

WELCOME

The North-Western and Neagh-Bann Catchment Flood Risk Assessment and Management (CFRAM) study, commissioned by the Office of Public Works (OPW) and completed in 2017, identified areas at risk of flooding in Dundalk. This study developed a long-term strategy and identified high-level measures to manage that risk.

Following on from this, Louth County Council appointed the Binnies and Nicholas O'Dwyer Joint Venture to deliver the Dundalk Flood Relief Scheme. This Scheme aims to assess in greater detail the flooding extents in and around Dundalk, and subsequently identify, design, and submit for planning consent a Preferred Option that alleviates coastal and fluvial (river) flooding around Dundalk.

Although the primary purpose of the scheme is to provide flood protection to people and properties, amenity enhancements, such as a Greenway, may be incorporated where suitable.

WHY WE ARE HERE TODAY

Following the previous Public Participation Day (PPD) held for Blackrock in March 26, we are here today to present the potential measures for the protection of Dundalk, both from the coastal and fluvial flooding risks. We would like your feedback regarding the potential high-level measures in order to proceed towards the selection of a preferred option.

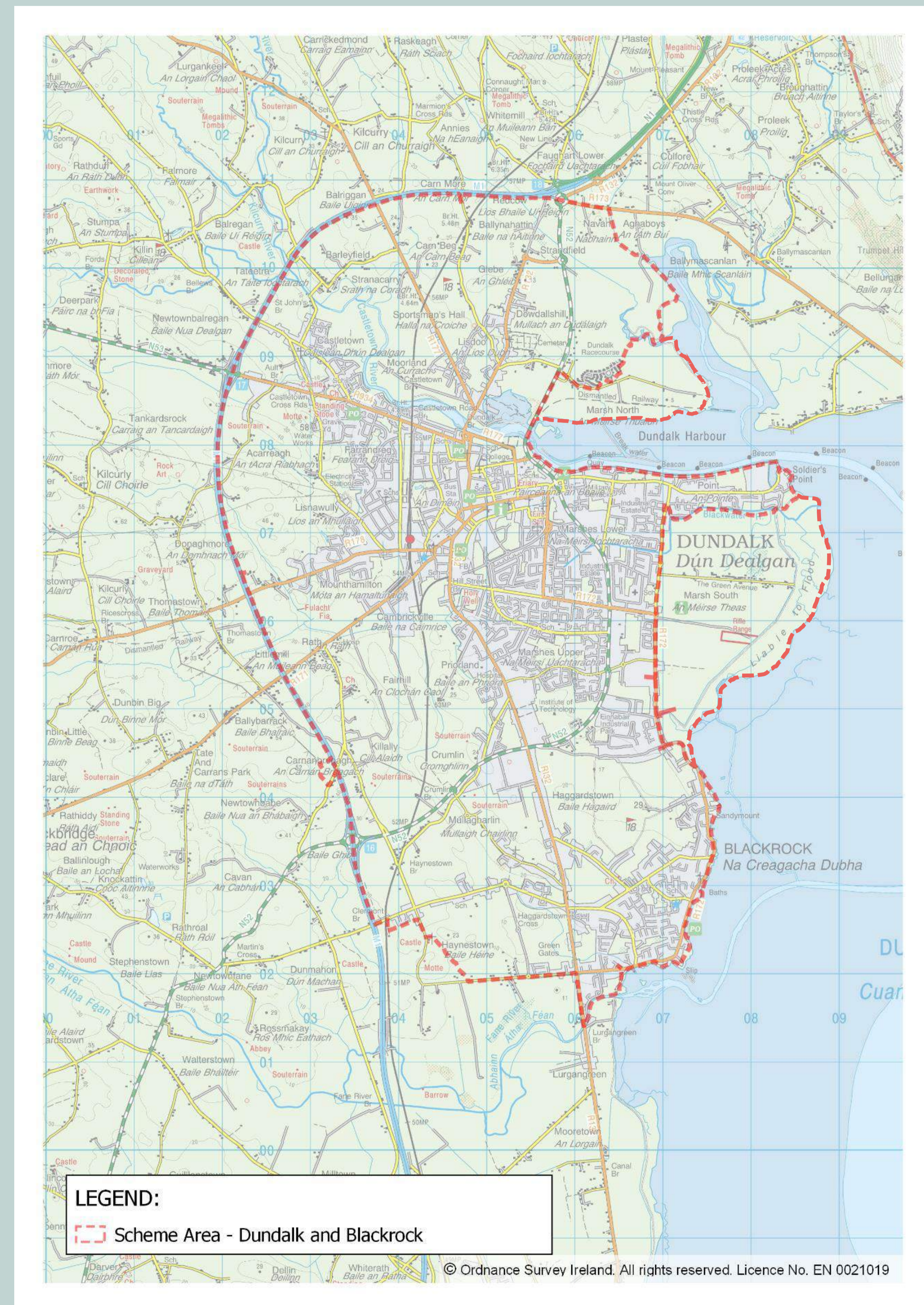
ABOUT THE PROJECT TEAM

Louth County Council acting as the client is working in partnership with the OPW to undertake this flood relief scheme.

The OPW is the national funding authority for flood relief projects. Funding for the scheme is being provided through the current National Development Plan. Non-flood related measures, such as public realm or greenway, will require alternative funding sources.

Binnies / Nicholas O'Dwyer Ltd. Joint Venture is designing the scheme on behalf of Louth County Council. Nicholas O'Dwyer Ltd. is a consulting engineering firm with its head office in Dublin and currently working on flood relief projects in Wexford, Tipperary, Rosslare and Dublin. Binnies UK are a global consultant bringing their specialist skills in marine modelling and coastal protection and Flood Design.

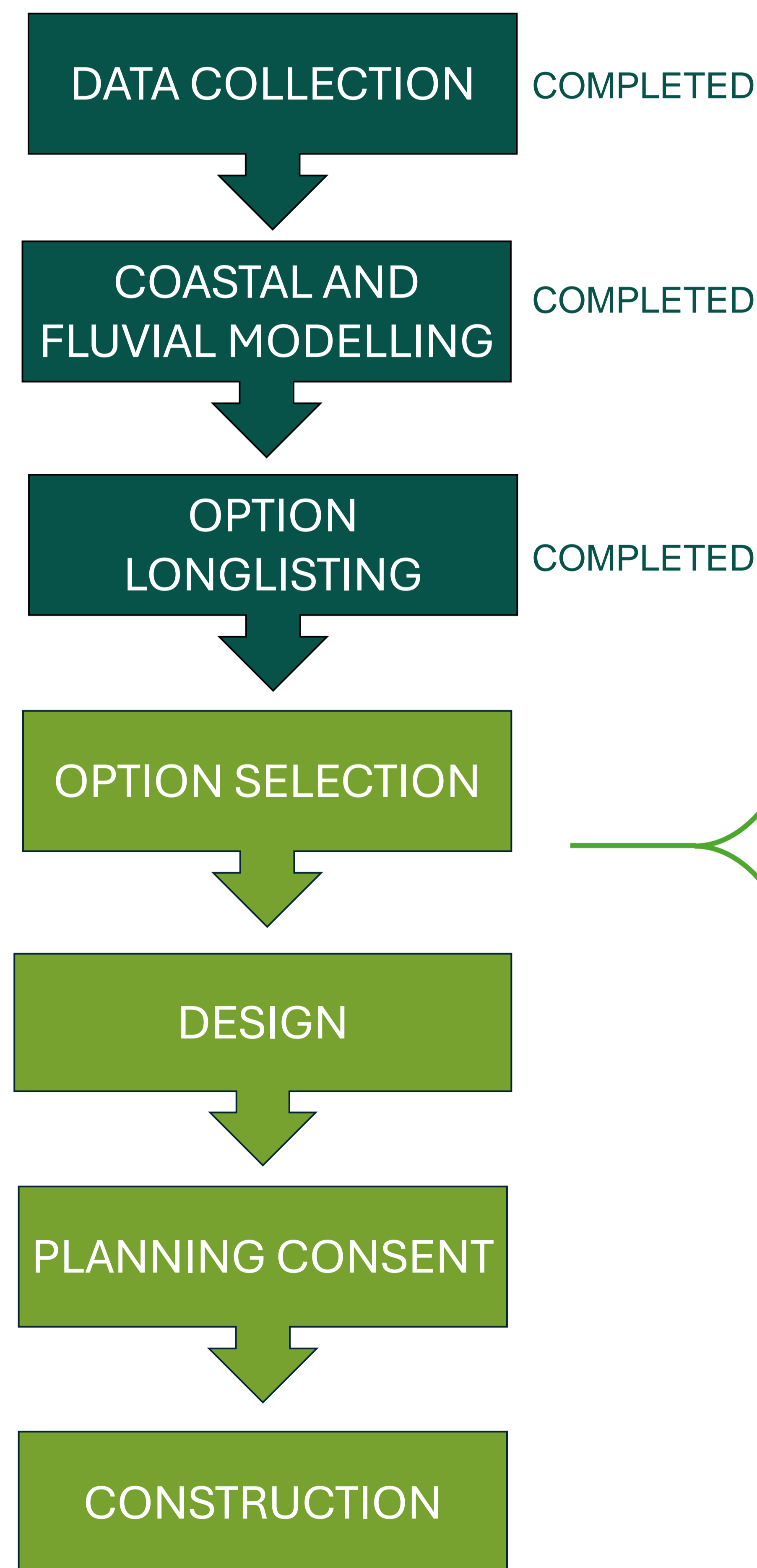
DUNDALK SCHEME AREA





SCHEME DEVELOPMENT PROCESS

The objective of this project for the town of Dundalk is the identification, design, submission (for planning consent), and the construction of a Flood Relief Scheme to manage and mitigate fluvial (river) and costal flood risk.



A long list of flood relief options were compiled and evaluated to identify the most appropriate solutions for shortlisting.

The impacts of these shortlisted options will then be evaluated in a scored **Multi-Criteria Analysis** to determine a ranking for each option. These rankings, together with the public opinions of the options, are used to determine which option should be brought forward as the preferred option.

Multi-Criteria Categories to Choose a Preferred Option



Today, we would like your opinion on the emerging potential options so that your views can form one element in the evaluation when choosing a preferred option.

Once identified, the emerging preferred option will be shared with the community for consideration before the scheme is brought forward for planning consent.

OPTION DEVELOPMENT PROCESS

Following the estimation of flood extents, potential flood risk management options are developed and assessed to identify a preferred solution. The option development process includes the following stages:

FLOOD RISK MANAGEMENT POLICIES

Policies are potential management approaches to address flood risk within an area. These define the alignment of the proposed flood defences.

FLOOD MANAGEMENT MEASURES

Flood risk management measures are potential solutions to address the impacts of flooding.

Not all measures are suitable for every location or management policy, so each measure was qualitatively screened to evaluate its appropriateness.

OPTIONS LONG LIST

- Develop a long list of potential measures. This represents a wide range of possible approaches to managing flood risk, both *individual measures* and *combinations of measures*. These options broadly align with the policy approaches identified previously.
- Each option is assessed qualitatively against a defined set of criteria:
 - technical performance, (does it work!)
 - compatibility with local constraints, such as environmental, social, and cultural considerations.
 - adaptability to Climate Change.
- Options that did not sufficiently meet these criteria were screened out to produce a more focused shortlist for further development.

That's today

We want to hear your views!



EMERGING OPTIONS

- A short list of options was developed from those not eliminated during the long list stage.
- The shortlist **Emerging Options** are progressed through further engineering design and assessment
- Emerging Options are presented to the public to gather feedback before undertaking a detailed multi-criteria analysis to identify a **Preferred Option**.

PREFERRED OPTION

A Preferred Option is selected and design and planning of the option can commence.

ENVIRONMENTAL CONSTRAINTS

Dundalk Bay is a designated Special Area of Conservation (SAC) and a Special Protection Area (SPA). SACs and SPAs are protected sites designated under EU legislation (Habitats and Birds Directives). They are designed to meet specific conservation objectives for designated habitats and species. SACs are designated to protect a wide range of habitats or species while SPAs are designated for the protection of bird species.

Designated Areas



Dundalk Bay SAC

Qualifying Interests

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide
- Perennial vegetation of stony banks
- Salicornia and other annuals colonising mud and sand
- Atlantic salt meadows
- Mediterranean salt meadows



Salicornia



Atlantic Salt Meadows



Oystercatcher

Dundalk Bay SPA

Qualifying Interests

- Great Crested Grebe
- Greylag Goose
- Light-bellied Brent Goose
- Shelduck
- Teal
- Mallard
- Pintail
- Common Scoter
- Red-breasted Merganser
- Oystercatcher
- Ringed Plover
- Golden Plover

- Grey Plover
- Lapwing
- Knot
- Dunlin
- Black-tailed Godwit
- Bar-tailed Godwit
- Curlew
- Redshank
- Black-headed Gull
- Common Gull
- Herring Gull
- Wetland and Waterbirds

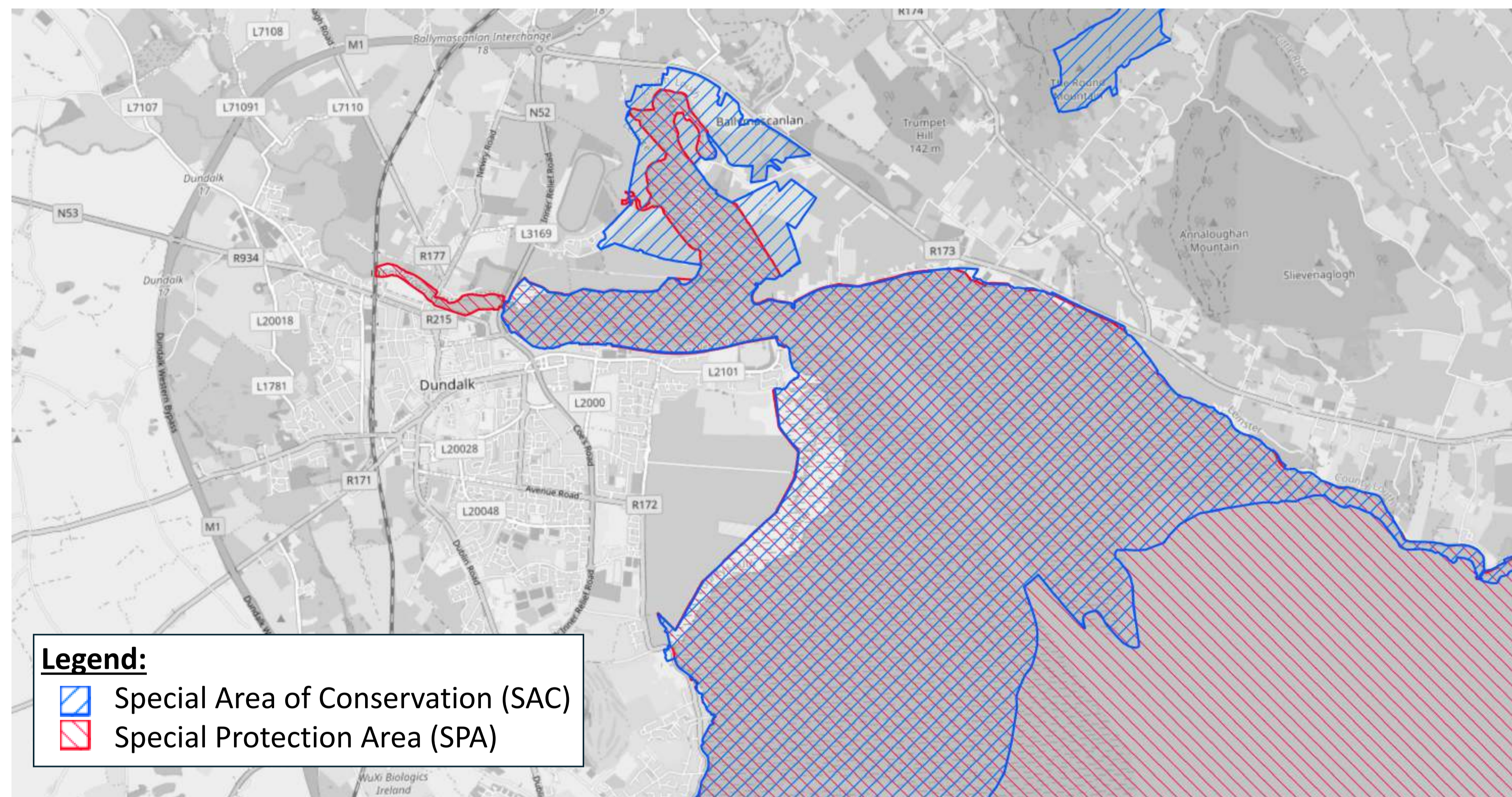


Lapwing



Grey Plover

WHAT DOES THIS MEAN FOR THE FLOOD RELIEF SCHEME?



The presence of SAC and SPA designations means that any flood relief proposals must be carefully designed to **avoid or minimise impacts on protected habitats and bird species**, meaning:

- ✓ Seaward expansion should be avoided
- ✓ Habitat impacts must be minimised
- ✓ Nature-based solutions prioritised where feasible
- ✓ Any loss of habitat would require compensation

European environmental legislation requires a rigorous assessment process where works are likely to have a significant or adverse impact on a protected site:

- Stage 1: Screening for Appropriate Assessment (AA)
- Stage 2: Appropriate Assessment – Natura Impact Statement (NIS)
- Stage 3: Examination of Alternatives if Stage 2 cannot mitigate adverse impact
- Stage 4: IROPI (Imperative Reasons of Overriding Public Interest)

WHAT IS IROPI? (*Imperative Reasons of Overriding Public Interest*)

Conditions: It is a last-resort exception to the Directive only applicable if there **are no alternative solutions** and the public interest overrides the ecological damage.

Compensatory Measures: If invoked, the developer must implement measures to ensure the overall coherence of the Natura 2000 network is protected

The **Habitats Directive** requires Member States to inform the Commission of the compensatory measures; this enables the Commission to review whether the compensatory measures are sufficient to ensure that the coherence of the network is maintained.

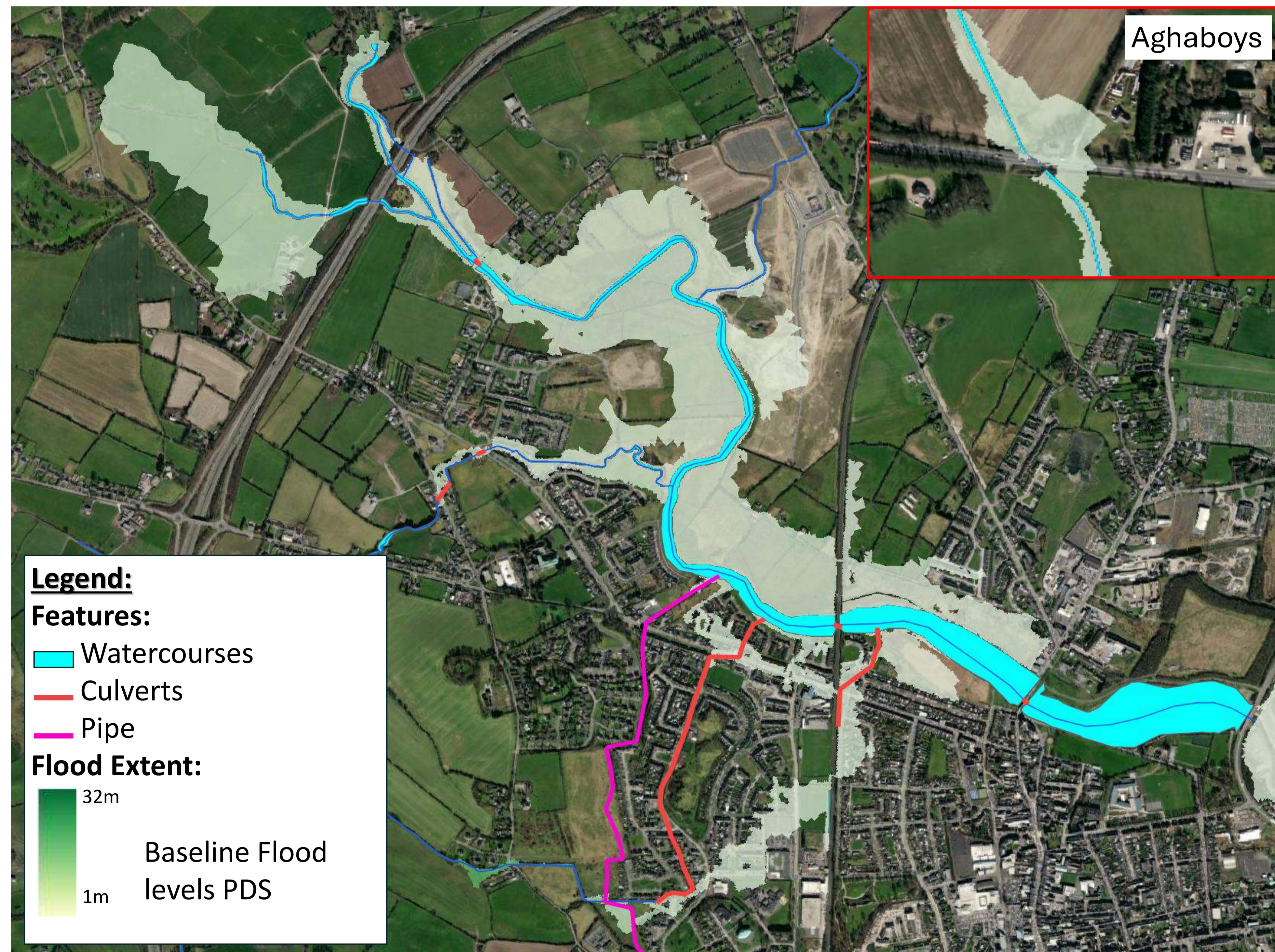


Protecting public safety from flooding and protecting the natural environment must both be considered in developing a preferred option

FLUVIAL (RIVER) FLOOD RISK

For a 1 in 100 year fluvial event (1% Annual Exceedance Probability (AEP)) + 1 in 2 year tidal event (50% AEP).

