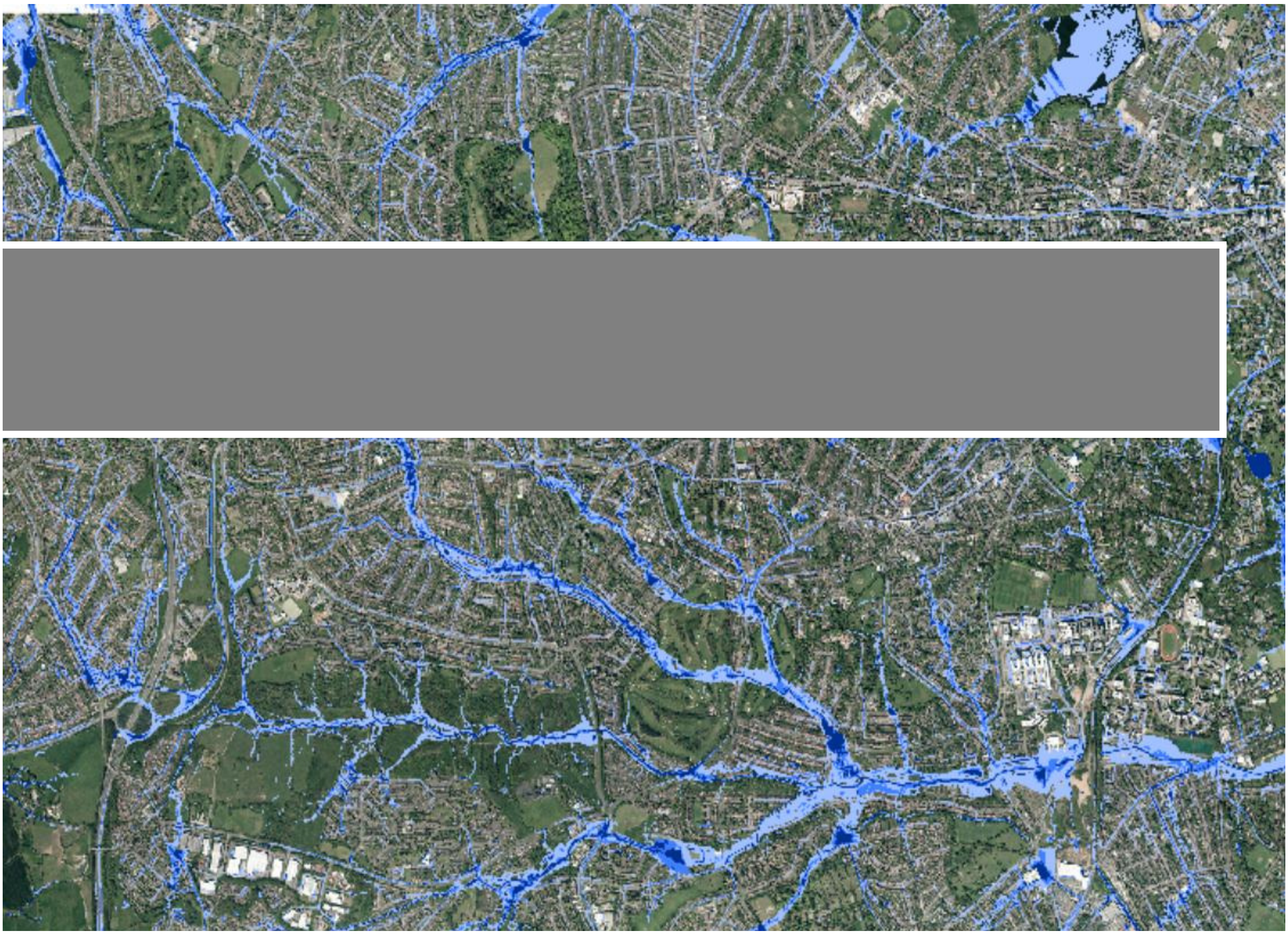

Birmingham City Council

ATKINS

Contents

1. Introduction

Birmingham City Council has been working together with the Environment Agency and Severn Trent Water to develop a long term Surface Water Management Plan (SWMP) for the City, identifying the causes and effects of surface water flooding in the area to fully understand the risks and where they are greatest, before going on to agree the most cost effective and sustainable way of managing those risks.

The Surface Water Management Plan (SWMP) outputs include maps that indicate the areas shown to be at risk of surface water flooding from a number of sources. This guidance gives a brief account of how the maps were produced, their purposes and the limitations on their usage.

