



**“Toddbrook: an English reservoir incident and its impact on the industry”**

**Maddie Prendergast**  
National Reservoir Safety Team  
Environment Agency (England)



## **PART 1 - INTRODUCTION**

- **English reservoirs and incidents in general**

## **PART 2 – TODDBROOK**

- **Incident**
- **Incident Response**

## **PART 3 – REACTION**

- **Owners review**
- **Independent Incident Review**
- **Recommendations and implementation**

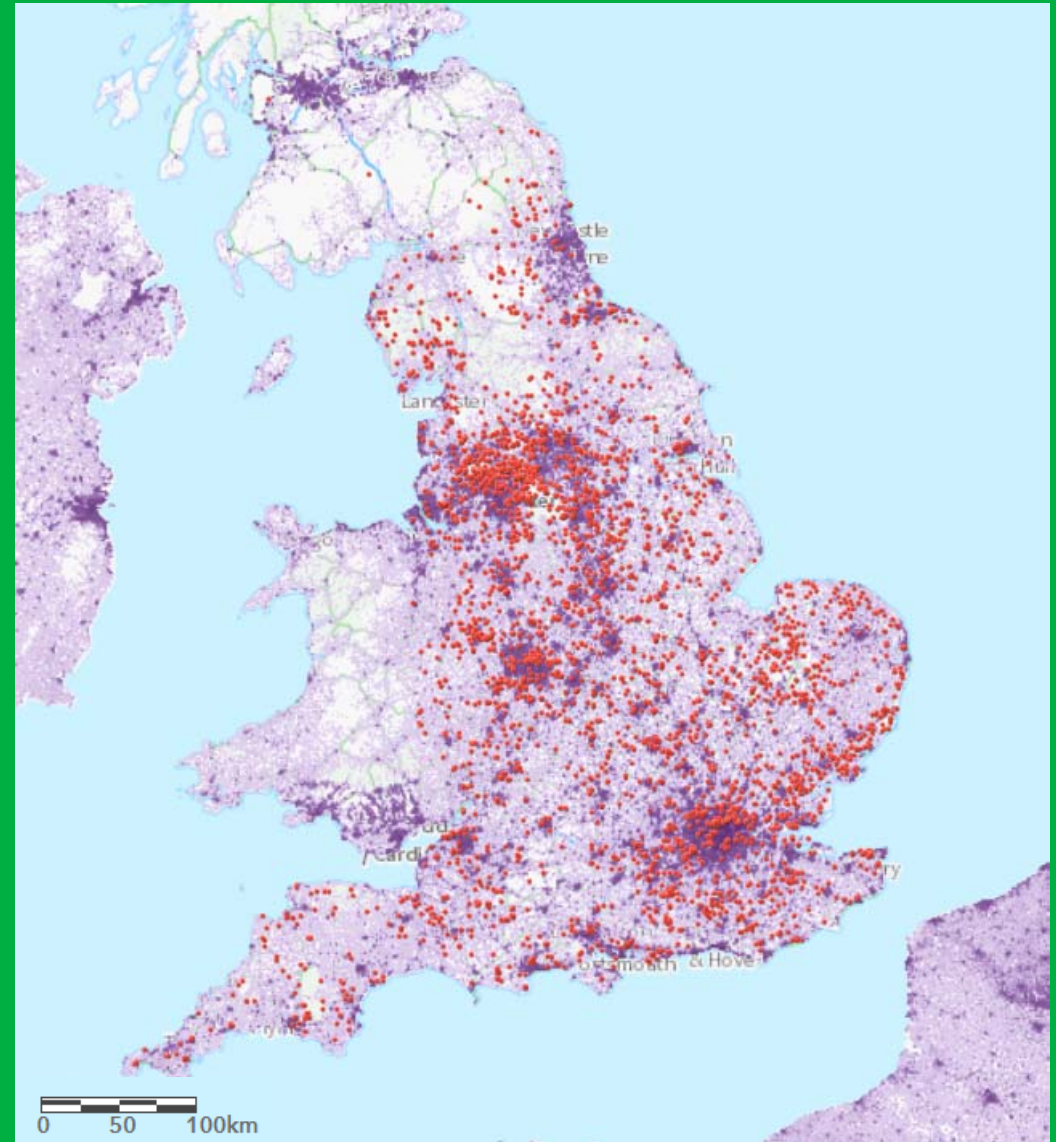
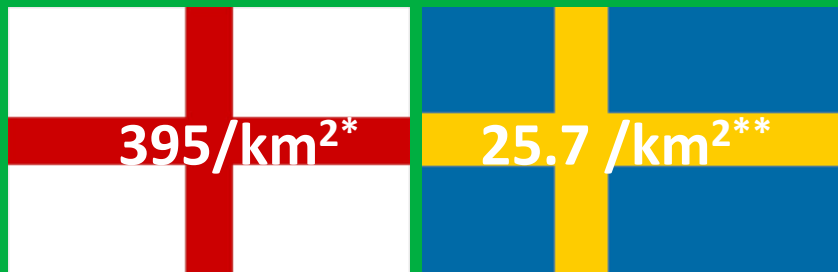
## **PART 4 – LONG TERM IMPLICATIONS**

