This publication was withdrawn on 25 November 2021

This document is out of date and has been replaced by 'Reservoir maps: when and how to use them.'

Reservoir Flood Maps (RFM) Guide

Explanatory Note on Reservoir Flood Maps for Local Resilience Forums – Version 5 – September 2016.

We are the Environment Agency. It's our job to look after your environment and make it a better place **- for you, and for future generations.**

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

Document Purpose

This document provides explanation of the reservoir flood maps (RFM) produced by the Environment Agency, including information on their production, accuracy and appropriate use.

It is intended for use by Local Resilience Forum (LRF) members to aid understanding for the purpose of preparing reservoir flood plans.

This document should be read in conjunction with information from the Cabinet Office on reservoir flood preparedness.

The following document may be of interest to those requiring more detailed technical information in relation to RFM and can be requested from the reservoir safety team:

- Environment Agency, 'Reservoir Inundation Mapping Specification', Issue F, (June 2009, Mott MacDonald and JBA Consulting)

Contents

Contents

Why are we making the data available to LRFs?

Pitt Review

The Pitt Review of the summer 2007 floods recommended that Government should provide Local Resilience Forums (LRFs) with flood maps for both large and small reservoirs to enable them to assess risks and plan for contingency, warning and evacuation. It was also recommended that the outline maps should be made available to the public online as part of wider flood risk information.

Reason for the maps

In April 2008 the Department for Environment Food and Rural Affairs (Defra) instructed the Environment Agency to assess the impact of dam breach flooding from all large raised reservoirs in England and Wales registered under the Reservoirs Act 1975, and produce flood maps for LRFs to use for emergency planning.

The maps provide an indication of the areas that could be affected by reservoir flooding and together with local knowledge can be used to plan for emergency response. The maps should be used to prioritise areas for evacuation/early warning and to help reservoir owners produce on-site plans and LRFs produce off-site plans.

The detailed maps are available on the Cabinet Office's Resilience Direct website for LRFs to use as part of their emergency role under the Civil Contingencies Act 2004.

Important!

Other uses

The maps were originally developed for emergency planning purposes. They can be used for other purposes, but care should be taken to understand the limitations of the maps and the assumptions made in the modelling before using the maps for other purposes.

Renaming of the maps

Initially and throughout their production, the maps were named Reservoir Inundation Maps (RIM). Since May 2010 the maps are publicly referred to Reservoir Flood Maps (RFM).

Format and management of the map

In this section

This section includes the following topics:

Data format

Data types and security classification

All RFM data is available in portable document format (PDF) or in the geographical information systems (GIS) formats, ESRI and MapInfo.

There are two types of maps:

- **Outline** (flood extent) maps.
- **Detailed** maps including initial and peak flow arrival times showing:
- Depth;
- Velocity;
- Hazard.

The maps were classified according to the old Government Protective Marking Scheme. Outline maps were not protectively marked, individual detailed maps were marked 'PROTECT' and an aggregation of detailed maps was 'RESTRICTED'. (Note that the pdfs of detailed maps are still labelled 'RESTRICTED' as this is what was agreed initially).

Under the new Government Security Classifications, outline maps are Official, and therefore not marked. Detailed maps are 'Official Sensitive'.

Further advice is also contained in Section 5.4 of the 'National Protocol for the Handling Transmission and Storage of Reservoir Inundation (Flood) Maps for England and Wales' (National Protocol).

All Reservoir Flood Map (RFM) data must be managed and stored in accordance with the latest version of the National Protocol. You can request a copy from the Reservoir Safety team.

What data has been issued?

An electronic set of 'Issue 1' outline map PDFs were sent to Environment Agency area teams and upper tier local authorities in December 2009.

Hard copies of 'Issue 1' outline maps were sent to reservoir owners in December 2009. 'Issue 1' was superseded by 'Issue 2'.

'Issue 2' outline map PDFs were sent to Environment Agency area teams and upper tier local authorities in April 2010. This also included GIS data together with reservoir and breach hydrograph summary sheets.

Hard copies of 'Issue 2' outline maps were sent to reservoir owners in April 2010.

All Reservoir Flood Map data including the detailed maps was uploaded onto the Civil Contingencies Secretariat's (CCS), National Resilience Extranet (NRE), in April 2010. In July 2014, all Reservoir Flood Map data was transferred to the Cabinet Office's new system, Resilience Direct.

