# SIX STEPS TO FLOOD RESILIENCE

## Guidance for local authorities and professionals

This guidance has been written by researchers at The University of Manchester and Manchester Metropolitan University in collaboration with the Building Research Establishment. The suggested reference is: White, I., O'Hare, P., Lawson, N., Garvin, S., and Connelly, A. 2013. *Six steps to flood resilience – guidance for local authorities and professionals.* Manchester.

ISBN: 978-1-905469-82-3

If you have any comments or want to make us aware of anything that we have not included then please contact us:

By post: Dr Angela Connelly,
Department of Planning and Environmental Management,
The University of Manchester,
Oxford Road,
Manchester M13 9PL

By email: angela.connelly-2@manchester.ac.uk

The information comes from interviews, surveys and workshops with flood risk management professionals, manufacturers, community representatives, along with a desk-based review of existing academic, policy and technical literature and historic flooding incidents. Images, unless otherwise stated, come from the Environment Agency. Design is by Nick Scarle, University of Manchester.

The work was undertaken as part of the SMARTeST project that was funded by the European Community's Seventh Framework Programme under grant agreement no. 244102.

## *Endorsement disclaimer*

Reference in this document to any specific commercial products, brand names, processes, or services, or the use of any trade, firm, or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favouring by any of the authors or institutions.

# SIX STEPS TO FLOOD RESILIENCE

## Guidance for local authorities and professionals

Version 1: June 2013

## Contents

## Acknowledgements

Many people contributed information, advice, and support during the production of this document, particularly members of the SMARTeST National Support Group (including manufacturers) as follows:

| | |
|---|---|
| Fran Comyn, Jill Holden | Association of Greater Manchester Authorities (AGMA) |
| Douglas Barnett | AXA Insurance / Association of British Insurers |
| Fred Turner | Caro Flood Defence Systems Ltd |
| Gavin George | Aquobex |
| John Alexander | Aquobex |
| Roy McIntosh, Marc Becker | SEPA |
| Jim Barrack | Tilt Dam |
| Frank Kelly | UK Flood Barriers |
| Jane Simpson | United Utilities |
| Peter Mooney, Richard Pickles | Watertight International |
| Sue Morgan | Flood Ark |
| Mervyn Kirk | Isothane |
| Simon Higginson | Hi Bar |
| Rob Childs | British Board of Agreement |
| Dave Bartram | Environment Agency |
| Tom Saville | Ove Arup and Partners Ltd |
| Peter Atchison | PAGeotechnical Ltd |
| Manuela Escaremeia | HR Wallingford |
| Mary Dhonau | Mary Dhonau Associates |

We also received help and guidance from Stewart Cooper (Argyll Environmental), Kathryn Pygott (Arup), Jo Allchurch (LGA), Robbie Craig (Defra), Steve Merrett (The Environment Agency), Paul Cobbing and Amanda Davies (National Flood Forum), Francis Comyn (Rochdale MBC), Andy Oland (Atkins), and Alan Carver (Wigan Council).

## Introduction

This document is aimed at local authorities and other professionals who manage flood risk in England, particularly those who may need to procure flood resilience technologies for a community. It may also be relevant for community flood action groups. There is separate guidance for individual property owners who are self-funding projects since the process to be followed is slightly different.

The main aim is to provide guidance on making flood resilience (FRe) technologies, particularly at property and neighbourhood scales, part of an overall Flood Risk Management (FRM) strategy. The guidance draws together as much of the existing information on flood resilience that exists for England.

The focus is on retrofitting technologies to buildings and/or through community-wide flood resilience systems. For resilient construction methods in new build developments, refer to Communities and Local Government (CLG) (2007) *Improving the Flood Performance of New Buildings*, the Building Research Establishment (2012) *Flood Resilient Construction*, or the work from the *Long-Term Initiatives for Flood Events (Life)* project (2009). Please also note that, in accordance with UK Government guidance, the tools and technologies referred to in this document should not be used to permit developments in flood risk areas (CLG 2012).

