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# Flood Risk Assessment and Brownfield Regeneration

LEC, Lancaster University 15th February 2011

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# Summary

Residual risk

Why assess residual risk?

Policy Drivers and Guidance

Uncertainty – the knowns and unknowns

Choices

Limitations

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# Residual Risk

A residual risk is the portion of the risk that is left after a risk assessment has been conducted and all mitigation measures applied – Wikipedia

Exposure to loss remaining after other known risks have been countered, factored in or eliminated – business dictionary

The risk remaining after applying the sequential approach and taking mitigating actions – PPS25

# Why assess residual risks?

## 31st January 1995 - River Tyne

Defence built in 1955 after last big flood
Forecast level below crest of defence
Embankment  breached at Corbridge
14 properties flooded
Rapid inundation, rise of 6” per 15mins

## Suspected cause of failure

# Why assess residual risks?

## November 2000, Gowdall

Breach of River Aire defences

250 properties affected

## January 2005, Carlisle

Overtopping of defences

1800 properties

## January 2005, Warden

Breach of defences on River South Tyne

100 properties affected in catchment

# Why assess residual risks?

## July 2010 Sefton

20m breach of embankment on the River Alt

Flooding of Environment Agency owned land

No properties affected

# Why assess residual risks?

January 1953

Breach of tidal defences at Erith, Thames Estuary

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# Why assess residual risks?

Low probability

Unpreparedness and disbelief - “its never flooded before” or “if it floods here than the whole of Northwich would be flooded”