! Important Category 1 & 2 responders should access the detailed maps via Resilience Direct. Enquiries about Resilience Direct should be directed to the Cabinet Office.

The outline and simplified depth and velocity maps can be viewed on our website.

Dealing with requests for data

Dealing with external requests for data

Outline and simplified depth and velocity maps can be viewed on our website. Requests for access to any other reservoir flood mapping data received by LRFs must be referred to the Environment Agency's Reservoir Safety Team.

Data release

! Important

You must not proactively release the data.

Information security

Security, storage and transfer of 'Official-Sensitive' Maps

The Outline maps are not protectively marked. The detailed maps are marked 'Official Sensitive'. However, please be aware that the pdfs of detailed maps are labelled in line with the original marking of 'RESTRICTED'.

All Reservoir Flood Map data must be managed and stored in accordance with the latest Government Security Classifications and the National Protocol.

Frequently asked questions

Who owns the data?

The Environment Agency owns the data.

How can I obtain copies of the detail RFM?

All RFM data is available on Resilience Direct. Access to the RFM data must be requested via Resilience Direct.

Requests for detailed RFM for non-emergencies should be referred to the Reservoir Safety Team who will respond in accordance with the Environmental Information Regulations 2004.

Who should I contact for more information?

Contact the Reservoir Safety Team

How to use the maps

In this section This section includes the following topics:

Dam breach flooding

What is a dam breach?

A **dam breach** is an opening, gap or rift in a dam structure. The following can contribute to a dam breach:

- natural deterioration or poor maintenance of the dam structure;
- extreme rainfall, floods or earthquakes;
- settlement of the dam;
- seepage through the dam structure;
- poor construction or faulty design of the dam;
- reservoir not operated properly.

What is dam breach flooding?

Dam breach flooding happens when a dam impounding a reservoir breaches, causing water stored in the reservoir to be released through the breach and flooding areas downstream of the dam.

The dam breach scenario simulated on the maps is a “credible worst case” scenario. This represents a “generic” dam failure that can be adopted across the country. But you need to bear in mind that there are many different potential dam failure scenarios which could also happen.

What the maps show

Mapping

Each reservoir has four types of map summarised in the table below:

Map type	Information shown on map
Extent	▪ Worst credible area susceptible to dam breach flooding
Depth	▪ Area susceptible to dam breach flooding ▪ Maximum flood depth thresholds ▪ Initial and peak flood arrival time
Hazard*	▪ Area susceptible to dam breach flooding ▪ Maximum flood hazard thresholds ▪ Initial and peak flood arrival time
Velocity	▪ Area susceptible to dam breach flooding ▪ Maximum flood velocity thresholds ▪ Initial and peak flood arrival time

*Maximum flood hazard describes the degree of 'danger' to which a receptor would be subjected by the flood, at different locations within the area of flooding, and is calculated from the equation reproduced below, published in *Defra (2005) Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose*, where V is velocity (m/s), D is flood depth (m) and DF is the debris factor, equal to 0.5 for D<0.25m and 1.0 for D>0.25m.

$$Flood\ Hazard\ Rating = D\left(V + 1/2\right) + D_F$$

A high 'hazard' rating indicates a higher level of danger to a receptor than a low 'hazard' rating.

Summary sheet

As well as the maps, each reservoir has a dam breach modelling and mapping summary sheet. This summary sheet gives key information on the reservoir and summarises the dam breach hydrograph calculation and modelling and mapping processes. The summary sheets are available on Resilience Direct.

What the maps do not show

What the maps do not show

The maps do not show the risk to individual properties of dam breach flooding.

The maps do not in any way reflect the structural integrity of the dam or the chance of it failing.

The maps do not indicate or relate to any particular probability of dam breach flooding.

Use by LRFs for emergency planning

Main use

The maps were prepared for emergency planning purposes and can be used to help reservoir owners produce on-site plans and LRFs produce off-site plans, and to prioritise areas for evacuation/early warning in the event of a potential dam failure.

The maps may be used for indicative purposes to identify areas where detailed analysis of the risk of reservoir flooding might be required. However, as some areas shown as not at risk from reservoir flooding may be at risk under different breach assumptions or using a different digital terrain model, they should not be relied upon as the sole information source for this purpose.

