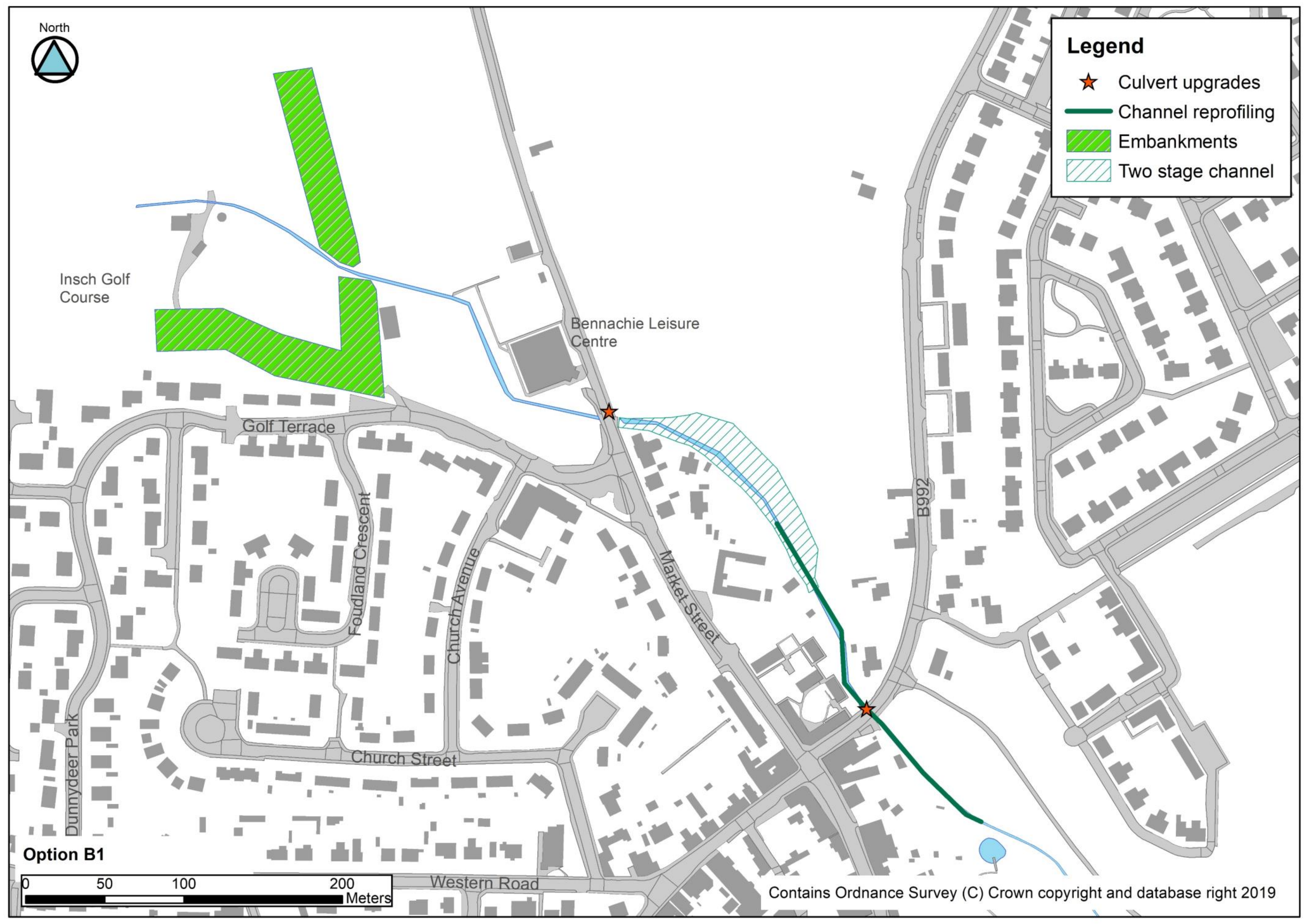
6 Area B – Options

Area B (Valentine Burn):

- Current standard of protection - **5 year**
- Properties at risk from the 200 year event - **17**
- Properties at risk from the 200 year plus climate change event - **17**

