Assessing future flood risks and opportunities for adaptation in the UK

(being undertaken as part of the UK Climate Change Risk Assessment: 2017)

SAYERS
AND PARTNERS

Presentation by
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Acknowledgements

- **Collaborators**
  - Matt Horritt
  - Andy McKenzie (BGS - British Geological Survey)
  - Edmund Penning-Rowsell (FHRC, Middlesex Uni)
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- **Client leads**
  - Dave Thompson/Kathryn Humphreys (Climate Change Committee)
  - Representatives from Scottish Environmental Protection Agency, Environment Agency, Rivers Agency NI, Natural Resources Wales

Outline of presentation

- **Objectives of the Climate Change Risk Assessment (CCRA)**
- **Approach to assessing future flood risk**
  - Flood types of interest
  - Future changes of interest
  - Adaptation levers and scenarios
  - The Future Flood Explorer
- **Concluding remarks**

Objectives of the CCRA

CCRA 2017: Background

Under the **UK Climate Change Act**

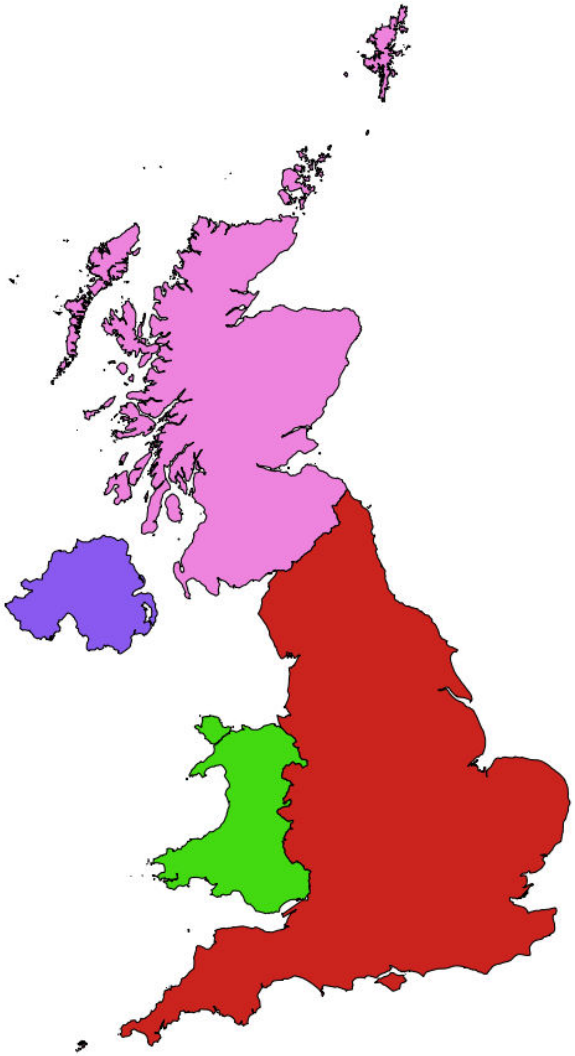
- The **Climate Change Committee** must undertaken a **Climate Change Risk Assessment** (the CCRA) every 5 years and inform Government's **policy programme** to address those risks
- The **Adaptation Sub-Committee** advises on this assessment and scrutinises the implementation of the policy programme
- The first CCRA was completed in 2012 building upon the Foresight Future Flooding studies in 2004, national assessment of flooding under climate change in 1998.
- The second CCRA is due for publication 2017 *(the flood risk component of this is the subject this talk)*

