Submitting locally produced information for updates to the Risk of Flooding from Surface Water map

Report version 4.3

May 2019

We are the Environment Agency. We protect and improve the environment and make it **a better place** for people and wildlife.

We operate at the place where environmental change has its greatest impact on people's lives. We reduce the risks to people and properties from flooding; make sure there is enough water for people and wildlife; protect and improve air, land and water quality and apply the environmental standards within which industry can operate.

Acting to reduce climate change and helping people and wildlife adapt to its consequences are at the heart of all that we do.

We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

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1 Introduction

1.1 Background

The initial version of the Risk of Flooding from Surface Water (RoFSW) was published in December 2013 as the updated Flood Map for Surface Water' (uFMfSW). It was published as part of the work to meet the requirements of the Flood Risk Regulations.

We update the Risk of Flooding from Surface Water map on a regular basis with appropriate locally produced information. Lead Local Flood Authorities (LLFAs) are able to include new mapping from local studies, to ensure the best available surface water flood risk information is published and available to Risk Management Authorities, partners and customers.

The Environment Agency does not plan to re-run the national scale model to update the mapping, nor to produce another national scale surface water flood map in England in the near future. Any further improvements in surface water flood mapping should be undertaken by LLFAs.

1.2 Why update the map?

In addition to our commitment to keep the Risk of Flooding from Surface Water (RoFSW) map updated to meet the continuing obligations of the Flood Risk Regulations, there are a number of other reasons why it is important to ensure that you continue to contribute data to keep the map up to date:

- Customers are now familiar with the map as a single source of surface water flooding information. Maintaining local maps without updating the national map will lead to a confusing picture for customers and uncertainty about where to go for information. The RoFSW maps are used to complete the public reports on the Long Term Flood Risk Information service on Gov.uk.
- The maps help LLFAs, our customers, Environment Agency and Government understand surface water flood risk consistently across the country.
- The single source of information helps to minimise queries from the public about surface water flooding. By contributing to it LLFAs can reduce the number of queries they have to respond to.
- LLFAs will need to be prepared to explain why they are using different mapping and what the differences are, if it is not included.
- Any work that we do to keep Government informed about the risk of flooding from surface water is based on this map, so it is important to keep this up to date to ensure that they get the best available information for their decision making.

Our Risk of Flooding from Multiple Sources combines information from different flood maps to show a clearer picture of the combined flood risk and which sources are contributing to this at a particular location. This information was made available in 2016.

1.3 Mechanisms for maintenance

The mechanism to update the maps will follow a similar pattern to the data submission process used in 2013 for creating the updated Flood Map for Surface Water, now known as the Risk of Flooding from Surface Water map.

LLFAs will not be required to install or use any specialist software or systems. LLFAs will simply need to compile and provide compatible model output data, in the correct formats, to the Environment Agency to incorporate into the next version of the map to be published. This document sets out the requirement for this.

1.4 Locally produced models

We would like LLFAs to make sure that any new locally produced information is created to be compatible with the Risk of Flooding from Surface Water map and can be incorporated into the published map.

Locally produced mapping does not need to be available for the whole of a LLFA Area. LLFAs can continue to update and replace the national scale mapping with locally produced information within a defined location. A defined location could be:

- a drainage
- area within an urban area
- an urban area (such as a town or city)
- a Flood Risk Area
- a complete LLFA area

Models submitted by LLFAs can either be new models (in compatible formats) or refinements of the original national scale modelling for the updated Flood Map for Surface Water. The models created as part of the Environment Agency's national scale surface water flood mapping exercise were provided to LLFAs, along with all model output data, on hard drives in October 2013. We provided the models so that LLFAs can use them to refine the data and maps in your areas. Each LLFA has received a self-contained set of model input data, and model output data relevant to their area.

The model input data was provided in widely supported, non-proprietary formats. This means that LLFAs can use any commonly available 2D hydraulic modelling software packages to run the models and are not restricted to the software used in the national scale project.

LLFAs (or their contractors) will be able to refine the model with local information (such as information about drainage rates, or more refined digital terrain modelling) to produce new mapping for their area. Mapping produced this way can be incorporated into future versions of the Risk of Flooding from Surface Water map.

1.5 About this document

This document explains how to assess if your data is compatible and can be included, and how to submit your data. Timescales for data submission will be confirmed to you in separate briefing notes.

It includes information on the preferred **format** of your **digital (GIS) data,** and **how we would like you to provide it to us**.

2 Incorporating new locally produced model information

2.1 Availability of new information

Surface water flood modelling and mapping is a rapidly evolving area of work. It is inevitable that new data, information and modelling techniques will become available over time, which LLFAs may wish to take into account when assessing local flood risk.

New information could include:

- reports from **recent local flood events**, or a better understanding of past flood events
- **more detailed data or understanding** of some of the factors that influence surface water flooding in an area (drainage rates or the critical storm durations, for example)
- access to **refined modelling** (for example from Water and Sewerage Companies)
- access to modelling techniques to represent **complex or specific flooding scenarios** (for example pumped catchments)

When new information becomes available, we recommend LLFAs **review their existing surface water flood mapping** and, where possible, use the new information to refine the modelling and mapping. This could include:

- incorporating the information into existing modelling (either the national scale model or a local model)
- using the information to create a new model (for example with integrated sub-surface drainage)

We also encourage LLFAs to use reports from recent local flood events and other information to adjust the suitability rating (derived from the confidence score) in the existing mapping. The methodology to update suitability / confidence scores can be found in section 2.8.

2.2 Carrying out new modelling

We recognise there are many reasons that you may need to carry out surface water flood mapping, for example:

- to better understand mechanisms and risk of flooding in complex drainage areas
- to better understand the scale and spatial distribution of investment in flood risk management and to inform Local Flood Risk Management Strategies
- to support specific planning and development of local drainage schemes and to better assess the options in areas that are known to flood
- to support emergency and spatial planning

- to raise public awareness of flood risk, so they are better prepared and can take appropriate action

This document will help you assess whether your modelling is compatible with the Risk of Flooding from Surface Water map. If you are about to carry out new modelling we recommend you use this guidance to make sure any new locally produced information can be incorporated into the Risk of Flooding from Surface Water map.

2.3 Using locally produced information in the Risk of Flooding from Surface Water map

Many LLFAs have created their own surface water flood maps using a range of methods and data; consequently, there are different maps showing flood risk. It is important that local mapping is **sufficiently consistent and compatible with** the Risk of Flooding from Surface Water map so information can be brought together into a single map.

Bringing the data together so that it can be published as the Risk of Flooding from Surface Water map will enable LLFAs, the Environment Agency, Risk Management Authorities, partners and customers to **interpret surface water flood risk in a consistent way** across England.

If you have locally produced information that you would like to incorporate into the map you will need to consider:

- how your models were created and what they represent
- what model output data you have
- whether there are any missing data layers or differences that need to be resolved

Locally produced mapping from Lead Local Flood Authorities (LLFAs) can be incorporated when it is:

- **compatible with the national scale surface water flood mapping** (see Section 2.4)
- **more representative of flood risk in your area than the current Risk of Flooding from Surface Water maps** (see Section 2.7)
- **has an equal or greater confidence score** (see Section 2.6)

If you answer 'no' to any of these points, then you may not be in the best position to submit your mapping for inclusion in the Risk of Flooding from Surface Water map at this stage, but please discuss with your local Environment Agency office, or contact the project team at rofsw@environment-agency.gov.uk for more advice. If your mapping is very nearly compatible there may still be some opportunities to incorporate your data.

2.4 Assessing compatibility

So that we can ensure that local and national scale mapping is sufficiently consistent and compatible so information can be brought together into the Risk of Flooding from Surface Water map, we've identified elements of the modelling or model input or output data which have a **significant influence on the resulting flood maps or on the way that they will be interpreted.**

In Annex A we have set out some **minimum standards** which locally produced information should meet for it to be compatible with the Risk of Flooding from Surface Water map. The Environment Agency's nationally produced mapping (2013) matches, or exceeds all of the minimum standards shown.

There are also **recommended standards** which offer 'good practice' approaches to surface water modelling at this scale but do not need to be met for data to be included in the Risk of Flooding from Surface Water map.

Below is a summary of the main requirements to ensure locally produced information is compatible.