Flood risk from the Valentine Burn

Option B1 – Storage & Direct Defences

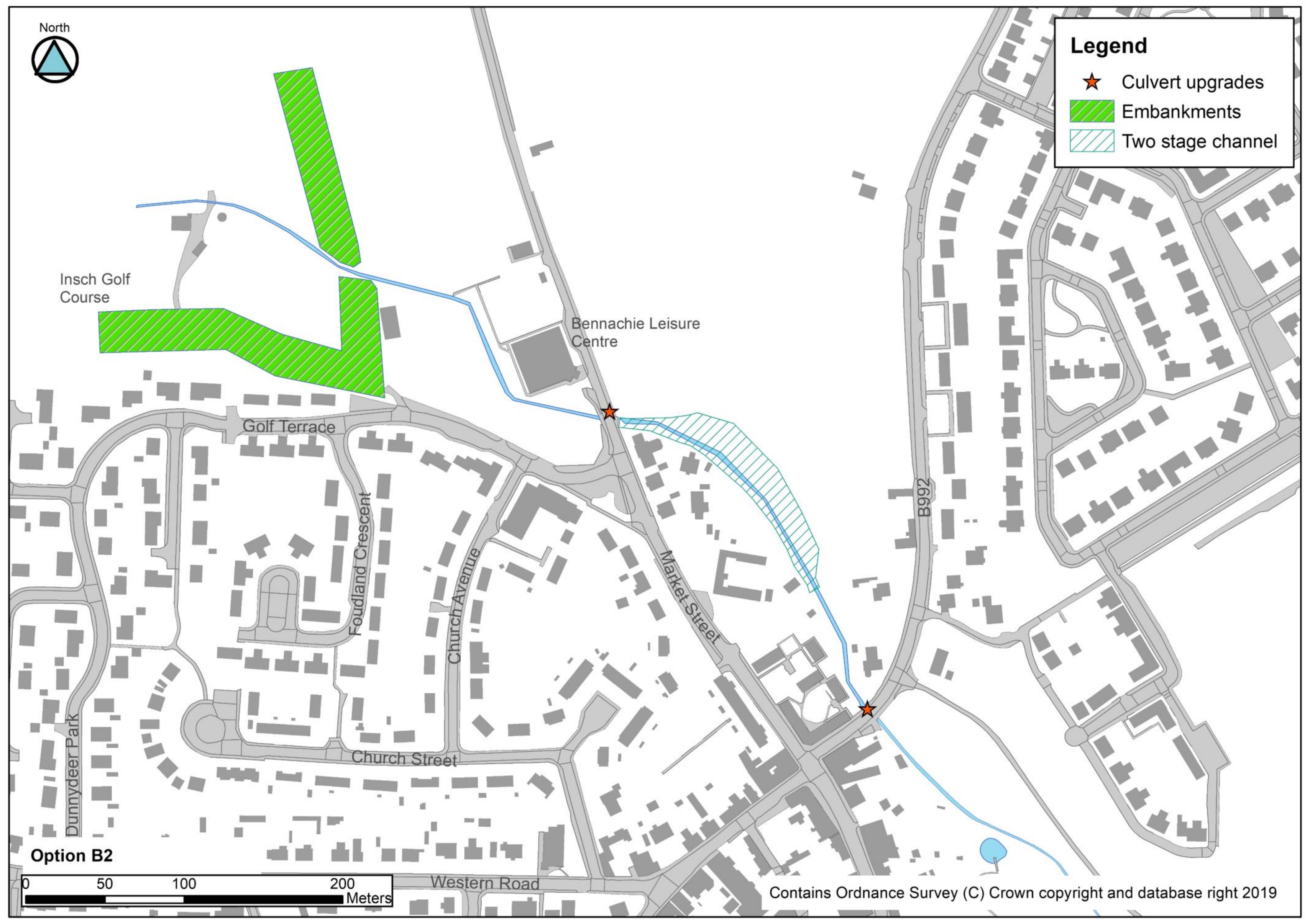


Option B1

Standard of Protection: 200 year plus climate change

- **Storage area** within Insch Golf Course to limit downstream flow to the 50 year flow. This will consist of two embankments and an outflow orifice.
- One **embankment** would run parallel to the Insch community centre playing field with a maximum height of ~3 m. A **second embankment** parallel to Golf Terrace would have a maximum height of 3.6 m.
- **Two stage channel** creation downstream of Market Street bridge over a ~170 m reach.
- **Channel reprofiling** to increase conveyance over a 235 m reach between Market Street and Insch Meadows.
- Estimated maximum possible **culvert upgrades** to increase the capacity of the Market Street and Drumrossie Street culverts. Both would have dimensions 4 m (w) x 1.5 m (h).

Option B2 – Storage & Direct Defences

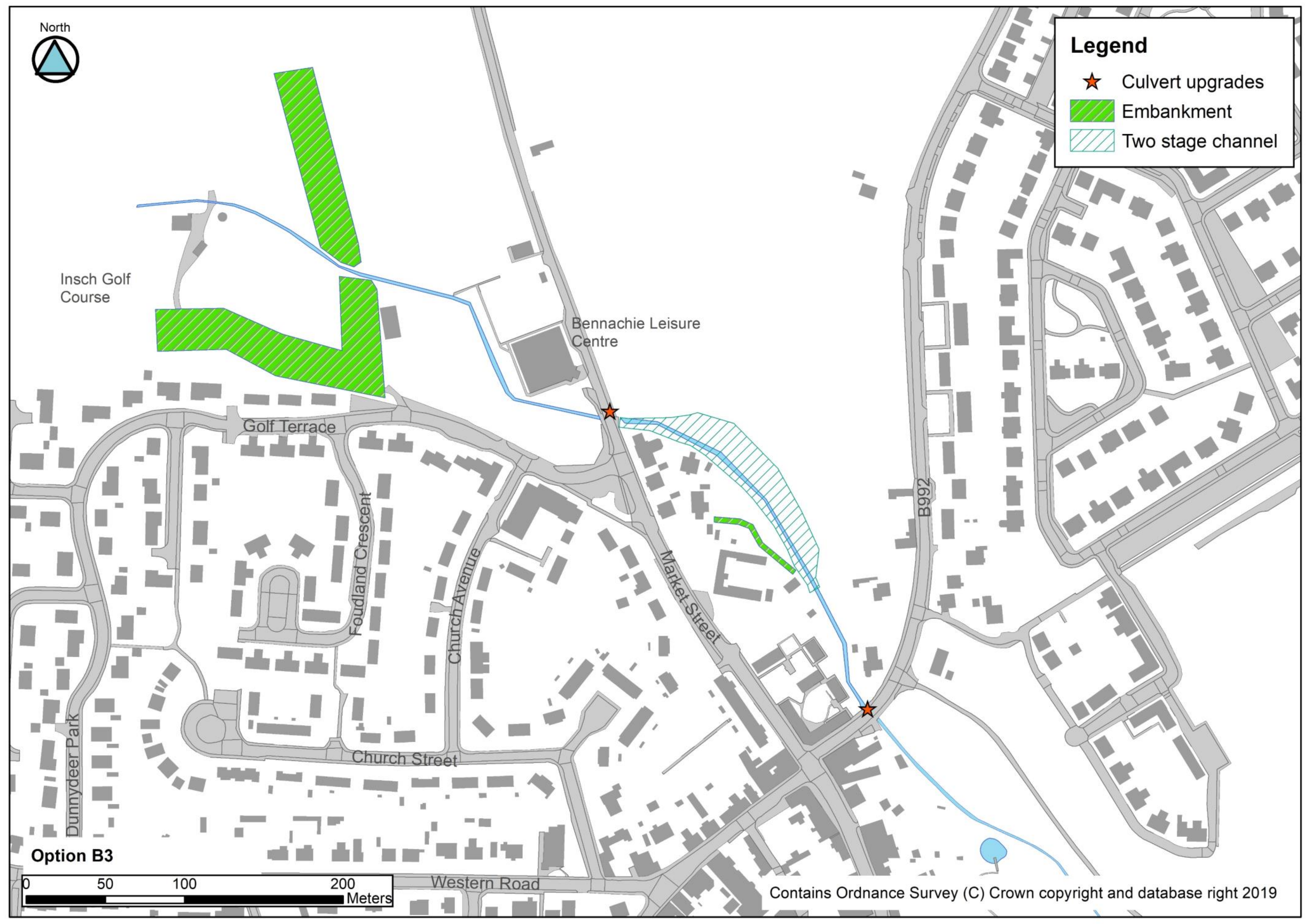


Option B2

Standard of Protection: 200 year plus climate change

- **Storage area** within Insch Golf Course to limit downstream flow to the 25 year flow.
- **Embankments** would run parallel to the Insch community centre playing field with a maximum height of ~3.8 m, and parallel to Golf Terrace with a maximum height of ~4 m.
- **Two stage channel** creation downstream of Market Street bridge over a ~170 m reach.
- **Increase the capacity** of the Market Street and Drumrossie Street culverts within the limits of existing structural constraints. The Market Street culvert would have dimensions 4 m (w) x 1 m (h) and the Drumrossie Street 3.5 m (w) x 0.75 m (h).

Option B3 – Storage & Direct Defences



Option B3

Standard of Protection: 200 year plus climate change

- **Storage area** and **two stage channel** creation as per Option B1.
- **Increase the capacity** of the Market Street and Drumrossie Street culverts within the limits of existing structural constraints as per Option B2.
- Construction of a **set back embankment** parallel to Market Street with a maximum height of ~1 m.
- Minor **raising of the bank** top upstream of Drumrossie Street culvert.

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7 Area B – Options (cont.)