Approach to assessing future flood risk at a UK scale

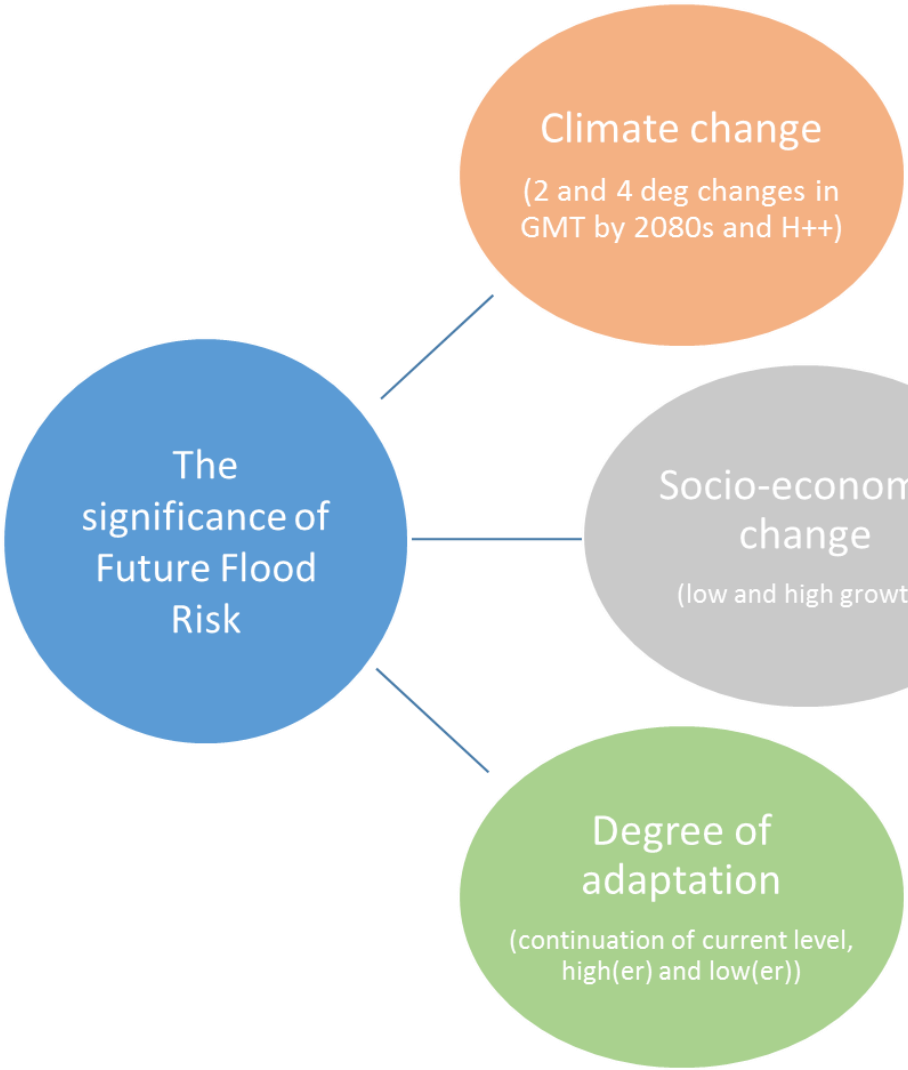
Flood sources of interest

All sources of flood risk across the UK, including:

- **Coastal**
- **Fluvial**
- **Surface water**
- **Groundwater**
  - Permeable Superficial Deposits
  - Clearwater (Chalk and other aquifers)



Future changes of interest



- **Sea level rise** (coastal flooding)
- **Peak river flows** (fluvial flooding)
- **Intensity of short duration rainfall** (surface water flooding)
- **Longer duration rainfall and evapotranspiration** (groundwater flooding)

- **Population** (changes exposure to flooding by Local Authority)
- **Average occupancy rates** (national values)

- Managing the **probability** of flooding
- Managing the **exposure** to flooding
- Managing the **vulnerability** of those exposed to flooding.

Future projections: Combination to be 'run'

- **Population: Low** and **high** scenarios of population growth with a single household occupancy).
- **Climate change:** Three changes **2,4**^{o}C change in Global Mean Temperature by the 2080s from the 1990s baseline. A non GMT related **H++** change too