Other areas where the map can help

The maps can be used to help with:

- **raising general awareness** - LRF members can use the maps to raise awareness of the risk of dam breach flooding in different areas. The public can view the outline maps on our website.
- **risk assessment** - LRF members can use the maps to help assess the risk of reservoir flooding, inform community risk registers and to produce community flood risk summary sheets.

Using the map to assess risk

The map can help in assessing relative risk, within the following constraints.

Uses	Information and limitations
Likelihood of dam failure or flooding	The maps do not in any way reflect the structural integrity of the dam or the chance of it failing, hence should not be used to assess likelihood or probability. The maps are intended to represent the likely extent, depth, velocity, hazard and timing for a hypothetical “credible worst case” dam breach flood event (see Dam breach hydrograph calculation below),
Impact	Due to the many assumptions made in creating the RFM, including the simplified modeling approach, caution must be taken when assessing flooded areas, depth, extent, velocity, hazard and timing, as they may be different from those shown. The map can’t be used to identify individual properties at risk of flooding, but may be used to identify areas where a large number of residential or commercial properties may be at risk. The maps are not suitable for identifying individual properties at risk and, therefore, may not be suitable for some detailed risk assessments, for example at the parish level.

Other possible uses

Uses	Information and limitations
Places not suitable for control centres	The maps can be used to prioritise control centre locations, while noting that areas not marked as at risk of flooding will still carry some residual risk.
Where key infrastructure at risk of flooding is located	While the maps do not identify the risk to individual properties and places, flood plans developed using the maps may be used to prioritise monitoring as a flood develops.
Where various facilities with vulnerable people at risk of flooding are located. These include hospitals, schools and care homes.	As for the infrastructure sites above, the maps may be used to help develop flood plans and to prioritise monitoring, during a flood although the maps do not provide an estimate of risk at specific locations.
Places likely to be unsuitable for evacuation routes, safe havens and rest centres.	As above, the maps do not provide an estimate of risk at specific locations.

How the maps were produced, and method selection

In this section

This section includes the following topics:

Dam breach hydrograph calculation

Principles

Dam breach estimation involves predicting the dam breach outflow hydrograph, and routing this hydrograph downstream of the reservoir to produce data for flood mapping.

The dam breach hydrograph is calculated using an approach which assumes the following breach scenarios depending on the type of reservoir:

Reservoir Type	Description of Reservoir Type	Assumed Breach Scenario
Impounding Reservoirs	Reservoirs filled by direct run-off from the upstream catchment	Reservoir water level has risen to dam crest level plus 0.5m. Subsequent overtopping or piping of reservoir leads to breach over entire height of dam.
Non-Impounding Reservoirs	Reservoirs which are not designed to obstruct or impede the flow of a watercourse, typically filled by pumping from an adjacent watercourse (i.e. pumped storage)	Reservoir water level has risen to dam crest level plus 0.1m. Subsequent overtopping or piping of reservoir leads to breach over entire height of dam.
Service Reservoirs	Non-pumped reservoirs constructed of concrete, brickwork or masonry (generally service reservoirs in a water supply system).	Reservoir water level has risen to top water level. Subsequent overtopping or piping of reservoir leads to breach over entire height of the reservoir wall.

! Important The assumptions above are intended to produce a single, simplified dam breach hydrograph that reflects a credible worst case scenario for a hypothetical dam breach.

It is important to note that there are many different possible dam breach failure scenarios. Using a single simplified hydrograph means that the maps will only give an indication of the flood extent, depth, hazard, velocity and timing that could possibly result from the credible worst case dam breach scenario.

Measurements used

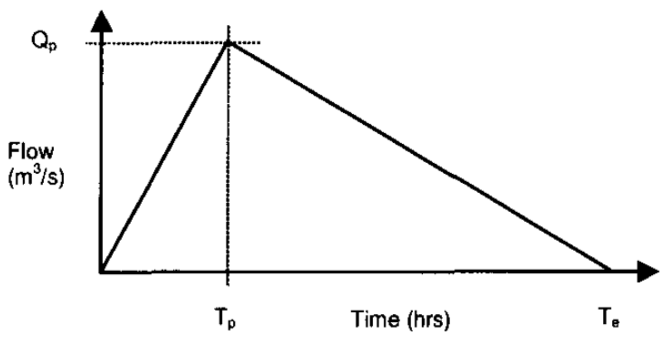
We used the following measurements to calculate the simplified dam breach hydrographs:

- Maximum dam height (m)
- Reservoir volume at top water level (m^3)
- Reservoir area at top water level (m^2)
- Dam crest level (m AOD)
- Dam top water level (m AOD)
- Dam crest length (m)

We obtained these measurements from our own data sources and from reservoir owners as part of the RIM project. If data was not available from either of these sources, we used digital terrain models, OS mapping and the International Commission of Large Dams (ICOLD) reservoir database. We verified all the measurements before using them to calculate the dam breach hydrographs.