- **Independent Reservoir Safety Review Report**
  - **Safety vs. compliance**
- **Reservoir Safety Reform: the next few years**

# Reservoirs in England

- 2118 Large Raised Reservoirs
- Volume >25,000 m<sup>3</sup>
- 21% Earthfill
- Highest dam: 63 m

Population density (2021)



\*UK Government Census ([www.gov.uk/government/publications/census-2021-first-results-england-and-wales](http://www.gov.uk/government/publications/census-2021-first-results-england-and-wales))

\*\*[www.statista.com](http://www.statista.com)

# Reservoir Incidents in England

*“if there’s an incident that could result in damage or injury”*

**Voluntary since 2007**  
**Mandatory since 2013:**

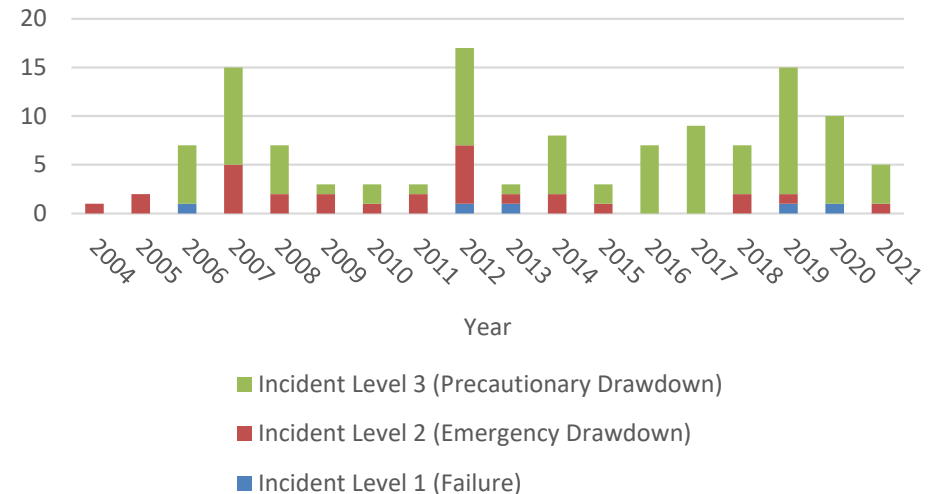
## Preliminary incident report

- *date and time*
- *location*
- *initial facts on the reservoir and actions being taken*

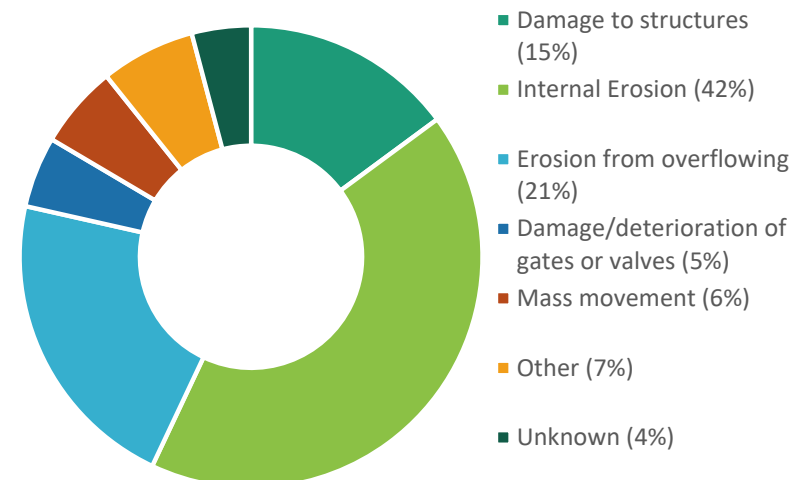
## Final incident report – 12 months from incident date