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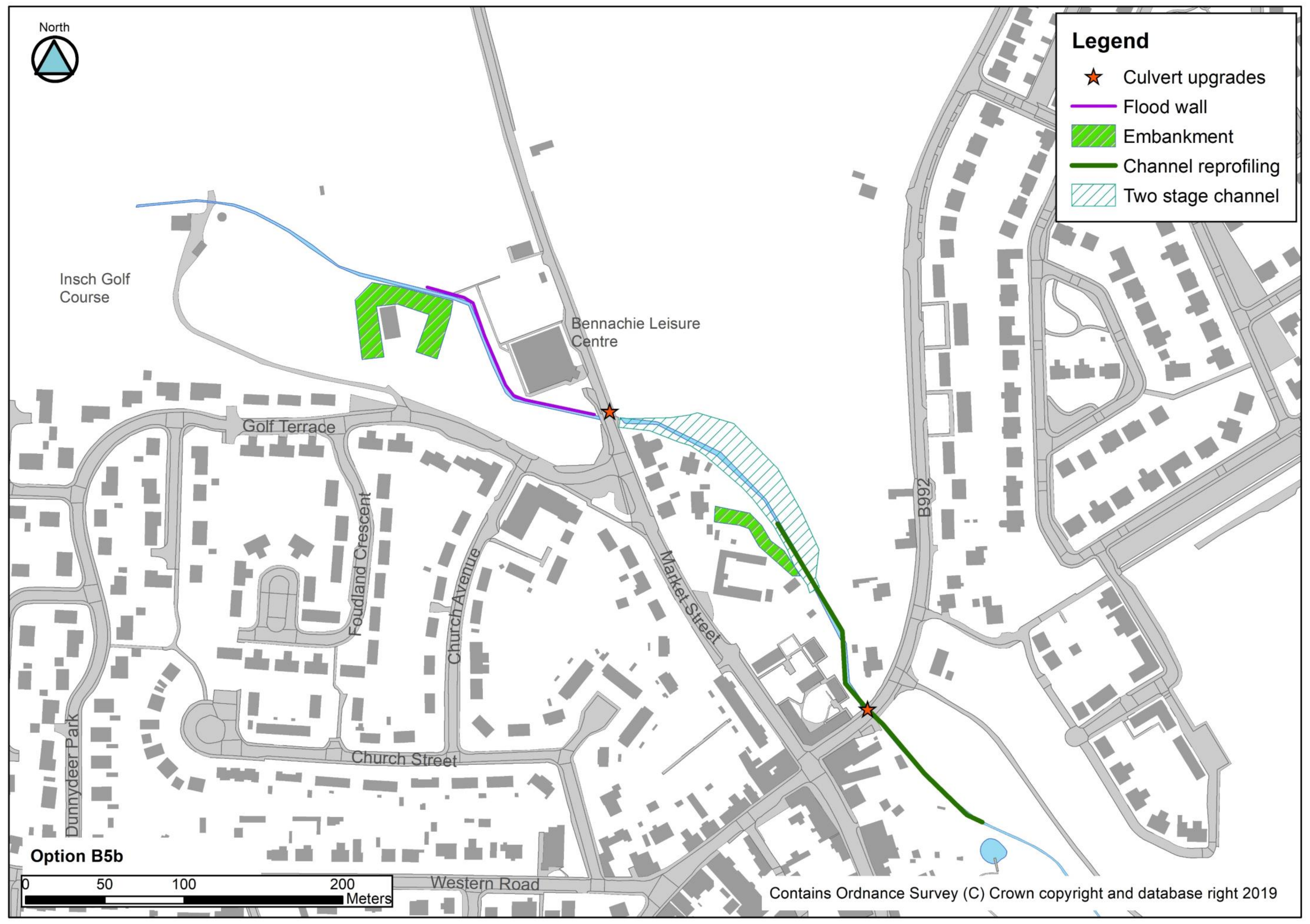
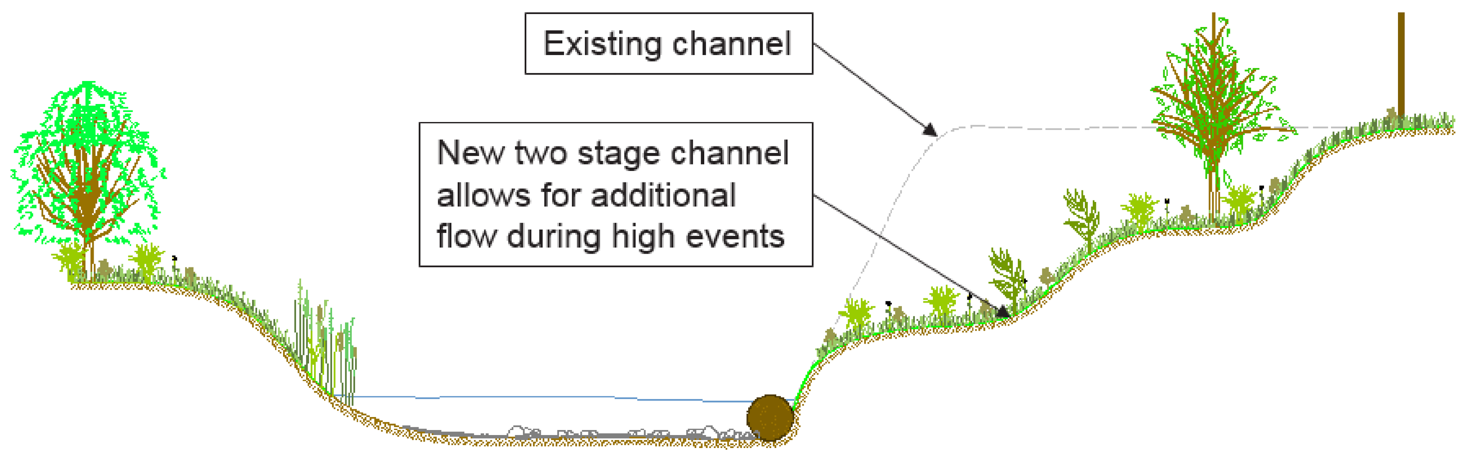
Option B5a & b – Direct Defences





Typical example of a two stage channel

Option B5a

Standard of Protection: 200 year plus climate change

- **Embankment** to protect Insch Golf Club House, maximum height 1.55 m.
- **Flood wall** extending ~150 m along the left bank by the leisure centre with a maximum height of 1.06 m.
- **Two stage channel** creation downstream of Market Street bridge over a ~170 m reach.
- **Increase the capacity** of the Market Street and Drumrossie Street culverts. The Market Street culvert would have dimensions 4 m (w) x 1.5 m (h) and the Drumrossie Street 3.5 m (w) x 0.75 m (h).
- **Set back embankment** east of Market Street, maximum height 1.3 m.
- **Flood walls** along both banks immediately upstream of Drumrossie Street culvert, ~0.5 m in height.