To be compatible, and suitable for inclusion, locally produced information should, as a minimum:

- include a flooding scenario with **3.3%** (1 in 30), **1%** (1 in 100) and **0.1%** (1 in 1000) chance of occurring (in any year)
- each scenario must have been produced using the same version of the model
- include flood **extent**, **depth, velocity, hazard** and **flow direction data**
- take into account the **deflection effect of buildings**
- take into account **sub-surface drainage** (in urban areas)
- use a model grid size no larger than **5m** (or equivalent, if using TIN)
- be compatible with the criteria set out in Annex A
- provide the best representation of flood risk within the LLFA area (compared with historic flooding information and specific knowledge of surface water flooding mechanisms)
- have an equal or higher confidence score than the existing mapping

It is likely that some LLFAs will have most of this information, but not all parts. **In previous updates we have provided for some flexibility in the criteria for submission to take account of models produced to earlier specifications. For this latest update much of this flexibility has been removed, as detailed below**

2.5 Flexibility in compatibility criteria

2.5.1 Mapping for 0.1% (1 in 1000) probability

In the initial updated Flood Map for Surface Water, published in 2013 to meet the Flood Risk Regulations, we allowed a substitute for the **0.1%** (1 in 1000) probability data if it was not available, to ensure that lack of this data was not the only reason not to include local modelling. However, we are keen to update this with actual modelled data for this probability, and require that all modelled areas that are incorporated into the map include this.

Note: In previous updates, various proxies were allowed as substitutes for this. For all future updates we **no longer accept** these proxies.

2.5.2 Hazard mapping

Although not a requirement of the Flood Risk Regulations, we use hazard mapping in post-processing of the data you submit. We filter out areas of very low hazard to ensure that the mapping is shown consistently across the country (see What is the What is the Risk of Flooding from Surface Water map? document, section 6.2 for more details and Annex E2 for examples). A hazard data layer is also made available as a Risk of Flooding from Surface Water output.

We would therefore like you to submit this with your data. Previous updates allowed for some flexibility in this requirement. However, if you are now unable to produce this output from your modelling this **will now** preclude the mapping from being included in the Risk of Flooding from Surface Water map.

2.6 Assessing confidence in new locally produced information

Assessing confidence in your local mapping will help you to decide **which mapping is most appropriate** in your area. You can use a mix of the Environment Agency's nationally produced mapping and locally produced mapping within your LLFA area, whichever is more representative of flood risk and has the higher confidence score in each 'hotspot' area.

Annex C contains more information about how the confidence scores and suitability ratings were developed, how you can assess confidence in your locally produced information and how this relates to the current Risk of Flooding from Surface Water Suitability layer.

2.7 Assessing whether locally produced mapping is more representative than existing mapping

It is good practice to use historic flooding information and specific knowledge of surface water flooding mechanisms to assess how representative locally produced information is of flood risk in your area. Use this together with your assessment of confidence to decide whether to submit your mapping for inclusion.

- If you have **higher confidence** in your local mapping than the existing mapping, we recommend you provide your mapping for inclusion in the Risk of Flooding from Surface Water map
- If your confidence in your local mapping and the national scale mapping is **equal** then consider which mapping you would prefer to use
- If you have **lower confidence** in your local mapping than the existing mapping, we recommend continuing to use the information currently contained in the Risk of Flooding from Surface Water map

2.8 Confidence Scores

2.8.1 What are Confidence Scores?

In previous projects, we developed a way to assess and describe confidence in the national scale surface water flood mapping across England.

Confidence scores tell users where there is a more or less robust prediction of areas at risk of surface water flooding; this can help LLFAs and partners to understand how suitable the mapping is for different purposes.

LLFAs and flood risk management authorities may have historic flooding, or other suitable information that can be used to adjust the default confidence scores.

2.8.2 Updating the Confidence Scores

During this update project we will be updating the suitability rating (derived from the confidence scores), for the locally submitted modelling and the national modelling. This update will be based on confidence scores submitted by LLFAs for their areas. **A confidence score can be updated, even if no new data is being submitted.**

To submit confidence scores for the national scale modelling please fill in the confidence score table, which can be found in section 2.8.7 Confidence Score Update Table. Submit this table along with a layer showing the location of the change, in a GIS or similar format, to rofsw@environment-agency.gov.uk.

We also require you to submit a revised confidence score for any areas where you are submitting locally produced mapping. This can be assessed using the information outlined below and detailed in Annex C and should be submitted as part of the attributes in your model domain for each model that you submit.

LLFAs and flood risk management authorities may have historic flooding information and other suitable information that can be used to adjust the default confidence scores. This information can cover any size of area. However, we recommend you provide feedback on **confidence scores** for areas **no smaller than street level.**

2.8.3 Reasoning Behind Changes to Confidence Scores

As shown in section 2.8.7, there are a number of reasons that the confidence scores may be changed; these are covered in more detail below.

New Scheme

If a new surface water scheme has been constructed this would change the impacts of the surface water flooding in that area, therefore a lower confidence score could be assigned to the existing mapping to portray this.

Flooding Information

Data that has been collected after a flood incident that challenges or verifies the extent in the modelling can be used to update the confidence scores. More detail on using historic flooding information can be found in the sections below.

Local Knowledge

Local knowledge can be used to increase or decrease the confidence score. For example, you may know of a culvert that alleviates surface flooding in this area but it has not been included in the modelling. You may choose to decrease the confidence in this case. See section 2.8.6 for more information.

2.8.4 Assess the Quality of Historic Flooding Information

We encourage you to use your historic flooding information to good effect. You may have historic flooding information for small areas (groups of 3 or 4 properties, for example), for multiple streets or for whole communities; all of this data will be useful when reviewing the confidence scores of the maps.

Quickly evaluate the quality of your information to support the confidence scores using the table below which indicates typical sources of data and the associated quality.

Quality of data to support review	Requirements	Examples
Compelling	• Quantified probability of rainfall event that caused the flood (e.g. 1%). • Good quality information about extent, depth (or level), or location of flooding. • Known source of flooding.	• Properties flooded, or flood extents recorded, from surface water flooding during the 2007 summer floods. Identified as having a probability of 1% in any year.
Acceptable	• Qualitative understanding of probability of rainfall event that caused the flood (e.g. 'more frequent' or 'extreme'). • Information about extent or location of flooding. • Known source of flooding.	• Individual properties flooded from surface water over a 10 year period; broadly corresponding to frequent rather than extreme flooding. • Imprecisely drawn extents from surface water flooding over a 3 year period; corresponding to frequent rather than extreme flooding.
Neutral	• Data set does not meet requirements above.	• Point data set of flood incidents, with no dates or information about the source of flooding.

2.8.5 A History of No Flooding

You may have extensive records from previous severe and widespread flood events, which show certain areas experiencing little, or no flooding at all. For example, you may have extensive records from the summer 2007 floods which show that a particular area did not flood, whereas nearby areas were badly affected by flooding.

This information can be a useful part of your historic flooding information when scoring the maps. It is important to understand where the national mapping may show flooding, where you have records of little, or no flooding during a severe and widespread flood event. This may help to guide appropriate future use of the maps in these areas.

2.8.6 Comparing Historic Flooding Information

To focus your scoring, we recommend you compare historic flooding information with the most appropriate layer of the national scale surface water flood mapping for each 'hotspot' area. The national scale mapping identifies flooding as a result of rainfall with the following probabilities of occurring in any year:

- **3.3%** (1 in 30)
- **1%** (1 in 100)
- **0.1%** (1 in 1000)

Whilst you may not know the probability of historic flooding; it should be possible to say whether flooding is **more** or **less frequent**, or somewhere in between. For example, an area flooding multiple times over a short period is frequent, or an area only flooding once in living memory following unprecedented rainfall may be extreme.

Where you **do not know the probability of flooding**, find the closest match. We recommend you compare historic flooding information with the following national scale mapping:

- for **more frequent flooding**, compare with the **3.3%** (1 in 30) national scale map;
- for **less frequent flooding**, compare with the **1%** (1 in 100) national scale map;

  you are not likely to have historic flooding information available to allow comparison with **0.1%** (1 in 1000) national scale map.

Alternatively, you might **know the probability of a historic flood**, for example, the summer 2007 floods were considered to have approximately a 1% chance of occurring in any year in some places in England and Wales. Where you know the probability of flooding associated with your historic flooding information, compare with the national scale maps with the closest matching probability.

2.8.7 Knowledge of the Flooding Mechanism

You may also have **specific knowledge of the surface water flooding mechanisms** in an area that you can use to support the confidence score. This may help you to identify unexpected patterns of flooding in the national scale mapping. You may know of important local structures or features that affect the surface water flooding mechanisms but may not be adequately represented in the national mapping such as:

- culverts
- highway drainage
- pumping
- tide locking
- effects of flood mitigation works
- model shows an obstruction to flow which does not exist
- model does not show an obstruction to flow which does exist

Quality of knowledge	Examples
Compelling	• You have detailed records of dimensions and capacity of a drainage feature passing through an embankment. • You know that a large culvert, recently designed and installed to alleviate surface water flooding, can carry substantially higher design flows away from this area than the average for the town. • You know that a wall here diverts significant flows in a substantially different direction.