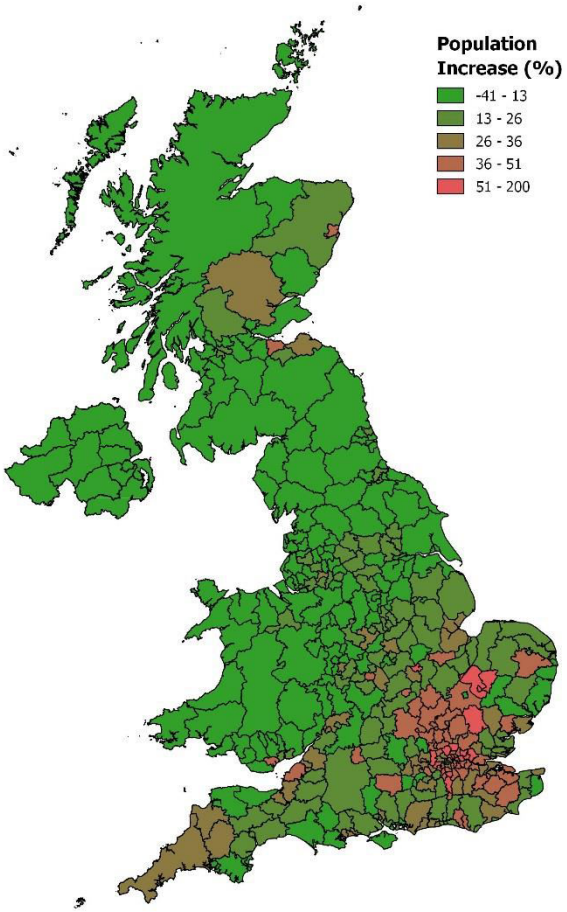
Core scenarios		Change in Global Mean Temperature		H++
		2 degrees	4 degrees	
Socio-economic change	Low	L2	L4	
	High	H2	H4	H++

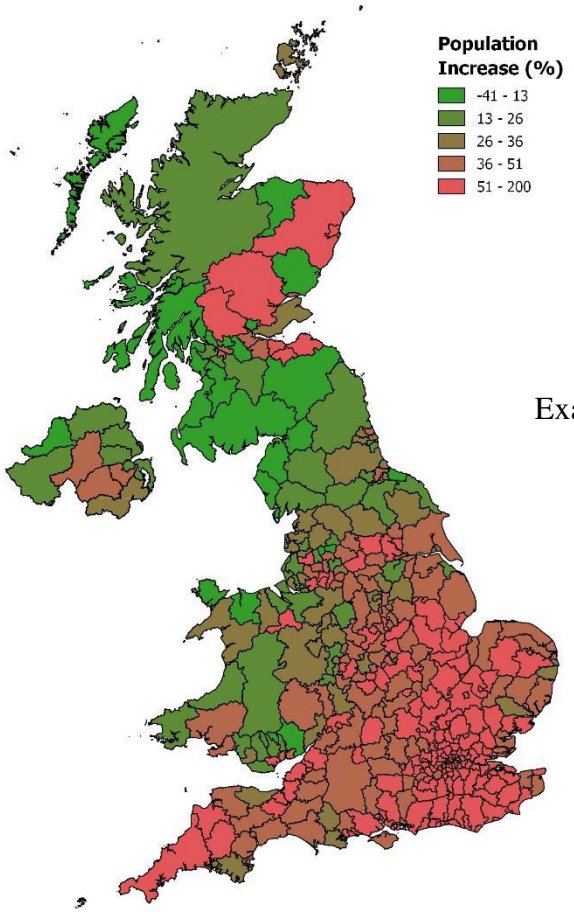
Climate change uplifts: Example of Intense rainfall, UK (all return periods)

Climate change factor	Global Temperature Increase	2020s	2050s	2080s
Lower	2°C	+0%	+5%	+10%
Medium	4°C	+5%	+10%	+25%
H++/WPD	n/a – notional 6°C	+17%	+35%	+70%

- Based on UKWIR results (sub 6 hours rainfall)
- Translated into change in Return Period run-off using generalised runoff approaches
- Similar across different areas of the UK for groundwater flood frequency, fluvial flows and sea levels

Population changes – Low and High





Example maps 2080s

	2025	2055	2085
Low	+7%	+16%	+20%
High	+10%	+30%	+53%

Analysis approach: Future Flood Explorer (FFE)