Calculation method

We used the following methodology to produce simplified dam breach hydrographs for a given reservoir. For more detail, please refer to the following: *Evans, et al (2009). Reservoir Inundation Mapping Trial Study – Volume I: Project Report. A report prepared by Mott MacDonald Ltd for the Environment Agency. February, 2009, Ref: 247474/02/E, Status: Final.*

<table>
<tr><th>Step</th><th>Action</th><th>Explanation</th></tr>
<tr><td>1</td><td>Assume the hydrograph shape is triangular as follows</td><td>
</td></tr>
<tr><td>2</td><td>Calculate peak discharge (Qp) using the following equations which depend on the type of dam</td><td>
<table>
<tr><th>Dam type</th><th>Equation to estimate Q_p</th><th>Reference</th></tr>
<tr><td>Earthfill embankment</td><td>$Q_p = FOS\left[0.607(V_w^{0.295} H_w^{1.24})\right]$</td><td>Froehlich (1995)</td></tr>
<tr><td>Concrete/masonry</td><td>$Q_p = cLH_w^{1.5}$</td><td>CIRIA C542</td></tr>
</table>
where:
FOS = factor of safety (equal to 1.5)
V_w = Reservoir volume at top water level (m^3)
H_w = Maximum dam height (m)
c = Coefficient of discharge (depends on dam construction type)
L = Length of dam crest across the valley</td></tr>
<tr><td>3</td><td>Estimate time to peak discharge (T_p) based on the following guidelines</td><td>
<table>
<tr><th>Dam type</th><th>Equation to estimate T_p (s)</th><th>Reference</th></tr>
<tr><td>Earthfill embankment</td><td>$T_p = 120 H_w$</td><td>Brown & Gosden (2004)</td></tr>
<tr><td>Concrete/ masonry</td><td>T_p = 30s or 720s (dependent on construction type)</td><td>CIRIA C542</td></tr>
</table></td></tr>
<tr><td>4</td><td>Estimate time to end discharge (T_e) so that the volume under the hydrograph is equal to the reservoir volume</td><td>$V_w = ½ (Q_p \times T_P) + ½(Q_p \times (T_e - T_p))$</td></tr>
</table>

Dam breach flood routing

Principles

The single, simplified dam breach hydrograph is routed dynamically, with a two-dimensional computational hydraulic model. The type of hydraulic model used depends on the phase in which it was modelled, as summarised in the following table:

RIM phase and type	Hydraulic model type
Phase 1 - Rapid RIM - (All reservoirs under the 1975 Act) – Type 1	JFLOW-GPU (Version GU)
Phase 2 - Specification RIM - (All Category A reservoirs and other ‘higher risk’ reservoirs – Type 2	Infoworks-RS-2D (version 9.51-MO or later) or TUFLOW (version 2008-08-AD-iDP or later)

The 2D model JFLOW-GPU is a simpler model where the inertia terms (or ‘acceleration slopes’) are left out of the controlling equations. Therefore this model is less able to work out velocities, depth and timing of the dam breach flood than the 2D models TUFLOW and InfoWorksRS-2D which use the full 2D free-surface shallow water equations.

The model setup and run time for the JFLOW-GPU model is significantly less than either InfoWorksRS-2D or TUFLOW. For this reason, and given the funding and programme constraints for the RIM project, InfoWorksRS-2D or TUFLOW are only used to model the higher-risk reservoirs, while JFLOW-GPU is used to model lower risk reservoirs.

See model properties and rationale **Model Properties and Rationale**.

Model properties and rationale

Model resolution

Model extents can range from 1km to 100km, depending on the size of the reservoir and downstream topography. Therefore, no specific mesh resolution has been specified, but the mesh has to be as small as possible given PC CPU and RAM constraints. The levels of all major embankments (flood, road, railways, etc) have to be “enforced” into the hydraulic model.

