# Impact Of And Response To Climate Change In UK Brownfield Remediation

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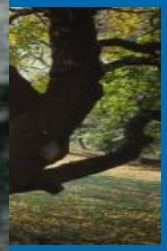
# Outline of presentation

- Background
- Experimental evidence
- Numerical modelling
- Technical adaptation
- Stakeholder perspectives
- Conclusions

# Background

## *Contaminated land management*

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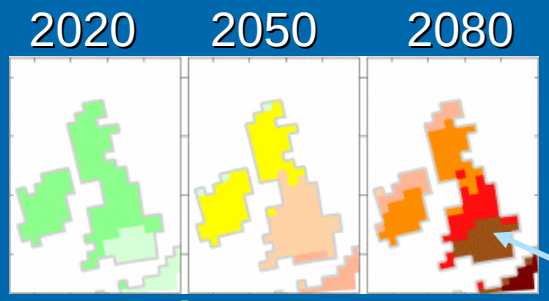
- Tools required for remediation industry to adapt to new risks

# Research objectives
## *Summary*

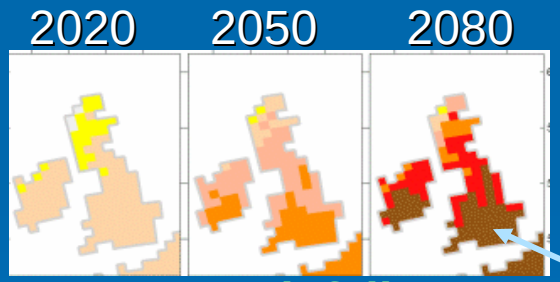
- Quantify the short and long-term impacts of climate change predictions
- Evaluate effects of climate change on contamination linkages
- Develop appropriate adaptation design strategies to account for climate change
- Examine the adaptive response of key brownfield stakeholders to climate change

# Climate Change
## *UKCIP 02 Predictions*

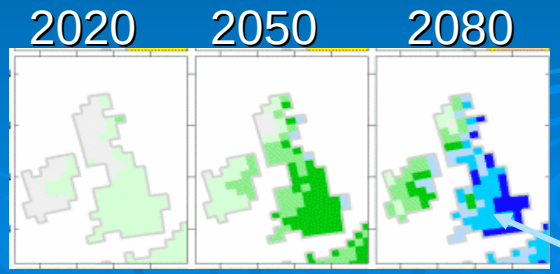
- Annual: hotter and stormier
- Summer: hotter and drier
- Winter: warmer and wetter