- **Maximise value from existing knowledge:**
  - UK has locally checked data held in national accessible databases (on river networks, defences, river levels etc, flood inundation) – Both for present day and some future climates.
- **An approach that is both credible and capable of exploring many futures at a UK scale**
  - Available information is used to create an emulator of the UK flood risk system (the FFE)
  - No spatial analysis is run real time (the FFE works purely from impact tables) it is quick (almost instant to run)

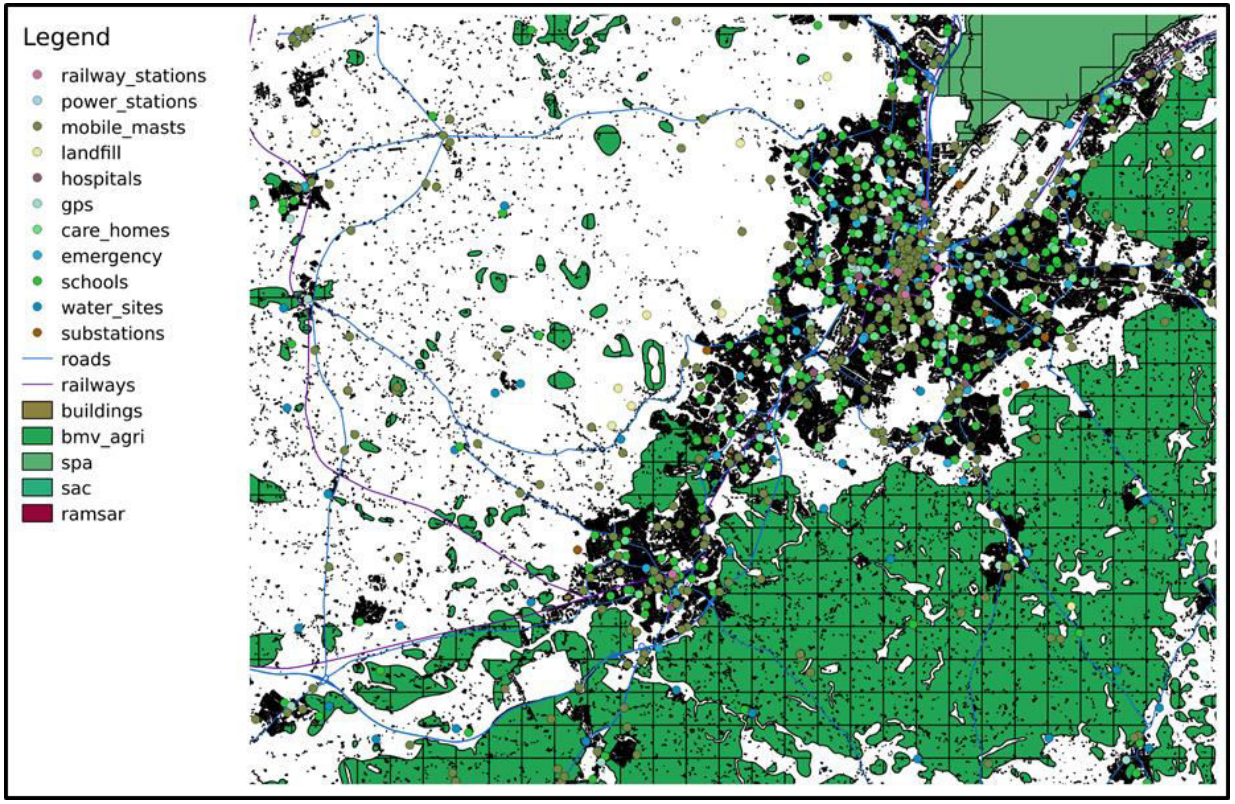
FFE Utilises available data

- **Flood probability** (defended, undefended and probabilistic analysis)
- **Flood defence assets** (standards, condition, type)

FFE Utilises available data

Receptor data:

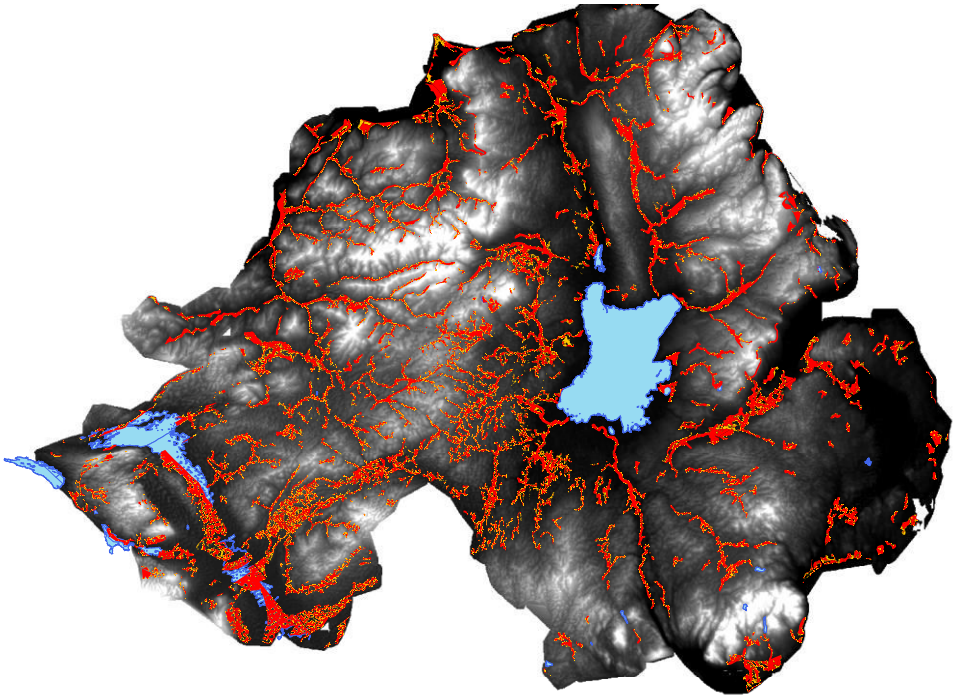
- **Property** (residential and non-residential)
- **People**
- **Agriculture** (Best and Most Versatile and Not)
- **Infrastructure** (a range of critical infrastructures)
- **Natural capital** (SPA and SACs)