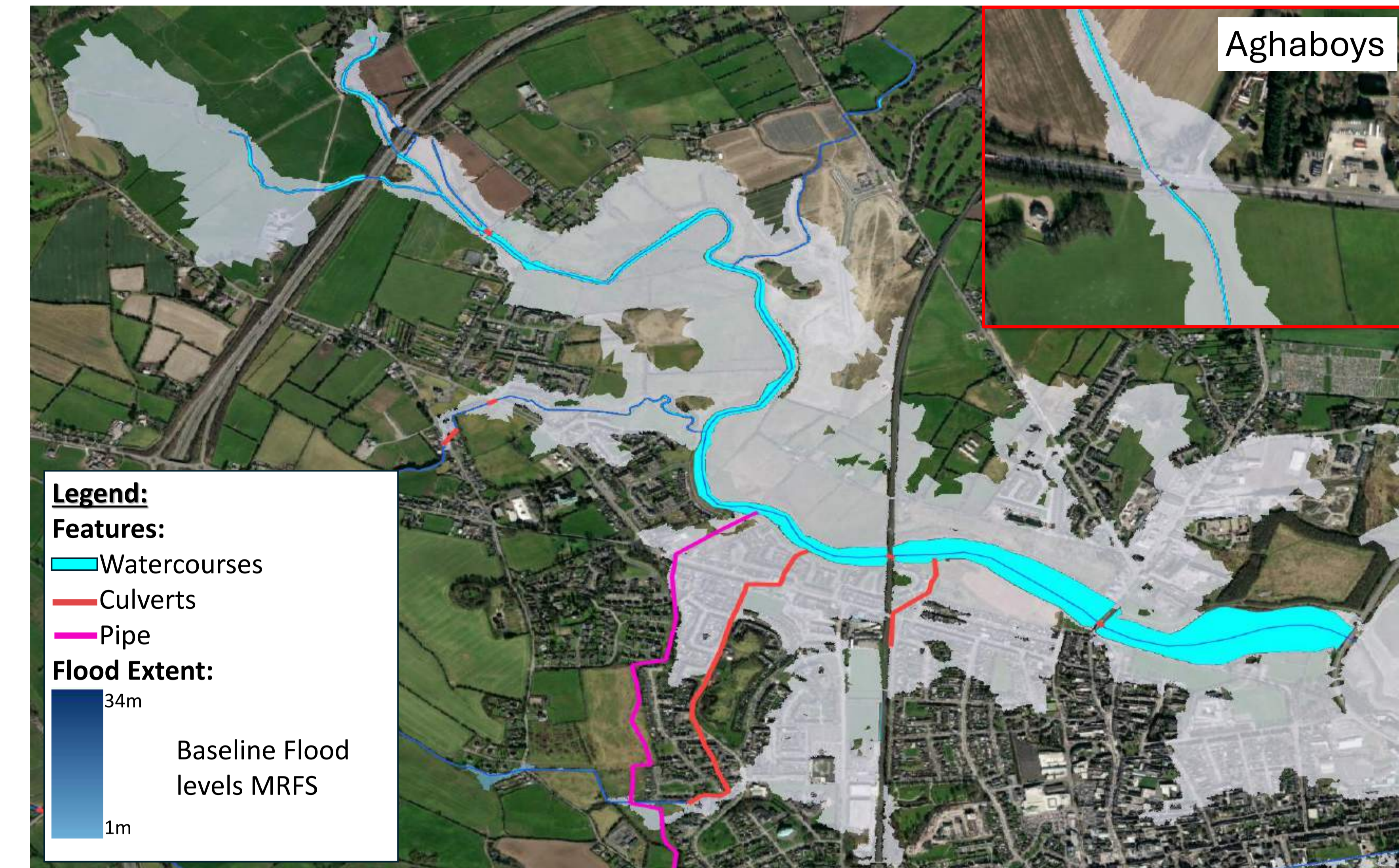
Present Day Scenario



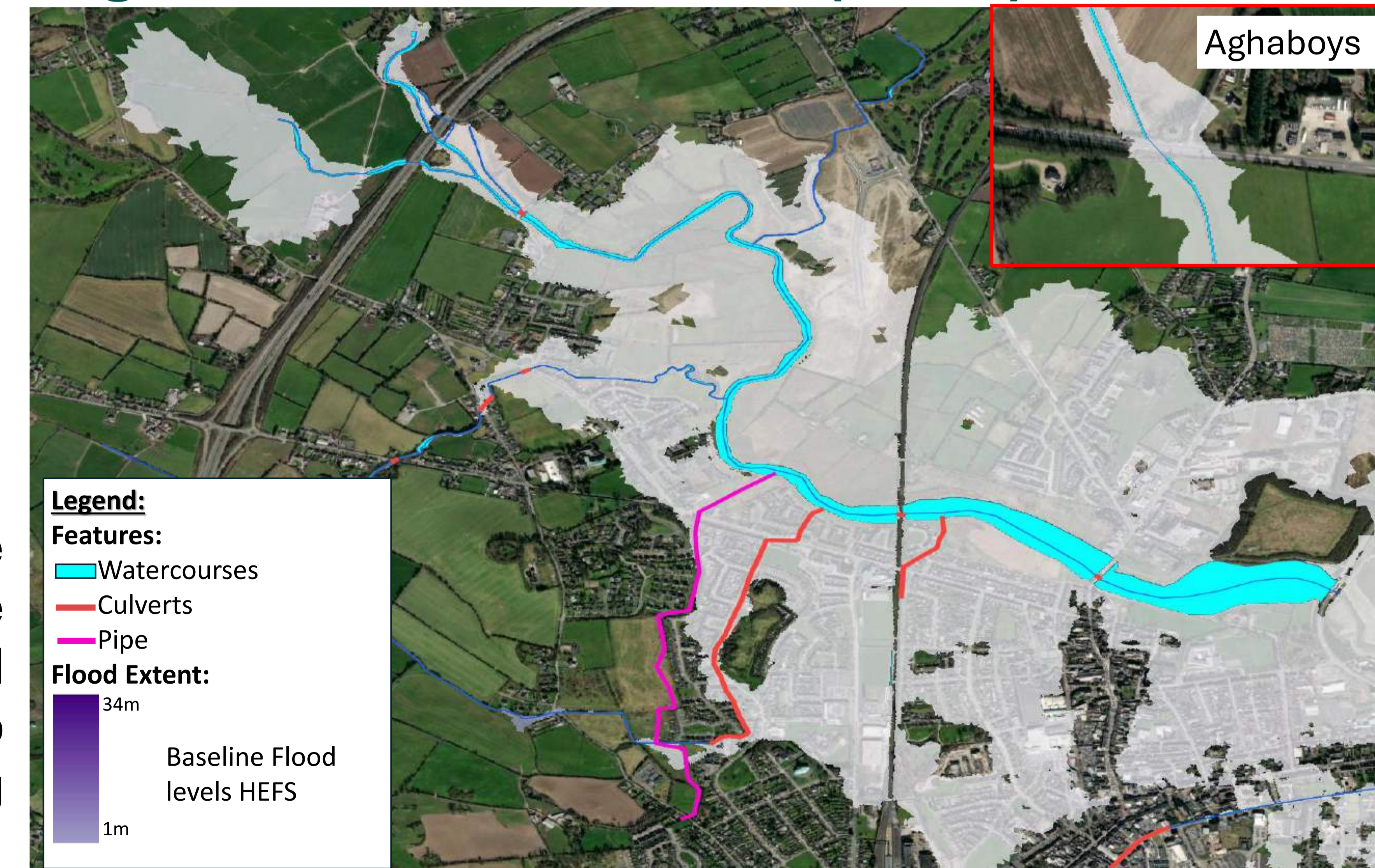
Flood Extent Scenarios:

Flood extent maps were developed for the Present Day scenario, and two future scenarios accounting for the potential impact of climate change. The Mid-Range Future Scenario accounts for an increase of 20% in peak flood flows, and extreme rainfall depths, including +500mm of mean sea level rise, and the High-End Future Scenario accounts for increase of 30% in peak flood flows, and extreme rainfall depths, including +1,000mm of mean sea level rise.

Mid-Range Future Scenario (MRFS)



High-End Future Scenario (HEFS)



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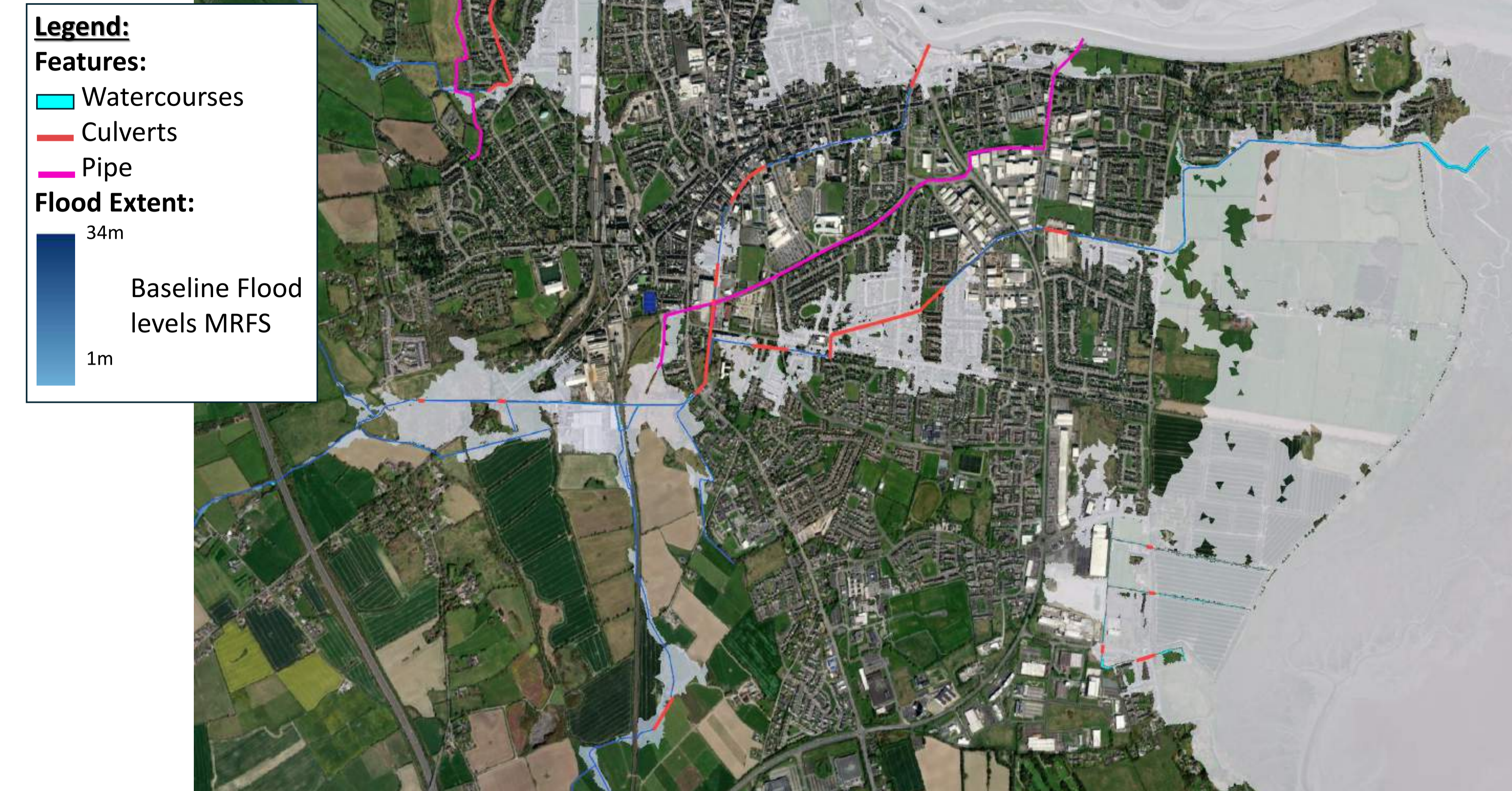
Present Day Scenario



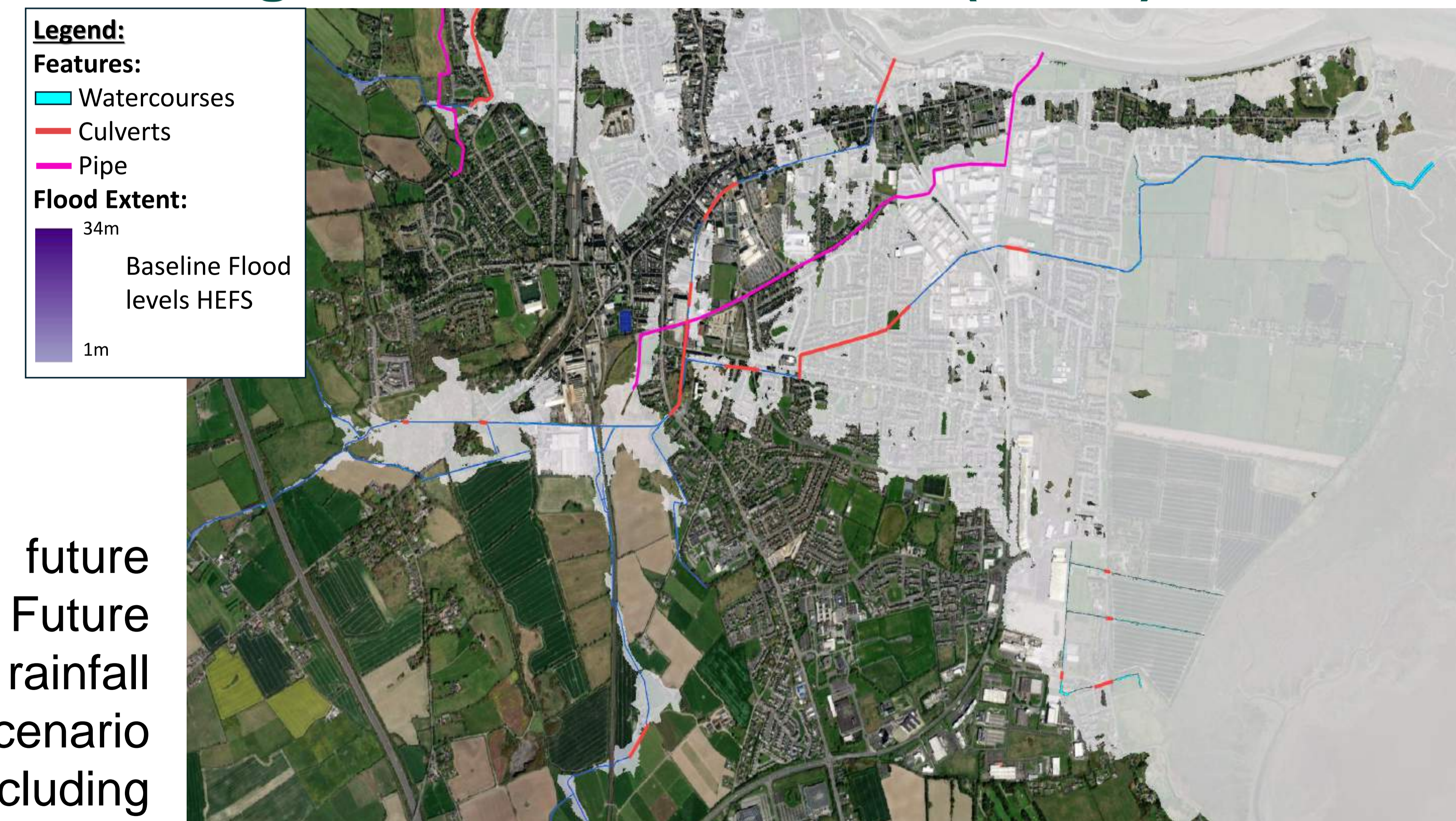
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Mid-Range Future Scenario (MRFS)



High-End Future Scenario (HEFS)



TIDAL FLOOD RISK

For a 1 in 200 year tidal event (0.5% Annual Exceedance Probability (AEP)) + 1 in 2 year fluvial event (50% AEP).

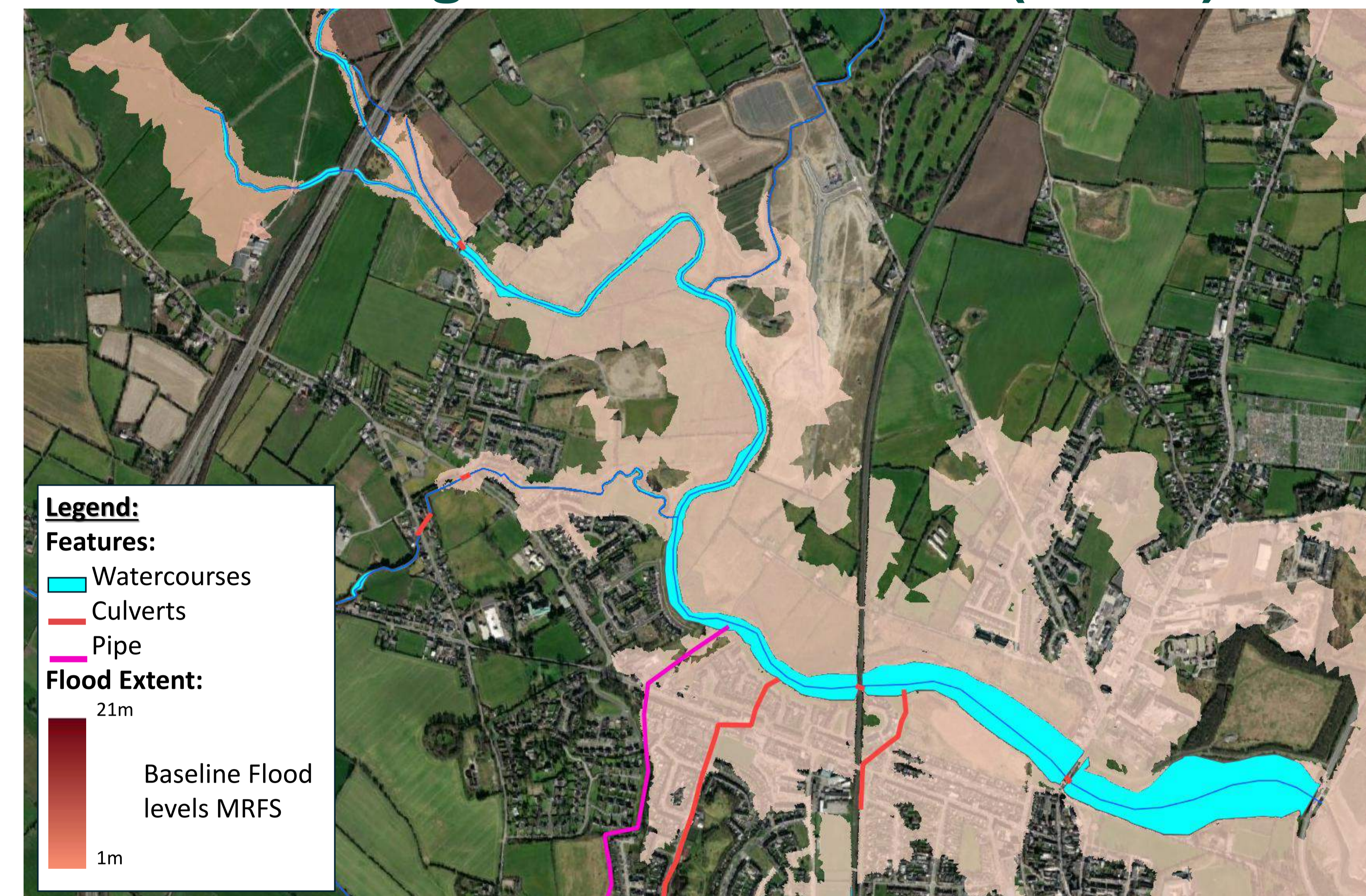
Present Day Scenario



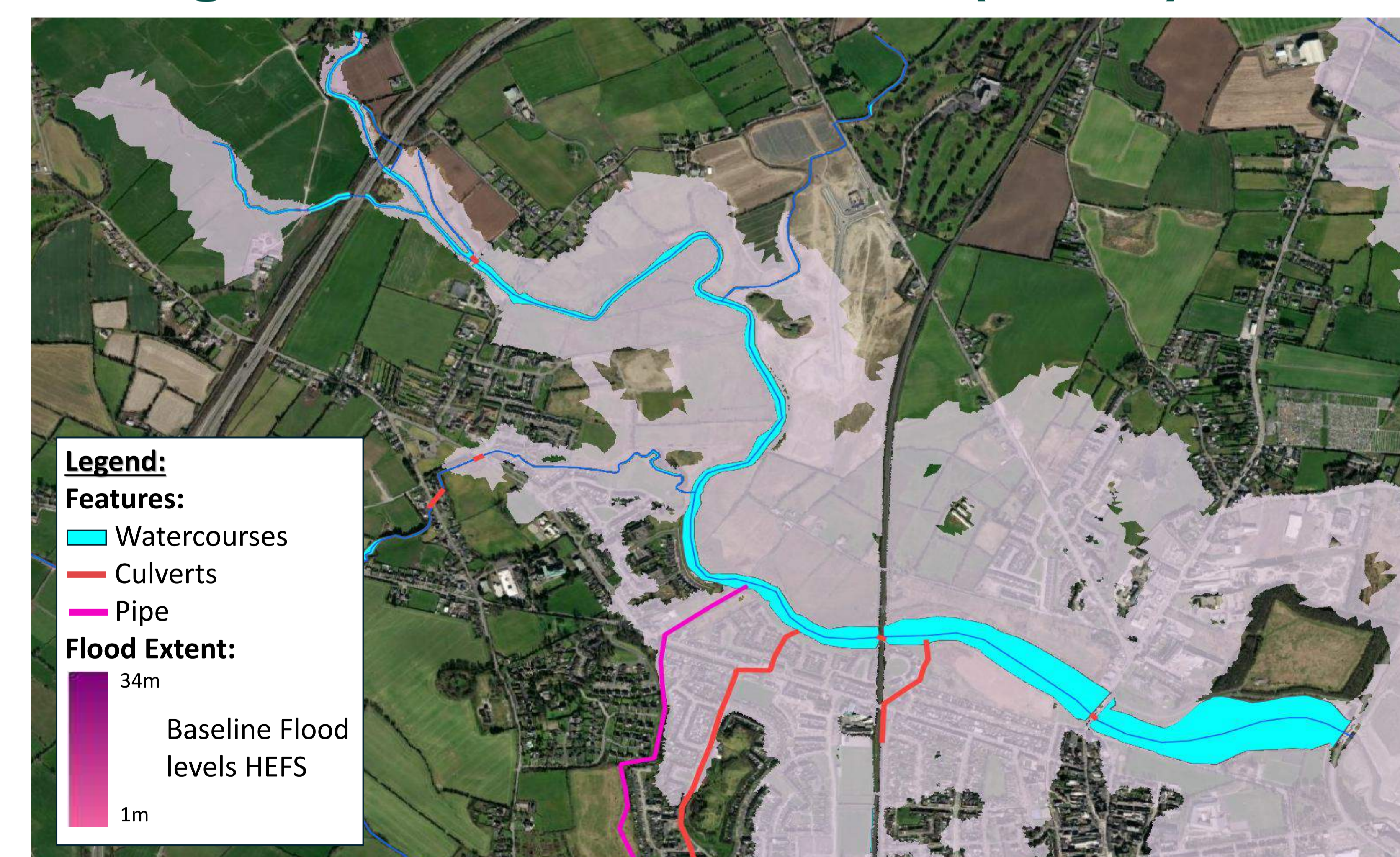
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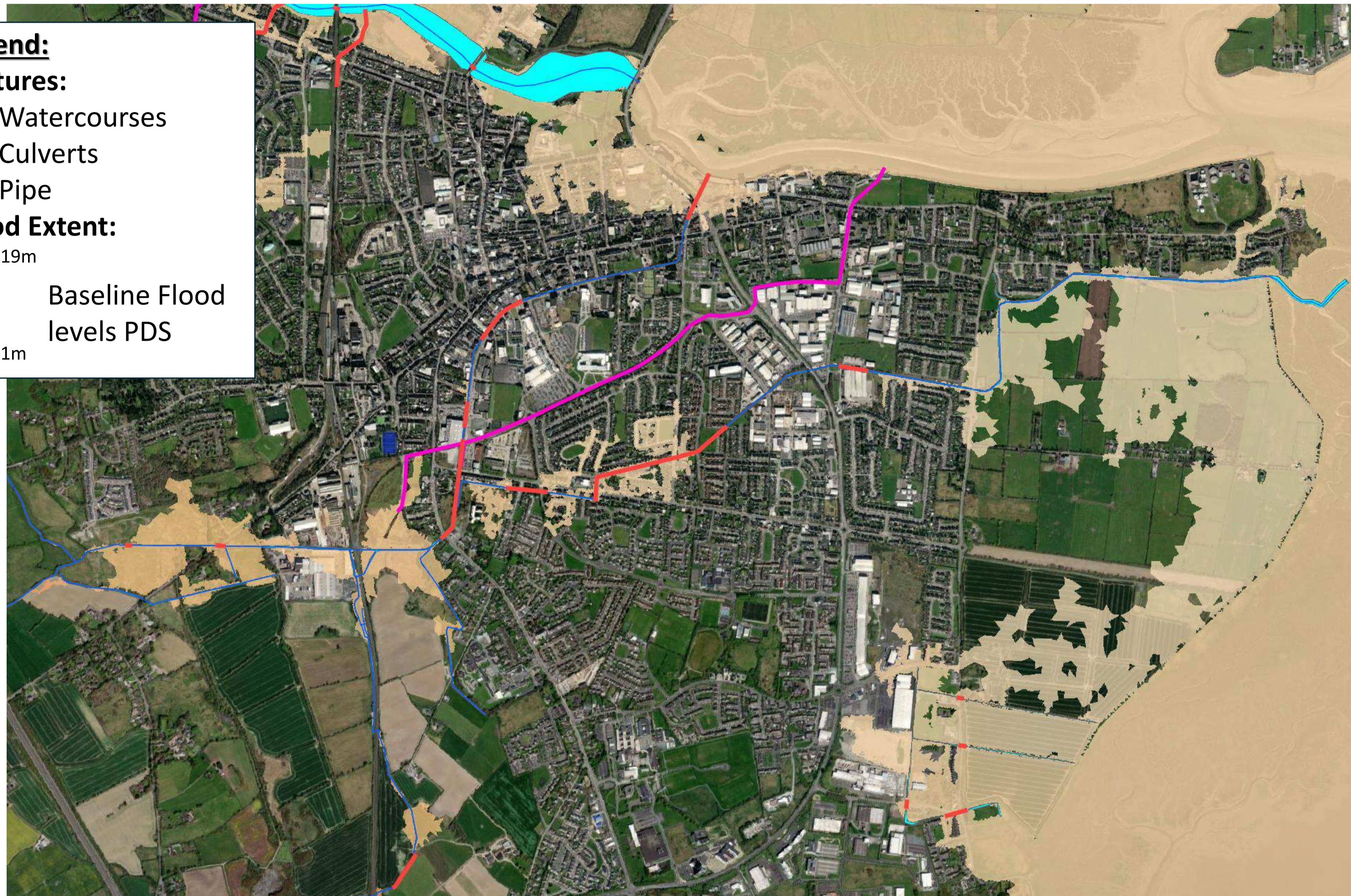
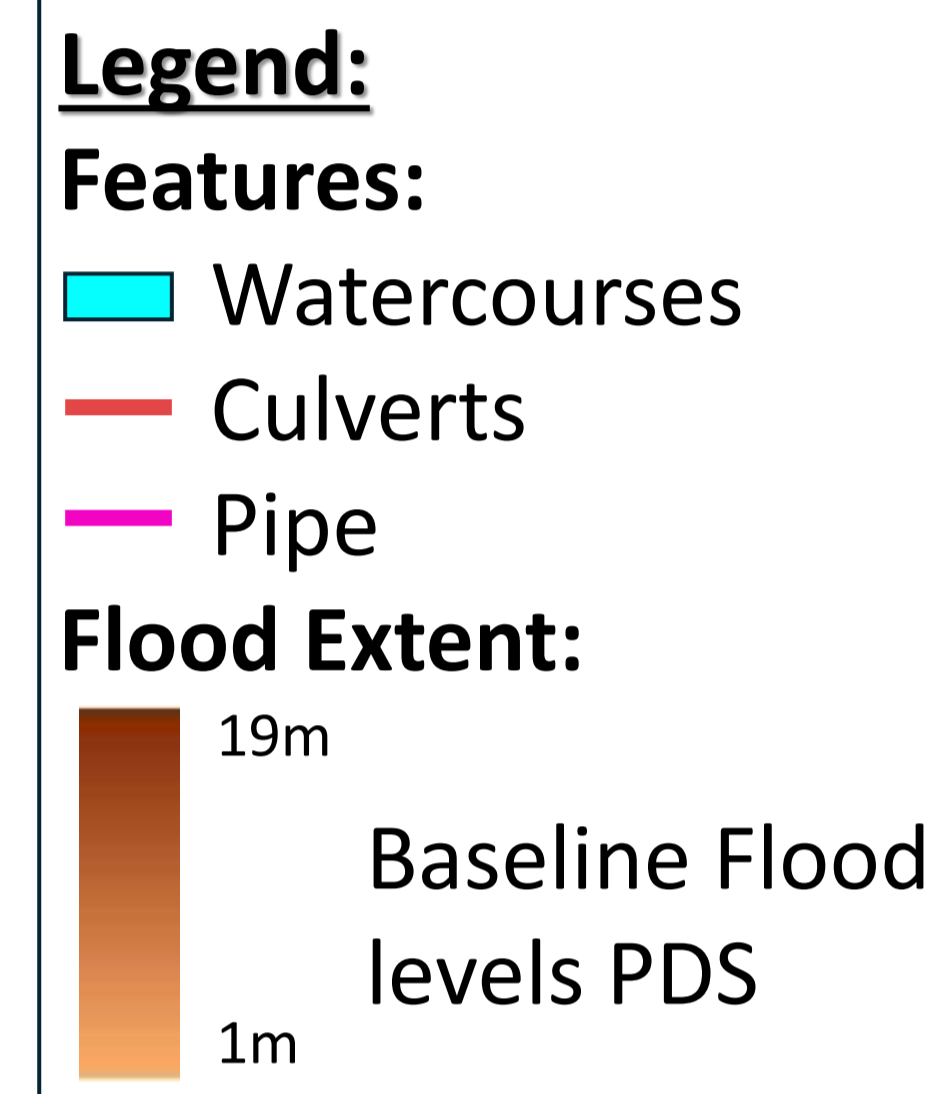
High-End Future Scenario (HEFS)