**Annual temperature** +4°C




**Summer rainfall** -60%



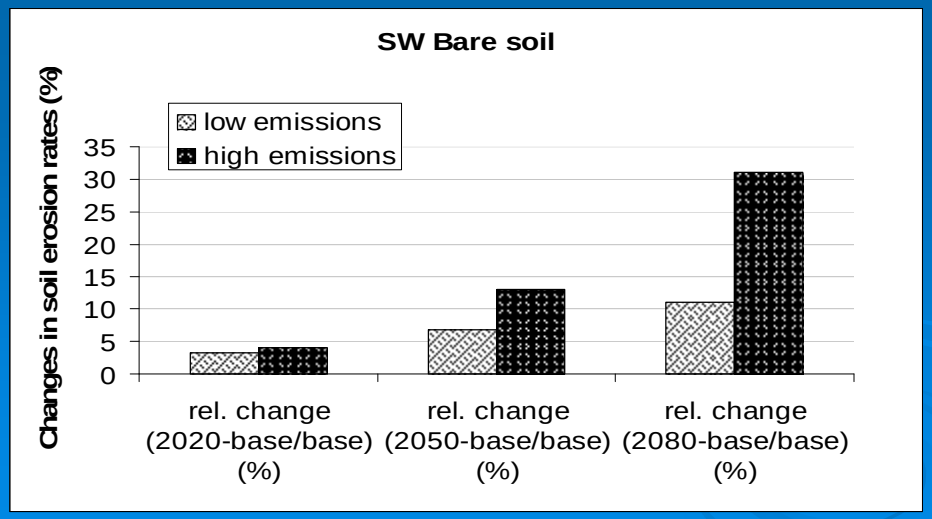

**Winter rainfall** +40%

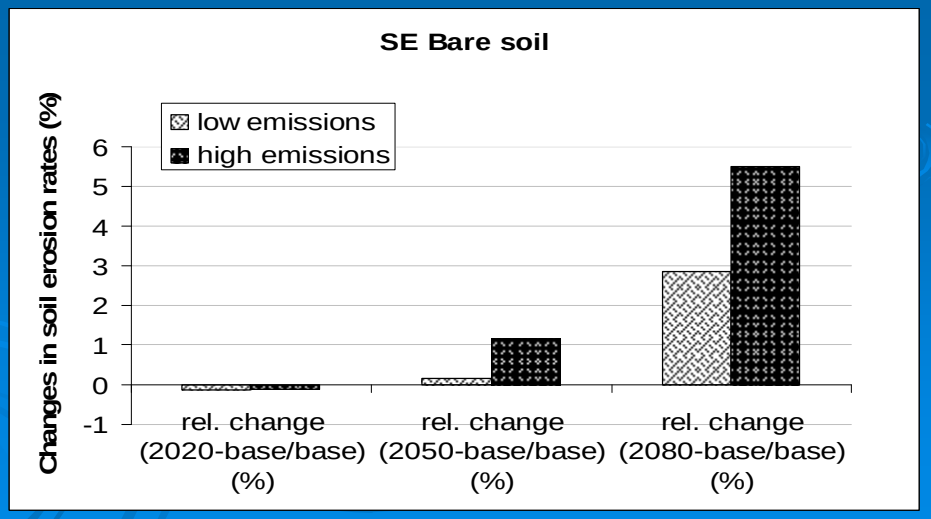
# Experimental evidence

- Extreme seasonal climate change scenarios applied to contaminated remediated soil over two years
- Soils included stabilised/solidified soils, cover systems and bioaugmented soils
- Bioremediated contaminated site soils: changes were more severe between seasons and between different soil systems compared to between climate change scenarios
- Compacted clay cover system: more damage was observed after the winters than the summers with an increase in permeability of one order of magnitude
- Future designs may require higher initial permeability (currently $10^{-9}$ m/s) to allow for increases of up to 3 orders of magnitude
- Containment systems with improved technical performance and which are more durable and sustainable, and hence likely to offer an improved resistance to climate change conditions, are currently being investigated and developed

# Numerical modelling

- Numerical simulation avoids high costs and long time-scales of laboratory work
- Erosion of bare contaminated soil by water movement using RUSLE2
- Up to 35% increase in erosion rate by 2080s with substantial regional variation
- Most erosion is prevented when vegetation is established



# Technical adaptation

- Risk assessment currently based on site-specific *source – pathway – receptor* model from the Contaminated Land Report 11 (2004)
- Proposed technical adaptation strategy extends this model by considering conceptual model of pollutant linkages and the UKCIP climate change predictions
- 4-step model proposed:
  1. Risk assessment based on current requirements, including conceptual model of pollutant linkages
  2. Risk assessment based on climate change, via qualitative assessment of UKCIP predicted impacts on pollutant linkages
  3. Risk management current position, i.e. remediation as appropriate followed by monitoring
  4. Risk management based on climate change if impacts judged to be important, particularly if contaminants remain on site

# Stakeholder perspectives

- Survey and interviews with local authorities and development industry
- Survey of developers indicates that remediation is cost-driven and climate change impacts are given a low priority
  - Consultants expressed concern as to long-term durability of certain remediation systems where contaminants are retained
  - Developers considered risks from flooding more significant
  - Local authorities have increasing awareness of climate change where significant minority are considering measures to improve robustness of past remediation works
- Potential role of planning system to adapt to climate change, e.g. more stringent planning conditions