Consequences can be higher than without defences

Costs of managing residual risk can be low compared to the damage avoided

# Policy driver

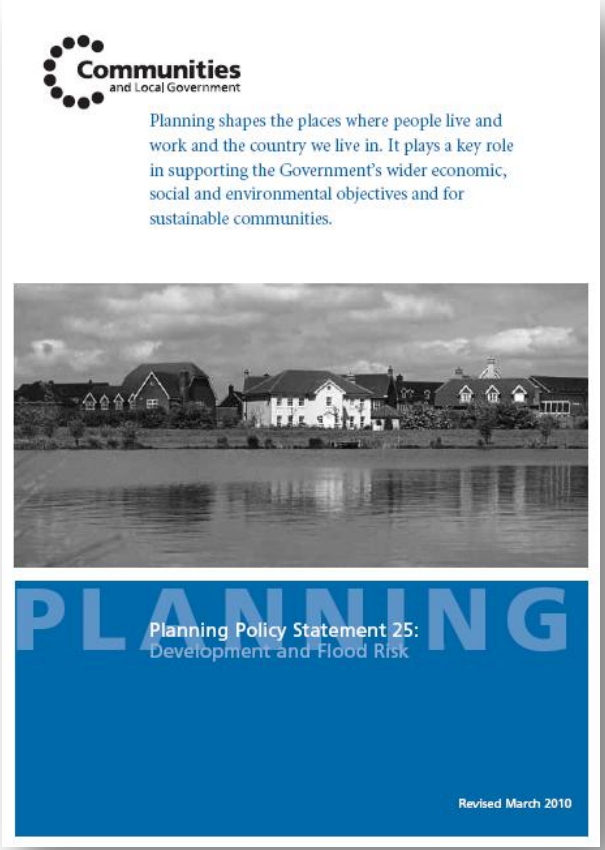
PPS25 – Annex G

Assess risk

Identify mitigation

Determine whether residual risks are acceptable

Safely managed

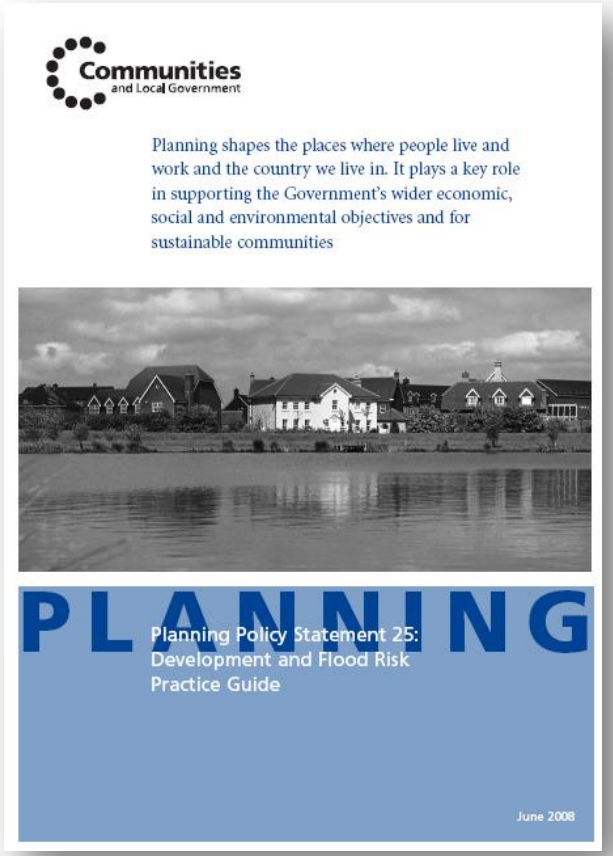


# Policy driver

PPS25 Practice Guide

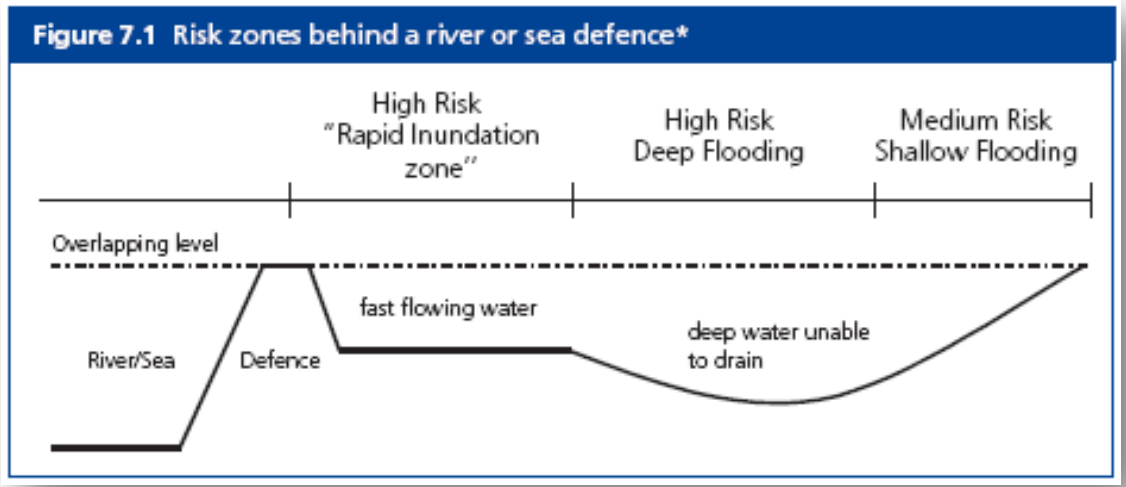
Additional guidance

FD2320 *Flood Risk Assessment Guidance for New Development* Phase 2 R&D Technical Report FD2320



# Guidance

FD2320 – Simple assessment, consequences based on depth and distance




Intermediate assessment – same approach but simple approach to probability

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# Guidance

FD2320

Detailed assessment – complex approach

Rigorous approach to assessing probability

2D Hydraulic modeling of flood behaviour

# Guidance

FD2321 – *Flood Risks to People*

Understanding of hazard and vulnerability within an area and to people

Depth
Velocity
Debris
Speed of Onset
Nature of area/development
Flood warning
Type of occupier

Acceptable & Safe

# Detailed assessment

Probability of breach is difficult (FD2411, 2007)

Prediction of breach location is poor
Prediction of time of breach is very poor
Prediction of formation is basic
Experience of closure is limited

Focus is therefore usually on consequences, i.e. 2D modelling

Best estimates of location, time of breach, size and closure

# Data

Digital Terrain Model (DTM)

Additional topographical information (survey)

Land-use data

Breach location, width and minimum elevation

Boundary conditions (flow, water level, duration etc)

Information on any other boundary conditions (outflows, inflows or water levels).

