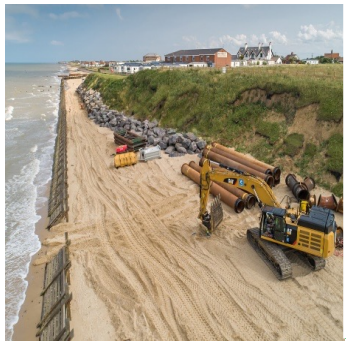







Emergency repair of flood embankments

Research & Development

Dr Chrissy Mitchell & Dr Taye Famuditi
christabel.mitchell@environment-agency.gov.uk
Flood & Coastal Erosion Risk Management Research & Development
Environment Agency, England

EUCOLD
March 16th 2023

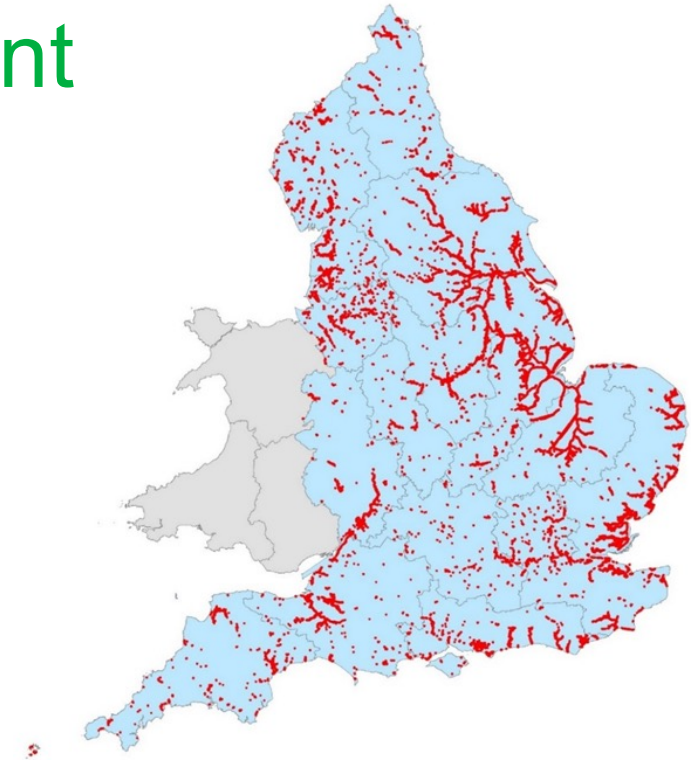
Environment Agency

The English Flood Embankment

… with wall

…with piling

- Failure of flood embankments may be due to various reasons, such as overtopping, seepage, internal erosion and piping, and slope instability.
- Recent incidents have been due to paleochannels, transitions (soft to hard material) and with some focus on burrowing animals
- Emergency response may become more frequent with climate change.



ENGLAND

- 17000km embankments
- 80% of regulated dams (those larger than 25000km^2) are soil based

Environment Agency

Wainfleet, England

Wednesday 12th June 2019

- River Steeping breached, impacting Wainfleet, Lincolnshire, England.
- ~two months' rain fell in two days.

- One farmer lost half his crops as 200 acres was flooded
- 130 properties flooded
- 590 people forced out of their homes
- An animal park was forced to close temporarily after being flooded

Environment Agency

Wainfleet, England

- 12 high-volume pumps to support Lincolnshire Fire and Rescue Service's efforts. Six operational, and six on standby in case the flood waters rise.
- 2 massive pumps were brought in by the Environment Agency. Five swimming pools' worth of water away from the town every hour.
- ~225 Olympic-sized swimming pools' worth of water was pumped out of flood-hit Wainfleet and into the sea in one night.

Ballast bags airlifted in by the Royal Air Force

Environment Agency

Communication vital for asset safety

As well as keeping public away from risk areas

And reducing further sewage on the system

An emergency airspace restriction was put in place aimed at drone users.
To avoid mid-air collisions with RAF helicopters and the police helicopter (used to monitor the floods).