# Stakeholder perspectives

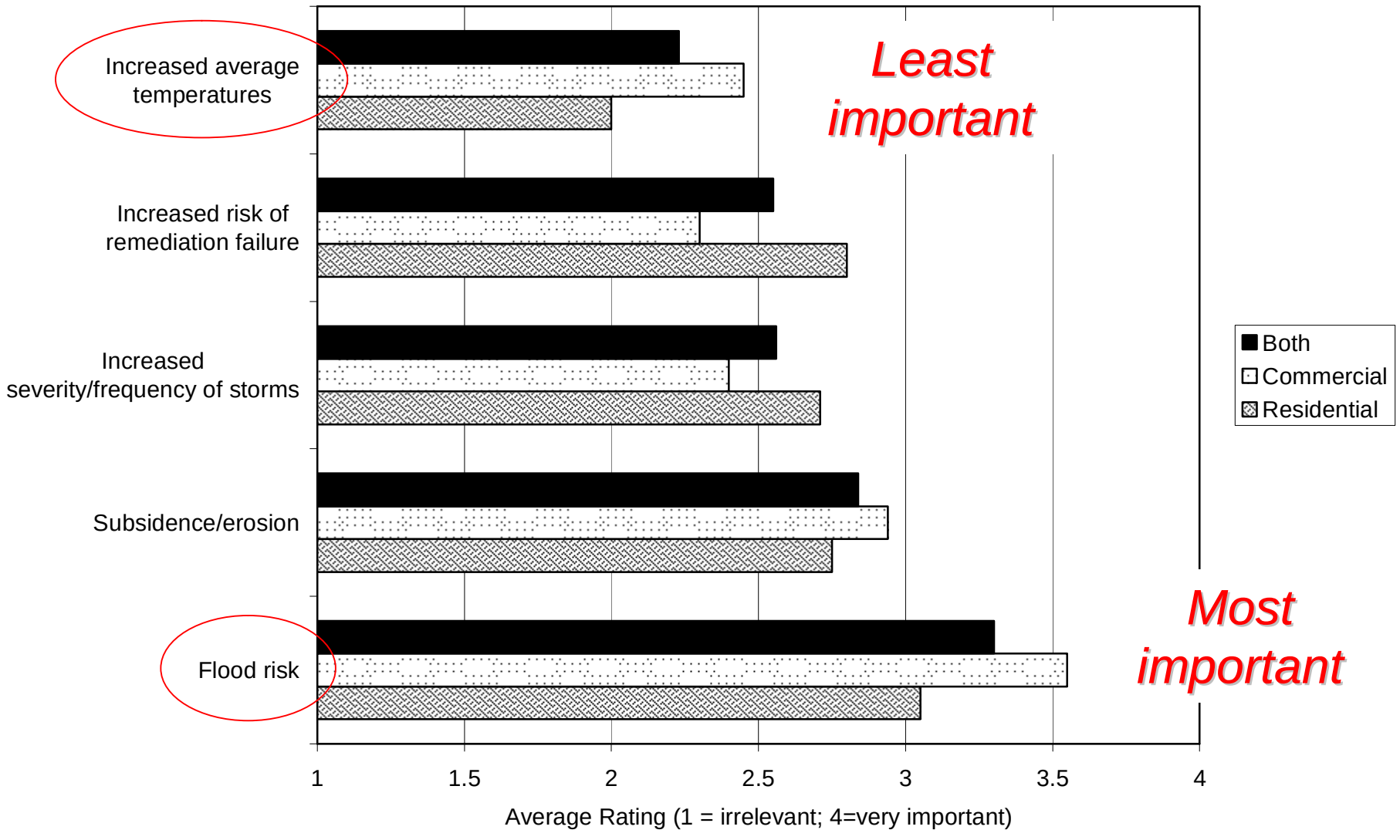
## *Typical interview responses*

*"My own personal view is that there are still a lot of question marks about … the retention of contaminated materials on site and … inadequate consideration is given to the real cost of ensuring long term durability …" (Consultant)*

*"… Most of the issues to do with climate change are obviously to do with flood risk and flood risk assessments, so therefore … you'd be looking at all of the problems [i.e. including pollutant linkages]… and then it would be an holistic approach to the design solution." (Developer)*

# Developer survey

## *Example: Type of climate change impact*



# Conclusions

- Certain climate change scenarios will have significant impacts – e.g. desiccation of covers, erosion and contaminant transport
- Significant influence on risk management of current sites and design of future remediation strategies
- Conceptual strategy developed for adaptation within current UK risk-based regulatory framework
- Survey of development industry and local authorities indicates lack of awareness of potential climate change impacts

# *Thank you for listening!*

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