Representation of hydraulic structures and urban areas

Hydraulic modelling is intended to give a general assessment. Therefore, the following assumptions apply:

- All major floodplain features (for example road and railway embankments etc) which influence or control water level and flow are represented in the hydraulic model.
- Bridges, culverts and other hydraulic structures on the watercourses are not represented in the hydraulic model.
- Buildings and urban areas are not represented in the hydraulic model.

Manning's n — Is set at 0.10 globally. The high value allows for an estimate of some of the broad scale effects of sediment entrainment and buildings and other obstructions not detailed specifically.

Cascade failure — It is common to find dams built in a series along a valley so that if an upper dam failed, the floodwater would pass into the lower reservoirs, potentially creating a 'cascade failure' of the lower dam(s).

- **For risk category A reservoirs:** Cascade failure of the downstream reservoir(s) is triggered if the dam crest of the cascade reservoir(s) is overtopped by 0.15m or more.
- **For risk category B, C, D and "unknown" reservoirs:** Cascade failure of the downstream reservoir(s) is triggered if the dam crest of the cascade reservoir(s) is overtopped by 0.00m or more.

Multiple breach failure — On some reservoirs there are a number of places where a hypothetical dam breach could occur. If the location of the breach has a significant impact on flooded areas, multiple breach locations are considered and flood maps which show flooding from both the individual breach locations, as well as a composite of all breach locations will have been produced.

Flood conditions in river systems downstream of the reservoir — Dam failure can occur during a period of high rainfall (rainy day conditions) resulting in flood conditions on the river system downstream of the dam. Flood conditions on the river system can make the flood depth, timing and extent resulting from the dam breach flood wave worse.

Flood conditions in the downstream river systems are not represented in the hydraulic models. This is due to the time constraints and complexity of estimating flood conditions downstream of reservoirs on a national scale. However, the digital terrain model (DTM) is likely to give approximate normal water levels in river systems, as the laser used to collect topographic data does not penetrate below water surfaces.

Digital terrain model (DTM)

Digital terrain model — The topography downstream of the reservoir is represented in the hydraulic model by a digital terrain model (DTM). Either LIDAR (Light Detection and Ranging) or IFSAR (Interferometric Synthetic Aperture Radar, also known as NextMap) aerial survey data is used to construct the DTM.

IFSAR data — IFSAR data resolution is to a 5m grid with a vertical accuracy of 0.5m to 1.0m for most data points. However, data can be much less accurate for highly vegetated areas (where IFSAR radar cannot penetrate to the ground) and for dense urban areas. IFSAR data is available for the whole of England and Wales.

LIDAR data — LIDAR data resolution is to a 2m grid, with a vertical accuracy to ±0.15m. But, data is only available for approximately 40 per cent of the area required for the RIM project.

LIDAR/IFSAR composite data

During the Rapid RFM process the composite LIDAR/IFSAR DTM was considered inappropriate, due to a tendency for inaccuracies in the elevation at the boundary between IFSAR and LIDAR tiles. However during the project the composite DTM was improved with the Geomatics team. This allowed it to be used for the Rapid RFM re-runs undertaken towards the end of the project.

Data used, features and resolution

Therefore generally, LIDAR data is used to construct DTMs where available, and IFSAR data is used for other areas. However 164 Rapid RFM re-runs undertaken at the end of the project used LIDAR/IFSAR composite data.

In all cases, the DTM has been processed to remove features such as vegetation, buildings, bridges, and so on. However, the DTM does include any significant embankments such as flood defences and road/rail embankments. It is important to note that the resolution of the DTM may, for example, mean that some small embankments or flow paths are not represented.

The grid resolution of the DTM was fixed at 10m x 10m for risk category B, C, D and "unknown" dam breach models (JFLOW-GPU models). For risk category A reservoirs (InfoWorksRS-2D and TUFLOW models) the grid resolution of the DTM was reduced to the smallest that could be achieved given the DTM and the restrictions imposed by the PC CPU and RAM.

Post processing

Thresholds

Output data from the hydraulic models is processed for mapping as follows:

- **Outline map**

Only one flood extent classification is given that represents the indicative flooded area.