Environment Agency

Coordination of the emergency response

…*It's complicated!*

Environment Agency *undertook works to repair and reinforce the bank at the site of the breach*
Lincolnshire County Council
East Lindsey District Council
Lincolnshire Police
Royal Air Force *Responded and dropped sand bags to seal breach*

Worked together as part of a multi-agency group to coordinate their response to evacuate Wainfleet

Fire and Rescue Service
Carried out measures to minimise the impact of flooding
Responded and pumped out properties
Visited affected residents to offer advice/ gather information

Witham Fourth District Internal Drainage Board (IDB) and Lindsey Marsh IDB *worked together to pump water away from the breached area.*

Environment Agency

Lessons learnt report

There was no assessment of the effectiveness of the emergency response itself

Important factors under consideration at the time of breach included:

- the design of the banks
- amount of vegetation on the banks
- silt levels
- the level of water in the relief channel
- cattle grazing on the banks
- overflowing surface water
- foul drainage systems

Recommendations included

- assessing the conditions of the banks
- monitor silt levels and vegetation growth
- reviewing maintenance programmes
- improve land management practices e.g. controlling cattle and managing the effects of burrowing animals,
- implement flood mitigation measures
- look at ways to better manage surface water
- to develop community plans.

Report: www.lincolnshire.gov.uk/wainfleet (Published: 14th February 2020)

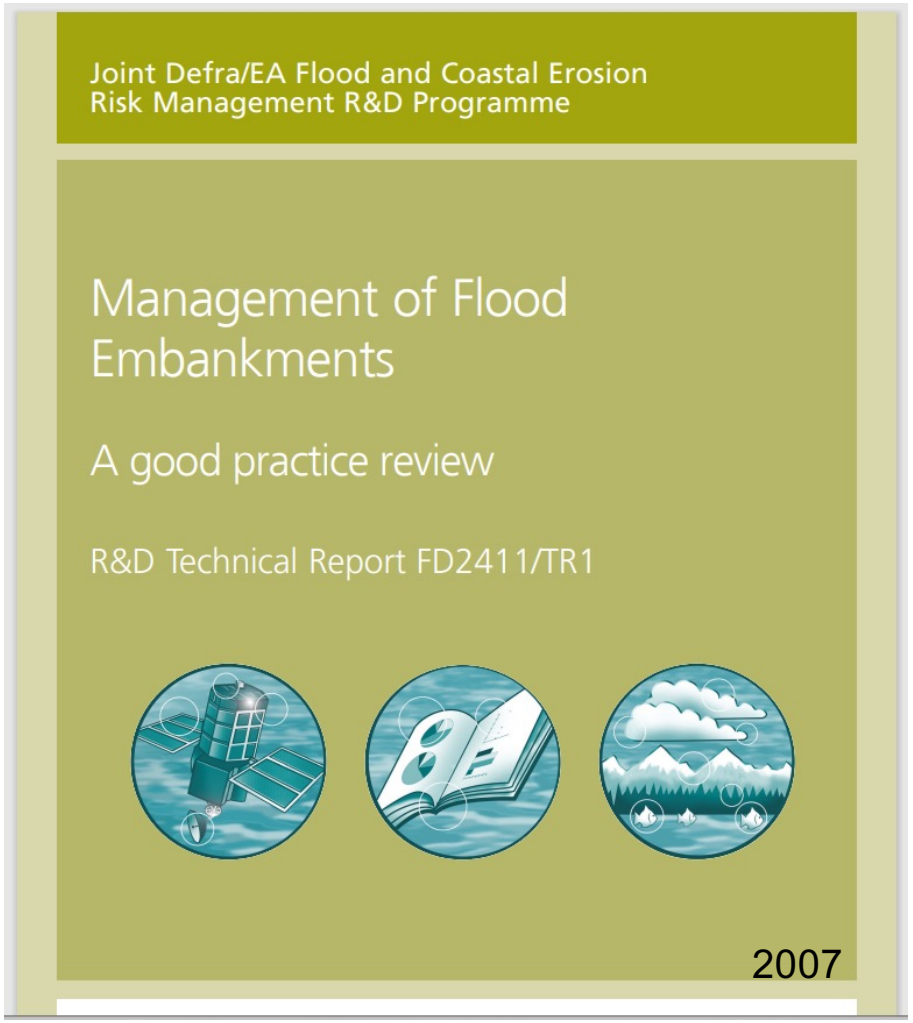
Environment Agency

Ongoing research & development

Environment Agency

Levee R&D Study

- Observed the different mechanisms of the breach
- proposed future research in this field including an improved understanding of soil and grass characteristics, to improve prevention measures.
- Provides guidance based on good practice
- Focussed primarily on reducing the risk of embankment failure under extreme conditions.