The term flood resilience (FRe) technology is used here as opposed to property level protection (PLP) because many technologies, such as demountable barriers, operate at neighbourhood scale. Also, many products cannot offer full protection as this is dependent on factors including the depth, duration, source, and extent of flooding.

In this document, 'the client' refers to a local authority and/or community group who want to commission FRe works. 'The project manager' refers to those who are in charge of the day-to-day running of large schemes. The 'end-user' refers to property owners and/or local residents who are in receipt of any FRe technologies and/or responsible for their deployment and/or maintenance.

| | |
|---|---|
| **Clients** | • Local authorities<br>• Water utility companies<br>• Housing associations<br>• Large businesses |
| **Project specific** | • Manufacturers<br>• Installers<br>• Surveyors<br>• Engineers |
| **End-users** | • Home owners<br>• Tenants<br>• Landlords<br>• Small businesses |

Groups covered by report terminology

## Flood resilience systems – where does technology fit in?

Recent flood events in the UK have been complex. They are so localised and dynamic that it is neither cost-effective, nor feasible, to rely solely on large-scale flood defences. Property owners and businesses are encouraged to tolerate some degree of flooding and to take responsibility for their own protection; in line with European and national policy such as Defra's Making Space for Water (2005), the EU Floods Directive (2007), and Sir Michael Pitt's review and recommendations following the 2007 floods in the UK (Pitt 2008). Increasing resilience at building and neighbourhood scale has become one important aspect of a broader flood risk management system.

FRe technologies and systems deal with flood risk at the **receptor**. In this context, FRe technologies and systems can prevent flood water from entering a property (**resistance** or **dry proofing**) or, in the case of deeper and prolonged floods, slow down the rate of water entry and allow properties to be reinhabited quicker than they would had there been no protection (**resilience** or **wet proofing**).

FRe technologies and systems should not be considered in isolation. They should form part of a wider and sustainable flood resilience strategy that addresses both the social and technological aspects of flood management; from warning systems, such as **telemetry**, to planning, emergency response and recovery. Consequently, understanding how the technologies and systems will behave when in use, particularly the mechanisms and conditions under which they may fail, becomes important.

FRe technologies and systems can be a solution where large-scale flood defences are inappropriate, challenging to implement, or where there is insufficient funding. For example, **cost-benefit** or **cost-effectiveness** analyses can show that small communities, where only a few properties require protection, may be more suited to small-scale FRe technologies. It is important to note that while such technologies only afford some level of protection and can be costly in the short-term, they often reduce the costs of replacement and/or reinstatement in the long-term. This is particularly marked when climate change is taken into account (Kazmierczak and Connelly 2011).

Generally, property-level FRe technologies should be used where the flood duration is short, the flood water speed is slow, and the depth is shallow. In terms of depth, this is no more than 600 mm above the property threshold (the **damp-proof course** or, typically, 150 mm above the outside ground level). Potential end-users should be made aware that where floods are deeper or more prolonged, flood water may eventually penetrate the building envelope and destabilise the entire structure. Other FRe systems, such as buildings skirt systems (see Step 2) can afford higher levels of resilience. These are typically tested to depths of 600mm to 900mm.

## Why guidance is needed

Uptake of FRe technologies is not widespread given the number of properties at risk of flooding in England. Only 1,100 properties were fitted with flood products during a Defra-led scheme between 2008 and 2011 (EA/ JBA Consulting 2012).Yet, the implications of climate change mean that many more properties and communities are likely to benefit from installing FRe technologies in the future, particularly if levels of investment in structural defences remain static (Adaptation Sub-Committee 2012).

Moreover:

- FRe technologies can be considered to be more flexible and adaptable in circumstances such as flash flooding and surface water flooding.
- FRe technologies often have to be made to order rather than simply bought off the shelf because of differences in building types as well as a need to ensure that they are suitable for the end-user.
- Surveys are needed because of varying levels of quality and condition of the properties to be fitted with FRe technologies.