TIDAL FLOOD RISK

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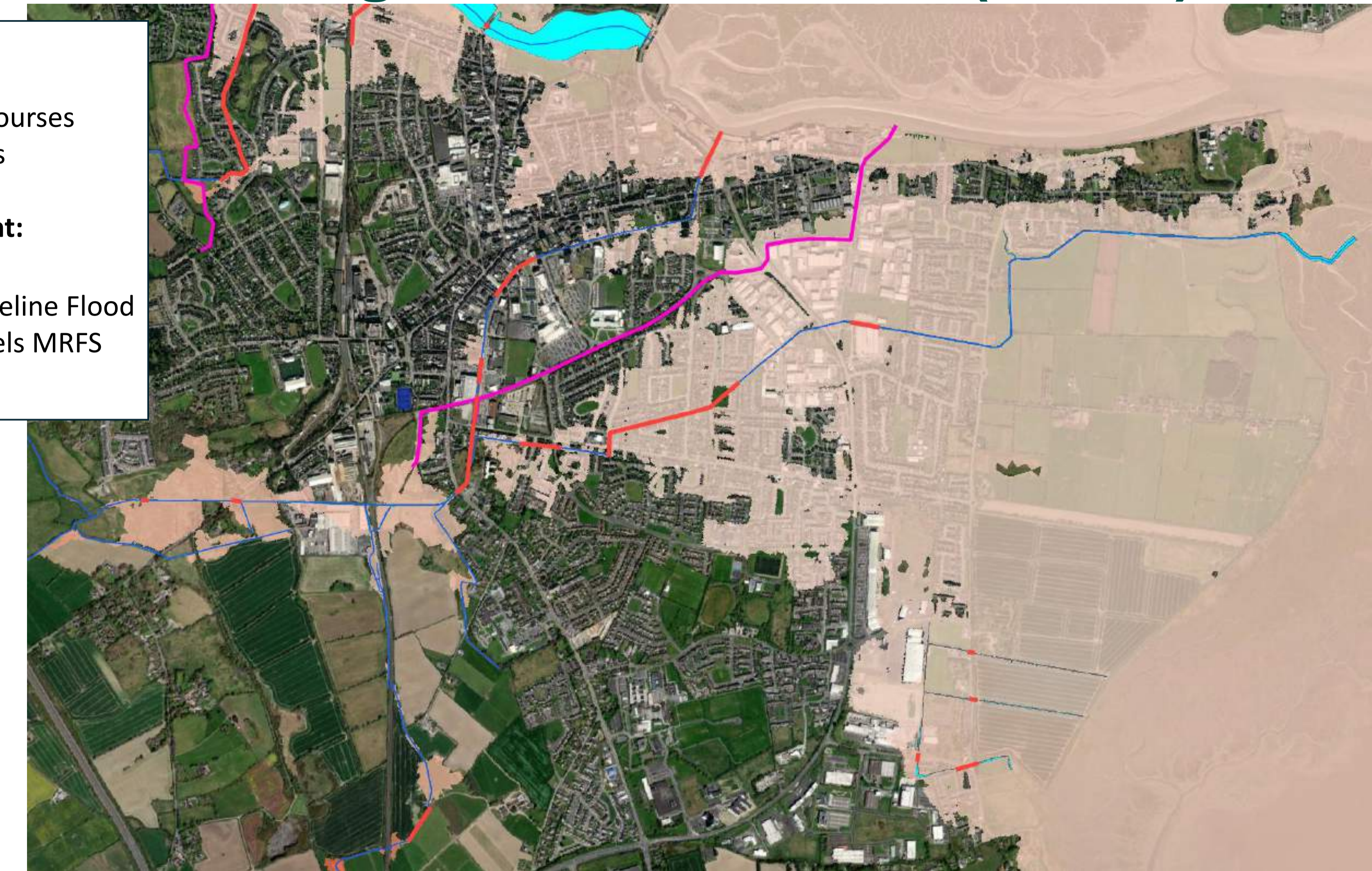
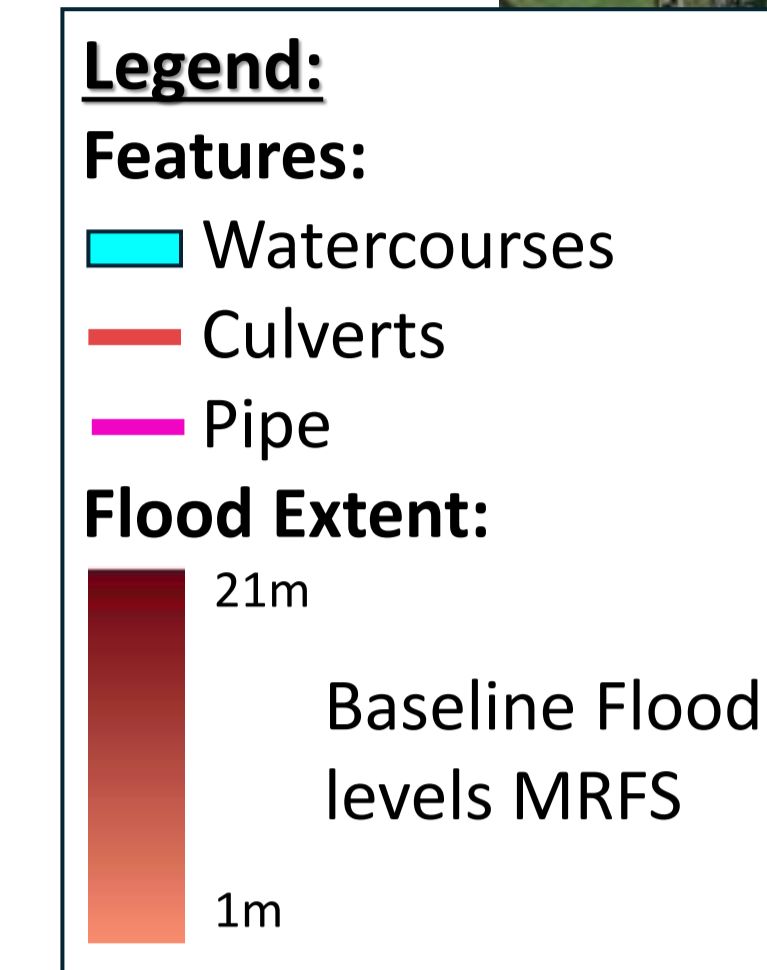
Present Day Scenario



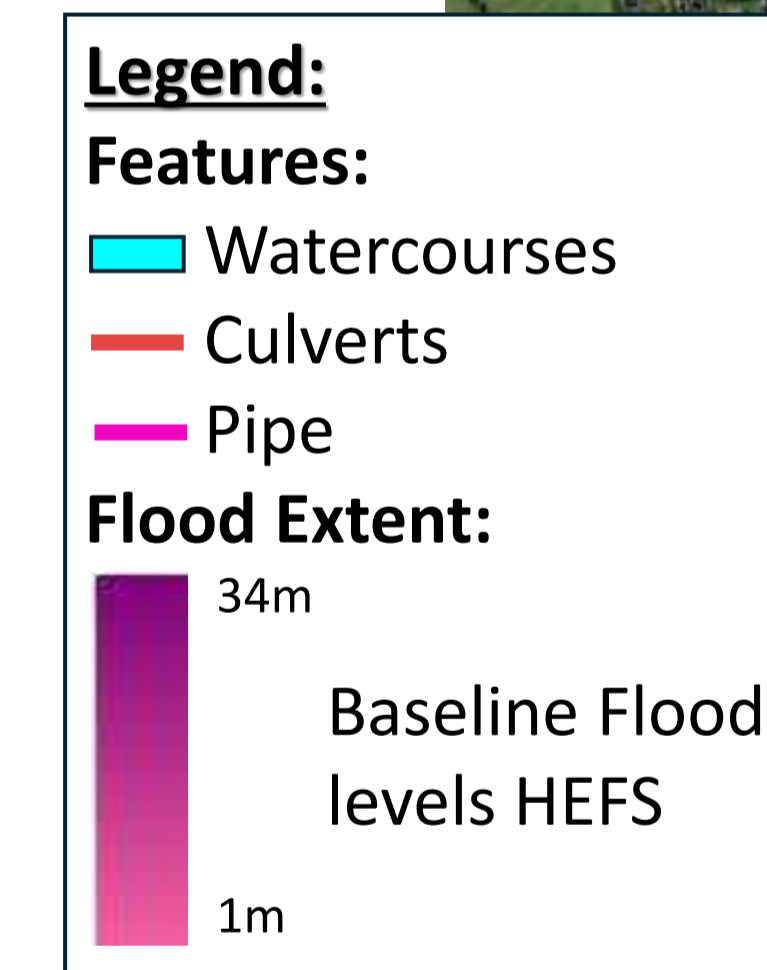
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Mid-Range Future Scenario (MRFS)



High-End Future Scenario (HEFS)



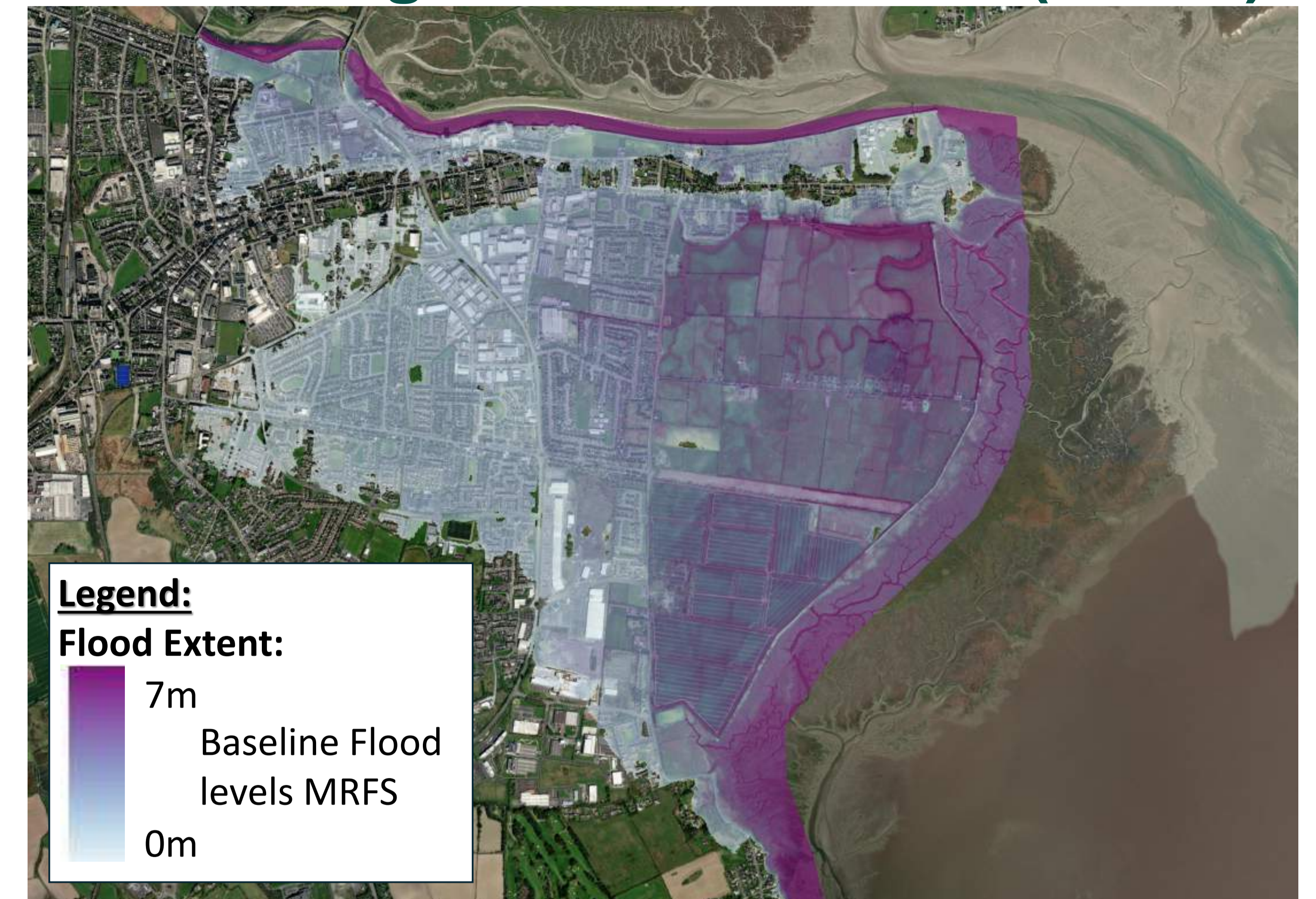
COASTAL FLOOD RISK (WITH WAVE ACTIONS)

For a 1 in 200 year coastal event (0.5% Annual Exceedance Probability (AEP))

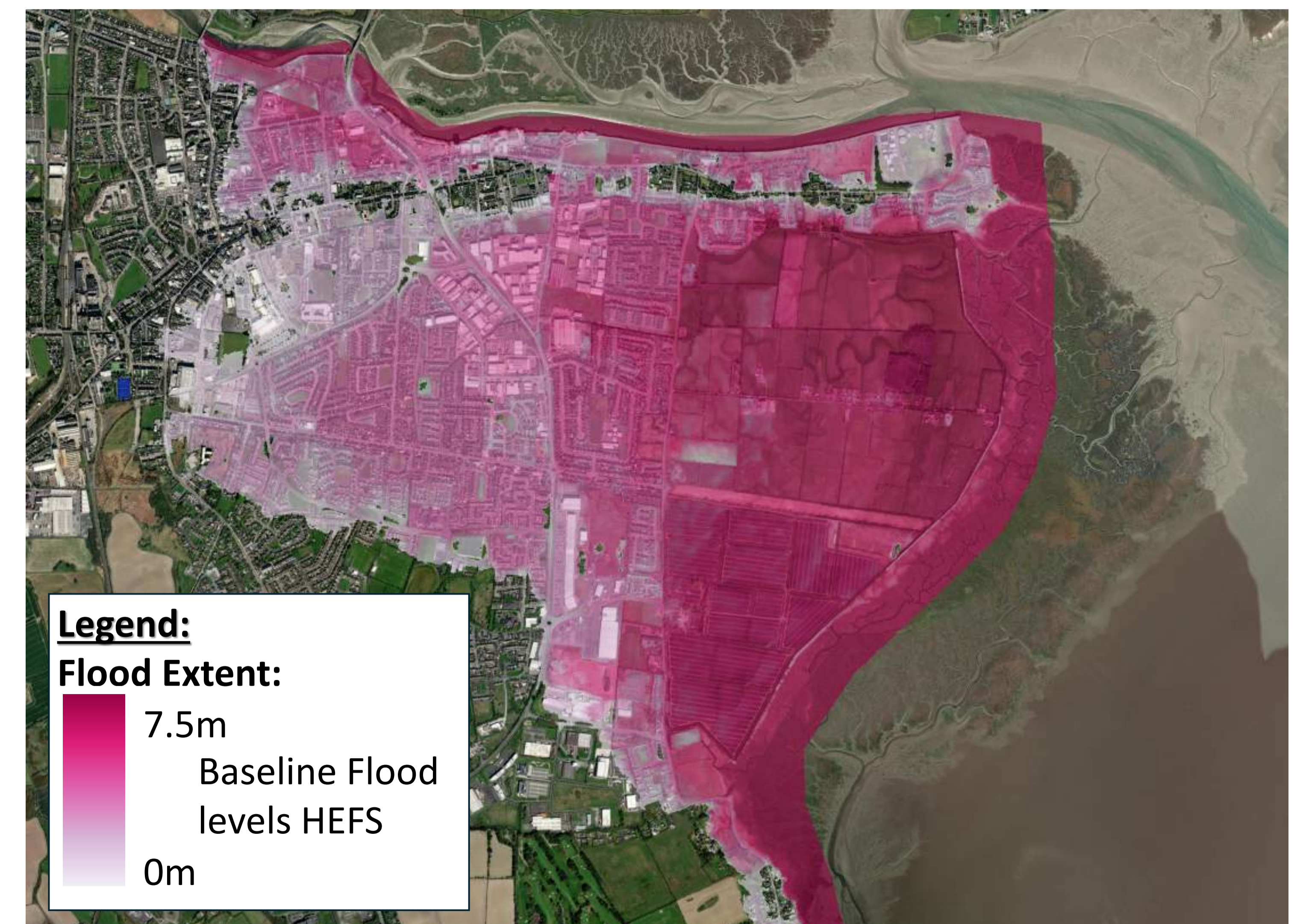
Present Day Scenario



Mid-Range Future Scenario (MRFS)



High-End Future Scenario (HEFS)



NATURE BASED SOLUTIONS

Nature Based Solutions (NBS) are actions that use a natural approach to accomplish adaptation and resilience against flooding events. In the context of this scheme, NBS can be used to restore fluvial processes, such as reconnecting the floodplain, creating upstream temporary retention basins or meandering rivers.

NBS are important because they can provide cost effective solutions in certain areas, as well as create or enhance habitats. Compared to hard engineering defences such as flood walls or culvert upgrades, NBS usually require less maintenance and have a lower carbon footprint. However, they are best suited for less dense areas and can be constrained by topography. Some NBS are also not suitable for managing high intensity of flooding, such as the 1-in-100 years design flood event considered for the Dundalk scheme.

Several NBS were evaluated in this scheme but unfortunately, due to spatial constraints of existing urban development, the number of these solutions applicable to the project were reduced. The ones considered in these options at present are natural storage and connection with the floodplain.



Spatial constraints in Dundalk, complicating the applicability of NBS

CLIMATE CHANGE ADAPTABILITY

Climate Change Adaptability is ensuring that flood risk management interventions are designed considering the potential increase in flood risk that could arise in the future due to climate change. Two climate change scenarios are considered: the Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS). These scenarios are based on climate modelling and projections documented by the Intergovernmental Panel on Climate Change (IPCC) and considers various timelines scenarios for the occurrence of the MRFS and HEFS.

Parameter	MRFS	HEFS
Extreme rainfall	+20%	+30%
Peak flood flows	+20%	+30%
Mean Sea Level Rise	+500mm	+1000mm

In the context of this scheme, the options are designed for Present Day Scenario (PDS) but also considering adaptation for future proofing, including for the MRFS and the HEFS.

The adaptation potential is assessed through the Scheme Climate Change Adaptation Plan (SCCAP), throughout the scheme development, where adaptation to MRFS and HEFS are considered from the initial measures screening stage to the preferred option stage. In particular, the Plan identifies and screens a list of potential adaptation measures and pathways, establish timing of trigger points for initiating new measures and assess adaptability and flexibility of the scheme.

FLUVIAL (RIVER) FLOOD PROTECTION MEASURES

Typical means of providing flood protection are presented below.

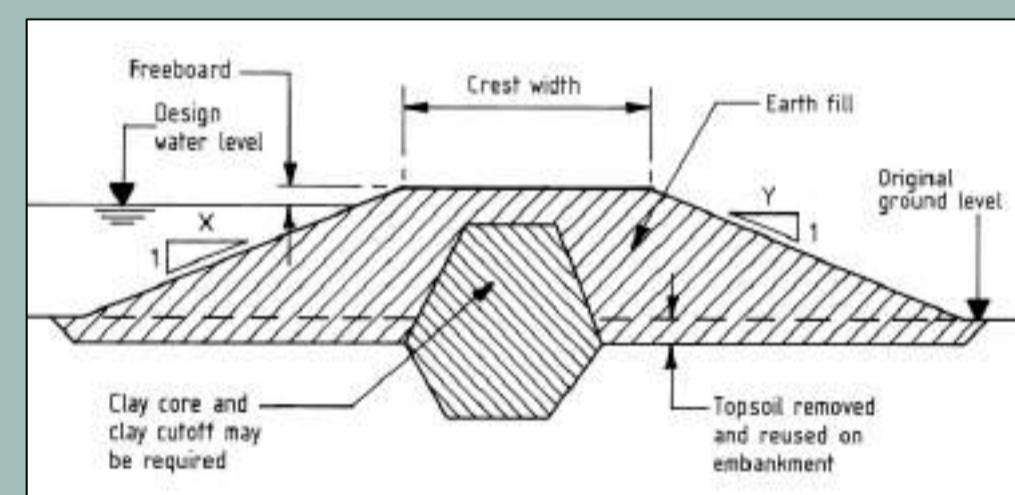
HARD ENGINEERING MEASURES

Containment - Embankments



Description:

- Embankments are earthen structures built along rivers to create a physical barrier and hold back floodwaters. Embankments often extend over long distances to protect large tracts of land from flooding.