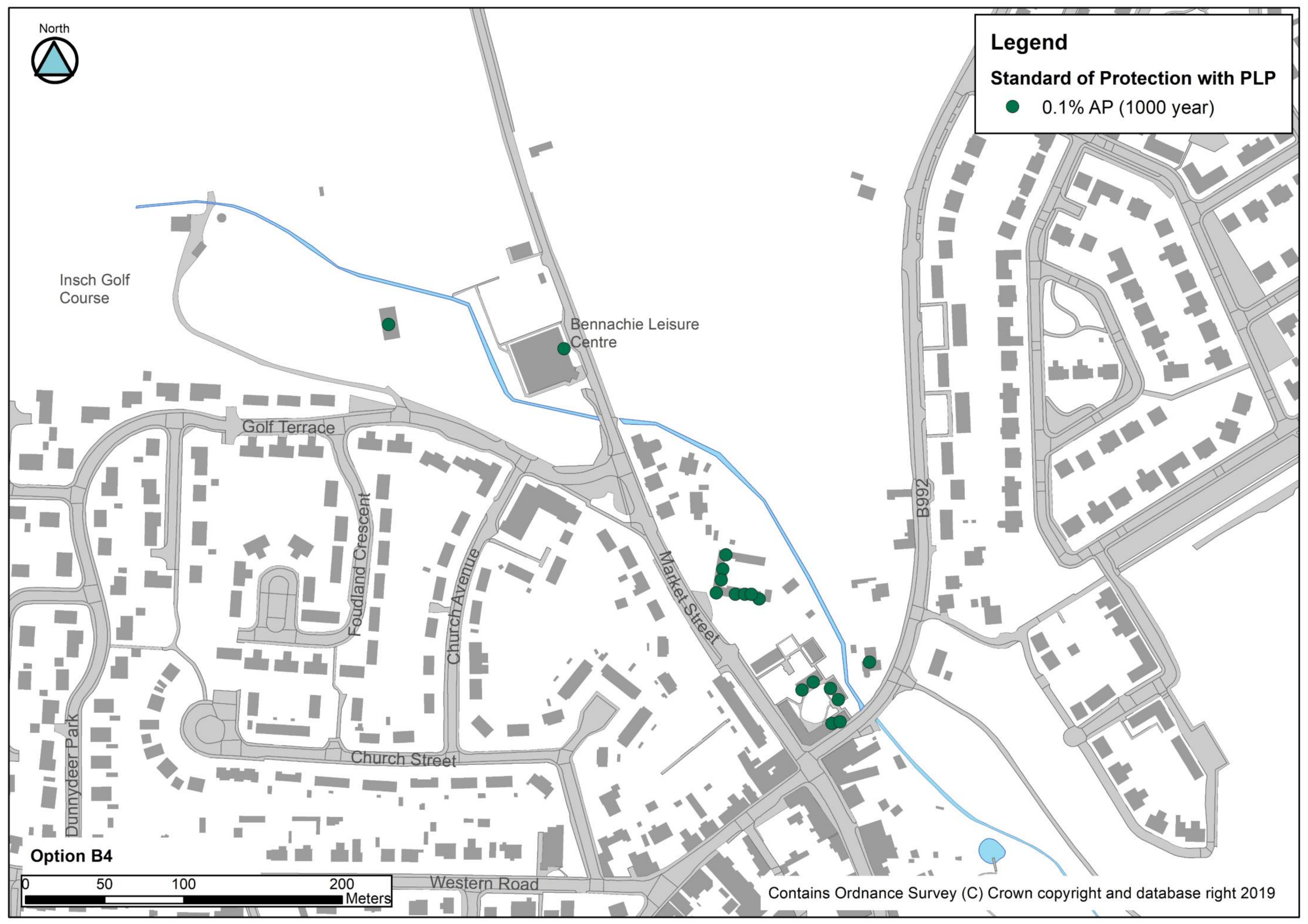
Option B5b

Standard of Protection: 200 year plus climate change

Like 5a but with no flood wall upstream of Drumrossie Street culvert and different culvert dimensions.

- **Embankment** to protect Insch Golf Club House, maximum height 1.55 m.
- **Flood wall** extending ~150 m along the left bank by the leisure centre with a maximum height of 1.06 m.
- **Two stage channel** creation downstream of Market Street bridge over a ~170 m reach.
- **Increase the capacity** of the Market Street and Drumrossie Street culverts to 4 m (w) x 1.5 m (h) box culverts.
- **Set back embankment** east of Market Street, maximum height 0.9 m.

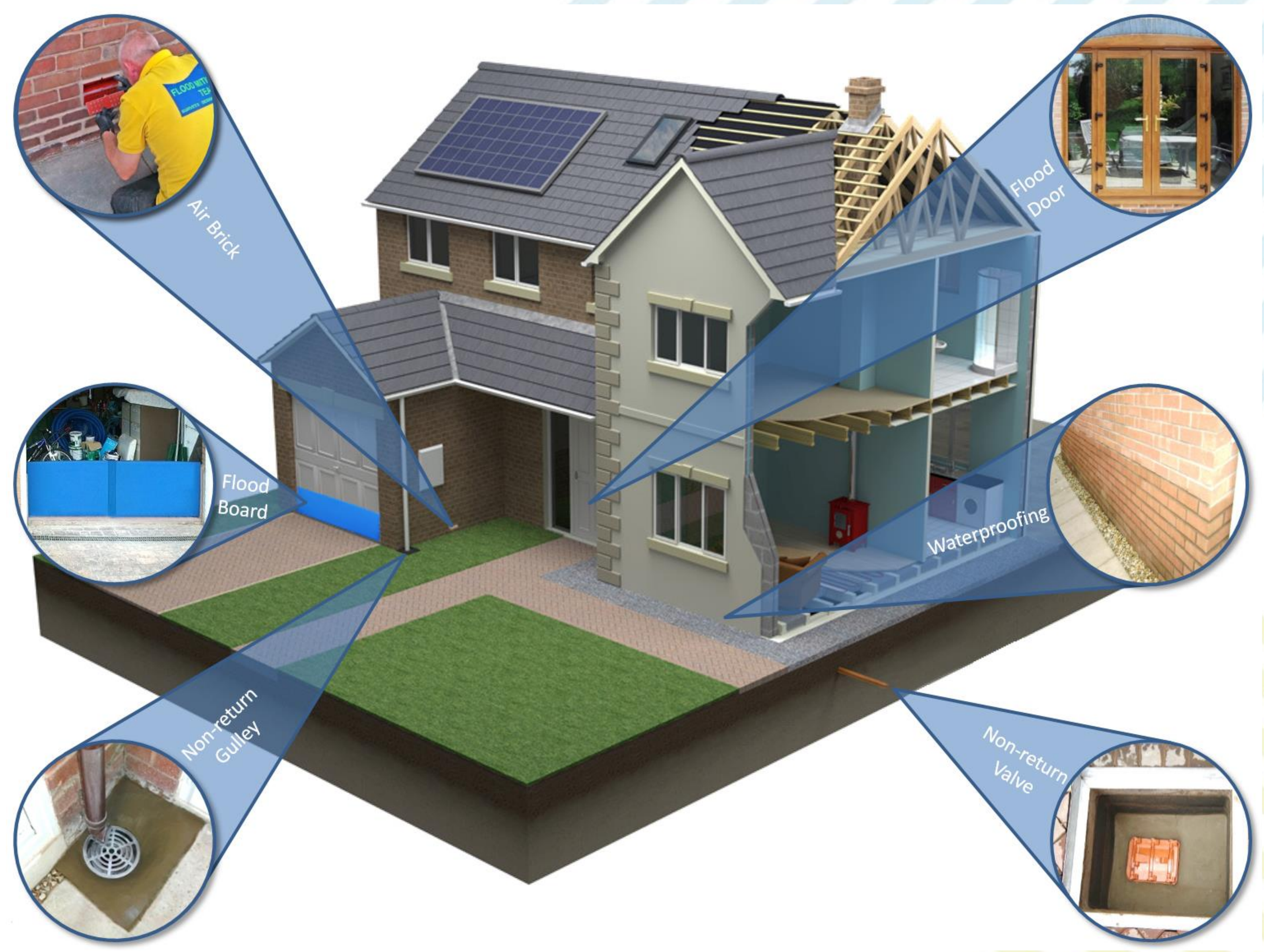
Option B4 – PLP



Option B4

Standard of Protection: 1000 year

- **Property Level Protection** (PLP)