Department for Environment Food & Rural Affairs

Environment Agency

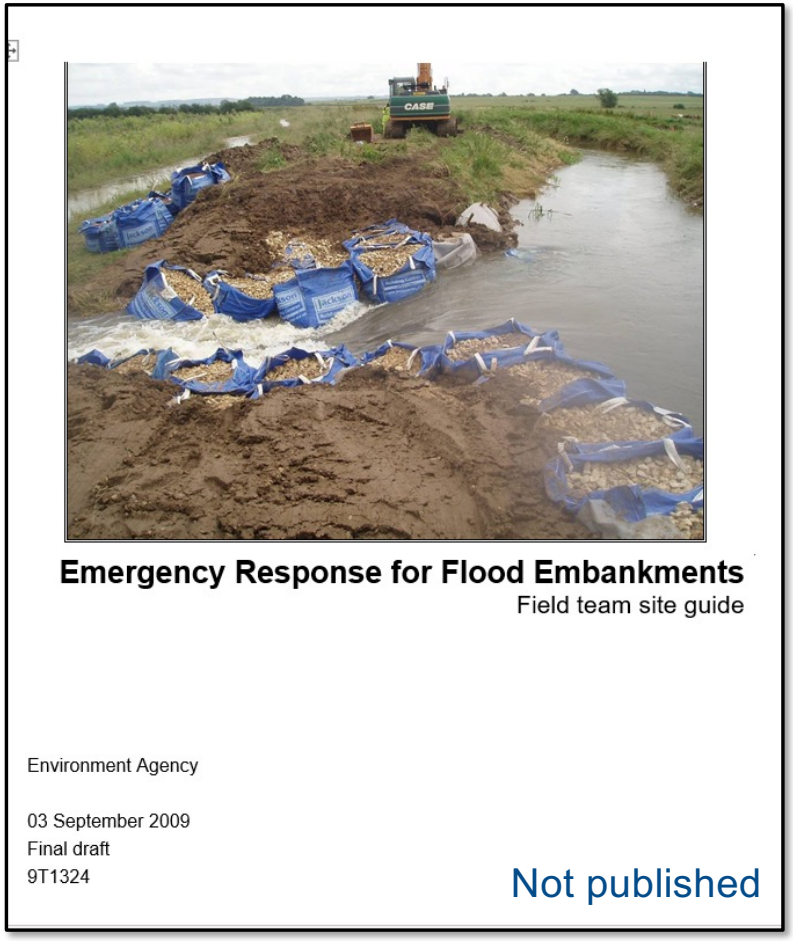
Emergency response- Good practice for flood embankments

Under review

- A summary Site Guide for use during events
- An Office Guide for consideration before events

It assists

- In the identification of embankment faults and/or failure
- In the diagnosis of the fault
- In the decision as to whether intervention is needed
- and whether it is safe and sensible to carry out an action



Department for Environment Food & Rural Affairs

Environment Agency

NEW Project objectives

Looks to bring the previous guide up to date and publish into practice

- To ensure emergency repairs to an embankment are carried out in the best way possible; for both imminent or already occurred failures.
- To capture learning from previous incidents
- Where a breach does occur, to ensure the most efficient techniques for repair are used during the emergency period.

Department for Environment Food & Rural Affairs

Environment Agency

Considering modern techniques

…other options for sandbags?

Equipment requirements
(training, access to site…)

Environment Agency

Injection/pneumatic compaction solutions and engineering techniques for seepage intervention

Exploring solutions such as

- Products that fill the voids (such as Benefil).
- Freezing techniques with chemicals injected.
- Cement based grouting, considering pollution potential.
- Compaction/ground improvement techniques such as Uretek's Power Pile
- Compressed airbags to compact surrounding strata or seal holes.
- Geosynthetic materials that meet environmental and aesthetic requirements
- Adding products/solution to the piping hole inlet location or area.

Environment Agency

Temporary and demountable levee response

- To be reviewed in their practical use for levees, including a review of potential failure
- Consider modern improved solutions for the type of long lengths of levee usage seen at Gowdall and Crossens.

Gowdall

Environment Agency

Net Zero Sustainability

Aim to achieve net zero carbon and ensure that other environmental factors, such as CO2 emissions, HAP, pollution, or biodiversity loss, are considered.

Evidence to support decisions which ensure long term management while in an emergency.

Environment Agency

Expected benefits of the emergency response R&D

- Evidence based options for emergency response, for all responders
- A ‘go-to’ toolbox, with information on the available techniques as well as practical guidance
- Improving the knowledge base with modern information (sustainability, new materials and products suitability)

To track this research:
https://www.gov.uk/government/organisations/flood-and-coastal-erosion-risk-management-research-and-development-programme

Environment Agency


Environment
Agency