- Note: Erosion and opportunity gains not explored

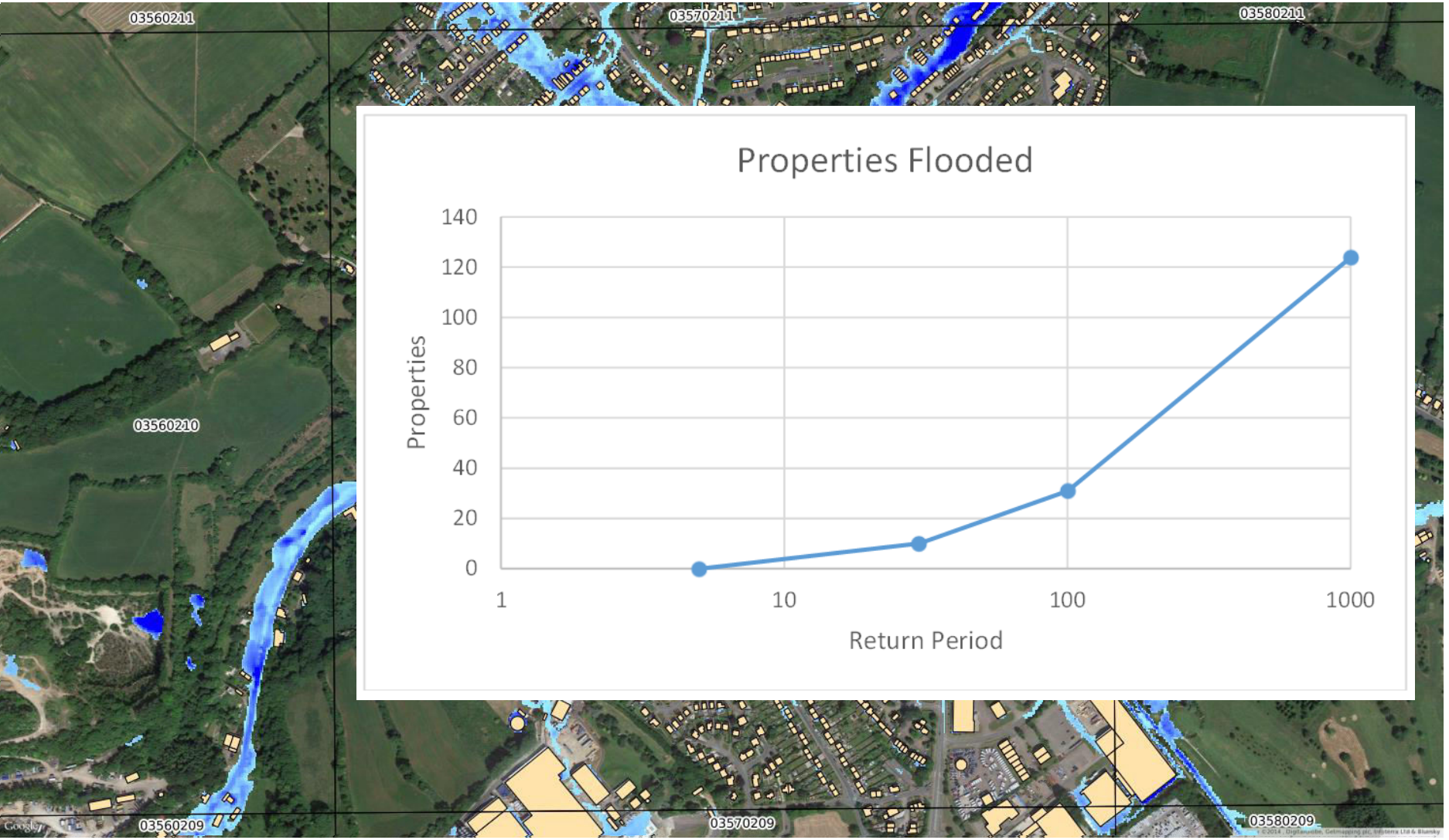
New primary flood analysis - Groundwater

- **Two aspects:**
  - Attribution of groundwater flooding extended to distinguish between limestone and chalk flo and flooding in other lithologies.
  - Groundwater flood susceptibility has been extended to cover Nort Ireland.