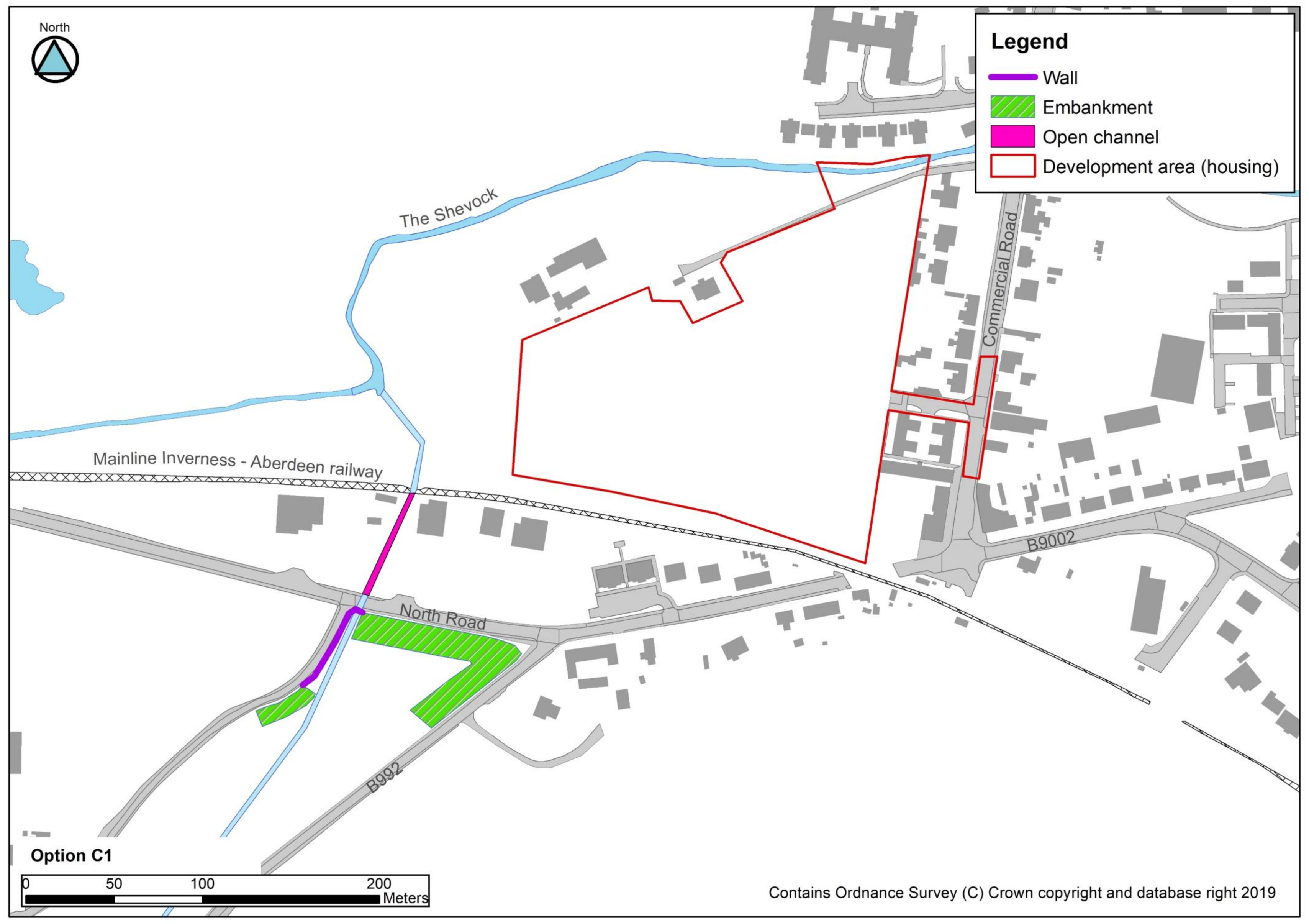
8 Area C - Options

Area C (Mill of Rothney Burn):

- Current standard of protection - **2 year**
- Properties at risk from the 200 year event - **17**
- Properties at risk from the 200 year plus climate change event - **17**

Flood risk from The Shevock and the Mill of Rothney Burn

Option C1 – Direct Defences & channel restoration

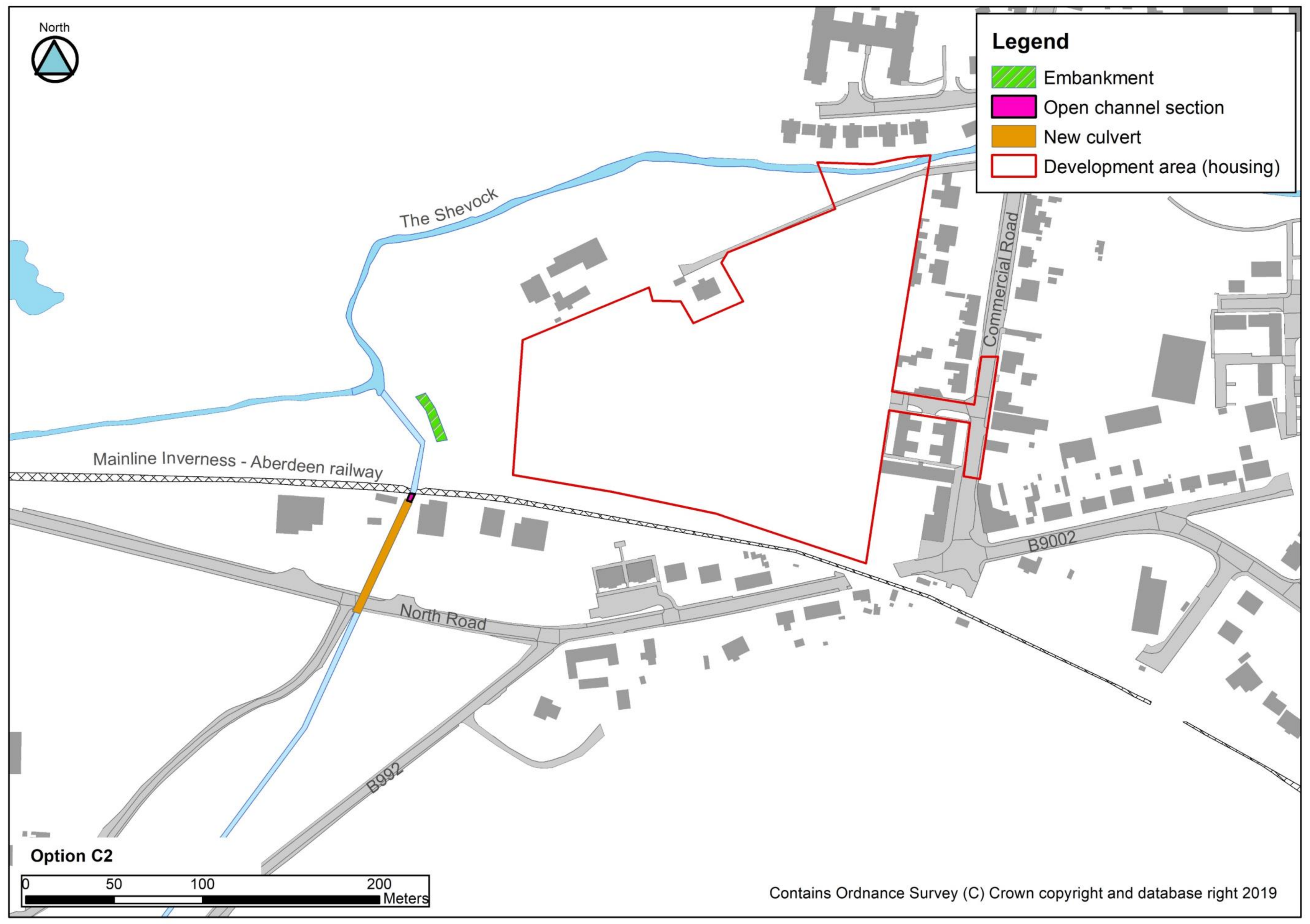


Option C1

Standard of Protection: 200 year plus climate change

- **Embankment** running parallel to North Road, maximum height 1.90 m.
- **Small embankment** to prevent flow onto the minor road, maximum height 1.10 m.
- **Wingwall** North Road bridge and extend the **wall** along the left bank to stop flooding to the road, maximum wall height ~1 m.
- **Remove the pipe culvert** in the industrial estate and restore an **open channel**, raising the bank levels to contain the Mill of Rothney Burn flows.