Acceptable	• You know that a flow route exists through a railway/road embankment (but you are uncertain of dimensions or capacity). • You know that there's a large culvert providing drainage out of this area, and that this means drainage in this area is more effective than the average for the town. • You know a wall here diverts low flows in a substantially different direction, but you're not sure what would happen in higher surface water flows.
Neutral	• You don't know for certain if there's a flow route through a railway/road embankment. • You know that drainage out of this area seems rather more effective than the average for the town. • You know there's a wall in this area, but you're not sure whether it would divert floodwater in a substantially different direction or whether floodwater could easily find a bypass and end up following the same route.

2.8.8 Confidence Score Update Table

Attribute	Description	Database name	Format	Values	Example
LLFA name	Full LLFA name	LLFA_Name	Free text	-	Puddleton County Council
Confidence Score	New confidence score for the area	Conf_Score	Pick List	1, 2, 3, 4, 5	3
Reason	What is the reason for the change in confidence score	Reason	Pick List	New Scheme Flooding Information Local Knowledge	New Scheme
Details	Further detail behind reason to confidence score update.	Details	Free text	-	You may wish to add comments, for example, the model ignores large culvert through this embankment; surface water backs up from tide locking affecting a much wider area than the maps show.
Source of information/ knowledge	Source of your information/ knowledge in this area.	Source	Free text	-	You may wish to note your document reference or other source of information here for future reference, for example historic flood reports, section19 reports, drainage engineer.

Note: Please do not add personal data to the free text fields, such as addresses and resident names.

3 Submitting locally produced information

3.1 Introduction

This section of the guidance sets out the preferred **format** of your **digital (GIS) data, and how we would like you to provide it to us.**

Summary of data submission requirements

In the locations where you would like to replace the existing mapping with locally produced mapping, the follow information is required:

- A **model domain**, which indicates where local mapping should replace existing mapping to update the Risk of Flooding from Surface Water map.
- Collated **model output data** for floods with **3.3%** (1 in 30), **1%** (1 in 100) and **0.1%** (1 in 1000) chance of occurring in any year for:
  - **depth**
  - **velocity**
  - **flow direction**
  - **hazard**
- Name each of your **model output data layers** in the form: <Model domain reference>_<model output (depth, velocity, hazard, flow direction)>_<annual probability of flooding occurring in any year>

  Example: **RivrTown_2010_03_Depth_30** (for a model covering River Town, completed in March 2010, showing depth of water in a flood with a 3.3% (1 in 30) chance of occurring in any year.)

Further details are included below about each of these requirements.

3.2 Summary of (GIS) data layers we need from you

Dataset	Why is this required?	Description	Annual probability of flooding	File format	Preferred file types
Model domain	**Essential** to indicate where local mapping should replace existing mapping to update the Risk of Flooding from Surface Water map.	The spatial extent of locally produced surface water flood modelling that you wish us to include in the RoFSW (GIS templates are provided). One model domain is required for each model.	Not applicable	Vector	ESRI (.shp) or MapInfo (.tab)
Depth	Used in the Risk of Flooding from Surface Water map and required by Flood Risk Regulations.	Model output for maximum water depth (in metres) in every model grid cell.	3.3% (1 in 30) 1% (1 in 100) 0.1% (1 in 1000)	Grid (one grid for each probability)	ESRI, MapInfo, or ASCII (.txt/.asc) grids TUFLOW .2dm and .dat/.xmdf files Triangulated Irregular Network (TIN)* e.g.InfoWorks mesh export *These formats will be re-sampled to grids.
Velocity	Used in the Risk of Flooding from Surface Water map and required by Flood Risk Regulations.	Model output maximum water velocity (in metres per second) in every model grid cell.	3.3% (1 in 30) 1% (1 in 100) 0.1% (1 in 1000)	Grid (one grid for each probability)	
Hazard	Used in data post-processing and made available as an RoFSW output.	Maximum hazard rating in every model grid cell as defined in Defra R&D on risks to people (also see Annex A)	3.3% (1 in 30) 1% (1 in 100) 0.1% (1 in 1000)	Grid (one grid for each probability)	
Flow direction	Used in the Risk of Flooding from Surface Water map and required by Flood Risk Regulations.	Flow direction (velocity vectors) at time of maximum velocity in every model grid cell.	3.3% (1 in 30) 1% (1 in 100) 0.1% (1 in 1000)	**Vector (one file for each probability)**	**ESRI (.shp) or MapInfo (.tab)**, or other GIS/text file format (we cannot use animations).

3.3 Model domain

For a description of a **model domain** please see Annex B.

What do you need to do?

In the locations where you would like to replace the national mapping with locally produced mapping:

- Create a **model domain** shapefile / MapInfo tab file for **each modelling study**, by creating a copy of the GIS template provided.
- Name the **model domain** using a **model domain reference**, in the form: <8 letters relating to location of model>_<year of model completion>_<month of model completion>
- Example: **RivrTown_2010_03** for a model covering River Town, completed (or last updated) in March 2010.
- Within each model domain shapefile / MapInfo tab **draw one or more polygons** to show the areas where you would like us to include your model outputs in the RoFSW (For more information, please see Annex B).
- **Complete the attribute table** for each polygon you have drawn, to provide information about the source of your data.
- Compile your **model output data** (you do not need to 'trim' your model output data to match the extents of the polygons you have drawn in your model domain shapefile/MapInfo tab, we will do that for you).

3.3.1 Template GIS file for model domain

Please use the template GIS file (in ESRI .shp or MapInfo .tab format) accompanying this document to capture important information about the source of your data for future reference.

If you haven't received a copy of the template GIS files, you can contact the Risk Assessment and Investment Team on rofsw@environment-agency.gov.uk

3.3.2 Attribute table for model domain

The attribute table is described below. Attributes in bold blue text are **mandatory fields**. Please include as much information about the model as possible in the attribute table. This information will be used by map users to identify the source of the information.

Each field can accept a limited number of characters shown in brackets, for example [50] where the maximum number of characters is 50.

Some fields require you to type in **one value from a list**, for example, under the 'Source digital terrain data' you might type "LIDAR EA" into the attribute table.

Attribute	Description	Database name	Format	Values	Example
ID (auto-generated)	This is a number auto-generated by GIS software	ID	Auto generated	-	15467
LLFA name	Full LLFA name	Name	Free text [50]	-	Puddleton County Council
Data owner	LLFA name, or 3rd party name (if applicable)	Data_own	Free text [50]	-	Puddleton County Council
Model domain reference	A unique reference for your model	Dom_ref	Free text [20]	[xxxxName_yyyy_mm] <8 letter locality of model>_<year of model completion>_<month of model completion>	Example: RivrTown_2010_03 (for a model carried out in River Town completed (or updated) in March 2010)
Model name	Name of model including reference to location	Mod_name	Free text [100]	-	River Town SWMP modelling 2010
Description	Describe reason for modelling	Descrip	Free text [250]	-	River Town SWMP covering town centre (completed March 2010)
Model completion date	Date model complete (or the last update to the model)	Mod_date	mm/yyyy	-	03/2010
Model type	Type of model	Mod_type	Free text [50]	-	Hydraulic model with basic drainage/surface interactions
Model software	Name of software used	Mod_soft	Free text [50]	-	TUFLOW

Hydrology type	Name/type of hydrology used	Hyd_type	Free text [50]	-	Direct rainfall - FEH Depth Duration Frequency
Attribute	**Description**	**Database name**	**Format**	**Values**	**Example**
Source digital terrain model	Source of digital terrain model used	DTM	Select from list	"EA Composite DTM" "LIDAR EA" "LIDAR Other" "NextMap" "Other DTM"	LIDAR EA
Source DTM resolution	Grid resolution of the digital terrain model	DTM_res	Free text [20]	-	1m / 2m
Model grid resolution	Resolution of the model grid	Mod_grid	Free text [20]	-	2m
Storm duration	Rainfall storm durations	Stor_Dur	Free text [50]		1hr, 3hr, 6hr
Representation of sub-surface drainage	Representation of sub-surface drainage	Sewer	Free text [100]	-	Reduction in rainfall amount of 12mm/hr
Surface roughness values	Source of information on surface roughness defined according to land use	Manning	Free text [50]	-	OS MasterMap
Representation of buildings	Representation of buildings in urban areas	Build	Free text [100]	-	Raised building footprints by 300mm

Debris factor	Debris factor(s) used in calculating hazard rating as defined in Defra R&D on risks to people Hazard rating = depth x (velocity + 0.5) + debris factor	Debris	Free text [100]	-	Debris factor of 0.5 for depths <=0.25m, and 1.0 for depths >0.25m (irrespective of landuse type)* *N.B. these figures are used as standard in Infoworks software, but can be varied in TUFLOW
Confidence score	Confidence score assigned to locally produced modelling - see Annex C for more information on assessing confidence.	Confid	Select from list	"1" "2" "3" "4" "5"	3
Comments	Other details about model	Comments	Free text [250]	-	None

3.4 Model output data - depth, velocity and hazard

For more information about **model output data** please see Annex B.

Model output data are the results of the modelling. They are typically provided in a grid or Triangulated Irregular Network (TIN) format, depending on the model software used in the study.