- *Main contributing factors*
  - *resultant studies*
- *effectiveness of instrumentation*
- *details of follow-up actions taken*
  - *lessons learned*

**Incident Level - all reported incidents**



**Mechanism of deterioration**



# Part 2: Toddbrook





# Toddbrook Reservoir

Canal Water Supply

Constructed 1837-1840

Dam 24m x 310m x 5m

Earth embankment dam with puddle clay core, and granular fill shoulders

Auxiliary spillway added 1964



Toddbrook reservoir incident (2019): independent review, 2019



Arup, 2022

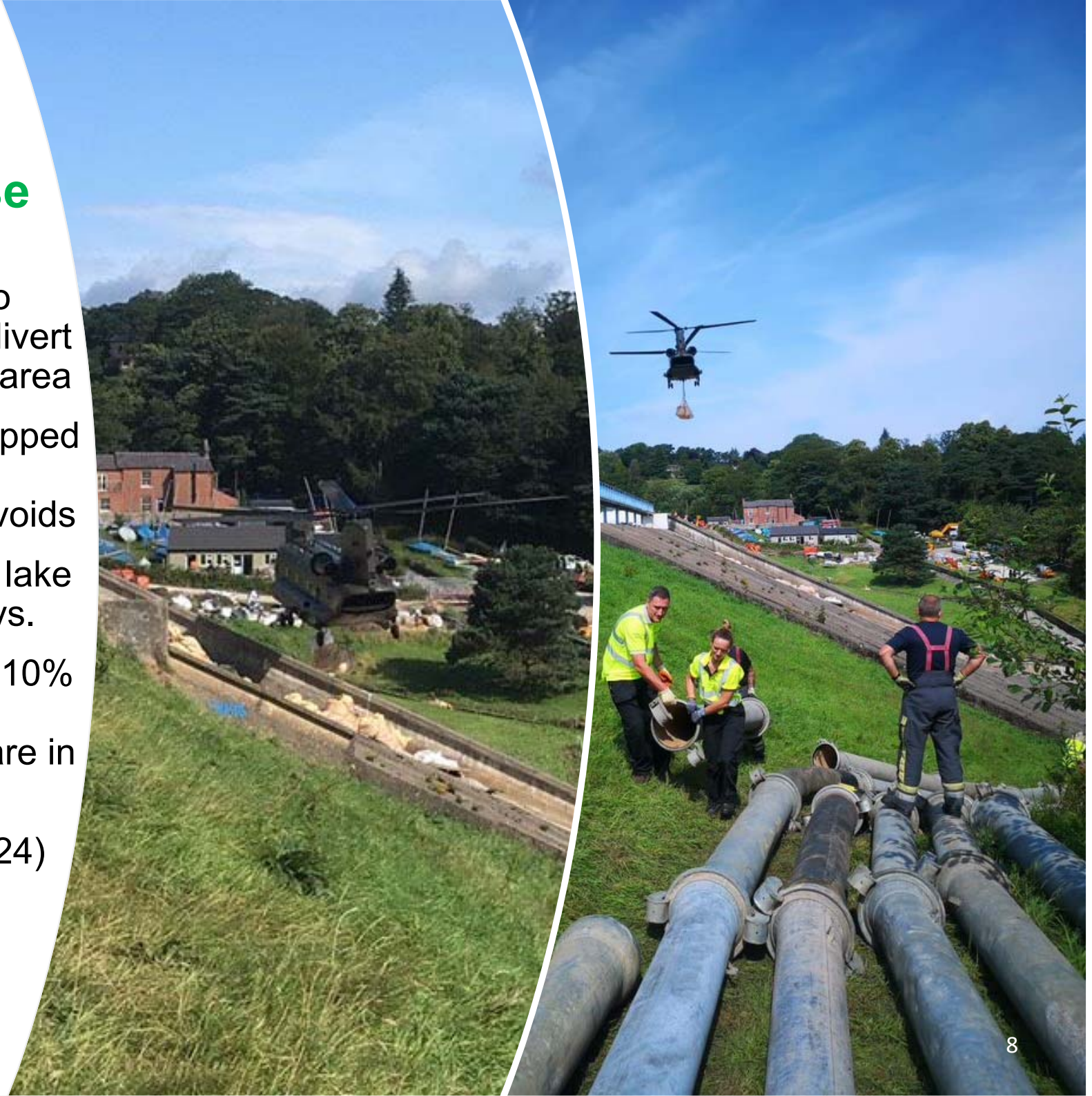


Toddbrook reservoir incident (2019): independent review, 2019



## Onsite response

- Sandbags on weir to increase level and divert flow from damaged area
- Aggregate bags dropped into the hole, and cement grouting of voids
- Pumping – reduced lake by 9 metres in 6 days.
- Reservoir held low (10% capacity) until permanent repairs are in place  
(due completion 2024)





# Offsite response

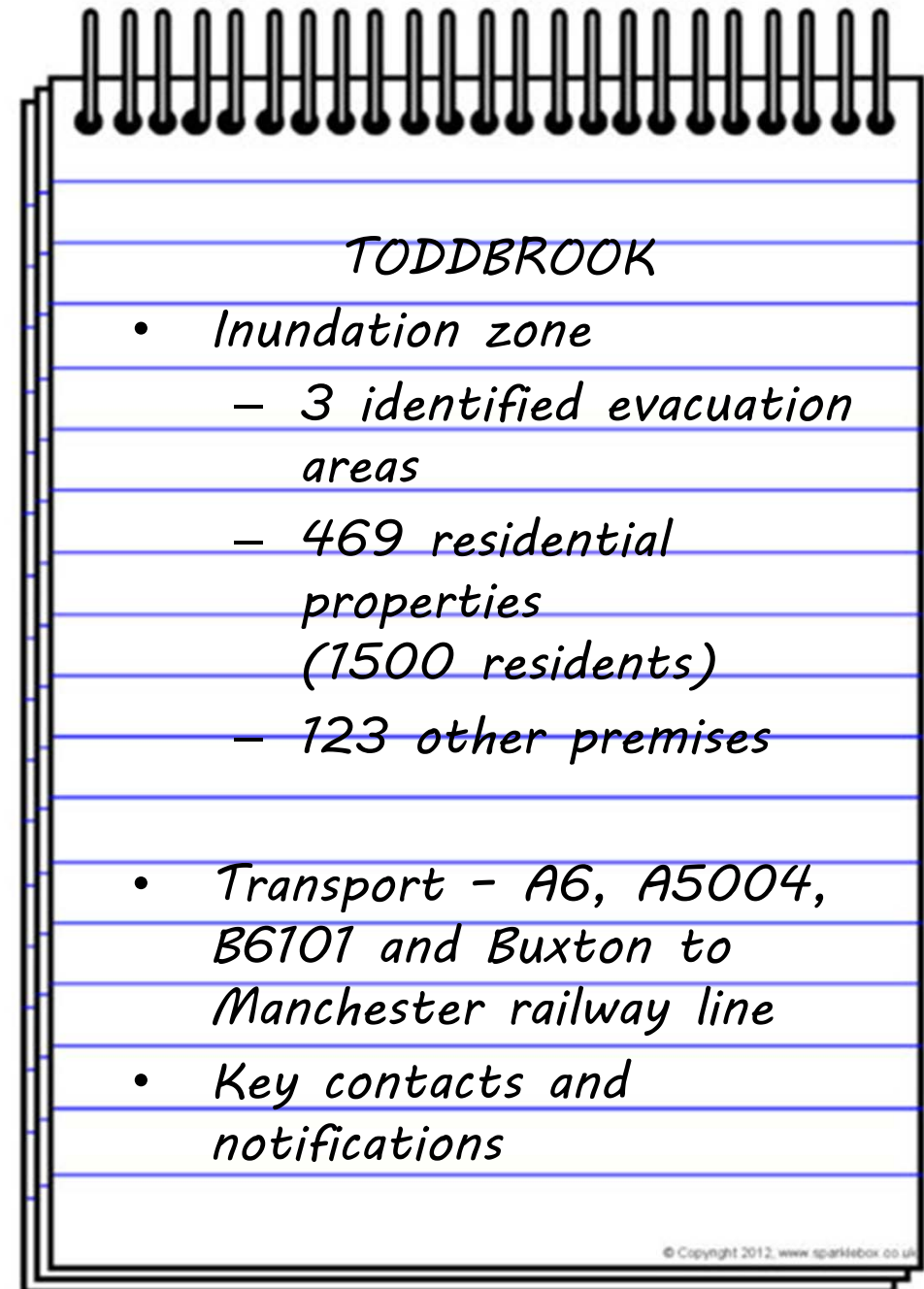
Derbyshire has 54 large raised reservoirs within the county borders.