Condition of defences

# Uncertainty

| Data | Known……Unknown |
|---|---|
| Topographical data | ⟷ |
| Flood defence information plus other topographical features | ⟷ |
| Condition of defences | ⟷ |
| Land use data / model parameters | ⟷ |
| Breach location | ⟷ |
| Breach elevation | ⟷ |
| Breach width | ⟷ |
| Time of breach | ⟷ |
| Flow or water level over time information | ⟷ |

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# Additional choices

## Choice of Software

14 software packages benchmarked by the Environment Agency

## Grid or mesh

Fixed grid or flexible mesh

## Grid/mesh size and orientation

A smaller the grid/mesh gives greater detail but longer runtimes

Orientation can affect flow paths

## Timestep

Smaller time steps increase run time

## Boundary conditions

Smaller watercourses, sewer flooding etc

Secondary breach location

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# Additional choices

## Model parameterisation

Land-use and roughness

## Building definition

Explicitly included or identified via roughness

Specify threshold level

## Scenario duration

Number of tidal cycles critical storm duration

## Run duration

Additional time for simulation

## Model scenarios

Return period, breach time, closure time

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# North West Breach Scenario Modelling Project

## Breach modelling at three locations in Cumbria

- Kent Estuary, Levens Hall
- River Mint in Kendal
- River Eden in Appleby-in-Westmoorland

## Guidance for developers

- Fluvial / tidal residual risks
- Drivers, purpose, data, uncertainties

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# Case Studies: Kent Estuary Tidal Breach

Kent Estuary Tidal Breach

Rural location

Few properties

Large flat area

Caravan sites

# Case Studies: Kent Estuary Tidal Breach

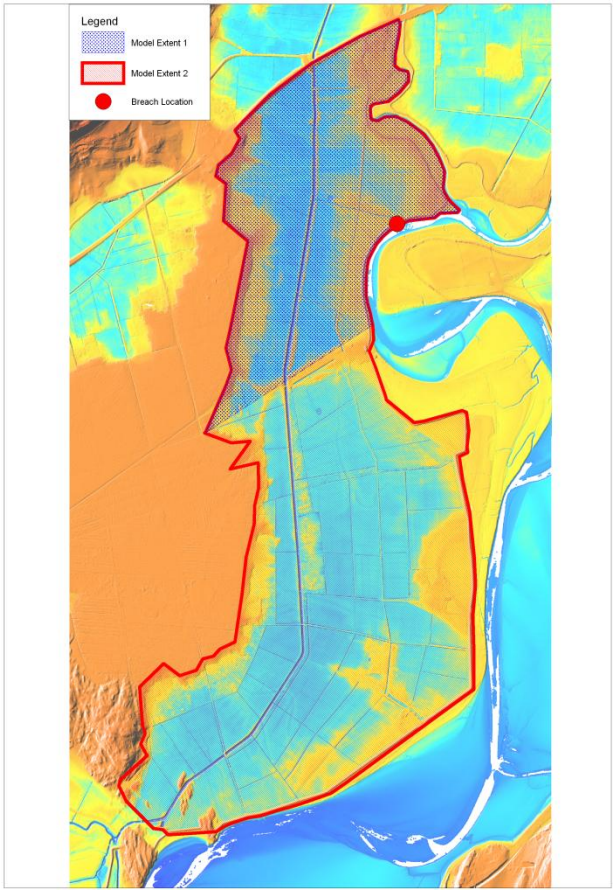
Soft embankment – 50m breach

Location based on greatest potential depth at the breach

Water level v Time boundary condition

Simple roughness parameterisation

Breach simulated at peak and prior to peak



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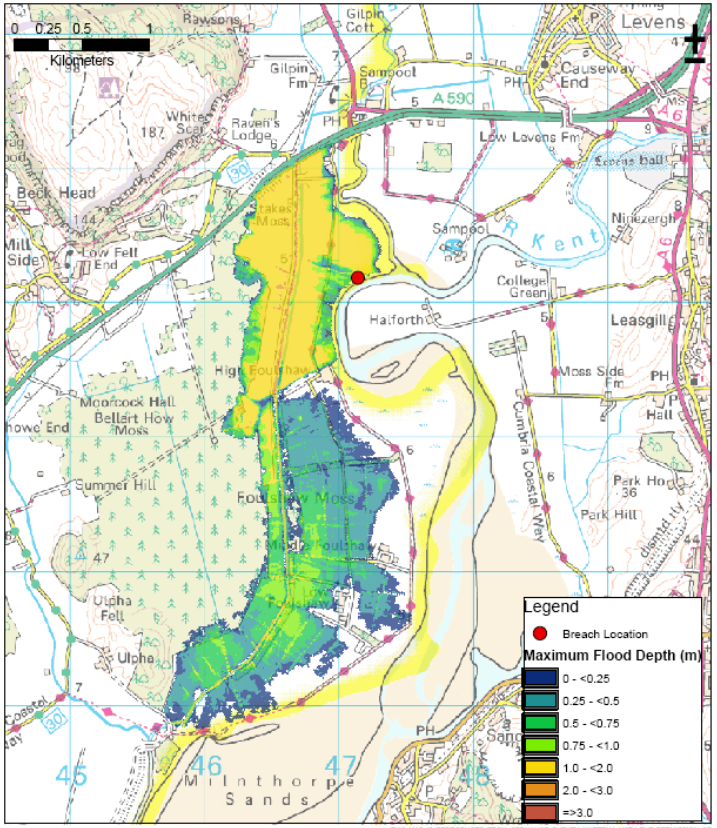