2. Purpose of the data

The purpose of the study, and the map outputs, is to identify the areas in Birmingham most at risk from surface water flooding to inform any decisions that affect or are affected by flood risk. This might include planning applications, emergency planning, flood alleviation projects and your own decisions as to whether to invest in protecting your property. However, you should **NOT** use the maps alone to decide whether a given property is or is not at risk.

3. How it has been created

The flood extents are based on detailed hydraulic models that take account of rivers, minor open watercourses and piped networks of culverted watercourses and public sewers. These models cannot include all pipework due to lack of information and excessive complexity, so individual house connections and gullies are not modelled.

When rainfall is applied to the model, it flows through drainage systems and floods where they become overloaded. The flow of flood water across the surface is also modelled in key areas, so that flood depths, speed and direction can be plotted. These key areas were identified in the earlier stages of the project, and are shown on the maps.

The peak depths are mapped to produce the flood outline maps. Storms with a 1 in 30, 1 in 100 and 1 in 200 chance of occurring in any year have been run and output as maps to give an idea of the relative likelihood of flooding. Depths of flooding less than 0.1m have been excluded for clarity. In addition, these would be unlikely to affect properties and would be seen as normal overland flow or puddles in the heavy rainfall that has been modelled.

A more detailed account of the SWMP modelling can be found in the SWMP report (link).

4. How it sits alongside other flood risk information

In addition to these outlines, the Environment Agency produces and publishes maps that show flood risk. These are continually reviewed and updated to ensure they are based on the best information available. In December 2013 they published new and updated flood maps on their website. The maps show risk of flooding from rivers and sea, reservoirs and for the first time, surface water. Table 4.1 below outlines the Environment Agency national datasets and how they can be used.

Product name	Online web name	What they can be used for
Flood Map	Flood Map for Planning	The existing Flood Map won't disappear.

	(Rivers and Sea)	It will remain on our website and will still be used by customers for land-use planning purposes.
National Flood Risk Assessment (NaFRA)	Risk of Flooding from Rivers and Sea	This map is our national assessment of the likelihood of flooding from rivers and the sea, taking into account flood defences.
Reservoir Flood Maps	Risk of Flooding from Reservoirs	This map shows the extent of flooding if a reservoir was to fail.
Updated Flood Map for Surface Water (uFMfSW)	Risk of Flooding from Surface Water	This map should be regarded as the primary source of national information on surface water flooding.
Flood Risk Maps	Flood Risk Maps	These are summary PDFs showing what can be affected by flooding, i.e. people, infrastructure and environmental areas of importance. These maps will be at a River Basin District scale showing the impact of flooding from river, sea, surface water and reservoirs.

Table 4.1: Flood Risk Maps prepared by EA

The Surface Water Management Plan map outputs only cover the areas of the City that were considered to be at greatest surface water flood risk, therefore outside of these areas the Environment Agency's Updated Flood Map for Surface Water (uFMfSW) can be used to give an indication the risk of flooding from surface water. Even in those areas covered by the Surface Water Management Plan map outputs, it may be useful to compare the two datasets. For this reason both datasets are available to view on the Birmingham City Council website.

The Updated Flood Map for Surface Water maps were prepared using a less detailed model that allows for sewers etc. by disregarding the first part of a storm before applying it to the surface as flooding. The amount of rainfall disregarded depends on the underlying soil type and an estimate of the capacity of piped the drainage systems. This coarser approach is needed to be able to run a model at a national scale. An earlier version the Flood Map for Surface Water (FMfSW) was used as one of the inputs to deciding which areas to model in more detail for the SWMP. A previous version of these maps was called the Areas Susceptible to Surface Water Flooding (AStSWF). This took a less sophisticated approach to disregarding rainfall, and is considered to be overly conservative for Birmingham. A detailed comparison of the modelling approaches is included in Appendix A.

The Environment Agency provides guidance on the surface water maps..

The Environment Agency guidance on surface water flood risk information recommends that Lead Local Flood Authorities should review, discuss, agree and record with partners what surface water information best represents local conditions, this is known as "locally agreed surface water information".

Birmingham's locally agreed surface water information will consist of the uFMfSW maps overlaid by the SWMP maps in areas where detailed studies were carried out.

The reasoning is that the SWMP process has taken account the effect of the drainage system in much greater detail than the uFMfSW process in the areas modelled. This means that the results should be more representative of local risk. Outside these areas, we have no specific results to plot, so the uFMfSW maps are the best available. Users may wish to interpret these in the light of comparisons in the detailed areas and to decide accordingly what additional information they may need to assess flood risk.