Typical Embankment Cross-Section

Consequences/effects:

- Embankments require regular maintenance.
- Requires sufficient space. Not suitable in confined areas.

Conveyance - Culvert Upgrades



Description:

- Culvert upgrades aim to improve the conveyance of water through the channel in flood events. It can include the addition of culvert channels or increasing the size of existing channels of the culvert.

Consequences/effects:

- Requires regular maintenance to remove the build up of debris and vegetation or else this can increase flood risk.
- Limited adaptation to climate change.
- Traffic management during construction.

Containment – Flood Walls



Description:

- Flood walls are permanent hard engineered structures built along the banks of a river to create a physical barrier to hold back floodwaters.

Consequences/effects:

- Visually obstructive when higher walls are required.
- Access to the river may be difficult.
- Require less lands than an embankment.

Pumping



Description:

- Pumping may be required in conjunction with other measures to ensure proper discharge of flows to their outlet during high tides and/or to reduce containment heights.

Consequences/effects:

- Significant energy consumption during operation, leading to high operational costs and carbon footprint.
- Limited area required but high noise level during operations.
- Risk of pumping failure and operational constraints.

NATURE BASED SOLUTIONS

Retention systems



Description:

- Upstream storage contains floodwaters for temporary storage. Water is then slowly released back to the river following a flood event. Storage can provide additional habitats and create opportunities to enhance amenity value.

Consequences/effects:

- Loss of land/ amenities during flood events.
- Can require an impounding structure (embankment, bund, dam, weir) for waters to be held back.

Floodplain restoration



Description:

- Floodplain restoration reconnects a river to its natural floodplain so high flows can spread out, slow down, and be temporarily stored, reducing downstream flood risk while enhancing ecological and water-quality benefits.

Consequences/effects:

- Loss of land/ amenities during flood events.
- Major ecological benefits, including creating new habitats for biodiversity.
- High climate change adaptability

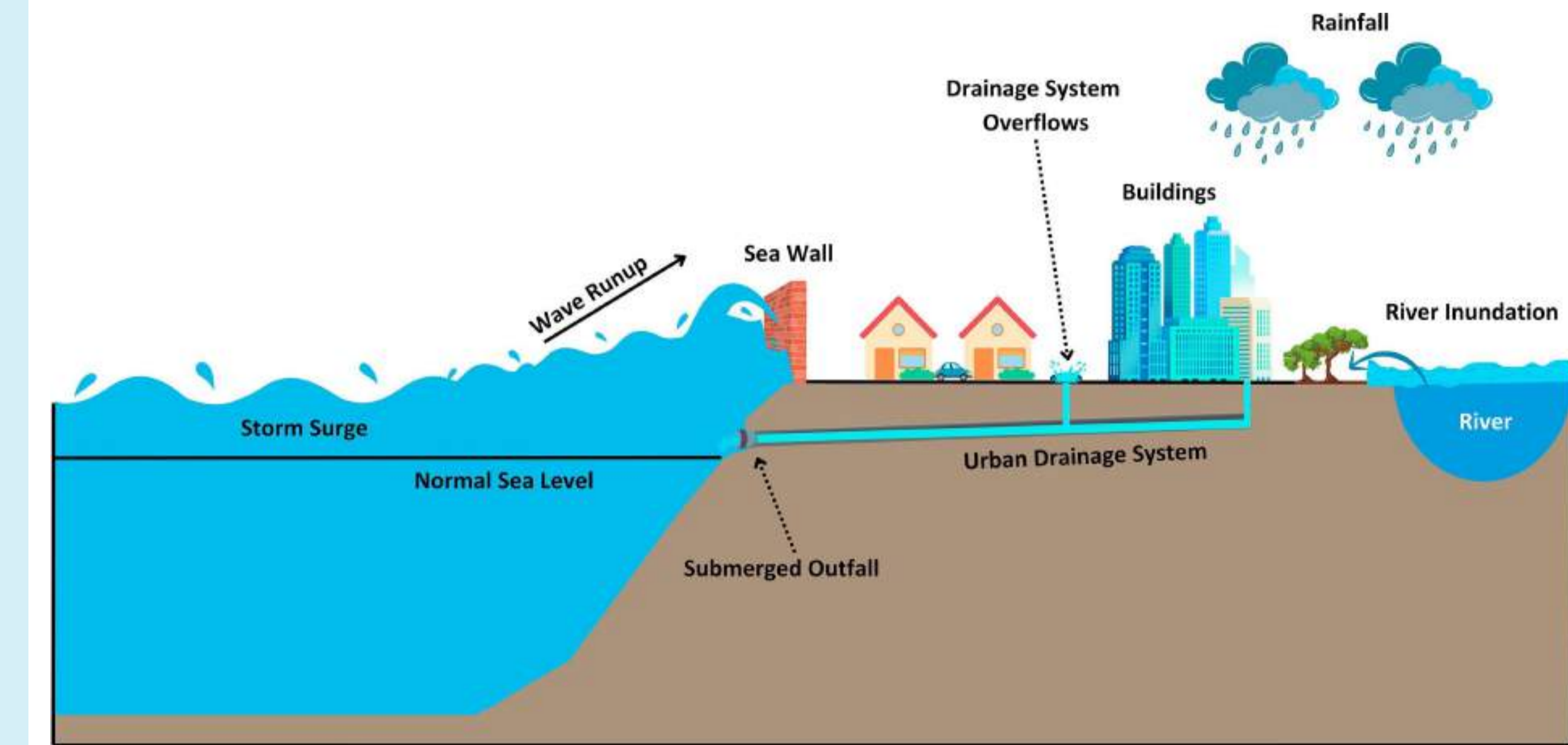
COASTAL FLOOD RISK MANAGEMENT POLICIES

The Dundalk Scheme is at risk from both tidal and coastal flooding.

Coastal flooding occurs when seawater reaches land and built-up areas along the coast. This typically happens during storms when high tides and large waves combine to raise sea levels and increase wave energy at the coast. In urban coastal areas, flooding can occur when waves overtop coastal defences, allowing water to flow into streets, public spaces, and low-lying areas behind the shoreline.

In areas where wave action is limited, flooding can be caused by high water levels, a combination of high tides and storm surge, which causes the defences to be overtopped.

Policies to manage coastal flood risk are broadly categorised as outlined below.



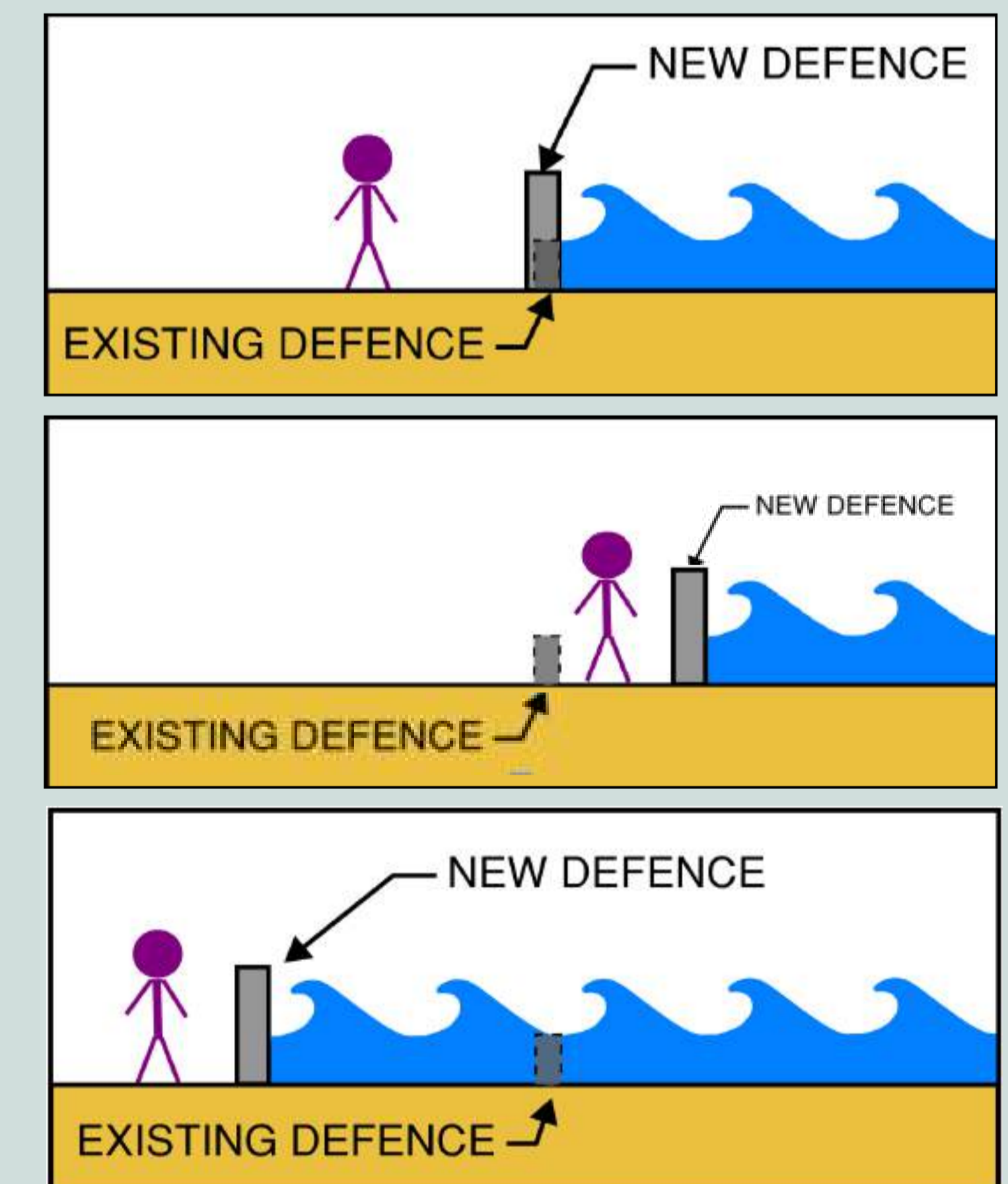
Do nothing This policy involves a decision not to invest in a flood risk management scheme.

Do minimum This policy involves undertaking minor maintenance and repairs to any existing defences, by carrying out the minimum work required to maintain the current or restore a previous standard of protection.

Hold the Line Maintain or improve the existing coastal defences to protect the current shoreline position. This typically involves maintaining, strengthening or raising existing defences.

Advance the Line This policy involves the construction of new defences seaward of the existing defence alignment, creating additional space between the sea and assets at risk.

Managed Retreat Managed retreat allows the coastline to move naturally (Set-Back) by establishing a buffer zone between the sea and the assets at risk. This could be done either by realigning an existing coastal defence or by retreating landward in areas where no established defences exist. This can create additional space for the development of new intertidal areas that act as flood risk control mechanism.



Applicability

For Dundalk, the 'Do Nothing' and 'Do Minimum' policies were not considered suitable as they would not provide the required Standard of Protection.

As a result, options development focused broadly on Hold the Line, Advance the Line, and Managed Retreat policies.

COASTAL FLOOD MEASURES

Coastal flooding measures are potential solutions to address wave and tidal flooding. Not all measures are applicable to all policies, and neither are all measures applicable to all areas of coastline, so a screening process was carried out to screen out some measures.

FLOOD PROTECTION MEASURES include measures that physically reduce the flood risk. These include:

A, B, C. Sea walls, embankments, stone or rock armour revetments (either new or upgrading existing) which provide a direct barrier to wave overtopping.



D. Breakwaters, which reduce oncoming wave heights.



E. Flood storage measures, such as storage tanks or ponds.



F. Groynes – used to trap sediment and form a buffer to wave action.



G. Saltmarsh restoration, which also provides a buffer zone to waves.



H. Beach management, including beach nourishment, reprofiling and dune management.



I. Demountable defences – temporary flood defences that are erected as required.



J. Individual property protection, such as flood doors & barriers, air brick covers, repointing, pumping systems.



FLOOD PREVENTION MEASURES, may also be included in Flood Relief Schemes. These include measures that aim to avoid placing people and properties at risk, such as:

K. Sustainable Planning and Development Management, which involves integrating long term– flood risk considerations into development strategies.

L. Land Use Management and Natural Flood Risk Management Measures, which involve the restoration of floodplains or wetlands by removing artificial or natural barriers

M. Voluntary Home Relocation, aimed at reducing long-term flood risk by encouraging property owners to relocate away from high-risk flood zones

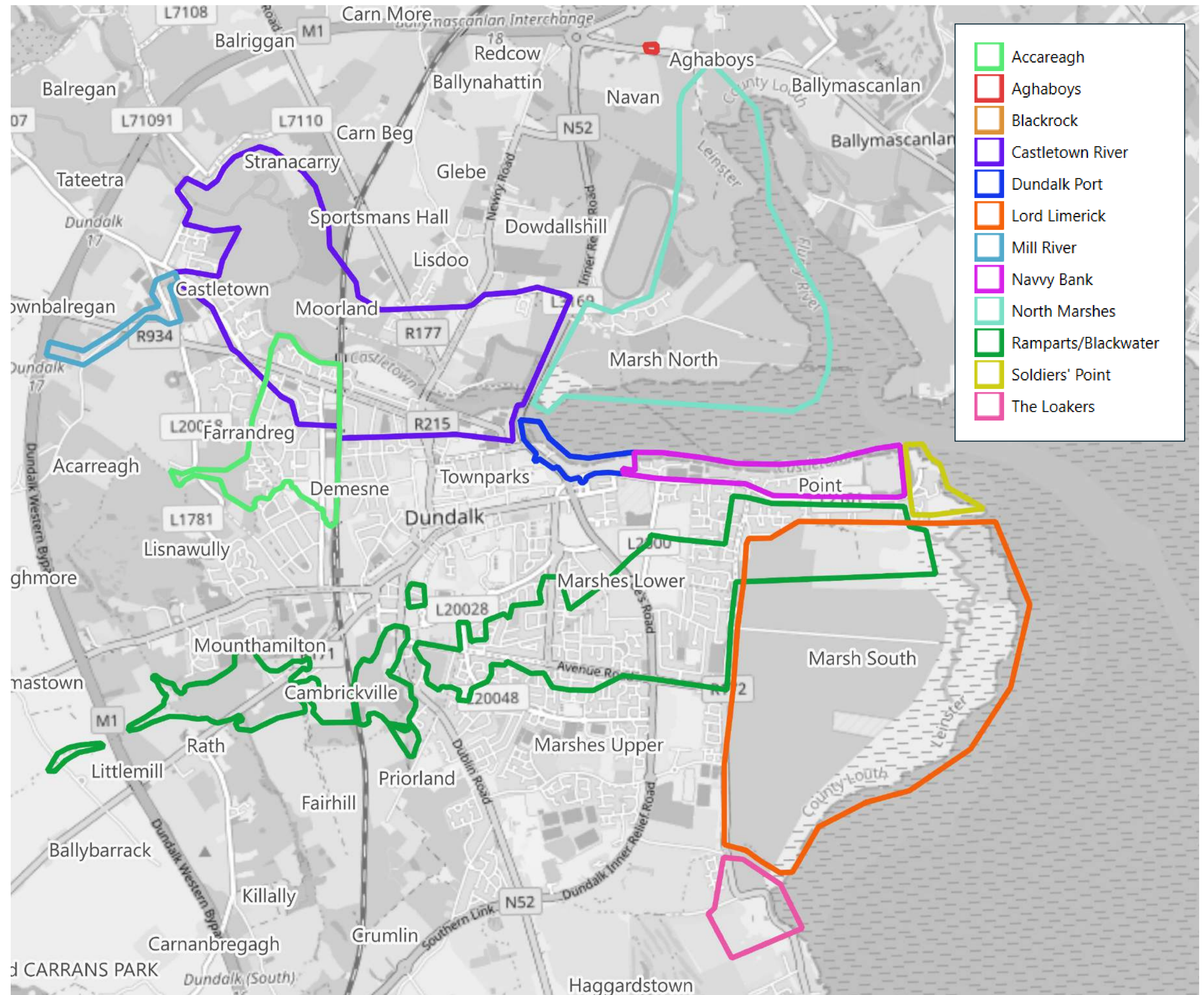
N. FLOOD PREPAREDNESS MEASURES, which are enacted in combination and include forecasting and warning systems, informed by flood data collection programmes. These can be used in developing emergency response action plans and implementing public awareness programmes to promote community resilience to flooding.

SCHEME AREA – FLOOD CELLS

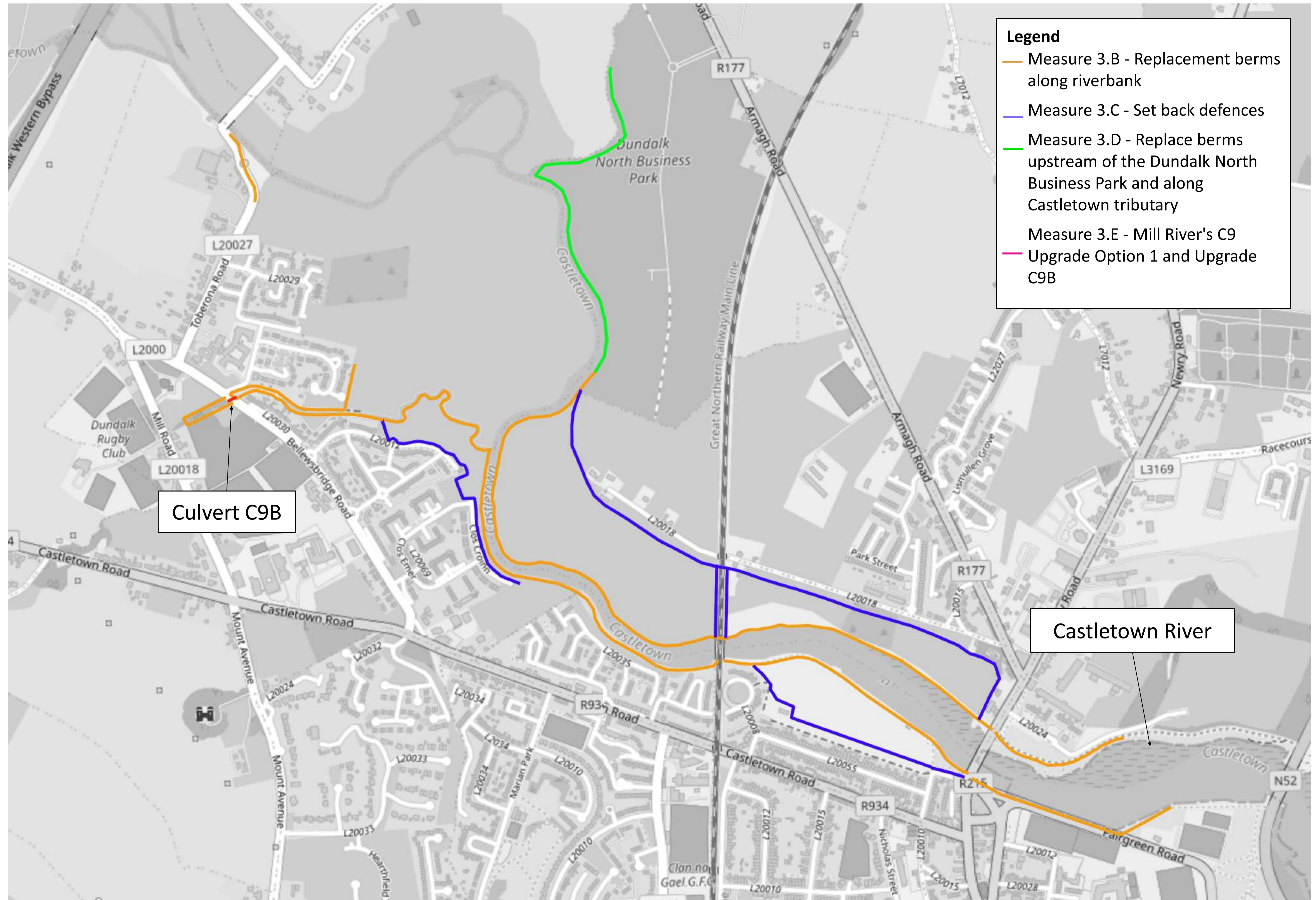
Flood Cells are sub zones within the scheme area, subjected to coastal and/or fluvial flooding but hydraulically distinct from one another.

For today's presentation, the flood cells were arranged into presentation groupings as shown below

Flood Cells	Presentation Grouping 1
Castletown River	Posters 16-19
Mill River	Posters 20-22
Accareagh	Posters 23-24
North Marsh	Posters 25-29
Aghaboys	Posters 30
Presentation Grouping 2	
Dundalk Port	Posters 31-32
Navy Bank	Posters 33-38
Soldier's Point	Posters 39-43
Presentation Grouping 3	
Lord Limerick	Posters 44-53
The Loakers	Posters 54-58
Ramparts/Blackwater	Posters 59-62



CASTLETOWN RIVER – OVERVIEW OF MEASURES

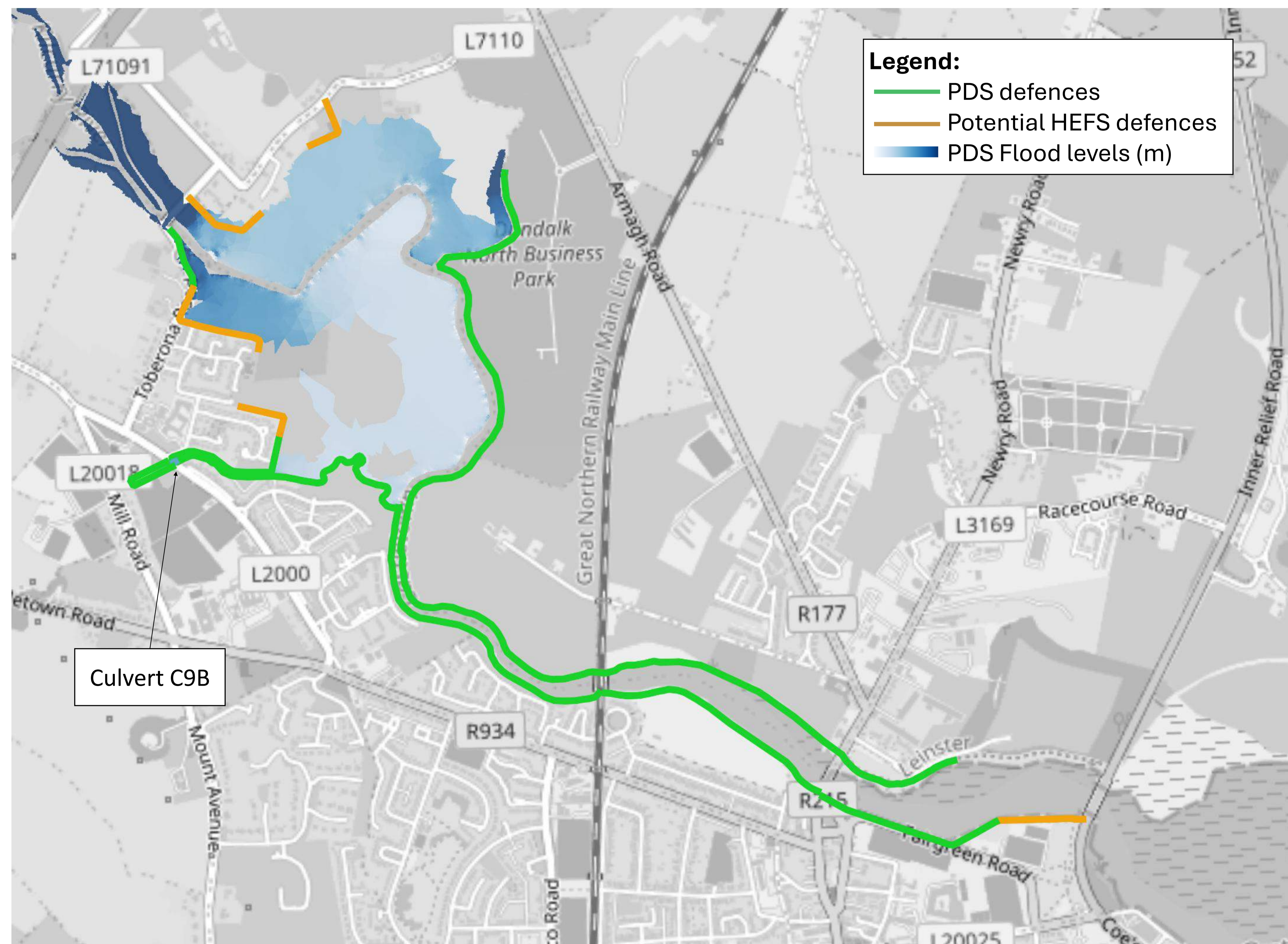


Discarded measures

<p>3.A – Storage</p>	<p>The hydraulic modelling has highlighted the significant volume of water required to be stored, which make this measure undeliverable at this scale.</p>
<p>3.F – Dredging of Castletown</p>	<p>This measure was discarded as it is not adaptable to climate change. Dredging is a temporary option that would have to be undertaken repeatedly.</p>

OPTION 1: Full Containment

Containment all along Castletown River and its tributaries (new embankments along riverbanks, either along the existing embankment alignment or slightly set back). Where space is restricted, walls could form part of the defense measures. The option also includes the upgrade of the culvert C9B on Mill River.