Research conducted by White *et al* (2012), for the SMARTeST project, found that professionals as property owners believed that there was a lack of information. Other barriers included:

- As an emergent sector, FRe technologies struggle to fit into existing governance structures and practices around flood risk management.
- Potential end-users have no way or measuring one company, or one product, against another. Standards, such as the British Standard Institute's Kitemark or the Office of Fair Trading's Trustmark scheme, could play a role here.
- There is a reluctance to install FRe technologies for aesthetic reasons because of the visual intrusion; some property owners believe that it will advertise that they are at risk and result in their property depreciating in value.

'Trust' is therefore a key theme underpinning many of the barriers; from the marketing of FRe products, their performance and installation to whether it can reduce insurance premiums. This guidance has been written to address the barriers to implementing FRe technology in the UK, particularly England. There are three principles running through it:

- To raise awareness of FRe technologies and their potential for flood risk management.
- To increase acceptance of the FRe technologies, which includes designing and specifying products that take account of the varying needs and abilities of future end-users.
- To lead to action that realises the capabilities of FRe technologies in practice, including ensuring that the correct operational systems are in place.

## How to use this guidance

The researchers who have written this guidance did so because of their involvement in a European Union funded project called SMARTeST. Its aim was to research, test and develop FRe systems, tools, and technologies. This included 'smart' products that work within a system of flood resilience along with damage and vulnerability assessment models.

Based on this research, a six step process is recommended that is designed to direct those considering FRe technologies towards best practice in selecting, procuring, installing, and ensuring that the technologies are maintained. Following the six steps and using the links to further guidance should lend greater certainty and clarity to the process. Users can:

- inform themselves of the benefits, and limitations, of FRe technologies;
- engage with stakeholders effectively in order to realise and to manage their expectations;
- follow a logical process, with ordered decision making points, questions to ask and tasks to complete in order to implement FRe technologies.

At the end of each section there is guidance on recommended information resources. Clicking on the links will open the associated web page. Throughout the text there are some words highlighted in bold. These, and other terms, can be found in the accompanying glossary.

The guidance assumes that funding will already be in place to begin a scheme. Annex 1 gives supplementary advice on available funding sources for FRe technologies. Also, community engagement should be undertaken throughout and may be resource intensive. Therefore, the good practice case studies focus on those areas where community engagement has been critical to the success of a scheme. For users who require more detailed information on community engagement, Annex 2 will be useful. Annex 3 looks at further considerations that may need to be taken into account when dealing with buildings of historic interest.


Figure 1: Schematic representation of the steps -

# STEP 1: UNDERSTAND THE RISK

## Why this step is important

Understanding the sources and level of flood risk in a given area will enable a fuller appreciation of where FRe technologies might be useful and to judge which FRe technologies are most appropriate. Step 1 also entails helping others to understand the risk as individuals will interpret risk differently, often depending on their past experiences, social and cultural perceptions.

## Responsibilities

An external surveyor, who is independent of the supply and installation steps, can be important in raising trust amongst the recipients of FRe technologies.

A review of small businesses in the Cockermouth area of Cumbria recommended that specialist advice be sought since some of them were provided with incorrect advice on the nature of their property and construction measures from building contractors (Ingirige, Proverbs and Wedawatta 2012).

Organisations such as the Royal Institute of Chartered Surveyors (RICS) and the Royal Institute of British Architects (RIBA) have lists of suitable surveyors. No accreditation exists for performing flood risk surveys. However, RICS offers professional development courses and have dedicated regional groups to equip chartered surveyors with relevant professional skills for flooding and the ability to deal with specific local issues. Clients and Project Managers could ask for evidence of such continuing professional development as membership of relevant professional organisations requires this.

Some specialist FRe manufacturers are capable of performing this role and offer a service in which they will undertake a detailed flood risk mitigation survey. In this instance, surveyors should disclose any limitations on their independence (including any fees or commissions payable), and the range and type of products or services they wish to offer.