- **Depth, velocity and hazard maps**

The maximum indicative outputs are classified into the following thresholds:

Depth thresholds	Hazard thresholds	Velocity thresholds	Travel time
> 2.00 m	Extreme Hazard (H > 2.00)	> 4.00 m/s	Model Assessment Node
1.00 - 2.00 m	Significant Hazard (1.25 < H < 2.00)	2.00 - 4.00 m/s	Initial Flood Arrival Time (hrs : mins)
0.50 - 1.00 m	Moderate Hazard (0.75 < H < 1.25)	0.50 - 2.00 m/s	Peak Flood Arrival Time (hrs : mins)
0.25 - 0.50 m	Low Hazard (H < 0.75)	0.25 - 0.50 m/s	
0.00 - 0.25 m	No Hazard (H = 0.00)	0.00 - 0.25 m/s	

You should not interpret the thresholds as precise depths, hazards or velocities of flooding, but as indications of possible values for emergency planning only.

The maximum flood hazard is calculated from the following equation (Defra, 2005), where *V* is velocity (m/s), *D* is flood depth (m) and D_F is the debris factor, equal to 0.5 for *D*<0.25m and 1.0 for *D*>0.25m.

$$Flood\ Hazard\ Rating = D\left(V + 1/2\right) + D_F$$

Travel times are rounded to the nearest five minutes. **You should not interpret them as precise times of travel for the dam breach flood wave,** but as an indication of flood travel time for emergency planning. The actual travel time of the dam breach flood wave will depend on many factors. These include the volume and rate at which water is released from the reservoir and the conditions in the river system at the time of the breach, which may vary significantly from the assumptions made to produce the maps.

Mapping and summary sheet

The summary sheets contain the following information for all reservoirs:

Mapping and summary sheet for every breach location

The following maps and summary sheet are available for every reservoir breach location:

Deliverable	Softcopy Format
Dam Breach Inundation Modelling Summary Sheet	A4 PDF
Maximum Flood Outline (Extent) Map	A0 PDF
Maximum Hazard Map	A0 PDF
Maximum Depth Map	A0 PDF
Maximum Velocity Map	A0 PDF

As well as the above, the following maps are available for every reservoir with multiple breach locations:

Deliverable	Hardcopy Format	Softcopy Format	Description
Maximum Flood Outline (Extent) Map showing composite of all breach locations	A3 Colour Hardcopy	A0 PDF	Composite maximum flood outline (extent) map showing composite of all breach locations
Maximum Hazard Map showing composite of all breach locations	A3 Colour Hardcopy	A0 PDF	Composite maximum flood hazard map showing composite of all breach locations

Electronic data for every breach location

For every reservoir breach location the following electronic data is available:

Deliverable	Spatial Data Type	Description
Location of Subject Reservoir	ESRI Point Shapefile	Point location of subject reservoir
Location of Cascade Failure Reservoir(s)	ESRI Point Shapefile	Point location of cascade reservoir(s) (if applicable).
Location of Breach	ESRI Point Shapefile	Point location of the assumed breach location. Include multiple breach locations (if applicable).
Maximum Flood Outline (Extent)	ESRI Polygon Shapefile	The maximum outline (extent) of modelled dam breach flood inundation
Maximum Flood Depth	ASCII grid	The maximum dam breach flood depth in ACSII grid format
Maximum Flood Velocity	ASCII grid	The maximum dam breach flood velocity in ACSII grid format
Maximum Flood Hazard	ASCII grid	The maximum dam breach flood hazard in ACSII grid format. Refer to hazard calculation above.
Initial and Peak Flood Arrival Time	ESRI Polyline and EXCEL file	1. Cross-sections polylines at 1km intervals, in terms of river centreline, downstream of the subject reservoir. 2. An associated EXCEL file containing the cross-section IDs, and initial and peak flood arrival times at each cross-section.3. A GIS file that combines cross-sections detailed in [1] with travel times detailed in [2] so that they can be plotted in accordance with the example* map provided in Appendix A.

How accurate are the maps?

Validation

Data sources

Given the nature of dam breach flood events, no comprehensive observational data is available for model and mapping validation.

Accuracy

We are not able to assess how accurate the map is in identifying areas at risk of dam breach flooding, as there are no comprehensive historic records available.

Note

The maps are intended to represent the likely extent, depth, velocity, hazard and timing for a hypothetical "credible worst case" dam breach flood event.