Advantages

Space is generally available for new embankments. This is a simple solution.

This option would protect areas on the south and north side of Castletown river and its tributaries.

This option would have minimal visual impact on the affected areas but would result in higher embankment heights compared to Options 2 and 3 (+0.5m and +0.7m respectively).

Limitations

This option could have an environmental impact on Castletown river, with works carried out close to the river and to the SPA.

It could potentially impact the river water quality and its status under the Water Framework Directive.

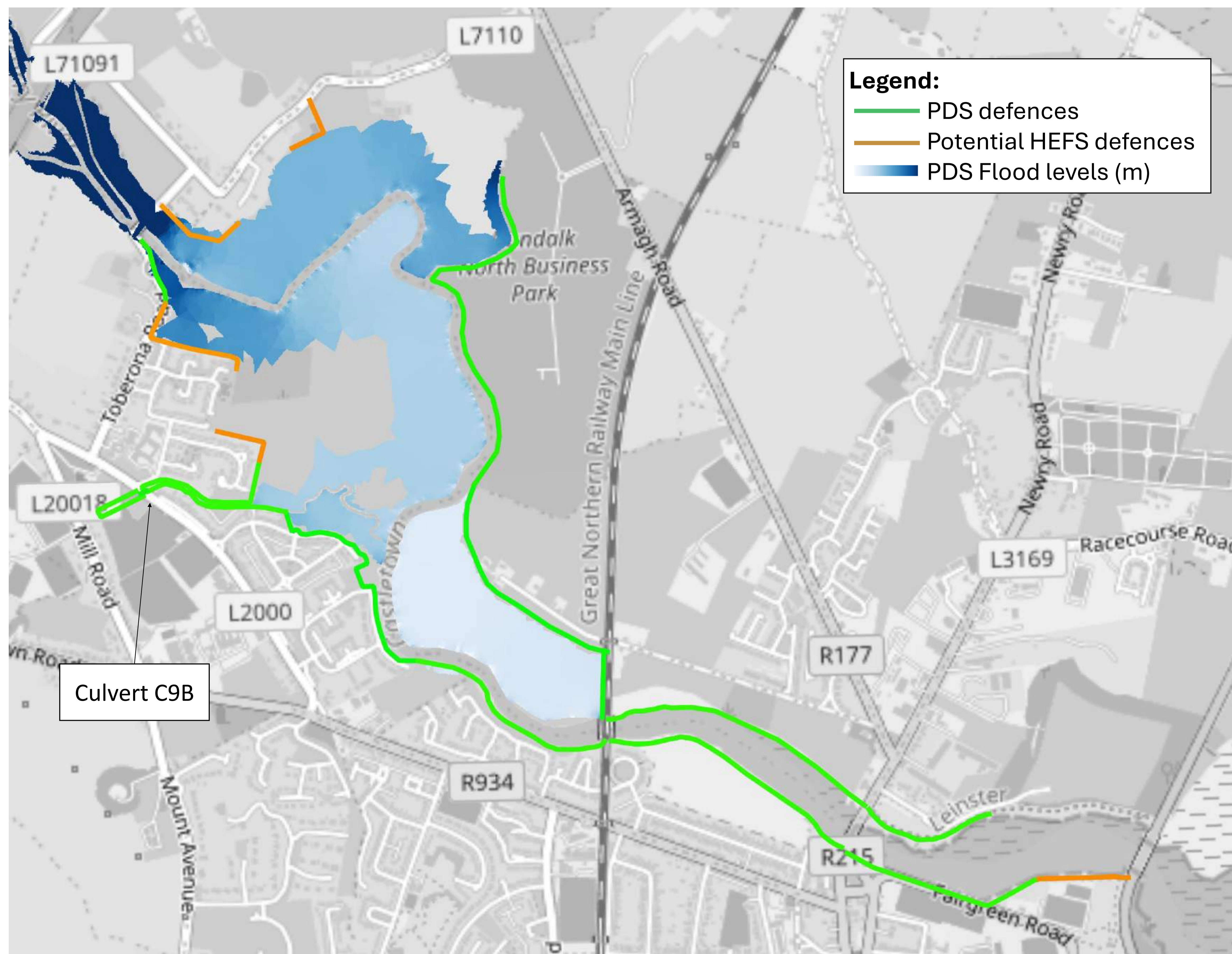
No reuse of the existing embankment possible.

This option must accommodate the existing bridges and wingwalls, which presents a significant design constraint.

Adaptation to climate change is limited and no NBS are used.

OPTION 2: Partial setback with floodplain restoration

Containment downstream of the Railway bridge (replacement berms along riverbanks or set back). Upstream of the Railway bridge and along the tributary, defences are set back allowing for floodplain restoration. Where space is restricted, walls could form part of the defense measures. The option also includes the upgrade of the culvert C9B on Mill River.



Advantages

There will be a reduction of water level in the river in comparison to Option 1.

This option integrates the use of Nature Based Solutions by restoring part of the natural floodplain of the river and will allow for the creation of habitats.

The area downstream of the railway bridge will still be protected, but an additional embankment will be required on the upstream of the railway bridge to protect the railway embankment

Limitations

There may still be some impact on the river and SPA during construction and for longer term on the water quality and WFD status.

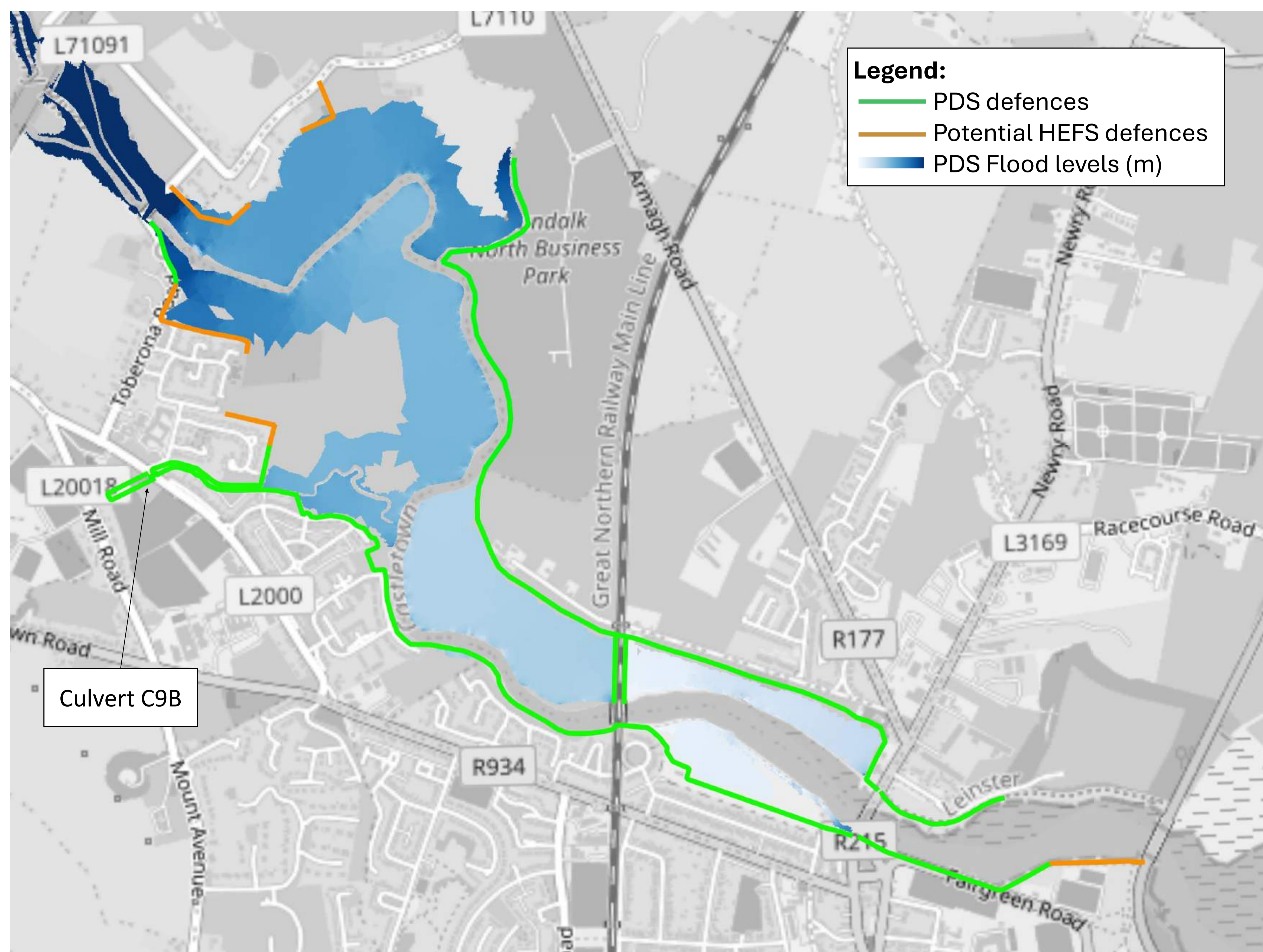
This option would naturally result in the flooding of the restored floodplain upstream of the railway bridge, as the existing bund has and will continue to degrade over time.

Some recreational areas would not be protected and may be flooded during extreme flood events.

As for Option 1, this option must accommodate the existing bridges and wingwalls, which presents a significant design constraint.

OPTION 3: Full Setback with floodplain restoration

Floodplain restoration wherever possible, upstream and downstream of the railway bridge, Where space is restricted, walls could form part of the defense measures. The option also includes the upgrade of the culvert C9B on Mill River.



Advantages

There will be a reduction of water level in the river compared to Options 1 and 2.

This measure restores a significant part of the natural floodplain of the river and will allow for the creation of habitats. This option utilises NBS to its fullest extent.

There is a higher climate change adaptability as the berms will be lower and more water can be stored in the natural floodplain.

Limitations

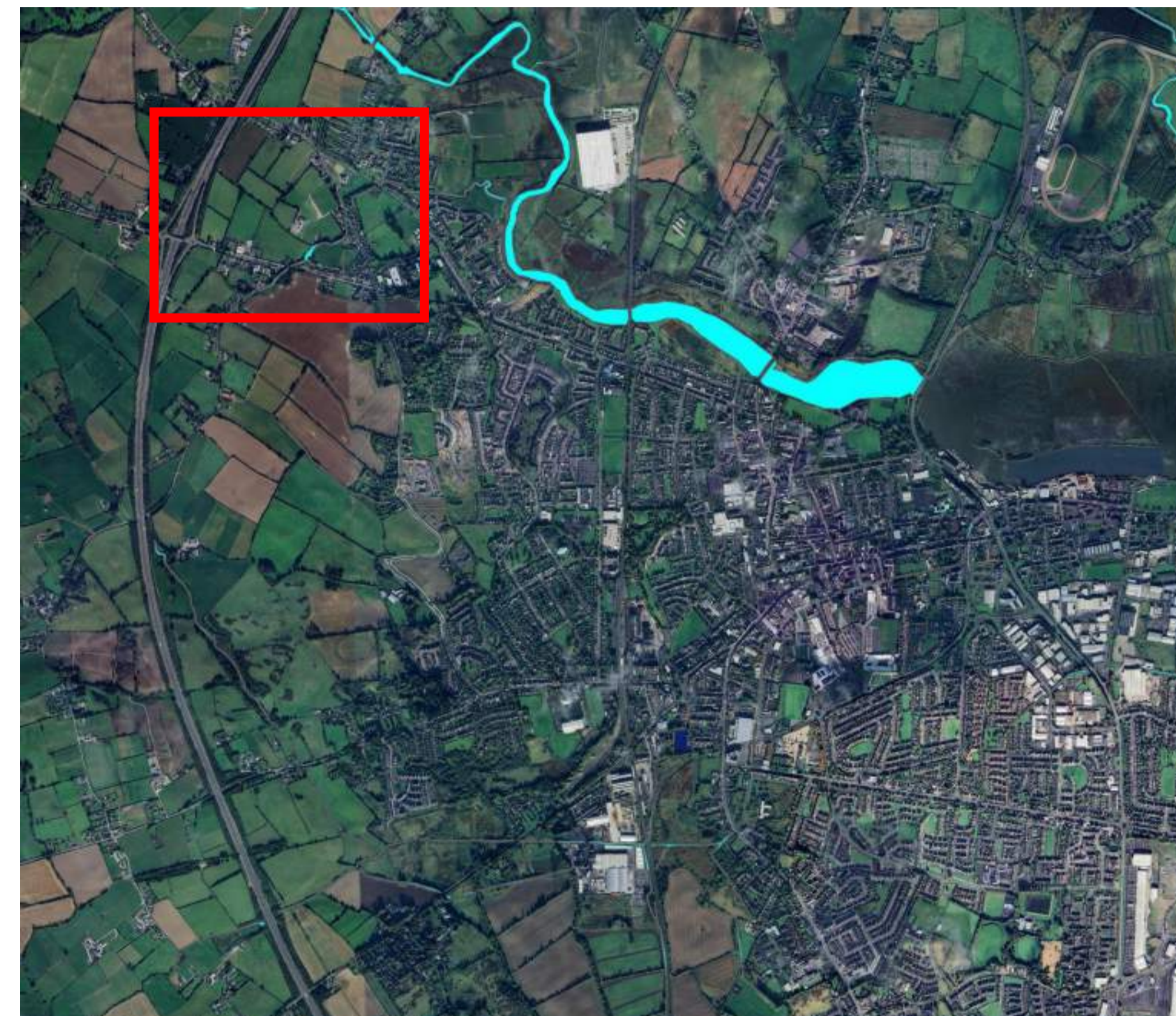
Impact on the river would be limited to containment areas but there is still a potential impact on the SPA.

This option would naturally result in the flooding of the restored floodplain on both sides of Castletown river, as the existing bund has and will continue to degrade over time.

Some recreational areas would not be protected and may be flooded during extreme flood events

As for Options 1 and 2, this option must accommodate the existing bridges and wingwalls, which presents a significant design constraint.

MILL RIVER - OVERVIEW OF MEASURES

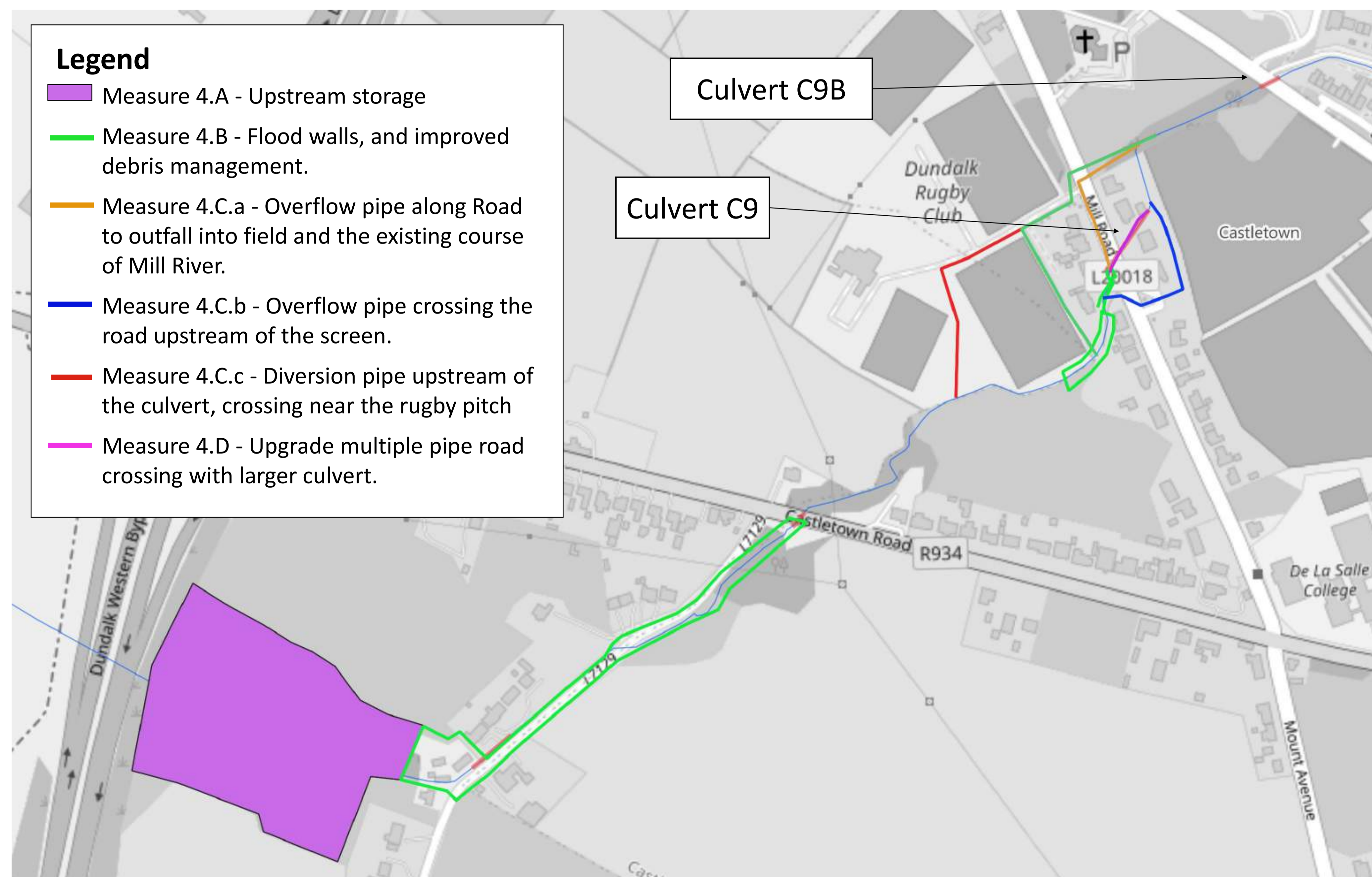


Discarded measures

4.A – Upstream storage	This measure was discarded as no houses are impacted by flooding upstream of Castletown road and the storage has no impact further downstream.
4.B – Flood walls, and improved debris management.	This measure was discarded as no houses are impacted by flooding upstream of Castletown road.

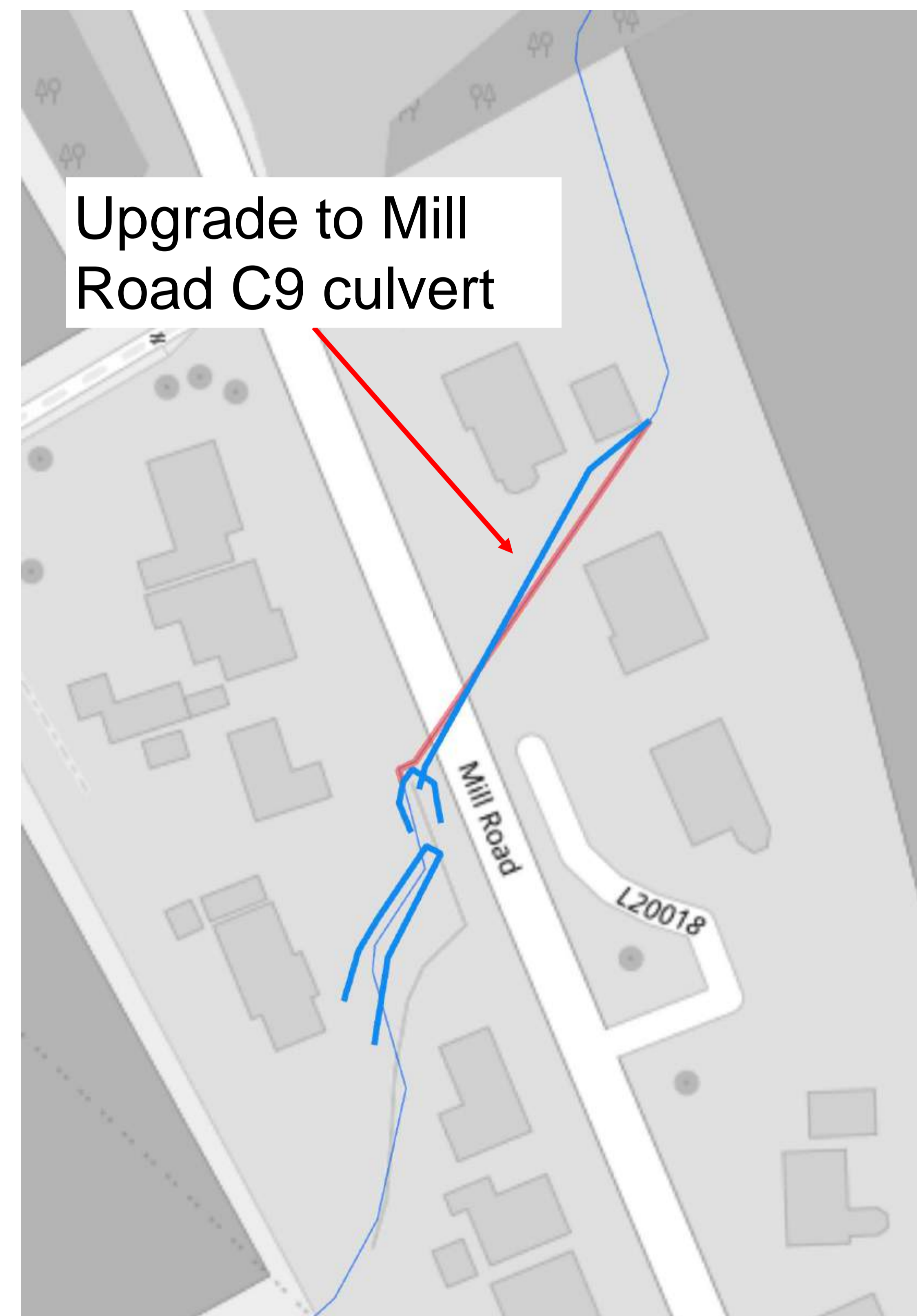
Legend

- Measure 4.A - Upstream storage
- Measure 4.B - Flood walls, and improved debris management.
- Measure 4.C.a - Overflow pipe along Road to outfall into field and the existing course of Mill River.
- Measure 4.C.b - Overflow pipe crossing the road upstream of the screen.
- Measure 4.C.c - Diversion pipe upstream of the culvert, crossing near the rugby pitch
- Measure 4.D - Upgrade multiple pipe road crossing with larger culvert.



OPTION 1: Upgrade C9

This option proposes to replace the existing culvert under Mill Road and in private properties. The existing 5 pipes are replaced with a culvert height of 1000mm and width of 1800mm. A small flood wall and head wall would be required at the culvert inlet.



Advantages

- No / minimal visual impacts or impact to amenity, likely to be socially acceptable.
- No changes to the culvert alignment.
- No archaeological or geological heritage impacts identified.

Limitations

- Regular maintenance required on culvert.
- Cover level constraint under the road.
- Landowner engagement required where the culvert crosses properties.
- Small flood wall and headwall required upstream of the culvert, with buildability constraints.

OPTION 2: Diversion along Mill Road

An overflow pipe diverts flood waters northward under Mill Road and further north rejoins the existing channel downstream. The existing culvert is maintained with minimal flows.



Advantages

- Minimal visual impacts or impact to amenity, likely to be socially acceptable.
- Avoid works in private properties or limited to boundaries, follows Mill Road.
- No archaeological or geological heritage impacts identified.