5. Limitations and Suitability

Although the SWMP modelling takes account of rivers, minor open watercourses and piped networks of culverted watercourses and public sewers, it is important to note that limitations remain, these include the following:

- Not all pipework, gullies etc can be modelled for practical reasons. In practice, these could either increase or reduce flood risk in a particular location depending on circumstances. For example, a low spot might have a gully in reality that isn't represented in the model, causing unrealistic ponding to be modelled – in this case, flood risk would be over-estimated. On the other hand, house connections may not have enough capacity for extreme storms, so flooding could occur outside back doors instead of in the street, in which case flood risk is being under-estimated.
- The modelling of the ground surface cannot represent every kerb, wall or channel that affects where floodwater actually runs. The ground model (both for the SWMP and uFMfSW maps) shows the general lie of the land and therefore gives a general idea of where floodwater might run. More detailed modelling is possible, but is considered cost-prohibitive for use at a strategic level, and thus will only be considered if there is a reasonable prospect of a specific action being taken as a result – for example, if a flood alleviation scheme were being considered..
- Detailed overland flow modelling has only been carried out in the selected key areas. These were identified on the basis of previous recorded flooding, previous risk mapping, potential for new or re-development and other factors. Outside these areas there may still be a risk of surface water flooding and the uFMfSW will give the best indication of this risk. However, it is not possible to guarantee that anywhere is completely free from risk..

6. Confidence

The model has been verified/ calibrated against measured flows and depths at certain locations, but this only gives confidence that it predicts well at those points. This confidence reduces with distance, especially as networks branch off upstream or downstream. This is one reason why, while we are confident that the model represents flood risk in general terms, we cannot recommend it for identifying risk to any given property at this stage.

The uFMfSW map does not have a corresponding overall confidence level; instead it describes for each location the "suitability" of the map as follows:

- When you click on a point on the map a screen is displayed that includes one of the following messages along with information about the risk and other supporting information: You can use the information in this area to see which areas are more likely to flood first, deepest, or most often.
- You can use the information in this area to see the approximate areas that would flood, and which parts would be shallower or deeper.
- You can use the information in this area to see the areas that would flood, which streets may be at risk of flooding, and get an idea of the approximate depth of flooding.

You can use the information in this area to see the areas that would flood and how deep they would flood, and also get an idea of how fast the water may flow. Overall, we consider that the level of confidence in the flood extents within the key areas is medium-high to high because of the higher level of detail and the level of verification achieved. Alternatively, we consider that the "suitability" of the SWMP flood outlines corresponds to the last of the ones above.

7. What it can/can't be used for

The main thing the maps CANNOT be used for is to definitively identify the risk to an individual property or properties – this goes for properties outside the flood extents as well as those inside. They CAN be used as part of such a risk assessment, provided that other factors are taken account of and these might include floor/ threshold levels, whether there is a basement, walls or other features that might prevent or add to flooding or the presence of protective measures such as floodgates.

One of the main reasons for carrying out the study was to have a strategy ready to be implemented as opportunities arise. So, for example, we identified that requiring surface water balancing on all new or re-developed sites would in time compensate in part for the impacts of climate change on flood risk across the city. Similarly, we identified potential schemes to be carried out when funding becomes available or to take advantage of re-development proposals to include all or part of the necessary actions.

The maps can be used by planners to assess the suitability of development proposals, subject to the above, and to decide what level of flood risk assessment to require of an applicant. Potential developers could also use the maps to help decide where to invest or otherwise – again in the light of specific conditions.

The maps can be used by emergency planners to inform their contingency plans. As well as the obvious plans for dealing with flooding events, other plans might be affected. Itmight be useful to know which routes emergency services should avoid in heavy rainfall, for example.

The maps should also be consulted when any highway alterations are proposed to see whether any areas at risk might be adversely affected, or whether the design could contribute to reducing risk.

8. View scale and background mapping scale

Our website and printed maps display the data on a base map of OS Street View, equivalent to a scale of 1:10,000. Displaying the flood extents on a finer map would give a misleading impression of accuracy at the level of individual buildings. The EA website uses a 1:50,000 map background.

Appendix A Modelling Approaches

Comparison of SWMP modelling approach with national mapping

The table below shows a summary of the differences in modelling approach between the SWMP models, nationally produced surface water flood mapping (uFMfSW) and the previous products. Note that where local mapping has been used in the uFMfSW this is likely to use different approaches, parameters or data.