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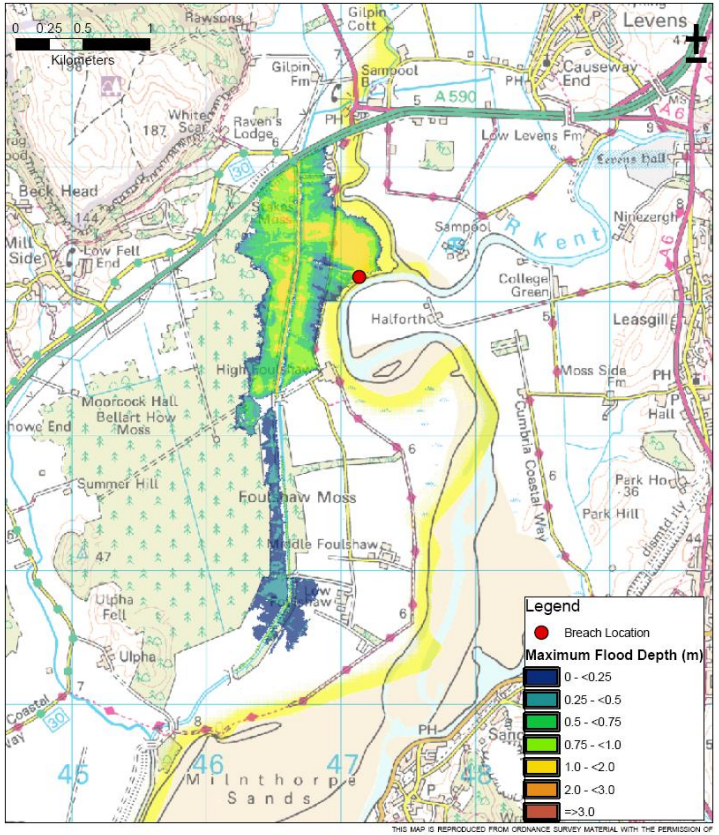


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# Case Studies: River Mint in Kendal