Please note that all model output data you intend to submit to update the Risk of Flooding from Surface Water map must be produced from the same model – i.e. the **3.3%** (1 in 30), **1%** (1 in 100) and **0.1%** (1 in 1000) annual probability scenarios must have been run using the same version of the model. Existing outputs from older models should not be submitted alongside current modelling in order to complete the required annual probability scenarios.

There is **no template GIS file** for grid / irregular mesh formats. **We can accept grid datasets** in several formats:

- **ESRI, MapInfo, or ASCII (.txt/.asc) grids**
- TUFLOW .2dm and .dat/.xmdf files
- **TIN e.g. InfoWorks mesh export**

Please note that all data will be re-sampled to a regular grid (at a 2m resolution).

3.5 Model output data - flow direction

There is **no template GIS file** for flow direction data (also known as velocity vector data).

Flow direction data may not be routinely provided as part of mapping studies and we recognise that many LLFAs will not hold this information.

Please provide flow direction data in **any GIS or text file format** and we will do our best to use your information. (We cannot use animations.)

3.6 A note about model scenarios

3.6.1 Influence of other sources of flooding

Some locally produced surface water flood modelling will be from models that are likely to take into account some main river, and possibly coastal/estuary component. Annex A outlines the minimum and recommended requirements for modelling scenarios and indicates that model output data should only be provided where modelled flooding is **predominantly the result of surface water conditions.** We invite you to include information about any significant non-surface water assumptions in your modelling in the comments field of the **model domain** shapefile / MapInfo tab file.

3.6.2 Storm durations

Locally produced mapping studies typically produce model output data for a range of storm durations. Please provide model output data for either:

- the **critical storm duration for the area**, or;
- **multiple storm durations**, from which we can extract the worst case for the area.

4 Creating a consistent map

LLFAs do not need to carry out any post-processing on their model outputs. We will process locally produced model output data in the same way as the RoFSW to **produce a consistent map.** The processed maps may noticeably vary from the original locally produced model outputs.

Section 4.1 summarises how we will process the model outputs to create a consistent map. Further detail about how we will create a consistent map and examples of the effect of processing the maps can be found in separate guidance What is the Risk of Flooding from Surface Water map?

4.1 Summary of post-processing steps

Below is a summary of the post-processing steps that will be applied to locally produced model outputs:

- Re-sample to a 2m resolution regular grid, including converting TINs and meshes into regular grids.
- Filter out areas of very low hazard (where water depth and velocity are very low)
- Remove small (isolated) areas of flooding and fill in isolated dry areas (within a larger flooded area)
- Categorise the data to make it easier for map users to interpret for the final banded products
    - Depth (into 6 bands)
    - Velocity (into 5 bands)
    - Hazard ratings (low, moderate, significant and extreme - for more information about calculating hazard ratings, please refer to Defra R&D on risks to people) (see Annex A for further detail)

5 Are you ready to submit your data?

If you answer 'Yes' to all of the questions below, you are ready to submit your locally produced mapping data. If you answer 'No' to any of the questions, please review the guidance listed in section 8.

Suitability and compatibility of your data	Yes	No
Is locally produced mapping fully **compatible** with the national scale mapping?* (If no, please talk to us as early as possible to see if it's possible to incorporate the data that you do have.)		
Is locally produced mapping **more representative** than the national mapping in each selected area?		
Have all annual probability scenarios been produced using the same version of the model?		
Does locally produced mapping **have an equal or higher confidence score** than the national mapping?		

Preparing local data for submission	Yes	No
Have you created a **model domain** for each of your models covering the locations where you would like to use your own mapping?		
Have you checked that your data is in the **correct format**, with the correct file names?		
Have you read the **briefing note about data permissions** and completed the **data licence**?		

6 Data permissions

RoFSW information is Open Data. To include your local modelling in our national information you need to give us permission to use your data, so that we can be certain that we can use the data you have supplied in connection with our statutory and regulatory responsibilities.

Please see a copy of the data licence on the following pages or get a copy from the project team.

Please return your signed data license to the project team at rofsw@environment-agency.gov.uk

Licence (please also refer to page 21)

Making use of locally produced mapping in the Risk of Flooding from Surface Water products

To:

Environment Agency
Horizon House
Deanery Road
Bristol
BS1 5AH

From:

Lead Local Flood Authority	*[LLFA name]*
Address	*[LLFA address]*

Information is provided for the following modelled areas (please complete a completed copy of the attached page with details of the data supplied for each model domain). This in addition to modelling provided as part of previous updates.

Modelled area
Example: River Town and surrounding areas

1. ....

2. ....

3. ....

We confirm that the Environment Agency is permitted to use the data we supply by:

1. Using the data internally in connection with their statutory and regulatory responsibilities. This includes use by contractors and partners who help it to achieve those responsibilities

2. Creating derivatives from the data such as incorporating it into mapping and new datasets or other products.

3. Providing the data or derivatives to others as required by s197 of the Water Resources Act 1991, s14 of the Flood and Water Management Act 2010 or any other statutory obligation.

4. Providing the data or derivatives to others in response to requests for information under the Freedom of Information Act and the associated Environmental Information Regulations 2004 and agree usage rights based on the standard Open Government Licence.

5. Making any derivatives available free of charge such as by publication as Open Data online.

6. Incorporating the data into the Environment Agency's Risk of Flooding from Surface Water map (or any equivalent update or replacement), which is an Open Data product.

(Please complete)

Signed	*[Signature of LLFA representative]*
Name (printed)	*[Name of LLFA representative]*
Position	*[Position of LLFA representative]*
Date	*[Date completed]*

Please print and complete this page for each separate model domain, and attach to the licence.

The data layers in **bold text** are necessary to meet the requirements of the Flood Risk Regulations and for updates to the RoFSW products.

Modelled area:	Example: **River Town and surrounding areas**

Dataset	Probability of flooding	File name of dataset (state 'not applicable' if dataset not provided)	Format
Model domain	Not applicable	Example: **RiverTow_2010_03.shp**	Example: ESRI shape file
Depth	**3.3%** (1 in 30)	Example: **RiverTow_2010_03_Depth_30.asc**	Example: Ascii grid *
Depth	**1%** (1 in 100)		
Depth	**0.1%** (1 in 1000)		
Velocity	**3.3%** (1 in 30)		
Velocity	**1%** (1 in 100)		
Velocity	**0.1%** (1 in 1000)		
Flow direction	**3.3%** (1 in 30)		
Flow direction	**1%** (1 in 100)		
Flow direction	**0.1%** (1 in 1000)		
Hazard	**3.3%** (1 in 30)		
Hazard	**1%** (1 in 100)		
Hazard	**0.1%** (1 in 1000)		

*** Other examples include ESRI, MapInfo, or ASCII (.txt/.asc) grids; TUFLOW .2dm and .dat/.xmdf files; Triangulated Irregular Network (TIN), e.g. InfoWorks mesh export**

7 Where to submit your model output data

What do you need to do?

Please submit your **digital (GIS) data** to the Environment Agency project team, for inclusion in the **Risk of Flooding from Surface Water map.**

Send your **digital (GIS) data** and **data permissions form** by**:**

- **Secure File Transfer** (suitable for individual files up to 2GB). Please email the project team to request your upload link at rofsw@environment-agency.gov.uk

- **Email** (suitable for files less than 10MB) to: rofsw@environment-agency.gov.uk
- **CD, DVD or Portable Hard Drive** addressed **to**

  Jerzy Banasik
  Environment Agency
  Ceres House
  Serby Road
  Lincoln
  LN2 4DW

Please contact your local Environment Agency office, or email rofsw@environment-agency.gov.uk if none of these methods are suitable and you'd prefer to arrange another method of transfer.

8 Where to go for help

If you are having difficulty understanding how to submit your digital (GIS) mapping, please get in touch with our **project team** for support in the first instance: rofsw@environment-agency.gov.uk

For enquiries relating to the RoFSW itself and its use, please contact the Environment Agency's project team: rofsw@environment-agency.gov.uk

You can also find further information about the Risk of Flooding from Surface Water map (previously known as the updated Flood Map for Surface Water) in the following documents:

- What is the Risk of Flooding from Surface Water map? **(May 2019)**
- **Risk of Flooding from Surface water – understanding and using the map (December 2013**), available from the project team

Annex D contains further links to sources of surface water modelling guidance that may also be of use.

Annex A - How to check if your locally produced information is compatible

This Annex sets out the minimum and recommended standards which surface water modelling practices and model outputs need to comply with, for them to be included in the Risk of Flooding from Surface Water map.

