

Impact of flooding (flood risk maps) summary: Methodology and mapping

1. Introduction

The Flood Risk Management (Scotland) Act 2009 (FRM Act) introduced a co-ordinated and partnership approach to how we tackle flood risk in Scotland in a sustainable manner. To fulfil this we are considering all sources of flooding and whole river catchments when making flood risk management decisions.

A key milestone of the FRM Act is the production of flood hazard and flood risk maps for Scotland. These maps will provide the most comprehensive national source of data on flood hazard and risk and include information on different likelihoods of flooding:

Likelihood of flooding	Fluvial and Coastal	Pluvial
High	10 year	10 year
Medium	200 year	200 year
Low	1000 year	200 year + climate change

In order to understand the impact of flooding we must first represent the source. To produce flood risk maps for each source of flooding SEPA has developed new datasets and methodologies for coastal, river and surface water flooding. These flood maps show extents, depths and (where appropriate) velocities and can therefore be used to understand the risk posed by these flood sources. These datasets have been used to create Scotland's flood risk maps.

This summary provides information on how we developed our flood risk maps and how to interpret this data. The primary purpose of this summary is to support Scottish Government, local authorities and Scottish Water in their understanding of how the maps were developed and support internal/external briefings and enquiries. This in turn will help to increase public awareness and understanding of flood risk. This summary assumes previous knowledge of flood maps and their development.

This summary will also be shared with the Loch Lomond and Trossachs National Park, Cairngorms National Park Authority and the Forestry Commission as responsible authorities from 21 December.

2. Development and review

2.2 Future review and development

The mapping of flooding is a dynamic process and the flood risk maps will be subject to review and change as we develop our input data, methodologies and techniques.

SEPA will work with responsible authorities and partner organisations to improve our confidence in representing flood risk across Scotland.

Ongoing developments that SEPA is working towards include improvements in both flood maps and the risk maps produced off the back of these:

Flood Maps

- Improving input data. For example, use new light detection and ranging (LiDAR) information that extends our coverage of higher resolution ground models
- Investigating how to effectively apply hydraulic modelling methods
- Considering where and how wave impact studies might improve confidence in outputs.
 - Risk maps improving resolution of property and population datasets
 - Improving the way risk is shown in the maps by grading receptors from low to high risk for each return period being mapped.

The map, as made publicly available on 15 January 2014, reflects the knowledge and data we have available at that time and were able to incorporate into our national methodologies.

3. Methodology and data

3.1 Approach

A nationally-applied methodology has been used to produce the flood risk maps for Scotland. The map provides information on the indicative impacts of flooding at the community level.

There is an inherent uncertainty in flood modelling as a result of assumptions and simplifications that are required to enable complex natural processes to be reflected through hydraulic modelling software. Please refer to section 5 for interpretation guidance.

3.2 Data

The data used to produce the flood risk maps is listed in table 1 (Appendix A, page 8). With the exception of the river, coastal and surface water hazard map outputs the datasets used are published by other bodies and therefore information about quality checks on these datasets has not been included as in other summary documents. The datasets are assumed to be reliable as they are the industry standard produced by national/governmental organisations. Information on how the datasets have been used is shown in section 3.3 below.

3.3 Methodology

Flood risk maps were produced using the river, coastal and surface water flood maps and have been created for the three reportable return periods (low, medium and high likelihood).

Flood risk maps have been created for each of the 243 Potentially Vulnerable Areas (PVA) across Scotland. The flood risk maps are based on the following receptors:

- Number of people
- Type of economic activity

- Businesses
- Transport (Roads)
- Transport (Railways)
- Transport (Airports)
- Integrated Pollution Prevention and Control (IPPC) installations
- Protected areas or bodies of water impacted by flooding
- Protected areas or bodies of water affected by pollution from IPPC installations

3.3.1 Number of people

The flood risk maps show for each source of flooding and likelihood the indicative number of inhabitants who potentially could be affected by impacts of flooding. This was calculated from a count of properties located within the flood extent, using property point data, multiplied by the average number of occupants in each property¹.