14 Have a site specific emergency plan – Toddbrook was one of them

Plans cover activation, alerting, management, co-ordination and response to emergencies

Information includes:

- Flood extent, travel time, velocity, depth and hazard area
- Evacuation zones



# Offsite response

1<sup>st</sup> August

Danger to life zone from modelled flood extent used to evacuate

- Within an hour, major incident declared, partners informed, road blocks in place
- Most evacuated within 90 minutes
- 85% of the town evacuated (1500 people) by 16:30
- Multi-agency response
- Construction contractor built a road to ensure fire and pumps could reach the site
- Community response – pubs, halls and the surrounding area opened doors to evacuees



Source: Environment Agency

BBC

7<sup>th</sup> August

- Residents returned to their homes



# Offsite response

## Lessons learned from offsite responders:

- Training on reservoir flood maps for all emergency responders should be undertaken
- Identify cross-border liaison officers where response covers administrative boundaries

## Emergency plans should be more specific on:

- 'return to premises' plan following evacuation
- Non-residential infrastructure which may be at risk
- Ensuring records are taken of evacuees by emergency services when evacuated, so that details can be recorded – particularly for vulnerable people.
- Reviews by Police and Highways to check road closures are still appropriate  
Number, location and size of potential rest centres, and resource requirement to run them
- Contact details of aggregate suppliers



**Current state**





# Toddbrook Spillway Incident Review

Two reviews:

- i. Government (Balmforth) independent review
- ii. Owner's (Hughes) review

Government (Balmforth)	Owner's (Hughes)
Poor design	Poor design
Water ingress through slab joints, leading to crack injection and rapid erosion of fill.	Water ingress beneath top slab from lack of cut-off over many years, leading to long term internal erosion, exacerbated by the rainfall event of July 2019.
Poor maintenance	Maintenance issues not significant enough to contribute



# Toddbrook Spillway Incident Review

## 22 Recommendations

Guidance

### **Reservoir owner and operator guidance: spillways**

How to design, inspect, monitor and maintain impounding reservoir spillways so they are safe.

Guidance

### **Reservoir supervising engineers: written statements and site visit reports**

How to write a reservoir written statement and a site visit report and what information to include.

Guidance

### **Reservoir inspecting engineers: inspecting high-risk reservoirs**

How to report on section 10 inspection findings, recommend measures in the interest of safety (MIOS) and advise on statutory maintenance.

## **Spillway design, examination and failure mechanisms**

This project has produced guidance on designing and examining spillways and the mechanisms that could lead to spillway failure.

From: [Environment Agency](#)

Published 27 June 2022

Category: **Whole life asset management**

Topics: **Asset maintenance, Asset monitoring, Asset performance, Design and build, Deterioration, Monitoring and detection, Reservoirs**

Project status: **Completed**

Project code: **FRS20238**

Date of completion: **27 June 2022**

### **Documents**

[Spillway design guide](#)

[Spillway examination guide](#)

[Spillway failure mechanisms guide](#)