To be compatible, and suitable for inclusion in the Risk of Flooding from Surface Water map, locally produced information should, as a minimum:

- include a flooding scenario as a result of rainfall with **3.3%** (1 in 30), **1%** (1 in 100) and **0.1%** (1 in 1000) chance of occurring (in any year)
- each scenario must have been produced using the same version of the model
- include flood **extent**, **depth, velocity, hazard** and **flow direction data**
- take into account the **deflection effect of buildings**
- take into account **sub-surface drainage** (in urban areas)
- use a model grid size no larger than **5m** (or equivalent, if using TIN)
- be compatible with the criteria set out below
- provide the best representation of flood risk within the LLFA area (compared with historic flooding information and specific knowledge of surface water flooding mechanisms)
- have an equal or higher confidence score than the existing mapping

a. Model Input data

Digital Terrain Model	
Minimum standard	Use terrain data that best represents the landscape, with a maximum grid **size of 5m**, with a vertical accuracy (root mean square error) of no more than +/- 150mm for LIDAR data, and +/- 1.0m where LIDAR data is not available. ***(Note that the RoFSW uses a grid size of 1m or 2m in many areas, which includes more detail about the ground surface than a grid size of 5m.)*** LIDAR can be obtained from the Environment Agency (http://environment.data.gov.uk/ds/survey/#/survey) under the Open Government Licence as part of the Environment Agency composite LIDAR dataset. *See also* **Model Grid.** *In some software, the DTM is edited to create the model grid. In other software, the DTM and model grid are separate.*

Recommended	In areas you consider to be **urban in nature**, use terrain data that best represents the landscape with a grid size **no greater than 2m**, with a vertical accuracy (root mean square error) of no more than +/- 150mm for LIDAR data. In areas you consider to be **rural in nature**, use terrain data that best represents the landscape with a grid size **no greater than 5m**, with a vertical accuracy (root mean square error) of no more than +/- 150mm for LIDAR data, and +/- 1.0m where LIDAR data is not available.

Probability of flooding	
Minimum	To be consistent with the existing mapping and to meet the requirements of the Flood Risk Regulations, model a flooding scenario as a result of rainfall with the following chance of occurring in any year: • **3.3%** (1 in 30) • **1%** (1 in 100) • **0.1%** (1 in 1000) Rainfall with a **0.1%** (1 in 1000) chance of occurring in any year is an extreme event and there is inevitably more uncertainty estimating scenarios of this magnitude.

Rainfall Inputs

Design rainfall duration	
Minimum	The critical rainfall storm duration (the duration of rainfall with the greatest flooding outcome) will vary depending on the physical properties of the whole surface water drainage system. As a minimum the 1, 3 and 6 hours should be run for the storm durations, these should then be combined to produce a map of the worst case flooding outcome for each model cell, from the rainfall durations modelled, for each given rainfall probability. The national scale mapping has been run using these storm durations. The worst case model outputs have been extracted on a cell-by-cell basis.
Recommended	Run the model for a range of rainfall durations that are most appropriate for your area, generally within a range from 0.5 hours to 12 hours depending on rainfall response times, for each rainfall probability. Combine these to produce a map of the worst case flooding outcome for each model cell, from the rainfall durations modelled, for each given rainfall probability.

Design rainfall depth	
Minimum	Either use the standard Flood Estimation Handbook (FEH) and depth duration frequency (DDF) techniques to derive rainfall depth, this can be using FEH99 DDF or FEH13 DDF.

	Use the DDF curves to calculate a total rainfall depth for rainfall of given duration and probability. Or derive the rainfall depth from a very long synthetic rainfall series produced by a continuous simulation stochastic rainfall generator calibrated to local rainfall observations and FEH DDF results.
Recommended	Use one or more of the following methods. The standard Flood Estimation Handbook (FEH) and depth duration frequency (DDF) techniques to derive rainfall depth, this can be using FEH99 DDF or FEH13 DDF. Use the DDF curves to calculate a total rainfall depth for rainfall of given duration and probability. Derive the rainfall depth from a very long synthetic rainfall series produced by a continuous simulation stochastic rainfall generator calibrated to local rainfall observations and FEH DDF results. Using local information on rainfall and flooding and comparisons between the methods to guide the choice. Compare and contrast between the methods to help evaluate the FEH13 DDF for urban drainage modelling.

Spatial rainfall distribution	
Minimum	As a minimum the spatial rainfall distribution methodology will differ depending on the size of the study area: • If the study Area <10km^2, then spatially uniform rainfall must be used. • If study Area >10km^2, then spatially varying rainfall must be used.
Recommended	Rainfall inputs varied spatially across the study area, considering variation in the DDF model outputs and plausible storm sizes.

Temporal profile	
Minimum	As a minimum the FEH 50% summer profile should be used.
Recommended	Test with both FEH 50% summer and 75% winter profiles (using corresponding SCFs and antecedent conditions).

Areal Reduction Factor (ARF)	
Minimum	As a minimum, an ARF of 1 should be used.
Recommended	See Table 3.2 of the CIWEM UDG Rainfall Guide (2016), available from https://www.ciwem.org/groups/udg/

Seasonal Correction Factor (SCF)	
Minimum	A SCF of 1 should be used for summer design events and FEH for winter design events (if used), unless explicitly accounted for in the spatial distribution.
Recommended	FEH used for all design events.

Green Area Hydrology

Losses	
Minimum	Based on soil types.

Antecedent soil moisture conditions	
Minimum	Based on soil types. If the flood modelling outputs are sensitive to the antecedent soil moisture conditions, then the joint probability of combinations of rainfall event and antecedent conditions must have been assessed.

Rural Hydrology

Flows	
Minimum	Either standard FEH techniques or continuous simulation (NB - direct rainfall approaches should not be used for detailed modelling involving rural catchments). If the flood modelling outputs are sensitive to the inputs from rural areas, then the joint probability of combinations of rainfall event and inputs from rural areas must have been assessed.

a. Flood modelling methodology

Modelling software and techniques	
Minimum	Use software that uses shallow water equations to produce reliable depth and velocity data. See Defra/Environment Agency Research & Development report 'Benchmarking the latest generation of 2D Hydraulic Modelling Packages' for further information on suitable modelling software.
Recommended	See Defra/Environment Agency Research & Development report 'Benchmarking the latest generation of 2D Hydraulic Modelling Packages' for further information on modelling software.

Model grid	
Minimum	Model outputs in a regular (square) grid of results containing attributes such as water depth (rather than flood level) and velocity data with a maximum **grid size of 5m**. The national scale mapping uses a **grid size of 2m** for all England and Wales. N.B. Some modelling software uses a triangulated irregular network (TIN) rather than a regular (square) grid. LLFAs can provide data in TIN format, but the data will be re-sampled to allow inclusion of the data in the Risk of Flooding from Surface Water map. For a TIN, use an appropriate equivalent resolution to our recommendation for a regular grid, with an element or triangle size of no greater than 25m^2

	In some software, the DTM is edited to create the model grid. In other software, the DTM and model grid are separate. Consider removing/reinforcing hydraulically significant topographic features within the model grid or DTM. Ensure large features such as railway embankments, significant bridges, motorway junctions, and other similar structures do not artificially block the movement of water across the floodplain.
Recommended	For future modelling, consider using a model grid resolution **no greater than 2m** (or equivalent TIN) to show details of the urban environment. Models with grid sizes greater than 5m are less detailed than the existing national scale surface water flood mapping, and are unlikely to capture the details of the urban landscape. However, some local LLFA modelling may have a coarser model grid size (5m for example), but may include more local detail in some aspects of the modelling, such as sub-surface drainage. Significant urban flow paths (for example, gaps between buildings) may be better represented using a finer grid. Grid size can have an impact on the following factors; consider the balance between these factors when selecting an appropriate model grid size: • computing capacity and model run time • usability of outputs (for example, manageable file size) • the size of the study area and the level of detail you wish to represent Use a dataset such as Ordnance Survey MasterMap Topography data to produce maps of building footprints, road layout and impervious areas. Use these maps as the basis for positively reinforcing important topographic controls on flow in the model topography as part of the model grid, and defining spatial variation in runoff, infiltration rates and hydraulic roughness. Consider removing/reinforcing hydraulically significant features in the model topography as part of the model grid. At a local scale you may consider reinforcing features such as roads, kerbs, and walls that could affect movement of water across the floodplain, as well as representing flow paths/passage of water through smaller structures.

Representation of urban landscape	
Minimum	Models include a representation of the effect of buildings on flooding, considering the deflection effect of buildings particularly on fast, shallow flows. Buildings are represented in the model by incorporating them into the model topography as part of the model grid.

Recommended	There are a range of methods to represent buildings and other elements of the urban landscape in a model; refer to Annex D for links to other guidance to determine the most appropriate method for your study. At a strategic level it is acceptable to use uniform surface roughness values for areas defined as 'urban' and 'rural' (or paved and unpaved) for assessing surface water flood risk. Studies at a local (or detailed) level should consider assessing roughness values in more detail to represent local effects of variable land use.