River Mint in Kendal - Overtopping and Breach

Urban location

Residential and commercial properties

Flooding also from River Kent

Overland flow paths and ponding

# Case Studies: Kent Estuary Tidal Breach

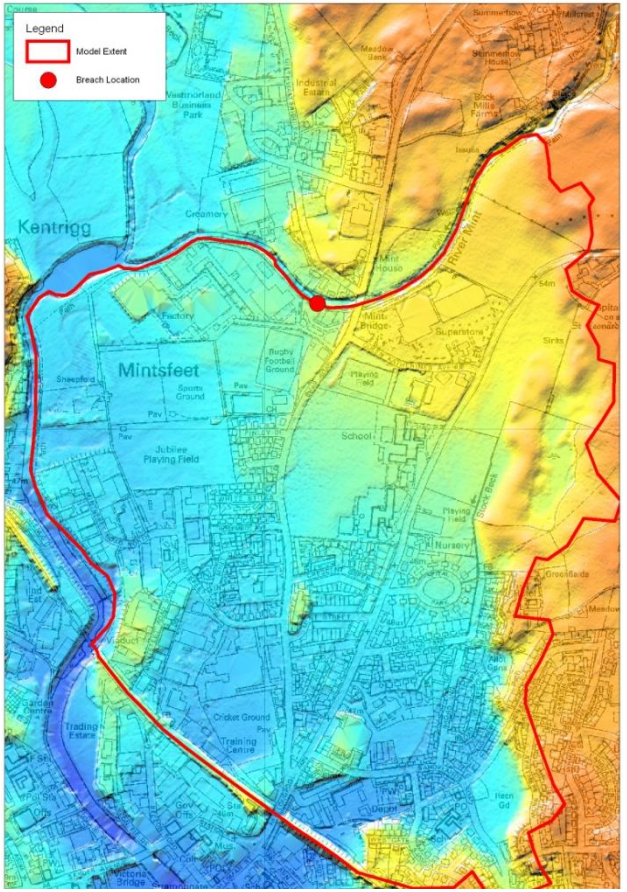
Soft embankment – 50m breach

Location based on previously recorded overtopping

Variable water level v Time boundary condition – defined from existing model

Roughness based on OS Mastermap

Breach simulated prior to peak



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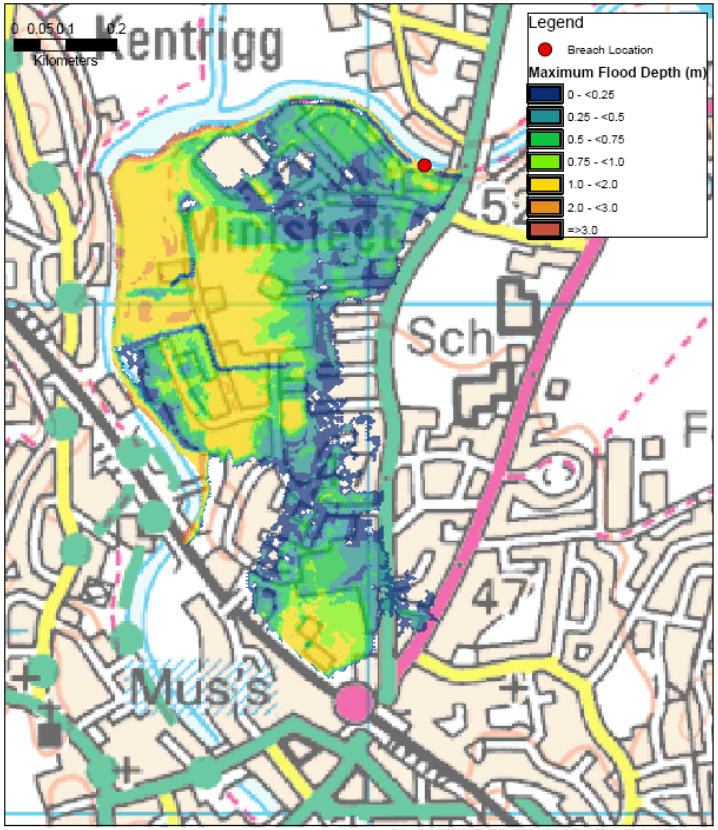


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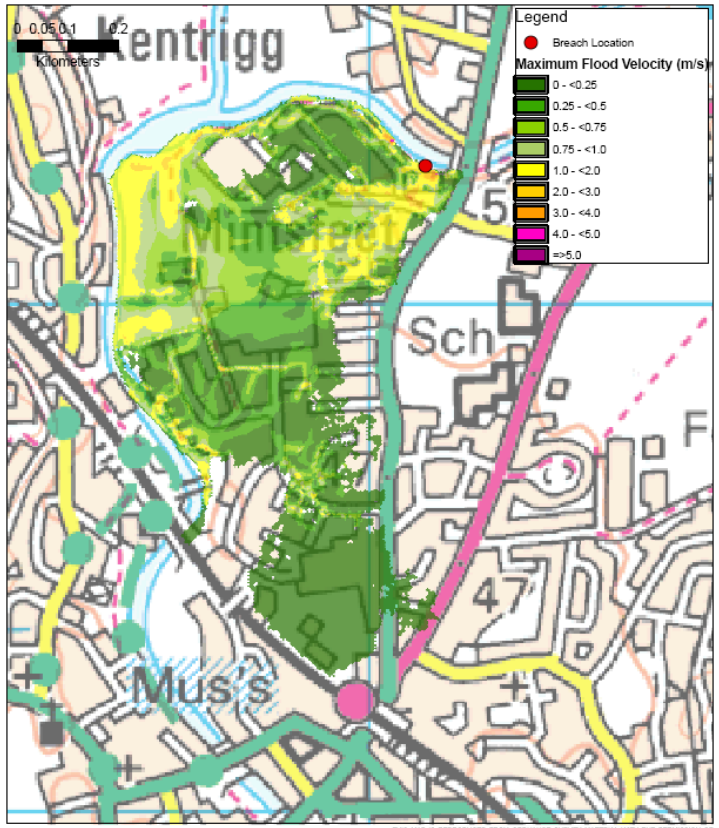