# Lessons learned for regulation



Compliance  $\neq$  safety

# Independent Reservoir Safety Review (Part B)

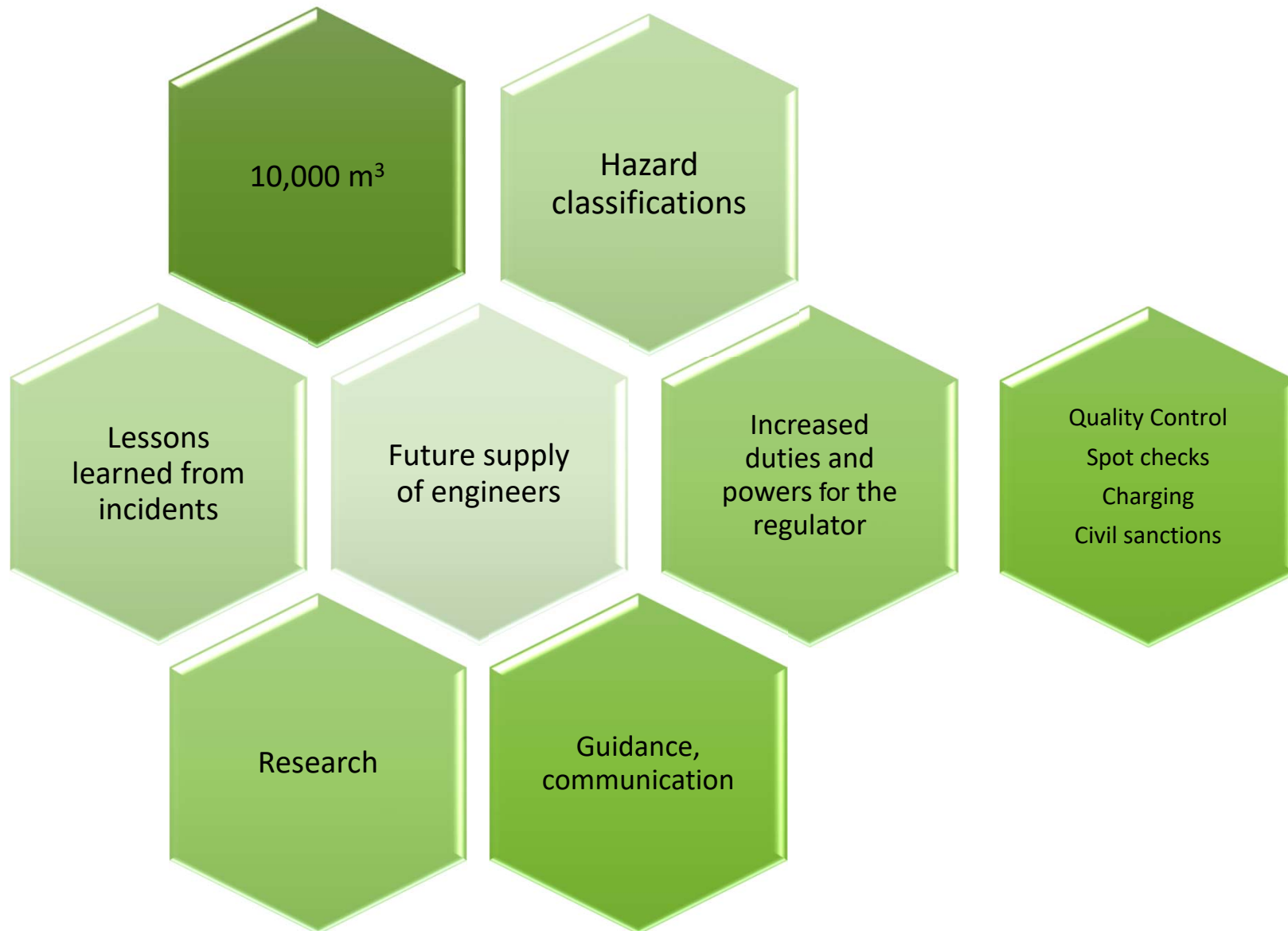
**The review identified common examples of poor practice in the work of reservoir safety engineers and concluded that the Reservoirs Act 1975 does not effectively support modern, risk-based safety practices.**

It recommended:

- a new risk/hazard based safety regime, where safety requirements are proportionate to risks;
- improving safety management practice by reservoir owners;
- improving inspection and supervision by reservoir engineers;
- strengthening the regulator's role.