3.3.2 Type of economic activity

The receptors which have been used to show the type of economic activity potentially impacted by flooding is consistent with those used in the National Flood Risk Assessment (NFRA):

- Property: Residential and commercial properties
- Infrastructure: Utilities (including power generation and communication) and transport (including road, rail and airports)
- Rural land use: Agricultural activity
- Economic activity: commercial (including manufacturing, retail services and community services)

Receptors were counted if located within a flood extent.

Economic damage figures were derived using industry standard pre-defined values for residential and commercial properties and agricultural activity. This data is held separately.

3.3.3 Integrated Pollution Prevention and Control sites

The FRM Act requires that SEPA identifies, and shows on the flood risk maps, 'installations....concerning integrated pollution prevention and control, which might cause accidental pollution if any type of flood...occurred'.

The IPPC data relates to new or existing industrial and agricultural activities with a high pollution potential, e.g. energy industries, production and processing of metals, mineral industry, livestock farming and waste management. Regulations segregate activities with high pollution potential into Part A (release of pollutants into air, water or land) and Part B (release of pollutants into the air). The flood risk maps concentrate on Part A sites only.

The sites were identified where they are located within a flood extent.

¹ The population of Scotland in 2010 was 5,222,100 with 2,360,000 households (Census and GROS, Feb 2012). The Occupancy rate obtained from census 2011 (Estimates of Households and Dwellings in Scotland, 2010) <http://www.gro-scotland.gov.uk/files2/stats/household-estimates/he-10/households-dwellings-est-2010.pdf>

3.3.4 Environmental sites impacted by flooding

The FRM Act requires that SEPA identifies, and show on the flood risk maps, specific 'protected areas or bodies of water which potentially could be affected if any type of flood...occurred'.

The protected areas and bodies of water (environmental sites) which were identified included areas used for water abstraction, areas designated for economically significant aquatic species, areas designated for recreational waters, nutrient-sensitive areas, conservation areas for wild birds, special areas of conservation and sites of special scientific interest.

The protected areas and bodies of water that intersect with a flood extent were identified and included within the flood risk maps.

3.3.5 Environmental sites affected by pollution from IPPC sites

This receptor combines the outputs from sections 3.3.3 and 3.3.4. The sites identified in section 3.3.3 were cross referenced with the identified protected areas and water bodies at risk of flooding from section 3.3.4. This determined the amount of protected areas and bodies of water potentially affected by pollution from IPPC sites during a flood.

4. Validation and quality review

A robust validation and review process was undertaken for the flood risk maps:

- **Peer contribution** – The Scottish Advisory and Implementation Forum for Flooding (SAIFF) Modelling Appraisal Strategy Group provided peer contribution to the approach for fluvial flood mapping. This group includes industry representatives, academia, representation from Society of Chief Officers of Transportation in Scotland (SCOTS), Scottish Water and Scottish Government.
- **Internal Review** – Risk map presentation was discussed at SEPA's business steering group and at internal workshops. This included presenting examples of outputs, collating comments and testing different options.
- **Local authority review**
Local authorities received presentations on the purpose, presentation and limitations of the risk maps through Local Advisory Group (LAG) meetings. There was also representation from local authorities at SEPA led workshops on the presentation of the risk maps.

5. Interpretation

The flood risk maps have been developed using a nationally-applied methodology. They are a tool to help raise public awareness and understanding of flood risk and to support flood risk management decisions.

The map is of a strategic nature to support flood risk management planning at a community level. It is not appropriate for property level assessment. This is due to the application of a nationally consistent methodology being applied to provide Scotland wide mapping and with this approach there are assumptions and inherent uncertainty. The zoom on the map, published on the SEPA website, is set to support the intended use of the maps at a community level. Similarly we would advise that when data is hosted on your internal servers that going beyond the recommended level of zoom will lead to increased uncertainty in the application of the map.