Drainage allowance	
Minimum	Models include a representation of the effect of the sub-surface drainage system. An allowance for the drainage system can be included in the model implicitly by reducing the rainfall hyetographs to represent the loss of water from the surface due to the effect of sewers, or explicitly by modelling the sub-surface drainage system in detail (e.g. using a pipe network model. There are a range of methods to use to allow for drainage; refer to Annex D for links to other guidance to determine the most appropriate method for your study.
Recommended	There are a range of methods to use to allow for drainage and selecting an appropriate storm durations; refer to Annex D for links to other guidance to determine the most appropriate method for your study. Sub-surface drainage can be included in the model implicitly by reducing the rainfall hyetographs to represent the loss of water from the surface due to the effect of sewers, or explicitly by modelling the sub-surface drainage system in detail (e.g. using a pipe network model) for example. In the national scale modelling, the rainfall hyetographs are reduced to represent the loss of water due to the effect of sewers. For modelling on a local scale, use local information about drainage rates, where available. Using different assumptions about sub-surface drainage may produce quite different patterns of flooding. Making assumptions about sub-surface drainage is one of the greatest areas of uncertainty in modelling surface water flood risk. We recommend incorporating local information about the drainage rates where available, as well as understanding the limitations of the method you are using to account for sub-surface drainage.

b. Outputs from the modelling

Modelling scenarios	
Minimum	The Risk of Flooding from Surface Water map presents the surface water flood risk for a **'current day' scenario** for the catchment, where structures and features behave normally. Locally produced information should not take into account possible 'future' scenarios such as taking account of climate change, urban creep, or various post-scheme implementation scenarios. They should also not take into account flood barriers or defences (fluvial, tidal or surface water) or any flood alleviation schemes. Locally produced information should be provided for a scenario where **non-surface water influences** (such as river, sea and groundwater conditions) do not unduly exacerbate, dominate, or equal the representation of surface water flooding conditions; where flooding is **predominantly the result of surface water conditions.**
Recommended	LLFAs can continue to produce modelling that takes into account local conditions and 'future' scenarios for local flood risk management purposes, where appropriate. Some locally produced surface water flood modelling take into account some main river, and possibly coastal/estuary component. It is quite common to run integrated catchment model scenarios with low and high water levels in main rivers and other receiving water bodies and interfaces (such as gates or outfalls). Factors such as phasing of tide cycles and gate operations can have a large influence on surface water flooding in coastal locations. In the national scale mapping, no allowance is made for **tide locking, high tidal or fluvial levels** where sewers cannot discharge more than 12mm/hr to rivers or the sea. In addition, **pumped networks** are not explicitly modelled so there is no allowance made for individual networks of Internal Drainage Boards. LLFAs may choose to assess the impact of these factors on surface water flood risk in detailed modelling studies for local flood risk management purposes.

Water depth, velocity and hazard	
Minimum	Regular (square) grid with a maximum size of **5m** for each flooding scenario. **Maximum water depth** (in metres), **maximum water velocity** (in metres per second) and **maximum hazard** attributed with a model output value on a cell-by-cell basis so that the data can be divided into categories. LLFA model outputs will be categorised into new depth, velocity and hazard bands for the updated Flood Map for Surface Water. In order to be categorised into new bands, LLFA data will need to contain model output values on a cell-by-cell basis. It may not be possible to use LLFA data that is already divided into bands if it does not include model output values on a cell-by-cell basis. N.B. Some modelling software uses a triangulated irregular network (TIN) rather than a regular (square) grid. LLFAs will be able to provide data in TIN format, but the data will need to be re-sampled to allow inclusion of the data in the Flood Map for Surface Water. In regards to the Hazard rating it is recommend following advice set out in (Defra/Environment Agency R&D project FD2321) (see Annex D for reference to this publication). For the national scale mapping, the following equation was used: • Hazard rating = depth x (velocity + 0.5) + debris factor With the following debris factors: Debris factor of 0.5 for depths <=0.25m, and 1.0 for depths >0.25m (irrespective of landuse type) (N.B. these figures are used as standard in Infoworks software, but can be varied in TUFLOW software)
Recommended	Regular (square) grid with a maximum size of **2m** for each flooding scenario. **Maximum water depth** (in metres), **maximum water velocity** (in metres per second) and **maximum hazard** attributed with a model output value on a cell-by-cell basis so that the data can be divided into categories. The national scale mapping is mapped at a 2m resolution. LLFA mapping will be re-sampled to match the national scale mapping. The re-sampled LLFA maps may look different to the original LLFA mapped outputs. It is important that flood risk managers focus on the areas of most significant flood risk. Some modelling methods (direct rainfall methods) input rainfall to every cell of the model, this means everywhere in the model could be perceived as 'flooded' to a very shallow depth. Flood risk maps can be **filtered to remove insignificant areas of flooding.**

	The national scale mapping uses a direct rainfall method and is filtered to exclude **very small areas** of isolated flooding, and flooding with a **very low hazard** to people. Methods that do not use direct rainfall may not need to be filtered. Maps created by different modelling methods (and using different assumptions) may look quite different or show quite different patterns of flooding. The RoFSW dataset is accompanied by a Model Details layer that holds information about the source of the mapping and the methods used to update it.

Direction of flow data	
Minimum	For the nationally produced mapping flow direction at the time of maximum velocity is used. This is the requirement for consistency between the nationally and locally produced data.
Recommended	For the nationally produced mapping flow direction at the time of maximum velocity is used. This is the requirement for consistency between the nationally and locally produced data.

c. Model use

Intellectual property	
Minimum	LLFAs must be confident that they have the right to pass data to the Environment Agency for publication and for flood risk management purposes (for example, publishing through the internet). See Section 6 for further information about data permissions and a copy of the licence you will need to submit.
Recommended	• LLFAs retain a copy of the model input and output files so that the models can be re-used in the future. • LLFAs know what data has been used to create the model and generate the outputs (these are likely to be available in technical reports that accompany the modelling. • LLFAs understand any licence restrictions of data used in model creation or development of outputs.

Annex B - Model domain and model output data explained

a. What is a model domain?

A model domain includes one or more polygons showing the **spatial extent** of compatible **surface water flood model outputs that you would like to include in the Map**.

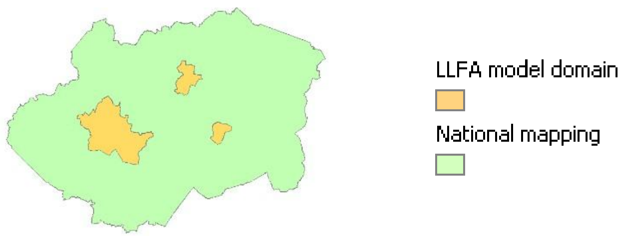
> **A model domain is essential for updating the RoFSW. The model domain indicates the area of existing mapping that should be replaced by locally produced mapping in the RoFSW, as well as providing details about the source of the data in that area.**
>
> **The existing mapping to be replaced will usually be the national scale mapping, but in some cases could be previous versions of locally produced mapping where further updates have been made.**

There is a **separate model domain** shapefile/MapInfo tab file for each modelling study. Each model domain shapefile/MapInfo tab may contain one or more polygons showing areas where you would like to include locally produced model outputs in the map.

For instance, if you wish to include model outputs for your whole model study area, draw a single polygon showing the full extent of your model study area. Or, if you only wish to include your model outputs in two or more, separate locations (because the national mapping is of sufficient quality elsewhere in your model study area) draw a polygon to show each area that you would like to include your model outputs.

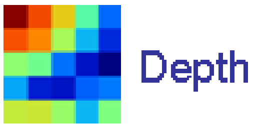
The model domain contains **information** (metadata) about the **source of the data** - for example, name of the study, completion date, and data owner. This will help map users to easily identify the source of the mapping, in each area, in the future. The model domain does not contain any model output data - model output data is stored in separate grid or vector files.

In the graphical representation below, the model domains are shown in orange. Compatible locally produced mapping is available here and will replace the national scale mapping; national scale mapping is retained for the rest of the LLFA area (shown in green).



b. What are model output data?

Model output data are the **results of the modelling**. Model output data are typically provided in a grid format. The results of the modelling for water depth, velocity and hazard are recorded for each square in the model grid (graphically represented below).



The results of the modelling for flow direction may be recorded as a vector file containing a series of directional arrows (graphically represented below, not all model outputs will display direction data in the same way). We recognise that this information may not be widely available from LLFA mapping studies.

c. How do the model domain and model outputs work together?