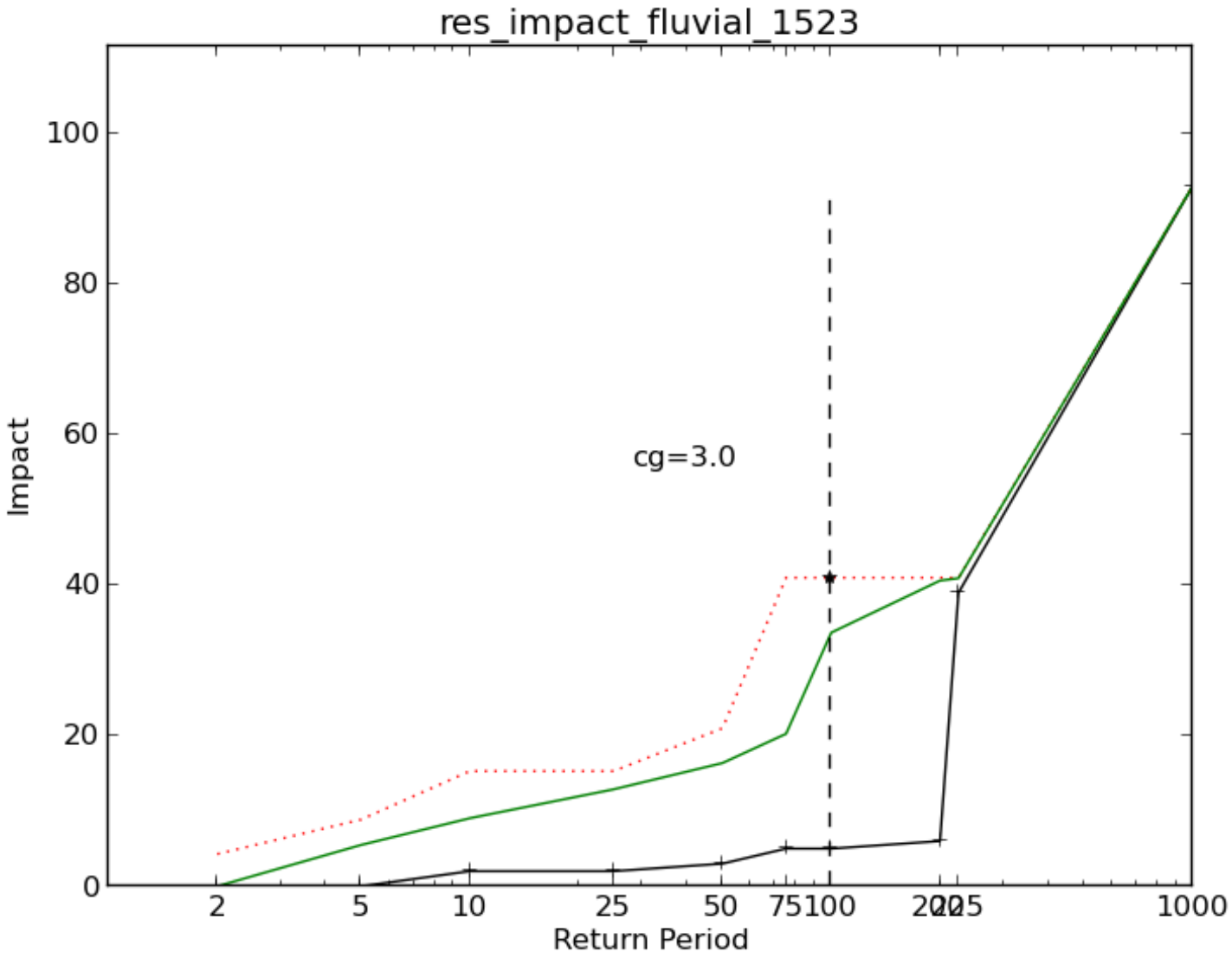


Work led by : BGS

Building the impact curves



Fluvial impact curves – with defences



Risk is sensitive to:

- **Changes in loading conditions (either due to climate change or active management):**
  - % increase in river flows, run-off
  - Metres rise in mean sea levels
- **Changes in defence performance/protection:**
  - Representative Standard and Condition Grade
- **Changes in exposure**
  - Number of properties and occupancy
- **Changes vulnerability**
  - The damage incurred if a receptor is flooded

Some provisional NI results (no adaptation)

Expected Annual	Present	2º 2080s	4º 2080s	H++ 2080s
Residential properties flooded	540	1 100	1 700	9 500
Non-residential properties flooded	130	300	520	3 100
Damages (direct)	£13m	£32m	£58m	£190m
People affected	1 300	2 600	4 100	23 000

- ~30s to calculate
- Subject to change (unchecked)

Approach to adaptation: Levers and scenarios

a) **Identify adaptation levers**
   - Standalone activities that influence either probability, exposure or vulnerability