# Reservoir Safety reform: the next few years



# Not without challenges

**Change**

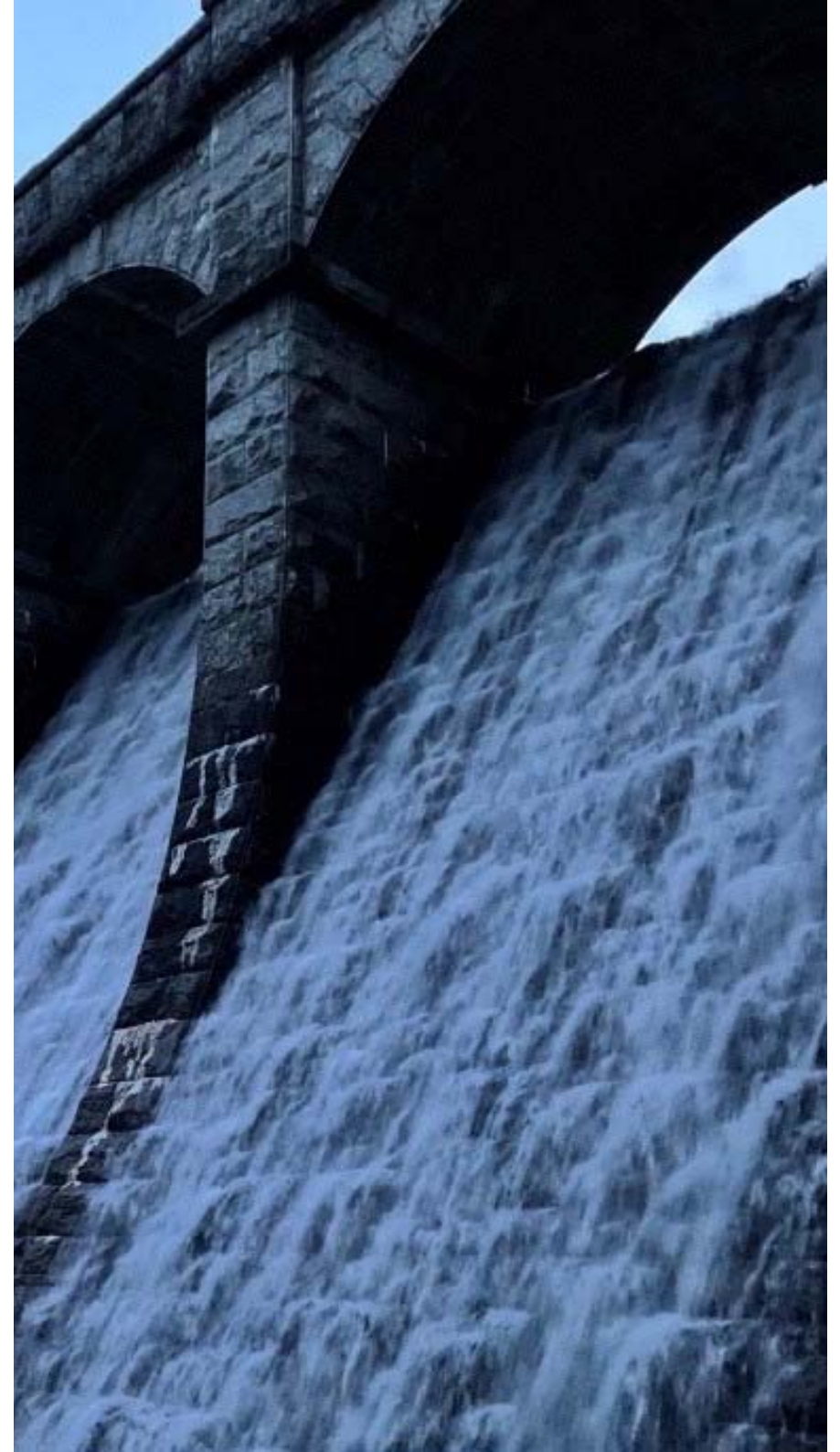
**Cost to owners**

**Inexperienced dam owners**

**Engineering resource**

**Data sharing**

**Political change**







Government Independent Review	<a href="https://www.gov.uk/government/publications/toddbrook-reservoir-incident-2019-independent-review">https://www.gov.uk/government/publications/toddbrook-reservoir-incident-2019-independent-review</a>
Canal and River Trust independent Review	<a href="https://canalrivertrust.org.uk/refresh/media/thumbnaill/41505-report-on-toddbrook-reservoir-by-dy-andrew-hughes.pdf">https://canalrivertrust.org.uk/refresh/media/thumbnaill/41505-report-on-toddbrook-reservoir-by-dy-andrew-hughes.pdf</a>
Reservoir Safety Review	<a href="https://www.gov.uk/government/publications/reservoir-review-part-b-2020">https://www.gov.uk/government/publications/reservoir-review-part-b-2020</a>
Government acceptance of recommendations and outline of what will be implemented	<a href="#">Written statements - Written questions, answers and statements - UK Parliament</a>
General information – search 'Reservoirs'	<a href="https://www.gov.uk/">https://www.gov.uk/</a>

maddie.prendergast@environment-agency.gov.uk