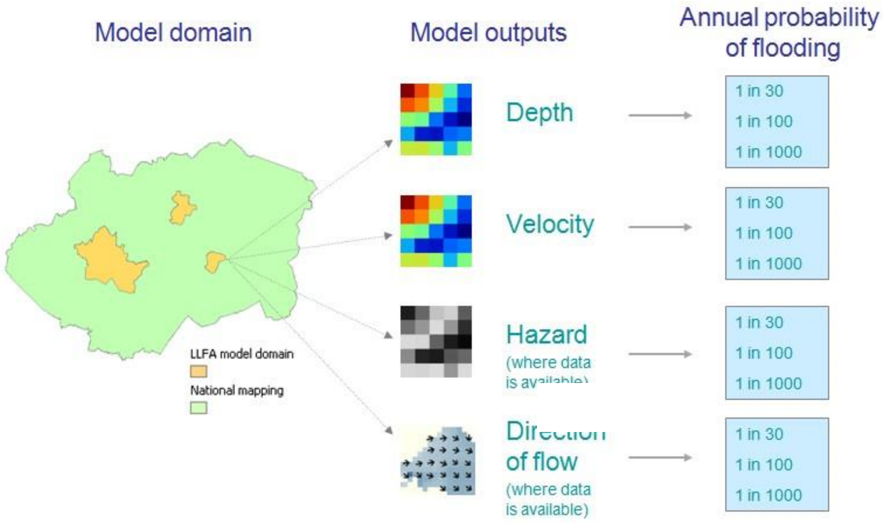
The **model domain** holds **information** (metadata) about the source of the data (model); the **model outputs** store the **results** of the modelling.

For each **model domain** there are **model output data** (depth, velocity, hazard, and flow direction) - illustrated below.

Model output data from local studies is likely to be available for a range of flooding scenarios. Model output data for flooding scenarios as a result of rainfall with a:

- **3.3%** (1 in 30)
- **1%** (1 in 100)
- **0.1%** (1 in 1000)

chance of occurring in any year are needed to meet the requirements of the Regulations.



Annex C - Assessing confidence

a. What are confidence scores and how do they relate to the suitability layer?

We developed a method to assess and describe confidence in the RoFSW. This confidence information was used to produce the **Suitability** layer that was provided as one of the map outputs.

Confidence scores tell users where there is a more or less robust prediction of areas at risk of surface water flooding. This can help LLFAs and partners to understand how suitable the mapping is for different purposes, and therefore the suitability layer was directly derived from this.

Confidence Score	Suitability Rating
☆	National to county
☆☆	County to town
☆☆☆	Town to street
☆☆☆☆	Street to parcels of land
☆☆☆☆☆	Property (including internal)

In the production of the initial map, default confidence scores were assigned to the national scale mapping, using information about the model inputs. LLFAs were then given the opportunity to adjust the default confidence scores using historic flooding and other information.

b. How were default confidence scores determined?

Confidence scores for the national mapping took into account the **quality of the data** used in the model and our understanding of the accuracy of model results for **different catchment types**.

Based on findings from validation work for this, and previous national surface water mapping projects, we were able to say:

- confidence is **higher** where LLFAs have supplied information on urban drainage capacities
- confidence is **higher** where we have LIDAR digital terrain model; confidence is **lower** where topography information comes from NEXTMap (a coarser resolution digital terrain dataset)
- confidence is **lower** in flat areas, because modelled flooding will be more sensitive to errors in the digital terrain model than for steeper areas

The confidence scale uses a star rating system, with **1 star** representing the **lowest** confidence, and **5 stars** representing the **highes**t. Confidence scores are assigned on a grid of 50m x 50m squares.

The table below summarises the confidence scores assigned to the national scale mapping based on a combination of input data and catchment characteristics.

		Urban		Rural
DTM		LLFA supplied drainage information	Default drainage information	
NEXTMap	Flat	☆	☆	☆
	Steep	☆☆	☆☆	☆☆
LIDAR	Flat	☆☆☆	☆☆	☆☆
	Steep	☆☆☆	☆☆☆	☆☆☆

c. Initial Review of national scale mapping

An initial review process took place before the publication of the initial map, which allowed LLFAs to:

- use local information and knowledge about historic flooding to review and assess confidence in the national scale mapping
- update confidence scores for the national scale mapping
- decide whether to recommend locally produced mapping for inclusion in the RoFSW

As a result of this 32 local models were submitted for inclusion in the RoFSW.

d. Assessing confidence in new locally produced information

We request that you use the information here to assess whether your locally produced modelling is more representative in the local area than the existing mapping, so that you can decide whether to submit this for inclusion.

Please use the information in Sections the tables below to assess confidence in the modelling that has been carried out in your local area and compare with the existing map Suitability layer, to make a decision on whether to submit the data. The map Suitability layer has been supplied on the hard drives which contained all the initial map outputs, and is also contained within both the Basic Package and Complex Package download from Sharefile.

The methodology to update the suitability rating (confidence score) in other areas can be found in Section 2.8 Updating Confidence Scores.

e. What do the confidence scores mean?

The table below summarises appropriate uses of surface water flood maps with different confidence ratings. The scale at which the information can be viewed and used is also shown. The national scale mapping has confidence ratings typically in the range 1 star to 3 stars.

Star rating	Recommended uses	Typical applications	Other mapping with this confidence rating
☆	Identifying areas with a natural vulnerability to flood first, deepest or most frequently.	SWMP strategic level assessment; prioritising areas for further modelling.	AStSWF (Areas Susceptible to Surface Water Flooding maps)
☆☆	For a given flood probability, identifying approximate extents, shallower and deeper areas. Counting properties at risk of flooding at national or regional scale, with order of magnitude accuracy.	National or regional scale property counts; identifying likelihood of flooding at a multiple streets / parts of a community scale; SWMP intermediate assessment.	FMfSW (Flood Map for Surface Water, 2010)
☆☆☆	For a given flood probability identify flood extents, and approximate depth of flooding. Identify streets at risk of flooding. Identify flow paths and areas of potential high velocity.	Local property counts; SWMP intermediate assessment; identifying likelihood of flooding at street scale (i.e. which streets).	National scale mapping (forms part of RoFSW). Confidence scores vary with input data and catchment characteristics.
☆☆☆☆	For a given flood probability identify flood extents, depths and approximate velocities.	Identifying which parts of a street are at risk (but not individual properties); SWMP detailed assessment; drainage system design and evaluation.	Fully integrated models representing hydraulics surface (including fluvial) and drainage system, and interactions between them.
☆☆☆☆☆	For a given flood probability identify flood extents, depths and velocities. Distinguish between street and property flooding.	Depth and velocity of flooding at property scale; SWMP detailed assessment; drainage system design and evaluation.	Fully integrated models representing hydraulics surface (including fluvial) and drainage system, and interactions between them.

f. Confidence scores for various local modelling approaches

The table below indicates the typical confidence scores expected from different modelling approaches commonly used by LLFAs and Water and Sewerage companies in surface water flood mapping studies. This table is aligned with the modelling typologies set out in pages 10-14 of the Annexes to Surface Water Management Plan Technical Guidance (this is referred to in the table as 'SWMP approach'). These are guidelines only; you may want to decrease the confidence score in your model if some of these requirements are not met, or increase the score if you have evidence that your model is performing better than indicated by the confidence score given in the table.

Model type	Model description/ equivalent SWMP approach	Example applications	Typical confidence score	Requirements
Future detailed modelling			☆☆☆☆☆	▪ Significant improvements in methodology and validation over current best practice.
Fully integrated	Coupled models representing hydraulics surface (including fluvial) and drainage system, and interactions between them. For example, dynamically linked surface and subsurface model representing water flowing within and between surface and drainage system. SWMP approach 3e, 4a, 4b	▪ Local options models ▪ SWMP detailed assessment ▪ Water and Sewerage Company detailed assessments	☆☆☆☆	▪ High quality/resolution digital terrain model (e.g. LIDAR 2m horizontal and +/-15cm vertical error, or better) ▪ Drainage system with information on pipe network, diameters etc. ▪ Green area hydrology based on soil types ▪ Spatial resolution sufficient to represent individual buildings ▪ Rainfall derived from FEH techniques ▪ Buildings, roads, and other features represented in model ▪ Spatially varying roughness ▪ Model validated against observations of flooding ▪ Modelled interactions between watercourses and surface water drainage systems
Hydraulic model with improved surface/ drainage interaction	As for 2 star model, with better representation of local drainage and/or surface hydraulics.	▪ SWMP intermediate assessment	☆☆☆	▪ High quality/resolution digital terrain model (e.g. LIDAR) ▪ Drainage allowance based on local assessment of drainage capacity or hydraulic model

	For example, direct rainfall on 2D model with locally estimated drainage allowance, drainage system model with surcharge flows routed overground. SWMP approach 2c*, 3c, 3d			▪ Green area hydrology based on soil types ▪ Spatial resolution sufficient to represent groups of buildings ▪ Rainfall derived from FEH techniques ▪ Buildings represented in model ▪ Spatially varying roughness
Hydraulic model with basic surface/ drainage interactions	Models representing hydraulics of surface and/or drainage system, with broad assumptions about interactions. For example, direct rainfall on 2D model with assumed drainage allowance, drainage system model with basic representation of above ground storage. SWMP approach 2b*, 3a, 3b	▪ SWMP strategic assessment	☆☆	▪ LiDAR or NEXTMap digital terrain model in steeper areas ▪ Rainfall derived from FEH techniques ▪ Drainage system model with simple representation of above surface storage, or ▪ Direct rainfall with drainage allowance and infiltration based on broad assumptions ▪ distresolution sufficient to represent flow paths along streets ▪ Uniform roughness assumption
Topographical analysis	Method based on topography only to identify flow paths and ponding. No estimates of depths or extents. For example, rolling ball, surface routing of arbitrary rainfall. SWMP approach 1, 2a	▪ SWMP strategic assessment	☆	▪ Model based on LiDAR or NEXTMap digital terrain model ▪ Identification of flow paths and ponding areas ▪ No assumptions about rainfall probability

*The Annexes to Surface Water Management Plan Technical Guidance do not separately classify direct rainfall models, grouping them all as 2. Here we define 2a as being a direct rainfall model with no drainage allowance, 2b as direct rainfall with assumed drainage capacity, 2c as direct rainfall with locally estimated drainage capacity.