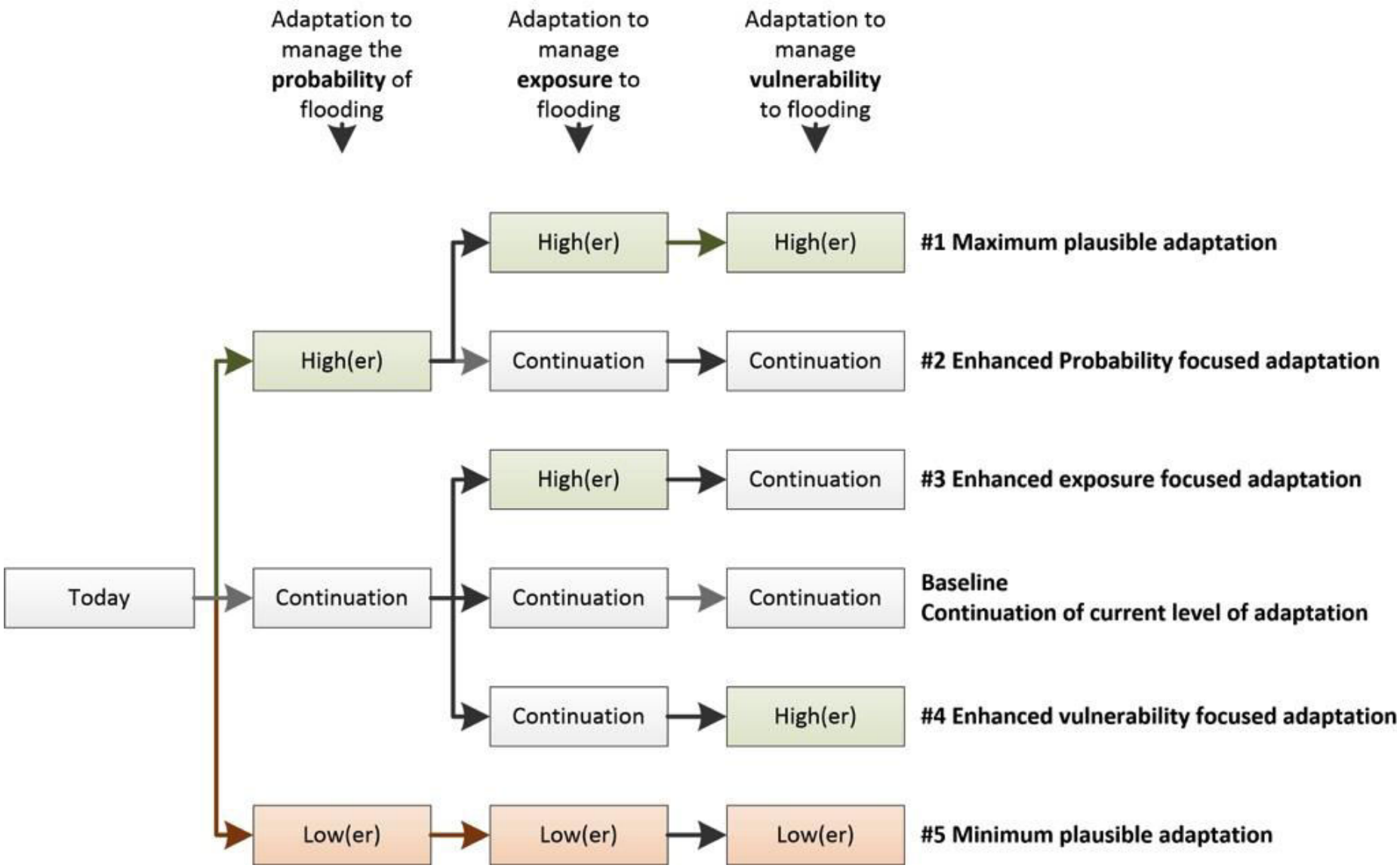
b) **Quantify the potential impact an adaptation lever may have assuming:**
   - A continuation of current levels of adaptation (CLA).
   - A low(er) level of adaptation.
   - A high(er) level of adaptation.

c) **Put together the Adaptation Levers to develop alternative adaptation scenarios**

Individual adaptation levers

- **Adaptation influencing the probability of flooding:**
  - River and coastal defences
  - Working with natural processes through:
    - Coastal realignment
    - Rural land management (run-off and storage)
    - Urban land management (run-off and storage)
- **Adaptation influencing the receptors exposed to flooding (exposure)**
  - Spatial planning
- **Adaptation influencing he vulnerability of those exposed.**
  - Receptor level protection measures
  - Forecasting and warning
  - Insurance and experience

From levers to adaptation scenarios



Some concluding remarks

- **FFE maximizes value from existing information**
  - to provide a step change in the credibility and speed for UK wide analysis
- **The fast run time enables:**
  - Many futures (climate, population and adaptations) to be explored and multiple risks estimated.
  - Individual drivers and sensitivities to be explored
- **Next steps**
  - Will be applied in the coming months

More questions…..please contact

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