Limitations

- As for Option 1, a small floodwall and headwall are required upstream of the new culvert, with significant buildability constraints.
- The route crosses several utilities and follows a line of overhead cables, leading to increased construction constraints compared to Option 1.

OPTION 3: Diversion upstream of C9

Overflow pipe crossing on Mill Road and going behind the downstream properties to join the channel. This option removes the constraint of the small culvert upstream on the main culvert and thus no flood walls are required. The existing culvert is maintained with minimal flows.



Advantages

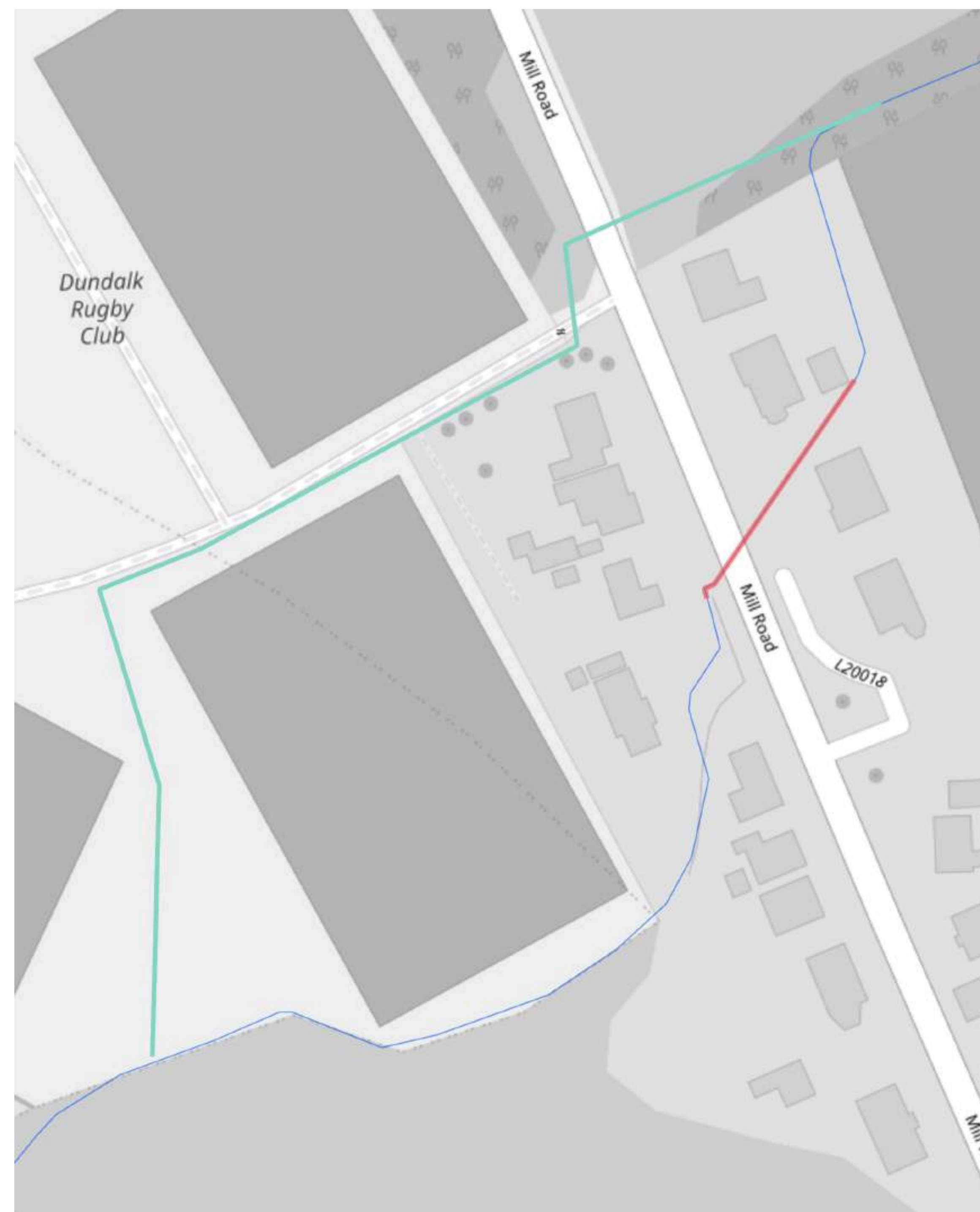
- As for Options 1 and 2, likely to be socially acceptable and avoid works in private properties or limited to boundaries.
- No flood walls are required upstream of the new culvert as the deviation starts upstream of the existing culvert entrance.

Limitations

- The culvert would cross Mill Road and an access road, leading to temporary traffic management and access limitation during construction.
- The route is adjacent to a green space with trees and hedgerows, leading to potentially higher environmental impacts.

OPTION 4: Diversion between rugby pitches

Overflow pipe starting 200m upstream of the C9 culvert and going between the rugby pitches then crossing Mill Road to join the channel downstream. The culvert sits at its deepest point 4.7m below the ground level. As the overflow pipe branches off further upstream, there is no need for flood wall upstream of the existing culvert.



Advantages

- Minimal visual impacts in the area.
- No flood walls are required upstream of the existing culvert.
- No archaeological or geological heritage impacts identified.
- Spatial constraints reduced.

Limitations

- Culvert is significantly longer and deeper than Options 1, 2 and 3.
- A deep chamber is likely required to reduce overall culvert depth.
- Construction disruption to the sport grounds during construction.

OPTION 4b: Diversion between pitches and houses

Overflow pipe starting 70m upstream of the C9 culvert and going between the rugby pitch and the house, then crossing Mill Road to join the channel downstream. The culvert is at its deepest point 3.6m below the ground level. As the overflow pipe branches off further upstream, there is no need for flood wall upstream of the existing culvert.



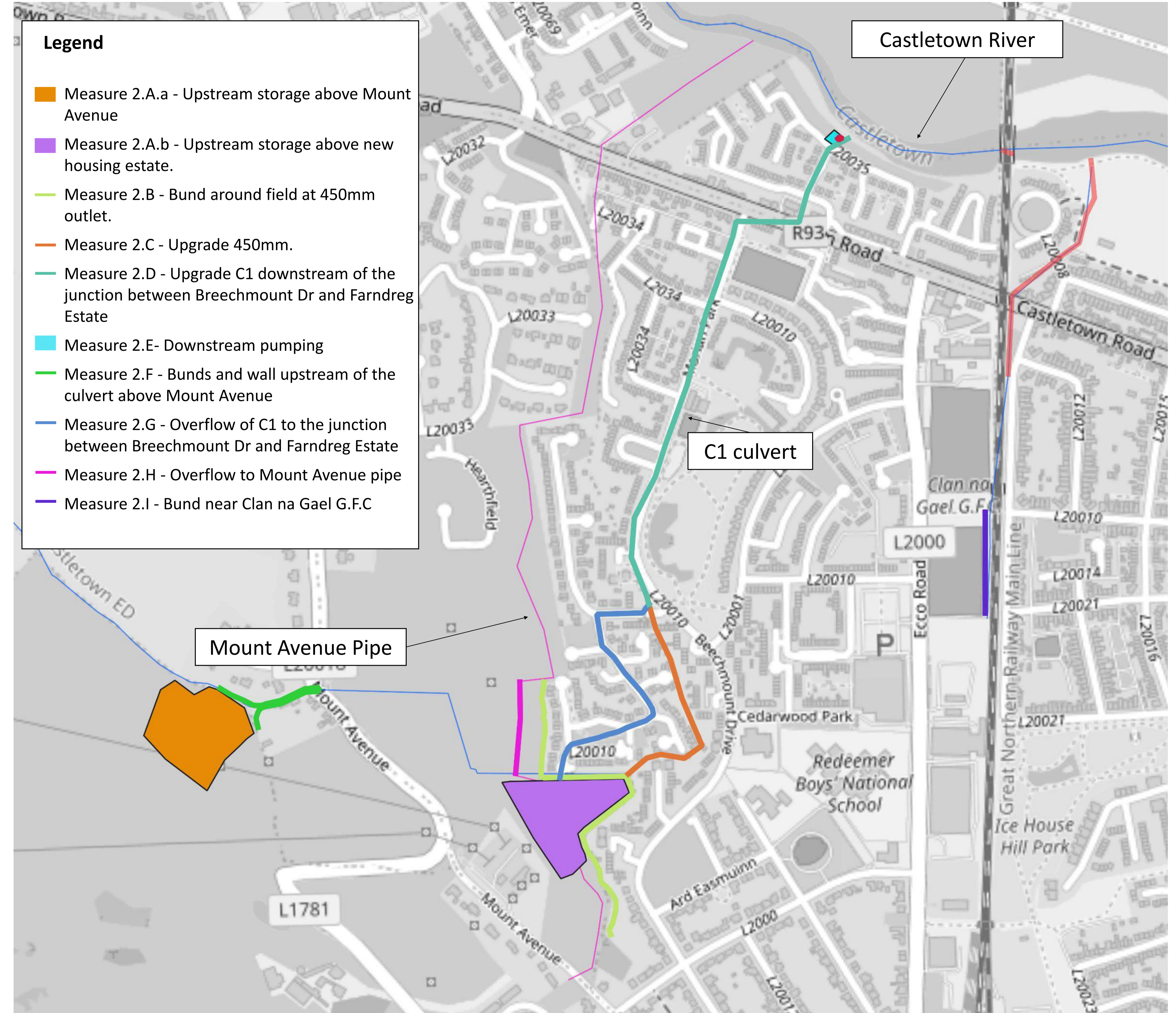
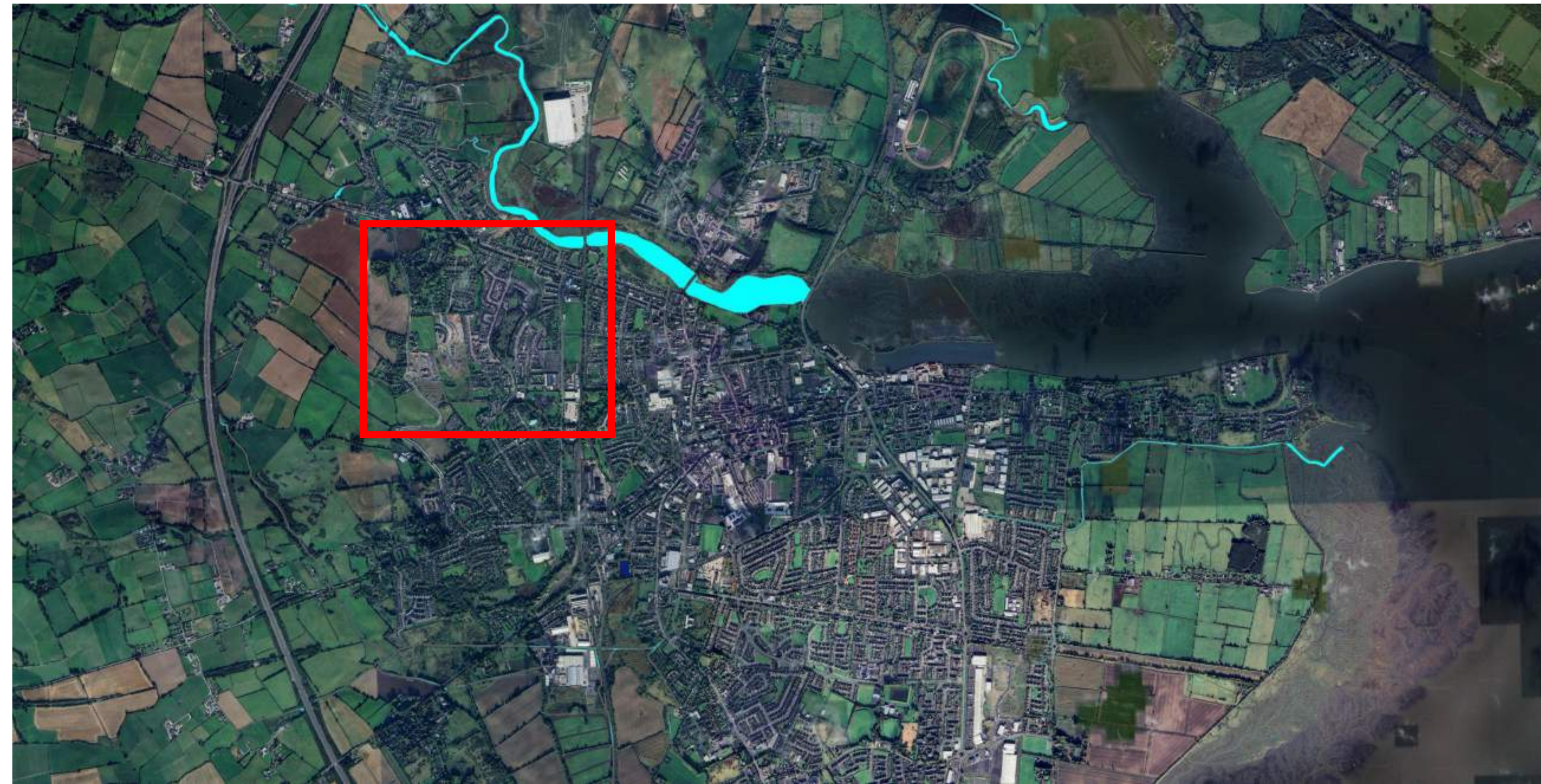
Advantages

- Minimal visual impacts in the area.
- No flood walls are required upstream of the existing culvert.
- No archaeological or geological heritage impacts identified.
- Culvert shorter and less deep than Option 4.

Limitations

- Culvert is longer and deeper than Options 1, 2 and 3 within a confined space.
- Possible impact on tree roots nearby.
- Landowner engagement required, and disruption to the rugby club during construction.

ACCAREAGH – OVERVIEW OF MEASURES

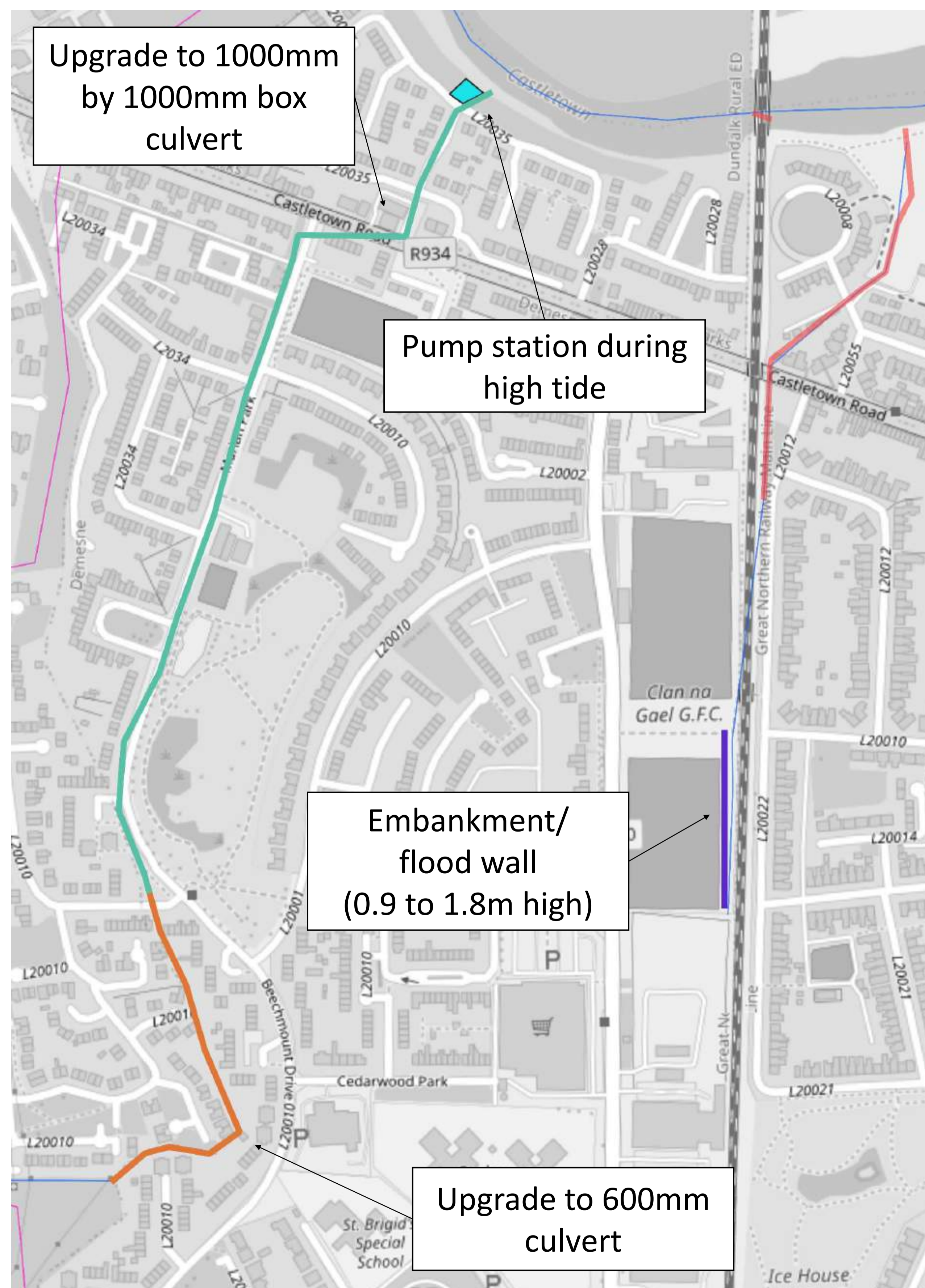


Discarded measures

2.A.a – Upstream storage above Mount Avenue	This measure was discarded due to high investment for low benefits, only one house potentially impacted and significant works expected.
2.A.b – Upstream storage above housing estate near Breechmount Dr.	This measure was discarded due to limited capacity and limited impact on downstream flooding
2.H – Overflow to Mount Avenue pipe	This measure was discarded due to its limited effect to climate change, and it has a finite capacity.

OPTION 1: Improved conveyance and Containment

This option includes the upgrade of the C1 culvert in its entirety, from Farndreg to its outlet at the Castletown river. At the downstream end, pumping is required when the Castletown river is affected by high tide. In addition, a bund is installed near Clan na Gael G.F.C to avoid flooding due to the bottleneck at the culvert under the railway embankment.



Advantages

This option is straightforward and will keep the existing culvert alignment.

The upgrade of the culvert will cater for the pluvial and the fluvial flooding waters, reducing the risk in low-events.

Limitations

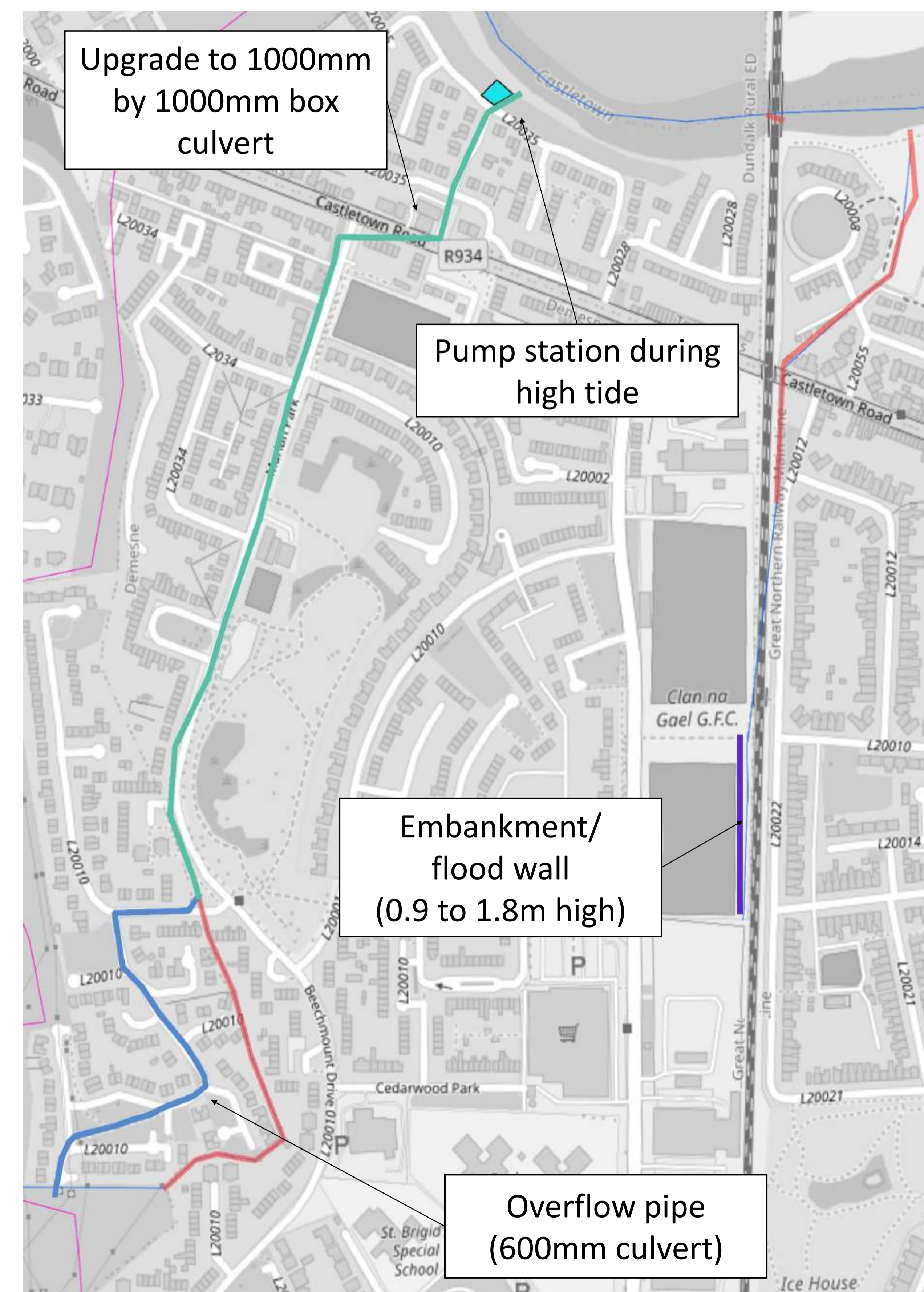
Most of the works will be carried out under residential properties in tight environments.

There will be a high disturbance of local residents and impact of services downstream of the junction between Breechmount Drive and Farndreg Estate.

There will be significant operational costs and environmental impacts near Castletown river.

OPTION 2: Conveyance, Diversion and Containment

This option includes the upgrade of the culvert C1 downstream of the Junction between Breechmount Drive and Farndreg Estate and the diversion of the 450mm to join the existing route at the junction. At the downstream end, pumping is required when the Castletown river is affected by high tide. In addition, a bund is installed near Clan na Gael G.F.C to avoid flooding due to the bottleneck at the culvert under the railway embankment.



Advantages

This option reduced the impact to private properties and increasing buildability compared to Option 1.

As for Option 1, the upgrade of the culvert will cater for the pluvial and the fluvial flooding waters, reduction the risk in low-events.

Limitations

There will be impacts on services downstream of the junction between Breechmount Drive and Farndreg Estate.

There will be significant operational costs and environmental impacts near Castletown river.

Both options display limited adaptation to climate change.