Option C2 – Direct Defences & culverting

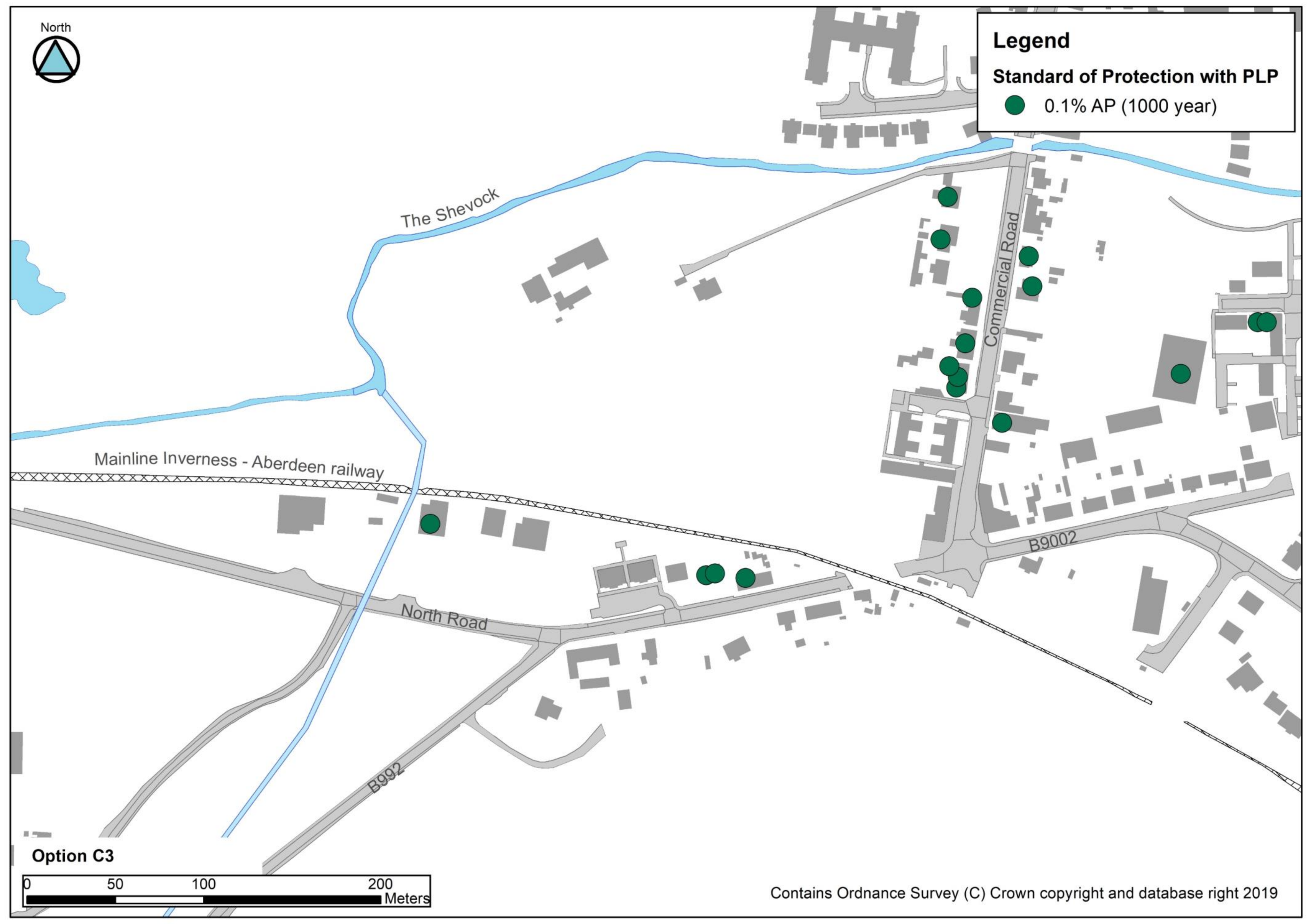


Option C2

Standard of Protection: 200 year plus climate change

- Replace and extend the North Road **culvert** through the industrial estate. The culvert would be approximately 4 m (w) x 1.5 m (h) with lowered bed levels.
- Small section of **open channel restoration** between the road and railway culverts for access and maintenance to both culverts.
- **Set back embankment** downstream of the railway line on the right bank, maximum height 0.8 m.

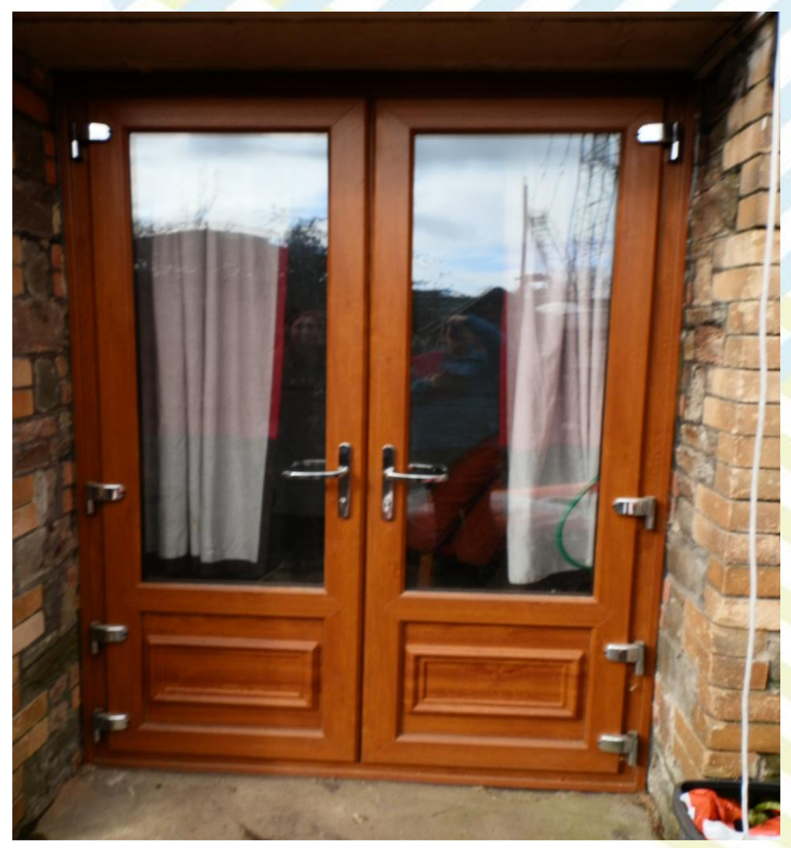
Option C3 – PLP



Option C3

Standard of Protection: 1000 year

- **Property Level Protection**



Typical example of an automated self sealing doors

9 Option Combinations

How the options have been assessed

Damages to all properties over 100 years ÷ Full cost of the scheme = Benefit Cost Ratio (BCR)

Each option has been assessed economically where if the damages over 100 years exceeds the cost of the scheme it is deemed to be economically viable (BCR > 1).