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# Case Studies: River Eden in Appleby-in-Westmoorland

River Eden in Appleby-in-Westmoorland - Overtopping and Breach

Small urban town centre

Well defined floodplain

Protected by mixture of hard, soft and demountable defences

Rapid inundation and deep ponding

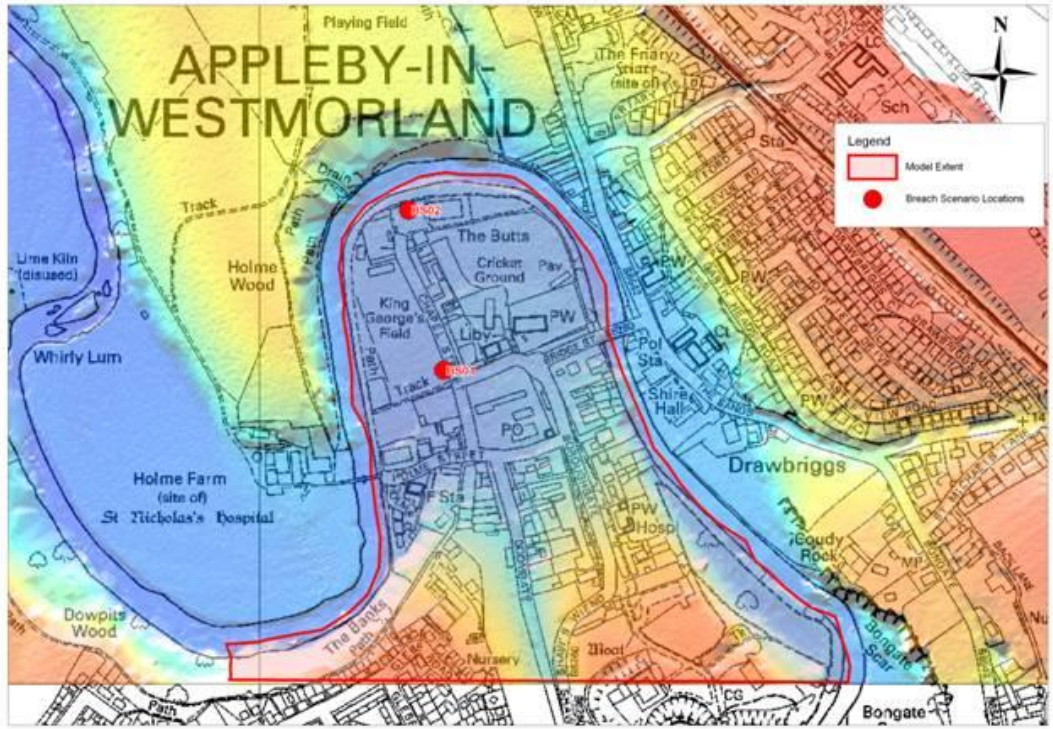
# Case Studies: River Eden in Appleby-in-Westmoorland