### *What should a flood risk mitigation survey include?*

The quality of any survey is dependent upon good, and up-to-date, awareness of the type and frequency of flood risk for a given area. Flood risk mapping data continually evolves and so it will be important to periodically reassess the risk from all sources of flooding when new data becomes available, when new flood risk management strategies are implemented, or when other flood risk variables are altered (for example, if there are land use changes or a new development is approved).

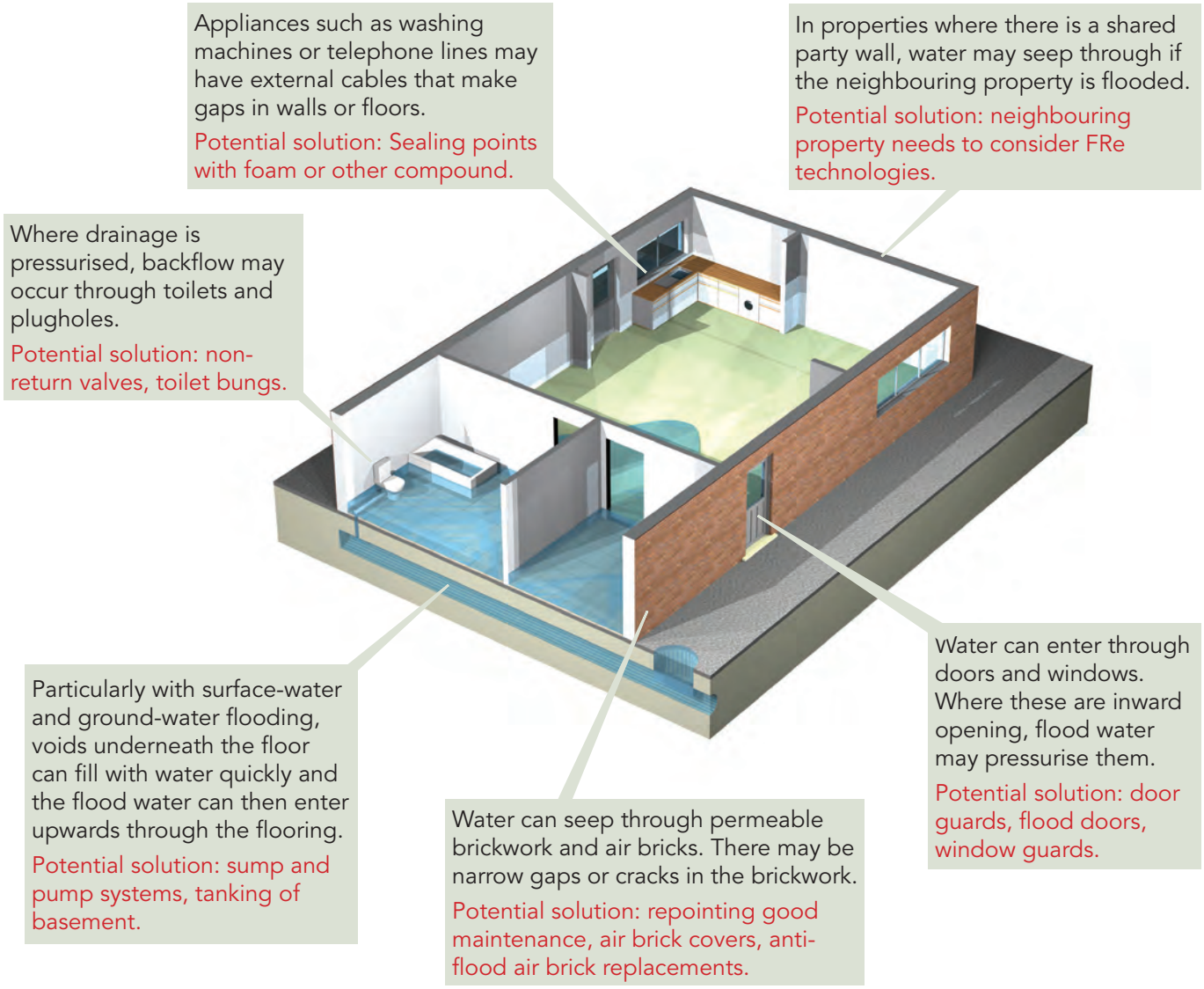



Figure 2: Routes of flood water entry to an average house (adapted from CIRIA 2005).