Annex D - Sources of surface water flood modelling guidance

Listed below are a number of documents which may be useful when considering how to carry out surface water flood modelling. However, please be aware that some of the documents refer to modelling methods that are more basic than the techniques we used to produce the Flood Map for Surface Water in 2010.

- What is the Risk of Flooding from Surface Water Map? (Environment Agency, April 2019)
- Updated Flood Map for Surface Water - National Scale Surface Water Flood Mapping Methodology (Environment Agency, May 2013) available from the RoFSW project team
- Computational modelling to assess flood and coastal risk - Operational Instruction 379_05 (Environment Agency, Oct 2010) available from a local Environment Agency office.
- Benchmarking the latest generation of 2D hydraulic modelling packages (Joint Defra/Environment Agency Research and Development report, Project SC120002, August 2013)
- Surface Water Management Plan Technical Guidance (Defra, March 2010)
- Annexes to Surface Water Management Plan Technical Guidance (Defra, March 2010)
- Integrated Urban Drainage Modelling Guide (WaPUG/CIWEM, 2009)
- Risks to people phase II (Defra/Environment Agency R&D project FD2321) (Defra/Environment Agency, 2005)
- Coupled 1D – 2D Modelling in Urban Areas, WaPUG User Note 40 (Allitt, R, 2009). Available for download from https://www.ciwem.org/groups/udg/.
- Code of Practice for the Hydraulic Modelling of Urban Drainage Systems 2017 (CIWEM UDG, 2017). Available for download from https://www.ciwem.org/groups/udg/.
- Rainfall Modelling Guide 2015 (CIWEM UDG, 2016). Available for download from https://www.ciwem.org/groups/udg/.

Annex E

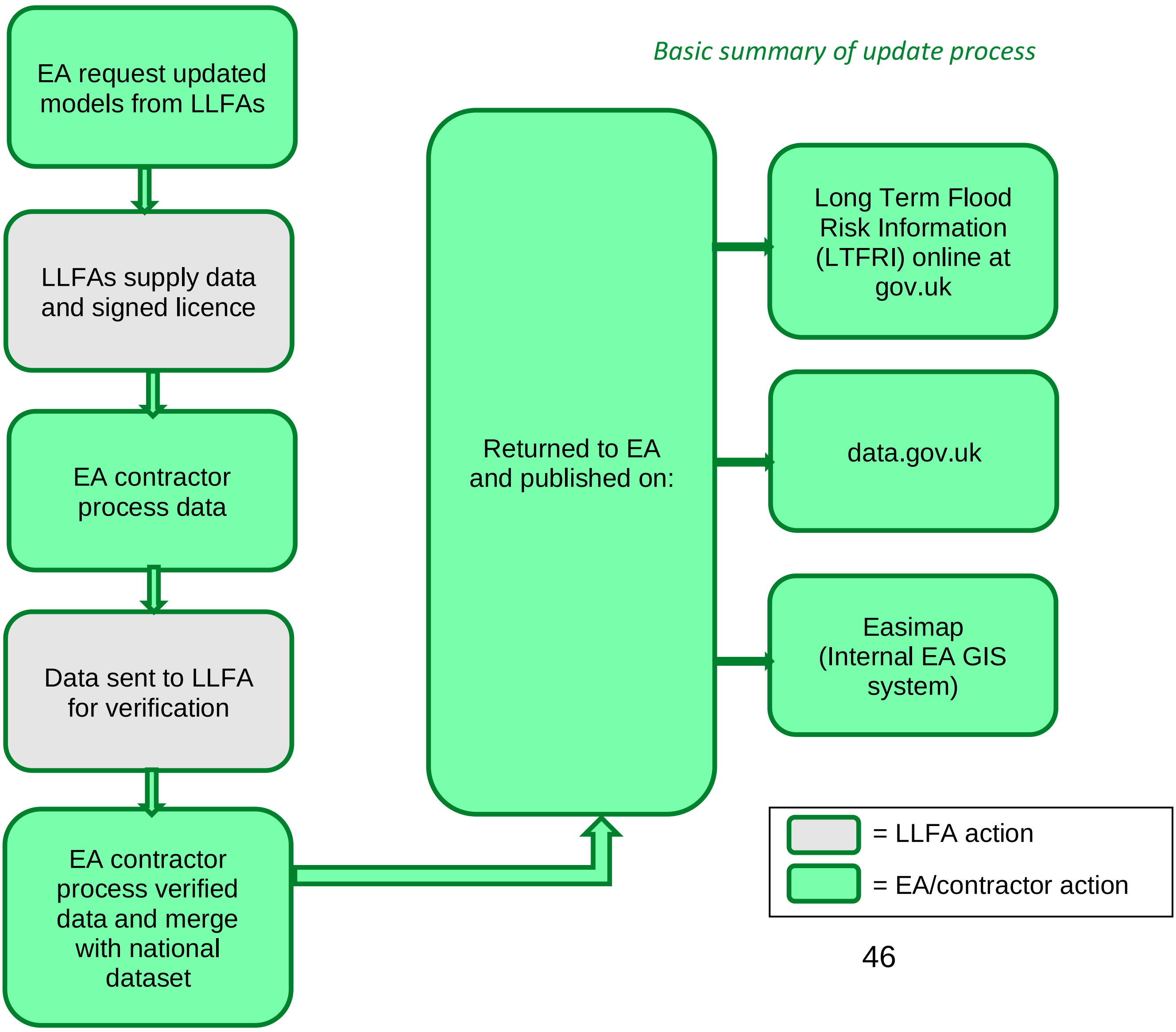
Quick guide to Risk of Flooding from Surface Water map update process

Who is this for?

We have created this quick reference guide to the RoFSW map update process to be used alongside the more detailed document "Submitting locally produced information for updates to the Risk of Flooding from Surface Water map". It is not intended to replace that guidance document. It is for use by Lead Local Flood Authorities (LLFA) and Environment Agency (EA) Partnership and Strategic Overview (PSO) teams.

The update process

The update process usually takes around 5-6 months from data submission to publication. We do not ask you to do any post processing or reformatting of the data you send us as we do this as part of our work to incorporate your models into the national dataset.



Minimum and recommended standards

The minimum and recommended requirements are part of a simple check to ensure that the local data you are wishing to submit is compatible for inclusion in the maps. Annex A of the "Submitting locally produced information for updates to the Risk of Flooding from Surface Water map" contains detailed information on how to check if your information is compatible. However the basic requirements are:

To be compatible, and suitable for inclusion in the Risk of Flooding from Surface Water map, locally produced information should, as a minimum:

- include a flooding scenario as a result of rainfall with **3.3%** (1 in 30), **1%** (1 in 100) and **0.1%** (1 in 1000) chance of occurring (in any year)
- each scenario must have been produced using the same version of the model
- include flood **extent**, **depth, velocity, hazard** and **flow direction data**
- take into account the **deflection effect of buildings**
- take into account **sub-surface drainage** (in urban areas)
- use a model grid size no larger than **5m** (or equivalent, if using TIN)
- be compatible with the criteria set out in Annex A
- provide the best representation of flood risk within the LLFA area (compared with historic flooding information and specific knowledge of surface water flooding mechanisms)
- have an equal or higher confidence score than the existing mapping

Final checks

Before submitting data please check that you have:

- Completed the data layers checklist, signed the licence which allows the data to be published as open data and read the data permission briefing note.
- Included all files (domain, depth, velocity, hazard, flow direction for all probability scenarios).
- Include completed metadata file.
- Ensure the data is in a correct format, with the correct file names.
- Checked permissions with any models that cross the boundary of another LLFA.

Contact

If you have any questions please contact us at rofsw@environment-agency.gov.uk

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

Then call us on

03708 506 506 (Mon-Fri 8-6)

Calls to 03 numbers cost the same as calls to standard geographic numbers (i.e. numbers beginning with 01 or 02).

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