Two breach locations

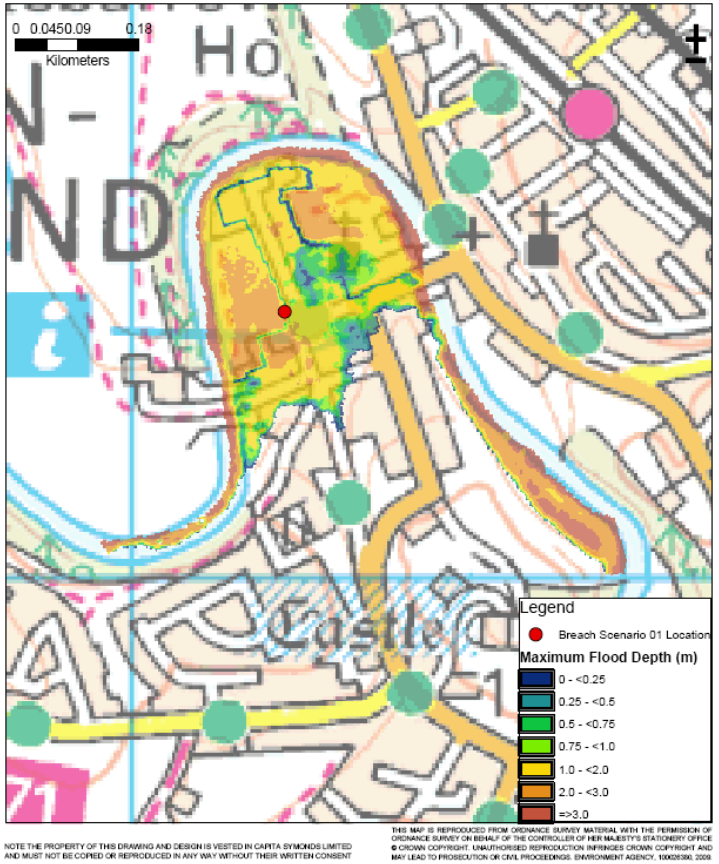
Water level v Time boundary condition

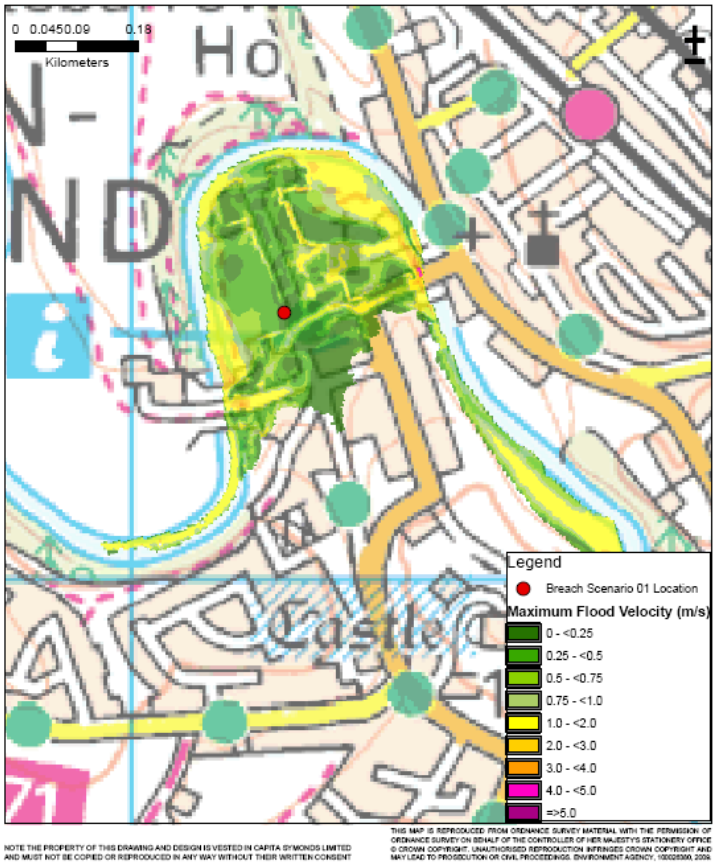
Roughness based on OS Mastermap

Breach simulated at peak and prior to peak



# Case Studies: River Eden in Appleby-in-Westmoorland

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# Case Studies

| Kent Estuary | River Mint, Kendal | River Eden, Appleby |
|---|---|---|
| Few properties flooded | Residential and commercial properties impacted | Residential and commercial properties impacted |
| Extent of inundation greatest with failure before peak, velocities greatest with failure at peak | Greatest depths and highest velocities did not coincide | In extreme event, the flood extent was the same regardless of breach location and time |
| Depths of up to 2m | Significant ponding occurred away from breach and River Kent | Depths up to 3m |
| Velocities of up to 3m/s | Depths up to 2m in urban area with velocities of 3 to 4m/s | Velocities up to 3m/s |

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# To Conclude

A residual risk of flooding will always remain

Important to understand the potential consequences, if not the probability

Assessment is currently based on conservative but realistic assumptions

Mitigation can then be identified to ensure safety of people and resilience of property

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There are known knowns; there are things we know we know.

We also know there are known unknowns; that is to say we know there are some things we do not know.

But there are also unknown unknowns – the ones we don't know we don't know.

Former United States Secretary of Defense, Donald Rumsfeld

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