Economical benefit (options with a BCR > 1) is the main driver though sustainability and environmental benefit has also been strongly considered when evaluating options.

Option 1

A1a – Mill Road embankment.

B1 – Golf Course storage, two stage channel, reprofiling, new culverts.

C1 – Embankments, flood wall, open channel restoration.

Damages avoided = £4,986,000

Cost = £5,729,000

BCR = 0.87

Option 2

A1a – Mill Road embankment.

B3 – Golf Course storage, two stage channel, embankments, new culverts.

C1 – Embankments, flood wall, open channel restoration.

Damages avoided = £4,986,000

Cost = £4,914,000

BCR = 1.01

Option 3

A1a – Mill Road embankment.

B3 – Golf Course storage, two stage channel, embankments, new culverts.

C2 – Culvert through industrial estate, set back embankment.

Damages avoided = ££4,986,000

Cost = £4,824,000

BCR = 1.03

Option 4

A2 – PLP

B4 – PLP

C3 – PLP

Damages avoided = £4,295,000

Cost = £2,071,000

BCR = 2.07

Preferred option

Option 5

A1a – Mill Road embankment.

B5b – Direct defences, two stage channel, reprofiling, new culverts.

C1 – Embankments, flood wall, open channel restoration.

Damages avoided = £4,986,000

Cost = £3,783,000

BCR = 1. 32

10 Preferred Option

Option 5

A1a – Mill Road embankment.

B5b – Direct defences, two stage channel, reprofiling, new culverts.

C1 – Embankments, flood wall, open channel restoration.

Why is this the preferred option?

- *Option is economically viable with a benefit cost ratio of 1.32.*
- *Option achieves a full standard of protection of 200 year plus climate change including engineered solutions to the areas with currently the lowest standard of protection.*

Additional Options for Consideration

There is no formal commitment for Scottish Government funding. Should a scheme achieve funding and hence move forward to detailed design, Option 2 and Option 4 would also be considered further due to the following:

- Option 2 – less social impact, more sustainable but culvert size constraints and low BCR.
- Option 4 – highest BCR but less sustainability.

Option 2

A1a – Mill Road embankment.

B3 – Golf Course storage, two stage channel, embankments, new culverts.

C1 – Embankments, flood wall, open channel restoration.