NORTH MARSHES

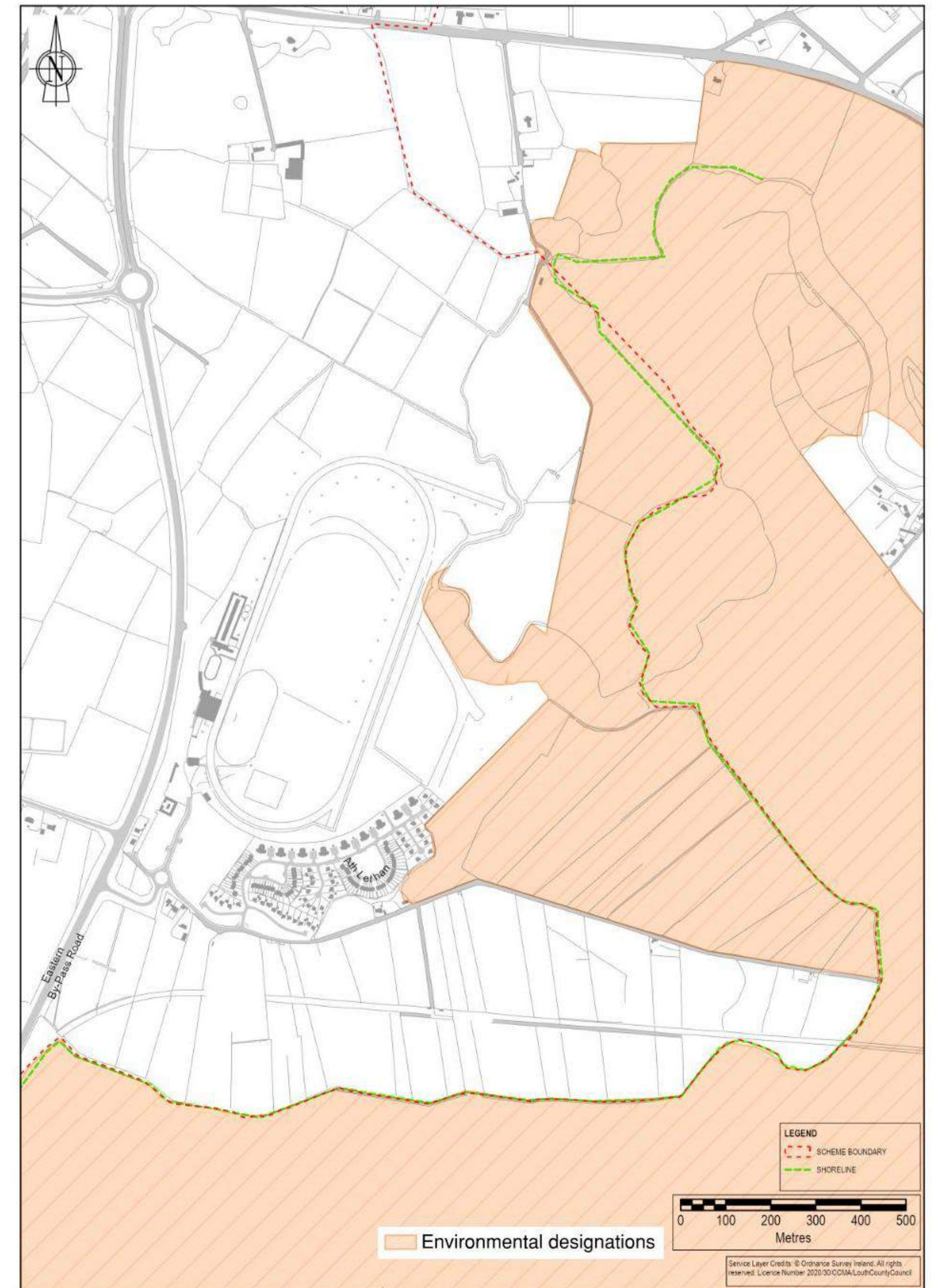
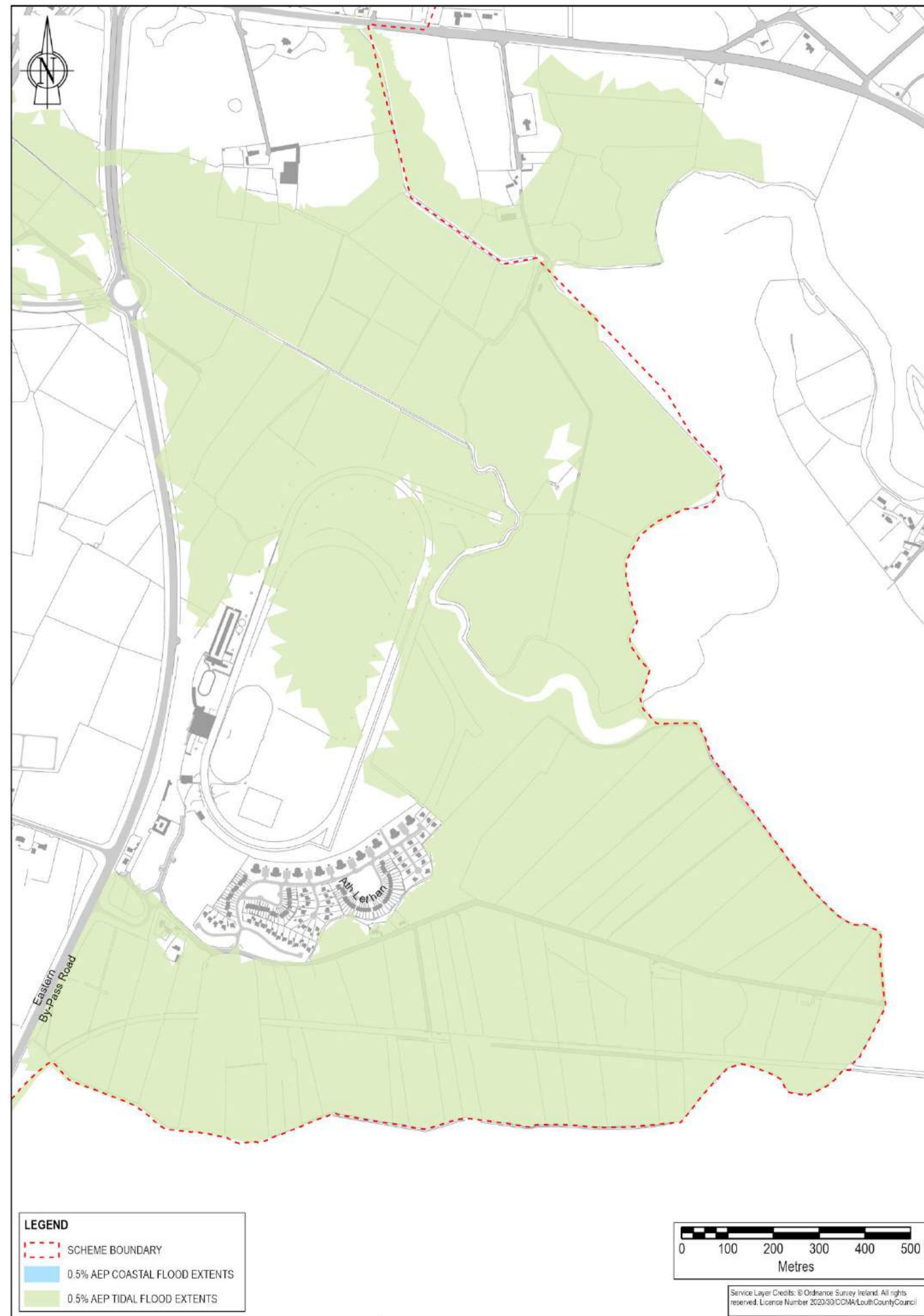
The North Marshes shoreline forms approximately 5km of the overall scheme boundary. The frontage to the east is predominantly tidal mudflats, backed by agricultural land on the west and separated by a grassed embankment. SAC, SPA and Ramsar designations extend across parts of the area (see map to the right.)

TIDAL FLOOD RISK

The map to the left shows predicted flood extents along the North Marshes frontage due to tidal flooding for the 0.5% AEP event at the Present-Day scenario. These extents confirm the need for interventions to mitigate flood risk to the community.

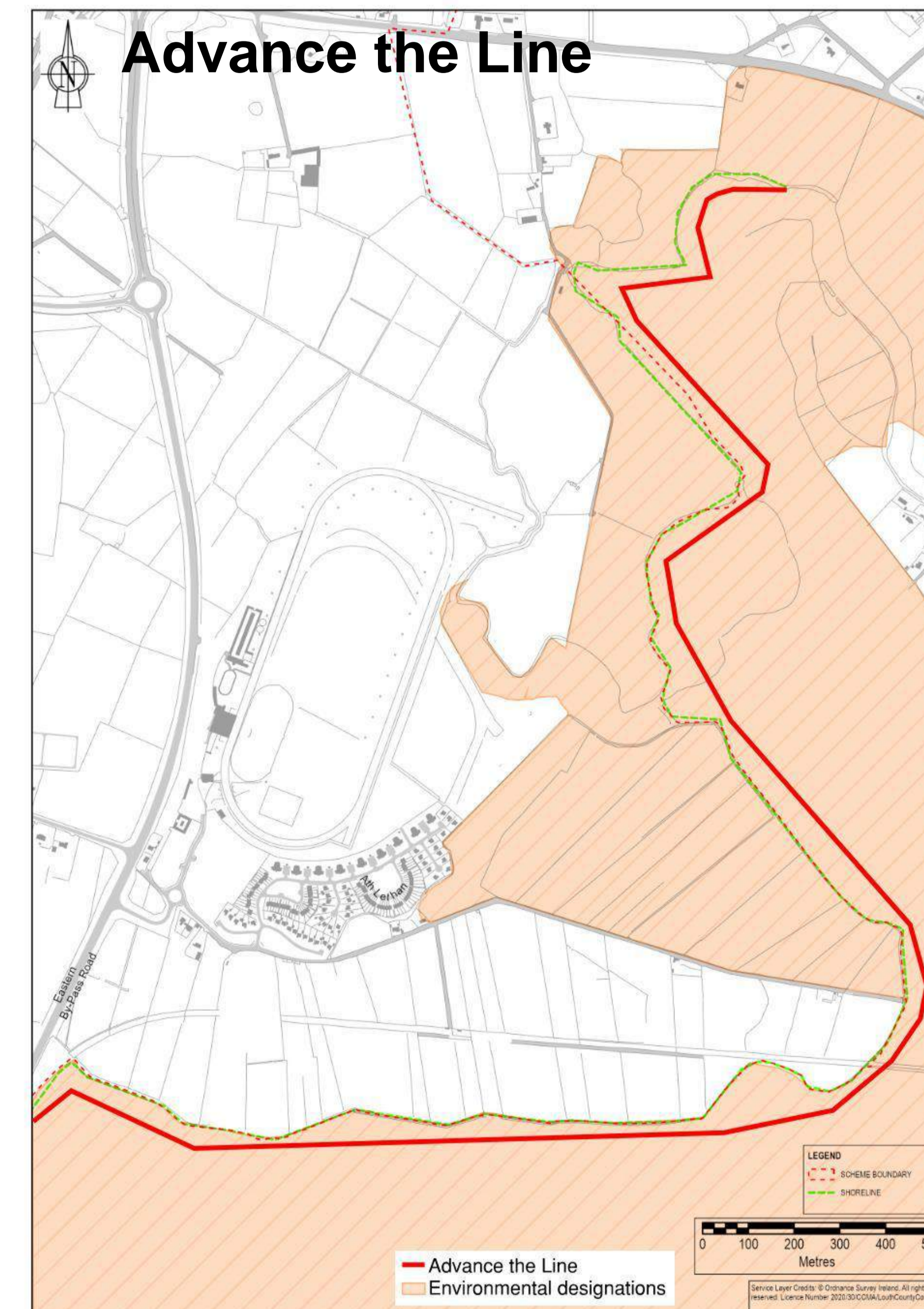
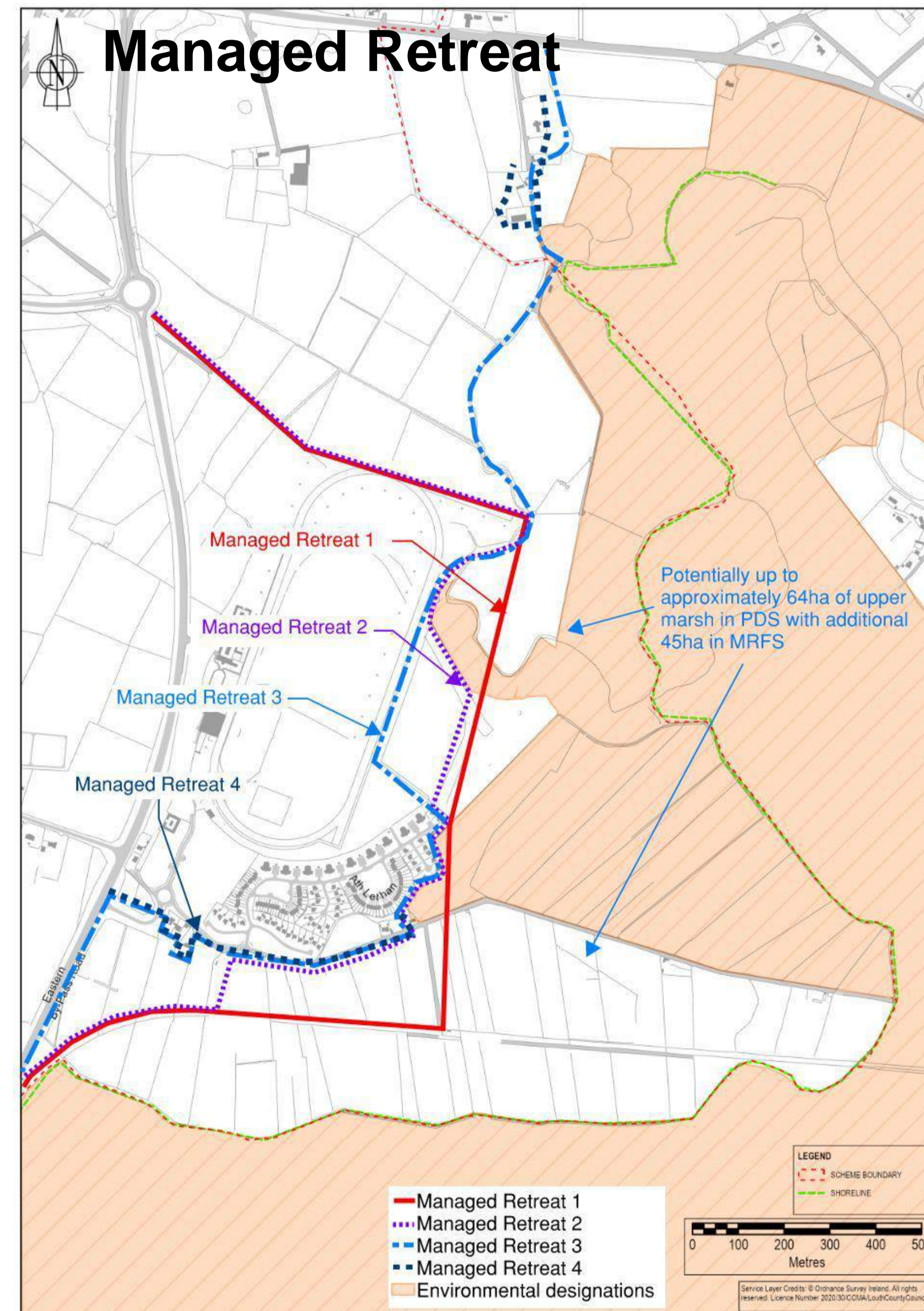
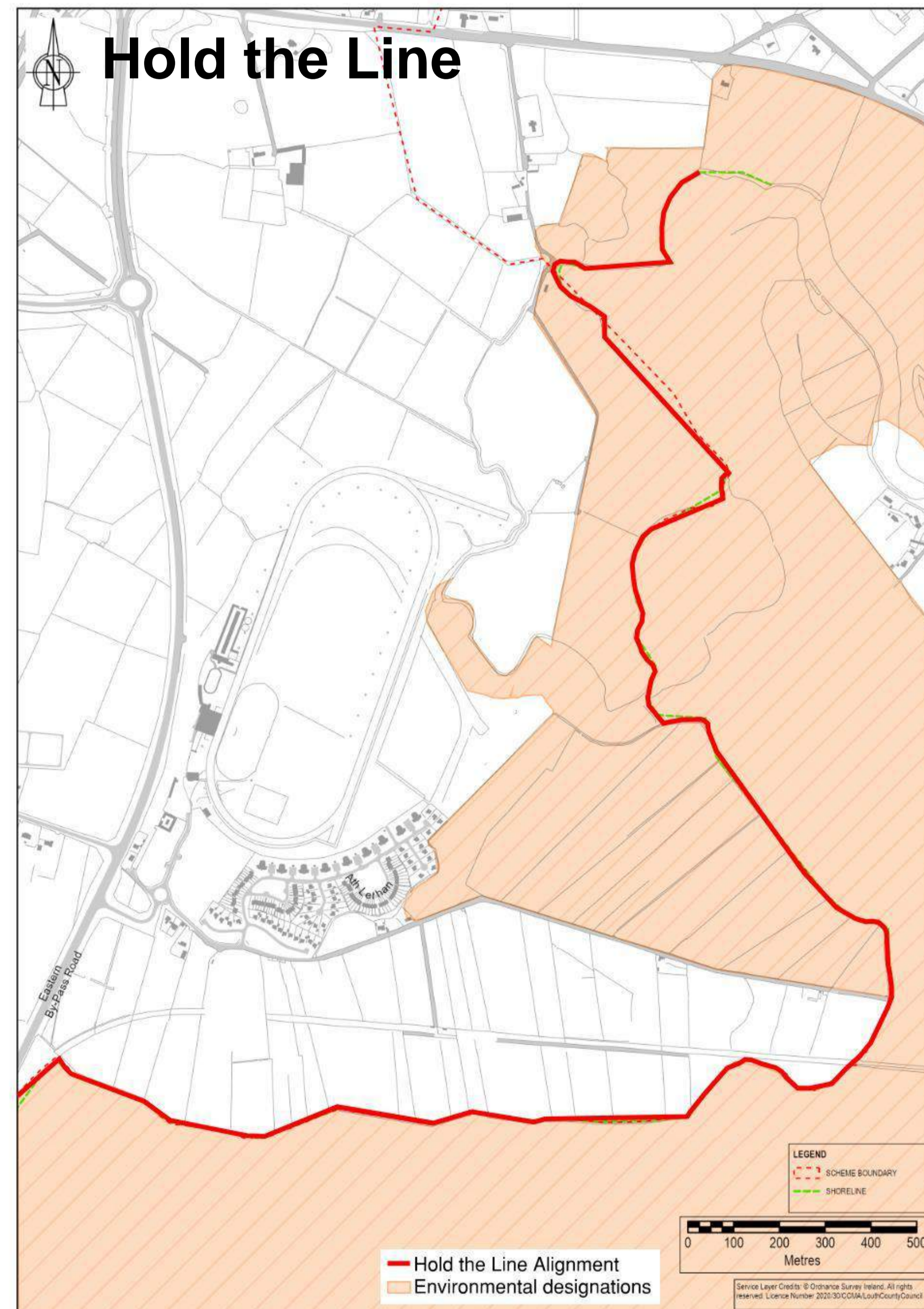
Due to the sheltered location of the marshes, there is no flooding from wave overtopping at North Marshes.

Key receptors in this area include properties and amenities such as the Racecourse, as well as utilities, access roads and agricultural land.



NORTH MARSHES APPLICABLE POLICIES

Hold the Line, Managed Retreat and Advance the Line policies are compared below.



Policy	Shortlisted
Hold the Line	No – results in long embankment length and environmental concerns
Managed Retreat 1	No – offers no advantage over Managed Retreat 3
Managed Retreat 2	No – offers no advantage over Managed Retreat 3
Managed Retreat 3	Yes
Managed Retreat 4	Yes
Advance the Line	No – results in long embankment length and environmental concerns

NORTH MARSHES MEASURES AND OPTIONS

MEASURES NOT APPLICABLE TO NORTH MARSHES

The following measures were not developed further into options for North Marshes.

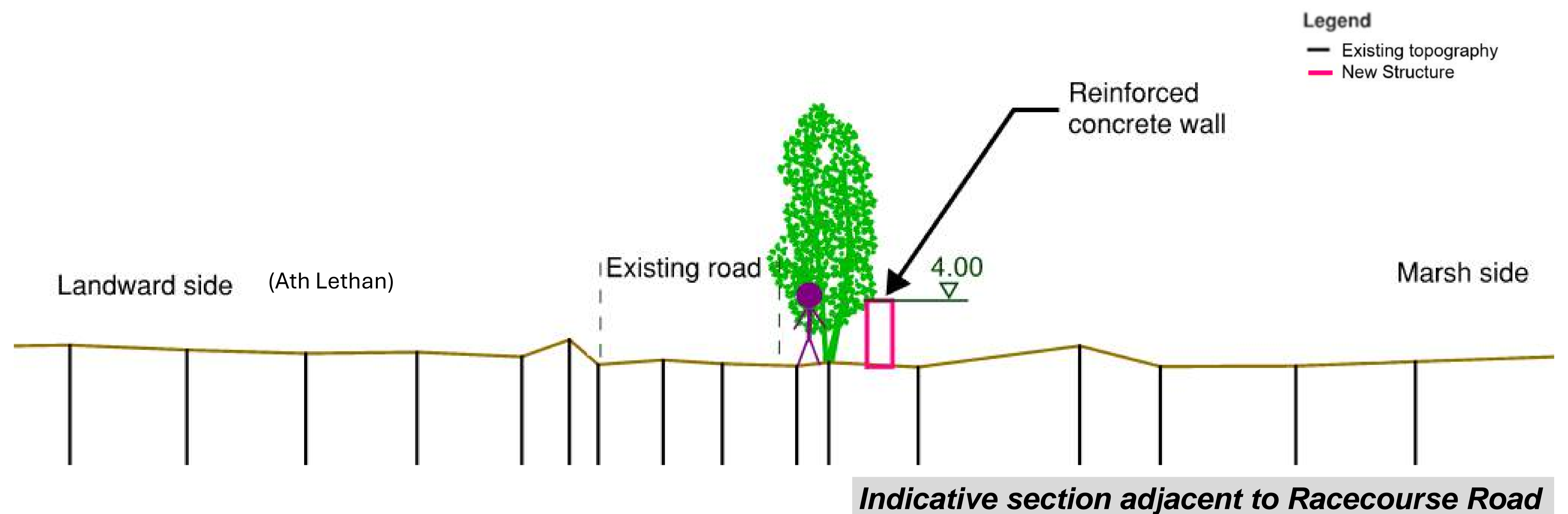
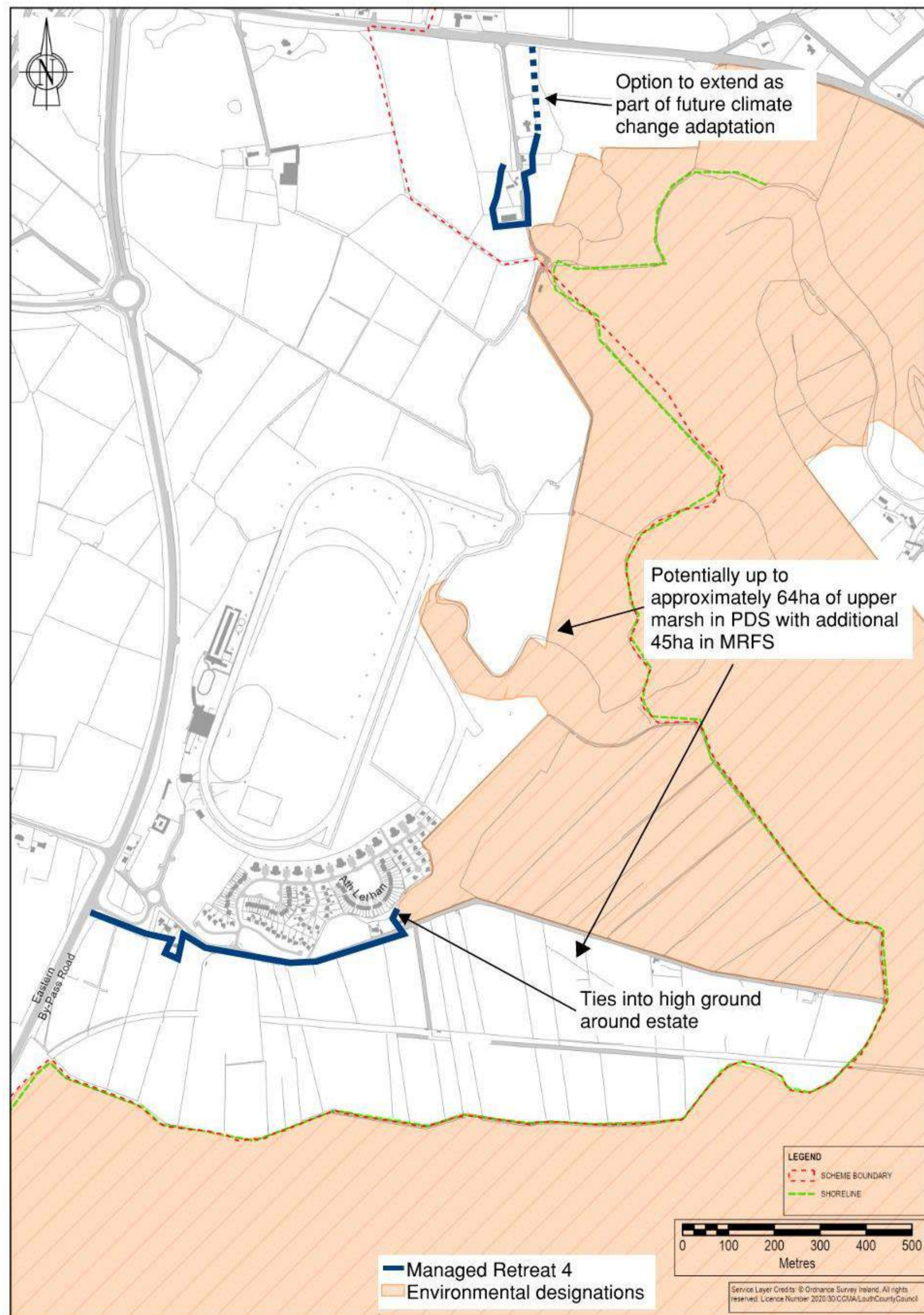
Measure	Applicability
Measure E – Flood Storage measures	Significant space requirements. Impractical.
Measure F – Groynes	Not applicable for the coastline conditions at North Marshes
Measure H – Beach management	Not applicable for the coastline conditions at North Marshes
Measure I – Demountable defences	Length of defence required makes demountable defences impractical to implement
Measure K - M – Flood prevention measures	Deemed to provide insufficient level of protection to meet the aims of the scheme
Measure N – Flood preparedness measures	Deemed to provide insufficient levels of protection to meet the aims of the scheme

Options (Longlist)	Applicable policies	Comments	Decision
Option 1 – Flood walls around affected residential properties (Measure A)	Managed Retreat, 4	Small footprint of works, targeting residential properties at risk of flooding	Shortlisted
Option 2- Flood walls at properties and grassed embankment through farmland (Measures A, C)	Managed Retreat, 3	Similar to Option 1 and in addition offers protection to the Racecourse	Shortlisted
Option 3 – Grassed/ rock faced embankment with wall (Measure A and B/ C)	All policies	No obvious advantage over flood wall for limited wave action	Discounted
Option 4 – Property level protection (Measure J)	Managed Retreat	Deemed to provide insufficient level of protection to meet scheme objectives	Discounted
Option 5 – Tidal barrage (Measure D)	Advance the line	Impacts on coastal processes and SAC/ SPA. Impacts on navigation. Significant maintenance requirements. Not adaptable to climate change.	Discounted
Option 6 – Marsh restoration (Measure G)	Managed Retreat	Possible conflicts with local constraints, high costs and social challenges	Discounted
Option 7 – Deepening the floodplain by dredging (Measure L)	Managed Retreat	Significant deepening of the floodplain would be required. Deep water ponding; not adaptable to meet future requirements	Discounted

NORTH MARSHES OPTIONS

Option 1 – Flood walls (Managed Retreat Policy 4)

This option comprises of the construction of flood walls at affected residential properties and allows for saltmarsh restoration within the area.