	SWMP	**uFMfSW (2013)**	**FMfSW (2010)**	**AStSWF (2008)**
Hydraulic modelling	1D pipe and channel flow with 2D overland flow modelling	2D overland flow modelling	2D overland flow modelling	2D overland flow modelling
Model software and equations	InfoWorks CS and ICM	JFlow+ (Shallow Water Equation-based)	JFlow-DW (diffusion wave-based) - does not solve full shallow water equations	JFlow-DW (diffusion wave-based) - does not solve full shallow water equations
Hydrological modelling	Fixed and NewUK runoff modelling with measured contributing areas	Direct Rainfall approach with allowances for the sewer network and infiltration (see below).	Direct Rainfall approach with allowances for the sewer network and infiltration (see below).	Direct Rainfall approach with no allowances made for the sewer network and infiltration.
Design rainfall	FEH rainfall for specific catchments (with areal reduction factor applied) for rainfall with a probability of occurring in any year: • 1 in 30 • 1 in 100 • 1 in 200	FEH depth-duration-frequency parameters defined on a regular 5km grid (with no areal reduction factor applied) for rainfall with a probability of occurring in any year: • 1 in 30 • 1 in 100 • 1 in 1,000	FEH depth-duration-frequency parameters defined on a regular 5km grid (with no areal reduction factor applied) for rainfall with a probability of occurring in any year: • 1 in 30 • 1 in 200	FEH depth-duration-frequency parameters defined on a regular 5km grid (with no areal reduction factor applied) for rainfall with a probability of occurring in any year: • 1 in 200
Storm duration(s)	1, 2, 3, 4, 6, 8, 12, 14 hours, summer and winter profiles	1, 3 and 6hrs used for all scenarios (unless specified locally by LLFA) 50% summer storm profile	1.1hrs used for all scenarios 50% summer storm profile	6.25hrs used for all scenarios 50% summer storm profile

Reduction in rainfall to represent sewers	Not applicable – explicitly modelled	In urban areas, a default loss of 12mm/hour	12mm/hour	0mm/hour (No reduction due to sewer drainage represented)
Reduction to rainfall to represent infiltration	Not applicable – explicitly modelled	Urban 70% runoff coefficient is applied In rural areas, runoff variation based on nationally mapped local soil types uses the ReFH losses model, and NSRIs 'SERIES Hydrology' data. Runoff parameters adjusted by local drainage information (from LLFAs and Water and Sewerage Companies) where available.	Urban 70% Rural 39%	100%
Digital terrain model (DTM)	Bare earth LIDAR/NEXTMap composite DTM provided by Geomatics in 2012. LIDAR data 2m horizontal resolution or finer in 90% of urban areas,	Bare earth LIDAR/NEXTMap composite DTM provided by Geomatics in 2012. LIDAR data 2m horizontal resolution or finer in 90% of urban areas, 5m NEXTMap SAR elsewhere.	Bare earth LIDAR/NEXTMap composite DTM at 5m horizontal resolution provided by Geomatics in 2010 containing Environment Agency LIDAR, PGA2 LIDAR and SAR.	Infoterra bare earth LIDAR and GeoPerspectives DTM provided in 2007.
Model grid size	Variable triangular mesh	2m regular grid	5m regular grid	5m regular grid
Representation of buildings	Not represented – modelled as floodable	Use of a (typically) 0.3m high "up-stand" and depth-varying roughness coefficients within the OS MasterMap building footprint.	Represented explicitly as unfloodable objects in the DTM. Building footprints raised by 5m in DTM as defined in 2009 OS MasterMap data.	Not represented
Representation of structures	Explicitly modelled	DTM was manually edited in over 91,000 locations to improve flow through 'flyover' features, such as	DTM was manually edited in over 40,000 locations to improve flow through 'flyover' features, such as	DTM was manually edited in over 5,000 locations to improve flow through 'flyover' features, such as

		rail/road embankment culverts, bridges etc.	rail/road embankment culverts, bridges etc.	rail/road embankment culverts, bridges etc.
Representation of other features	Not applicable	Road network defined in OS MasterMap Topography data lowered by 0.125m.	Not taken into account	Not taken into account
Manning's n values	0.125 where applicable	Varied by OS MasterMap Topography Layer Feature Code	0.1 rural, 0.03 urban	0.1
Mass balance	0%	0% (JFlow+ is mass conservative)	±1%	Not recorded
End of simulation criteria	Rainfall event duration + 8hrs	Rainfall event duration + 3hrs	Dynamic stopping condition. Models stop running if the number of wet cells is unchanged over a 1 hour period.	Dynamic stopping condition. Models stop running if the number of wet cells is unchanged over a 1 hour period.
Downstream boundary conditions	Event level at river outfalls, normal condition at 2D boundary	Free outfall	Free outfall	Free outfall
Validation	Short-term flow surveys and long term river gauging where available	3 pilot areas using historical observations and local modelling data	11 areas using historical observations and local modelling data.	Some qualitative comparison against historical observations and local modelling data.
Sensitivity testing	None	None	None	None