BCR = 1.01

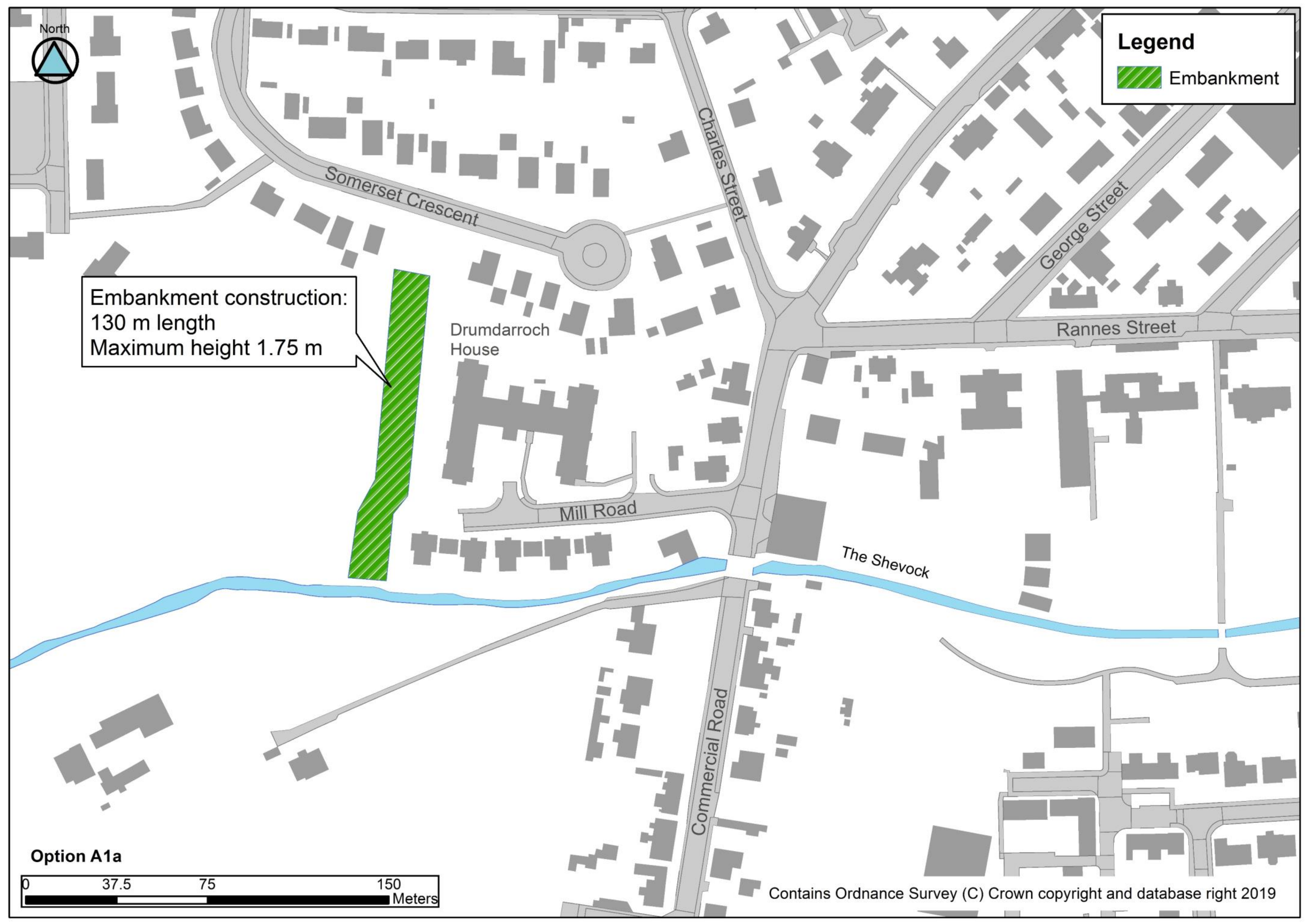
Option 4

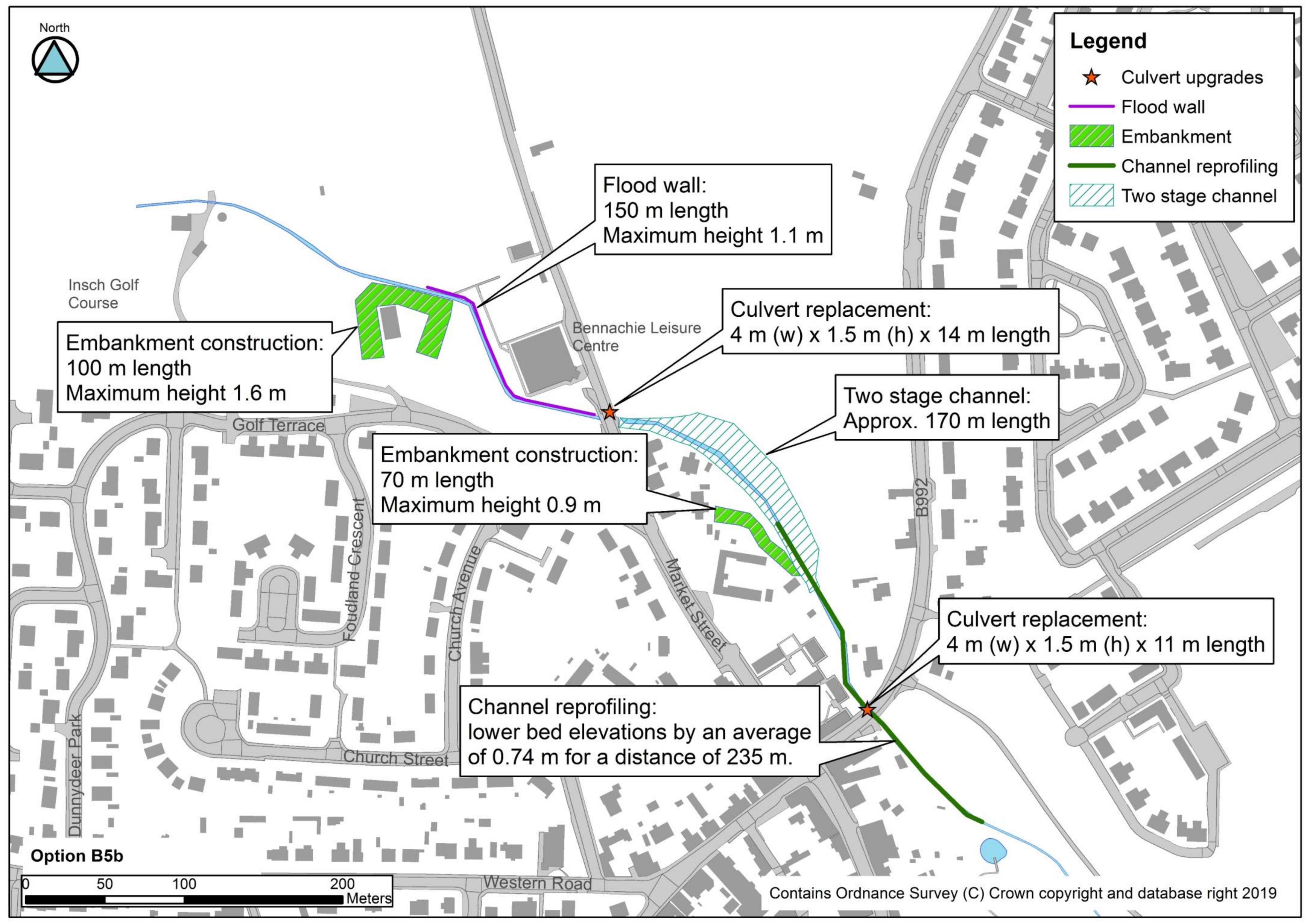
A2 – PLP

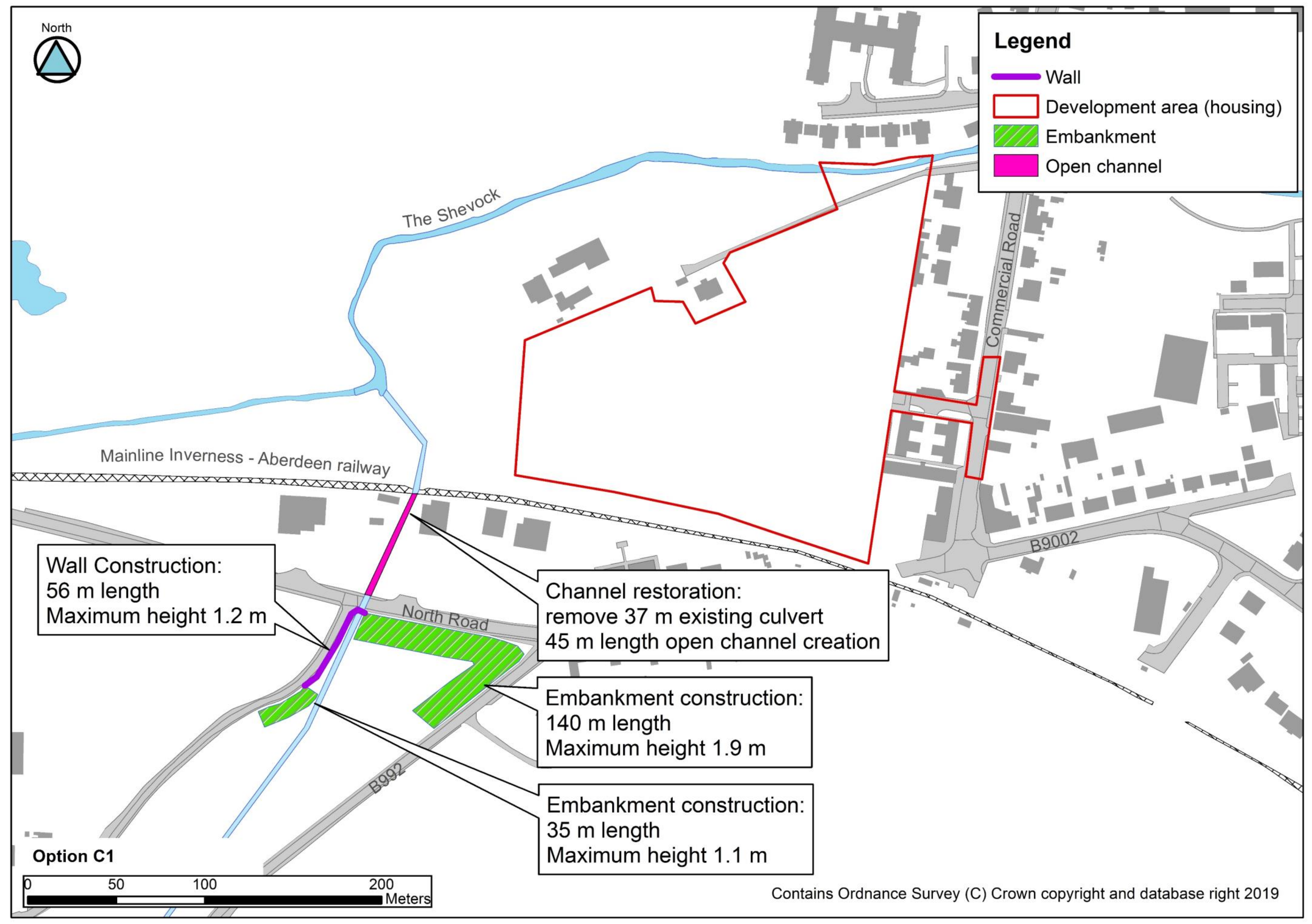
B4 – PLP

C3 – PLP

BCR = 2.07







Further information please visit the study website: www.inschfloodstudy.com