Advantages

- Minimal works at the boundary with environmentally designated areas.
- Potential for marsh restoration if embankment were to be allowed to breach.
- Shorter defence length reduces construction programme and cost compared to Option 2.
- Adaptation measures can be incorporated into current scheme to minimise future investment.

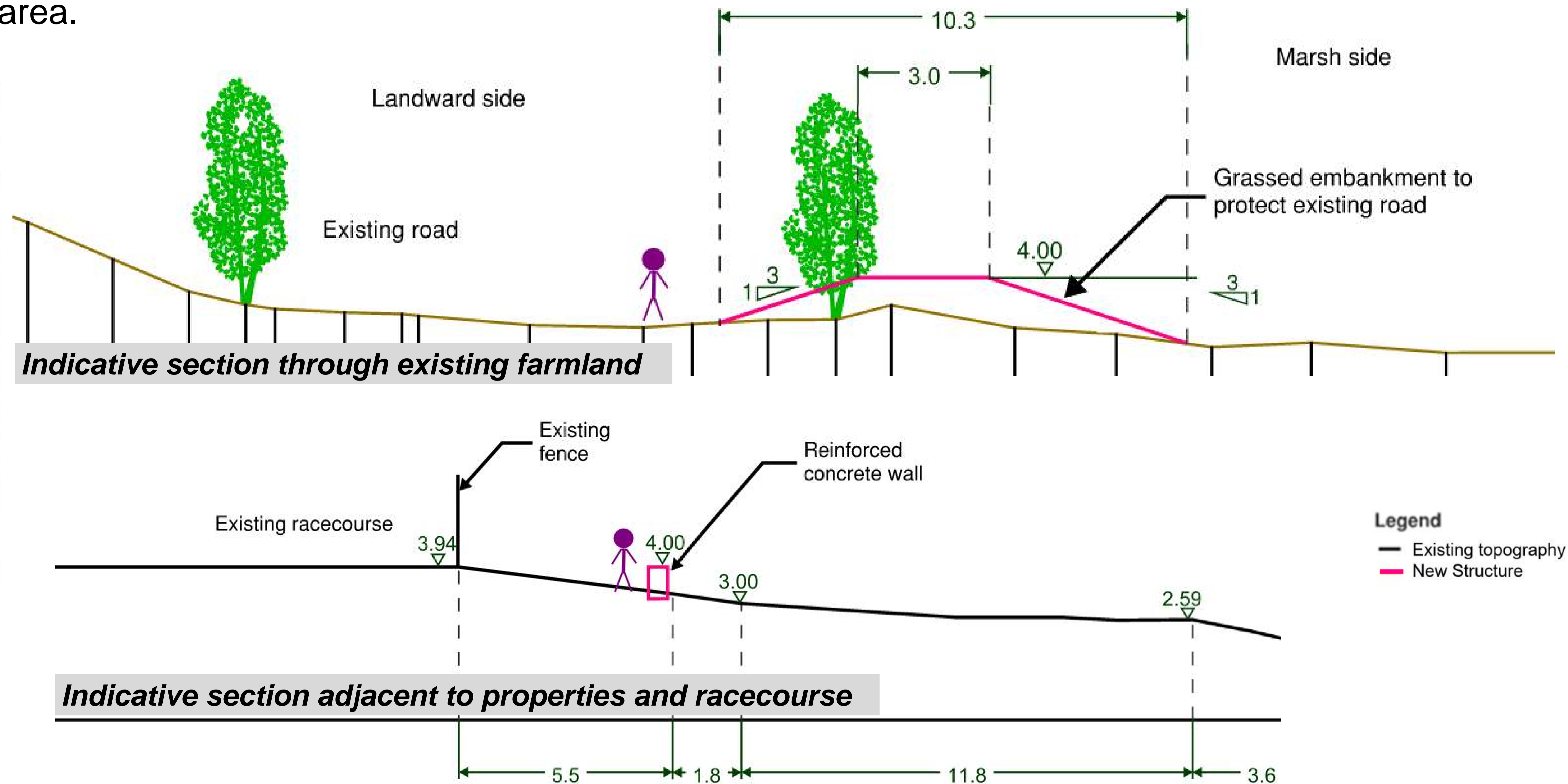
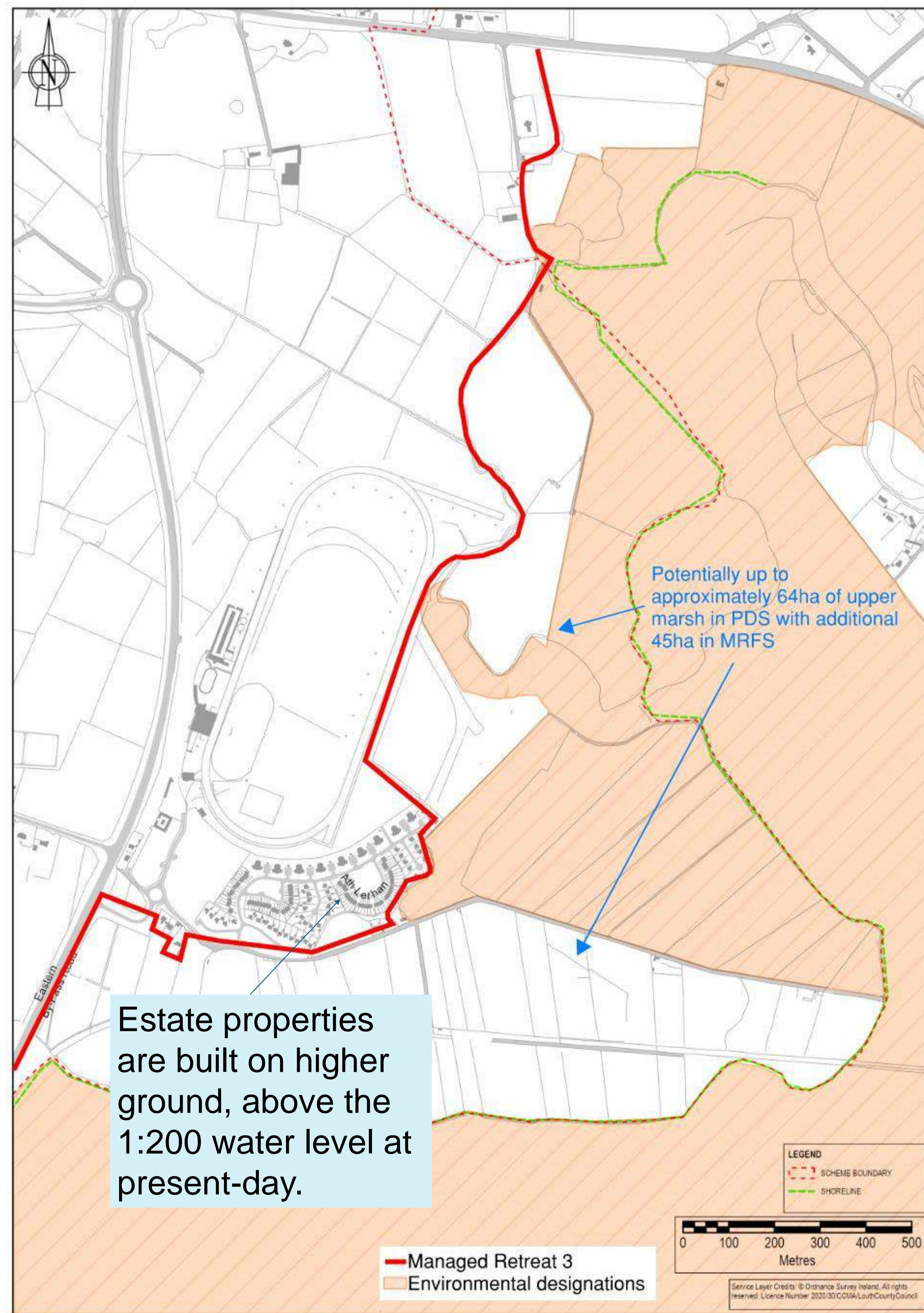
Limitations

- Loss of agricultural land.
- Potential visual impact on property views, likely to be localised as most properties are on higher ground.
- Risk of flooding to the Racecourse is not eliminated.

NORTH MARSHES OPTIONS

Option 2 – Flood wall & grassed embankment (Managed Retreat Policy 3)

This option comprises of a grassed embankment along most of the alignment, with flood walls adjacent to the Ath Lethan properties and racecourse and allows for saltmarsh restoration within the area.



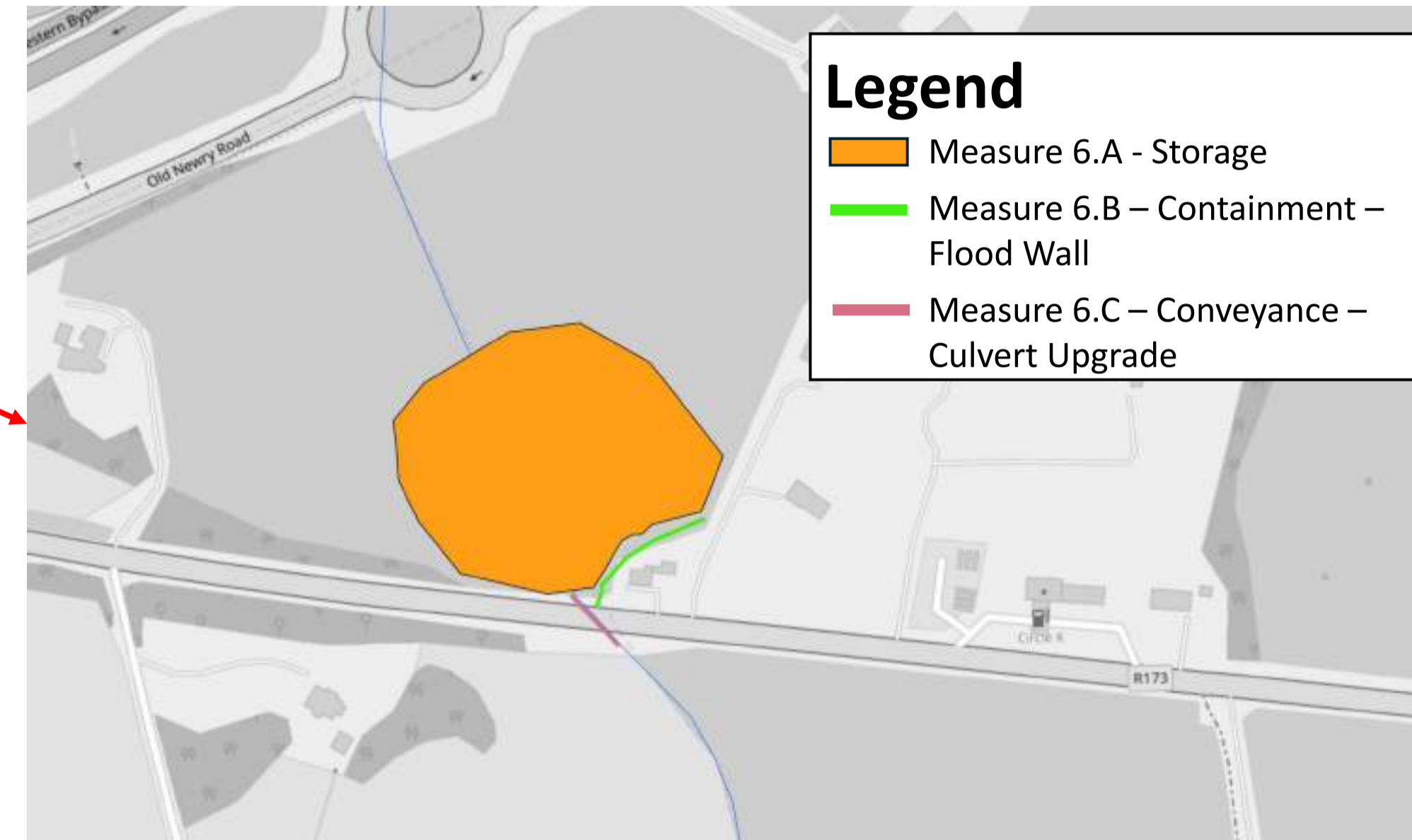
Advantages

- Minimal works at the boundary with environmentally designated areas.
- Potential for marsh restoration if existing embankment is allowed to breach.
- Offers protection to a wider area compared to Option 1.

Limitations

- Loss of agricultural land.
- Some visual impact on property views, likely to be localised as most properties are on higher ground.
- Longer construction programme and cost compared to Option 1.

AGHABOYS - OVERVIEW OF MEASURES



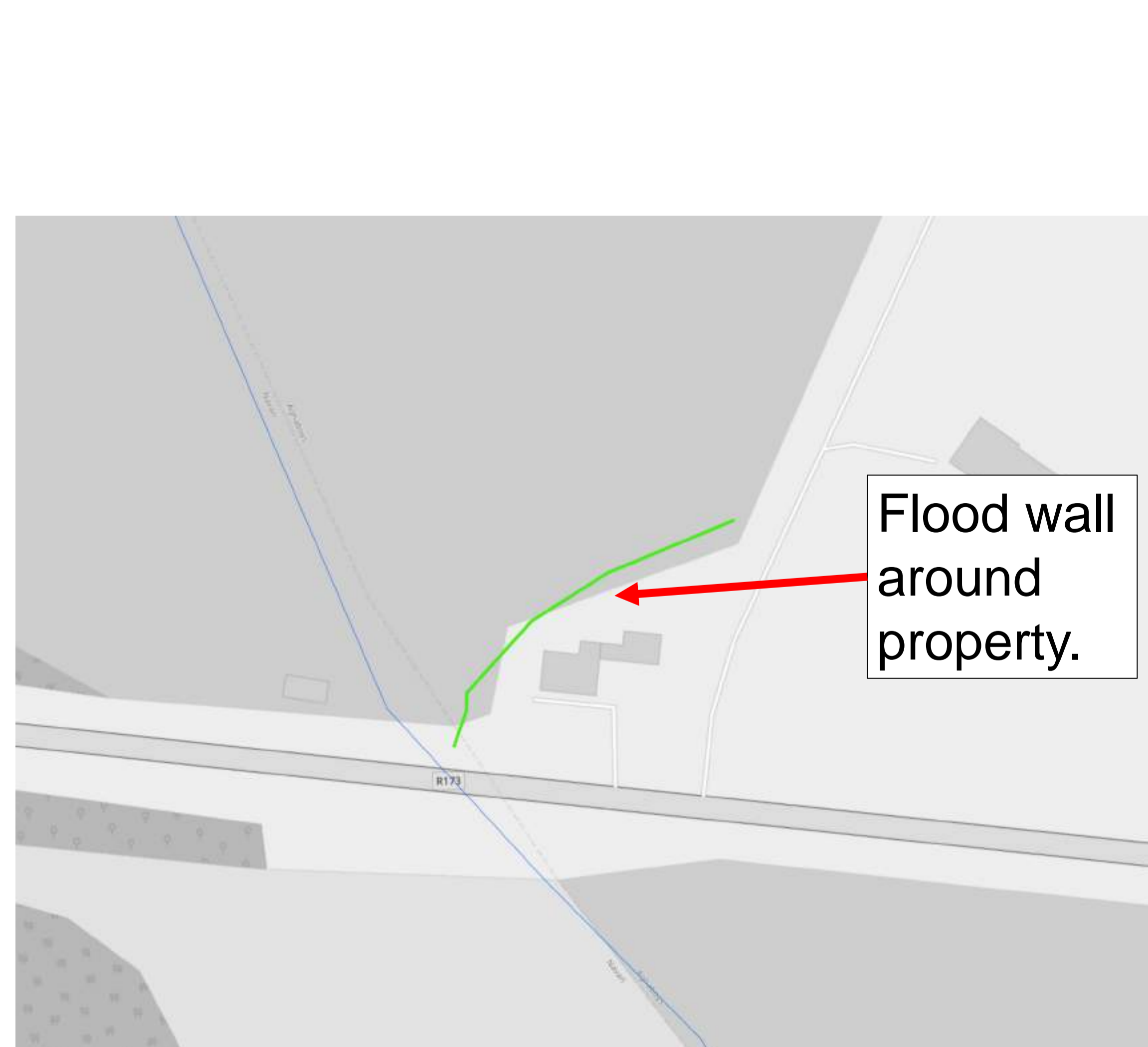
Discarded measures

6.A – Enhanced upstream storage in field u/s of road crossing.

This measure was discarded due to the high expected costs due to the requirements of significant embankments to protect one property.

OPTION 1: Containment

A wall is proposed around the boundary of the property. The wall required will be approx. 1.4m above the garden level. There may be a requirement to shift the existing channel west of the property to provide construction room.



Advantages

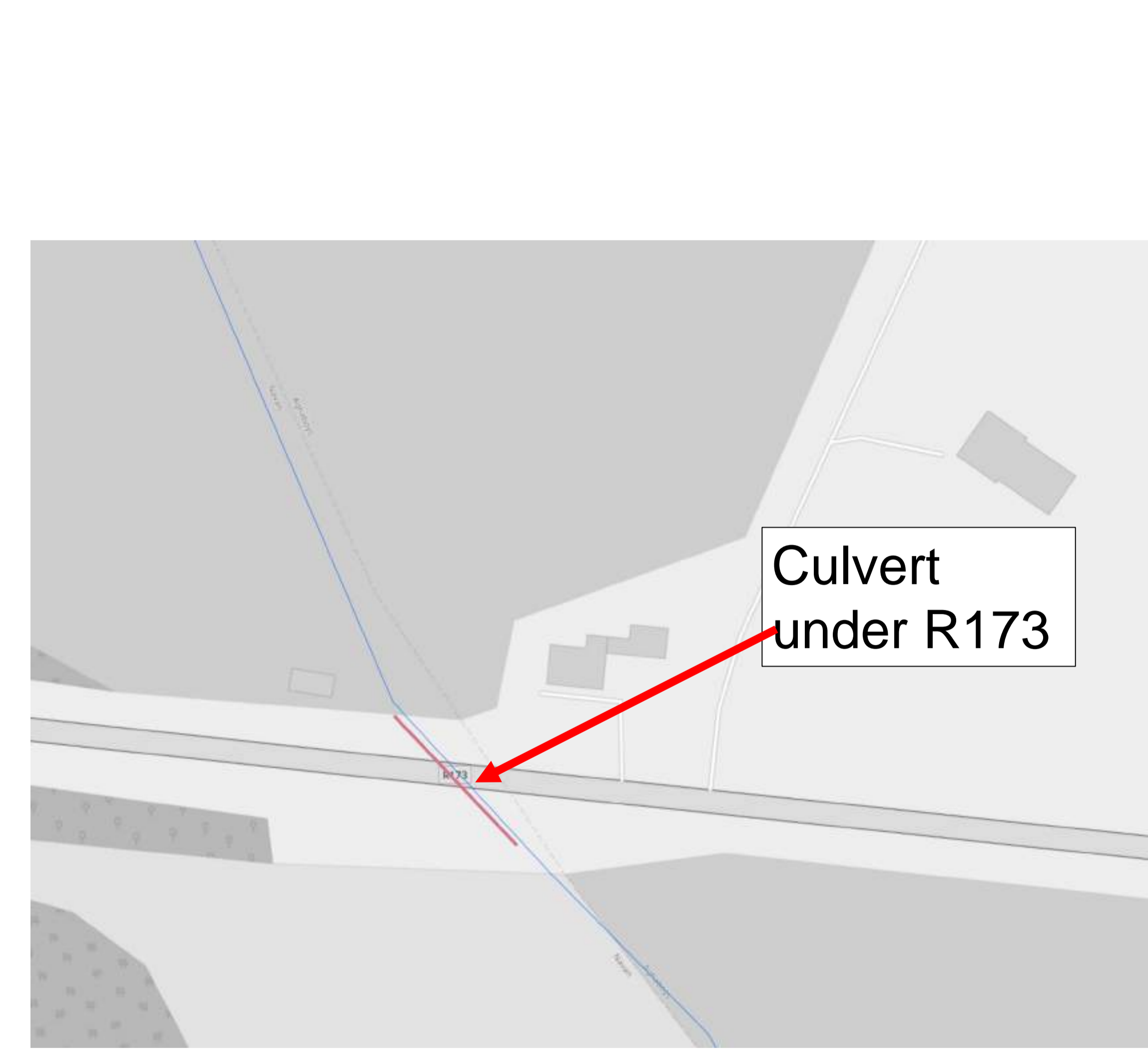
- Flood walls are effective at reducing flooding.
- No habitats / invasive species reported in surveys in direct proximity to works.
- Limited costs, but dependant on wall heights.
- Can be adapted to climate change if the wall foundations are designed for a climate change scenario.

Limitations

- Visual impact of flood walls, extent of impact dependant on height, though likely to be minimal
- Potential for loss of property garden area /impact to property during construction.
- Some landowner engagement may be required.

OPTION 2: Conveyance

The existing 900mm and 750mm culverts are maintained and augmented with a new 900mm culvert under the R173. For the current scenario, no flood walls are required along the property, but they could be required at a later stage for future proofing.



Advantages

- Effective at reducing flood risk.
- No habitats reported in surveys in direct proximity to works. & not within an SPA / SAC
- Limited costs expected.
- Minimal landowner engagement required.

Limitations

- Maintenance of debris on culverts.
- Cannot be adapted to climate change – would require flood walls