5.1 Assumptions

The methodology was implemented based on a number of key assumptions:

5.1.1 Flood hazard maps

The flood risk maps have been developed based on data outputs from the flood maps for coastal, river and surface water. Any assumptions that have been made during their development will also apply to the flood risk maps.

5.1.2 Flood risk maps

The flood risk maps have been developed using the best available national data. The data reflects counts of population, property, protected water bodies and IPPC sites as they stood when the relevant datasets were created. It is therefore assumed that the picture of flood risk from these datasets is the best national representation. As the maps are improved any updates to these datasets, for example updated property counts, will be taken into account.

5.2 Confidence

Flood hazard mapping and the assessment of the sources and impacts of flooding is a complex process. There are uncertainties associated with developing any assessment or modelling methodology which results in a level of uncertainty inherent in the final results.

Uncertainty can arise at each stage and from a range of sources. For example, sources of uncertainty in flood hazard and flood risk mapping include:

- The data going into the assessment such as hydrological or topographical information
- The method or model used
- Future changes e.g. climate change
- Economic and social uncertainties associated with receptor data such as population and property information.

The consideration of uncertainty enables us make informed decisions by providing a confidence in the data and the final mapped outputs. It also identifies where resources can be focused for further development.

5.3 Limitations

The flood risk map has been produced at the national scale using national datasets and a consistent methodology. The maps are strategic and intended for use at a community scale, informing flood risk management planning. They should not be used at the individual property level.

- As the flood risk maps are based on outputs from the flood maps for coastal, river and surface water flooding, consideration must be taken of the limitations of the those maps.
- Population demographics change more frequently than the maps are likely to be updated

Every effort has been made to create flood risk maps that reflect the knowledge and information available. As we develop and improve our data, methodologies and techniques the maps will be reviewed and updated. SEPA will continue to work with responsible authorities and partner organisations to improve our knowledge, understanding and the representation of the impacts of flooding across Scotland.

5.4 Caveats

- The map is not licensed for commercial use and all users must agree to terms and conditions before viewing the map.

Appendix A

Table 1: Data as an input to the flood risk maps

Data	Description
Coastal, river and surface water flood maps	The key input to the production of flood risk maps is the outputs produced by the flood maps for river, coastal and surface water flooding. The flood extent, depth and velocities were used to make assessments of flooding on a range of receptors.
OS MasterMap	This is a nationally maintained dataset that provides details of addressing, height and imagery, backdrop, detailed networks, and addresses and locations. Within the scope of this project, OS MasterMap was used for various reasons including identifying locations of airports and runways.
OS Integrated Transport Network (ITN)	Taken from the OS MasterMap, this dataset details all motorways, A roads, B roads, minor roads, local streets and private roads which in total display roads at a total length of 550,000km. This was used to determine how much of the transport network is at risk from flooding.
Land Cover Map 2007	This dataset provides land cover information for the full of the UK and is a dataset produced and provided by Centre for Ecology & Hydrology. The methodology classifies land cover into 23 land cover classes based on information about the broad habitat. This dataset was used to derive counts of agricultural activity affected by flooding.
Integrated Pollution Prevention and Control sites (IPPC)	Integrated Pollution Prevention and Control (IPPC) relates to new or existing industrial and agricultural activities with a high pollution potential, e.g. energy industries, production and processing of metals, mineral industry, livestock farming and waste management. The IPPC dataset was created as part of the Pollution Prevention and Control (Scotland) Regulations 2000.
Environmental Sites	This dataset is inclusive of: <ul style="list-style-type: none"> • Sites of Scientific Interest (SSSIs) • Special Areas of Conservation (SACs) • Special Protection Areas (SPAs) • Drinking water bodies identified under the Water Framework Directive (WFD) where water is abstracted from waterbodies for 'raw' consumption. The classification includes groundwater, loch and river waterbodies. • Cyprinid waters • Salmonid waters • Shellfish growing waters • Recreational waters • Nutrient sensitive areas including Nitrate Vulnerable Zones (NVZs) and catchments of estuaries, rivers and lochs which are designated under the Urban Waste Water Treatment Directive (UWWTD).