The assumptions made and simplified modelling approach means that if a reservoir actually failed it could cause flooded areas, depth, extent, velocity, hazard and timing which are different from those indicated.

The map does not in any way reflect the structural integrity of the dam or the chance of it failing.

Where the maps are likely to be more/less accurate?

Accuracy

The maps are more likely to be accurate for steeper areas where inundation is influenced by topography. They are likely to be less accurate over large, flat areas where local topography, such as dense urban areas, could influence the flow.

In all areas modelled using a LIDAR DTM the map is likely to be more accurate compared with those modelled using IFSAR. Phase 1 (Type 1) mapping generally used IFSAR DTM, however a number of Phase 1 re-runs used a later LIDAR/SAR composite. Phase 2 (Type 2) mapping used LIDAR where available, otherwise IFSAR was used.

There will, however, be many exceptions to these general situations and so it is very important that you use your knowledge of the local area to assess how suitable the map is for your emergency planning.

The dam breach scenario simulated is a "credible worst case" scenario. This represents a "generic" dam failure that can be adopted across the country. But, you need to bear in mind that there are many different potential dam failure scenarios which could also happen.

The following table outlines the assumptions made for the "credible worst case" scenario:

Issue	Assumption
1. Failure mode	Overtopping or piping
2. Height of breach	Breach is assumed through the entire height of the dam or embankment and terminates at the base of the dam or embankment. Thus all stored, and escapable, water is released during the breach. Note that wave walls are not considered in analysis.
3. Inflow into reservoir	Not explicitly derived or routed, however, implicit in that the reservoir is full and overtopping at time of dam breach.
4. Reservoir level at time of breach	(i) Impounding Reservoirs: Dam Crest Level plus 0.5m (ii) Non-Impounding Reservoirs: Dam Crest Level plus 0.1m (iii) Service Reservoirs: Top Water Level
5. Flow in river downstream of dam at time of breach	Not explicitly derived, but partially accounted for as DTM used for flood routing removes river channel below normal water level.
6. Dams in cascade	Breach in downstream dams if overtopped by breach outflow from upstream reservoir is to be analysed. Refer to specification outlined under Sections 3.2 and 3.3 for specific treatment.

Caution

Given the assumptions used in the dam breach analysis process, and the inability to validate the results, the maps will only give an indication of the areas that may be flooded if the dam were to breach.

It should also be noted that the information contained on the maps does not in any way reflect the structural integrity of the dam or the chance of it failing.

Data sources

The hydrographs created for the modelling need data from different sources. The following table shows where the data was sourced:

Data Required	Primary Data Source
Maximum Dam Height (m)	- EA Reservoir Database or; - Prescribed Form of Record
Reservoir Volume at Top Water Level (m^3)	- EA Reservoir Database or; - Prescribed Form of Record
Reservoir Area at Top Water Level (m^2)	- EA Reservoir Database or; - Prescribed Form of Record
Dam Crest Level (m AOD or local datum)	- Prescribed Form of Record
Reservoir Top Water Level (m AOD or local datum)	- Prescribed Form of Record
Dam Crest Length (m)	- EA Reservoir Database or; - Ordnance Survey 1:10,000 Mapping or; - Aerial Imagery

What should the maps not be used for?

Identifying individual properties

The maps are not suitable for identifying individual properties at risk of dam breach flooding. Therefore, they may not be suitable for supporting community/parish flood plans if these require a detailed assessment of individual properties.

Other uses

The maps were originally produced for emergency planning purposes. However, they can be used for other purposes, such as to inform risk designations under the Reservoirs Act 1975. However, care should be taken to understand the limitations of the maps and the assumptions made in the modelling before using them for other purposes.

Updating and future plans for reservoir flood maps

The future/ Feedback

Subject to government's priorities and the availability of further funding, it is possible that:

- Specification RFM may be produced for reservoirs which currently only have Rapid RFM at the moment.
- RFM may be produced for small raised reservoirs which are considered high risk.

Would you like to find out more about us, or about your environment?

Then call us on
03708 506 506 (Mon-Fri 8-6)

email
enquiries@environment-agency.gov.uk

or visit our website
www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)
floodline 0345 988 1188

Environment first: This publication is printed on paper made from100 per cent previously used waste. By-products from making the pulp and paper are used for composting and fertiliser, for making cement and for generating energy.