Where possible, additional data should be used to provide an indication of social vulnerability (areas with a high number of rented properties, areas of deprivation) and physical vulnerability (buildings and infrastructure). It will also be important to take account of future climate change through the data provided by the United Kingdom Climate Projections (UKCP). Guidance on data sources and mapping are given at the end of this step.

A full flood risk mitigation survey should look for all potential points of water penetration and highlight any apertures or weak points in the floors or walls that may not be immediately noticeable (See Figure 2). It should also suggest the potential FRe technologies that can be used to reduce the risk. The ability of the end-user to deploy the technology should be considered. Once this is done, a client can move onto step 2 of scoping out the available products, what they can and cannot do, and suppliers.

Planning permission may need to be sought for larger schemes; for example, those that seek to permit temporary or demountable barriers or those involving listed buildings (Annex 3). A local planning authority should be contacted early in the process if there are questions over whether compliance to any statutory building control and/or building regulations is required.

## Review of Step 1

- Identify the flooding problem, the sources, and consider the existing flood defence system to figure out how FRe technologies can help.
- Incorporate long-term planning by accounting for climate change and other potential changes to risk (See Good Practice 1).
- A good flood risk mitigation survey should provide a comprehensive assessment of all routes by which flood waters can enter a property and measures to prevent or reduce this. A comprehensive report should address the following items:
  - Environment Agency data on flood risk;
  - Topographical data (detailed surface features of the landscape);
  - Surface water flooding data;
  - Groundwater flooding data;
  - Data on historic flood incidents;
  - A risk assessment;
  - Maps, sketches and summary recommendations that can be understood by a lay audience.
- Surveys should provide clear and concise information for the product manufacturers' specification and installation (Steps 3 to 5).
- Surveys might also include practical suggestions of FRe technologies with approximate costs. They should also take the ability of end-user to deploy the technology into account.
- These should also consider remedial measures to make walls more resistant such as re-pointing and water-proofing treatments to external walls, both above and below damp proof courses. -
- Potential qualification for grants and funding may be identified by the surveyor
- Check the flood risk mitigation survey by asking the following questions:
  - How does the flooding of one neighbourhood limit damages in a neighbouring area?
  - Can the introduction of technologies in one neighbourhood/ property influence flooding in a neighbouring area?
  - Have all possible points of entry been considered?
  - Are there any issues with the overall condition and maintenance of a property that could undermine the use of technology?

## Step 1: Outcomes

The main outcome of Step 1 will be a comprehensive flood risk mitigation survey that provides a detailed picture of what mitigation and protection is needed and a recommendation of the product(s) and/ or systems that may be used. This will be crucial for informing the design and specification of technologies (Step 4) and also as baseline data when the levels of residual risk are reassessed (Step 6).

## Recommended Tools and Resources

Flood risk managers and professionals can sign up to The Local Government Association's (LGA) network through their group 'Flownet'. The Flood Risk Management Portal draws together information on mapping, stakeholder engagement and roles and responsibilities.

The Environment Agency has an e-learning module dedicated to property level flood resilience technologies.

The Institution of Civil Engineers (ICE) and the Chartered Institute of Water and Environmental Management (CIWEM) may also be able to provide further advice and support.

The following two reports will give you an indication on what can be expected from surveyors in relation to flooding:

EA/ JBA Consulting (2012). Evaluation of the Defra Property Flood Protection Scheme.

Ingirige, B., Proverbs, D. and Wedawatta, G. (2012). Impacts of Flooding on SMEs and their relevance to Chartered Surveyors. Royal Institute of Chartered Surveyors.

You can find professional surveyors, or others suitably qualified to fulfil this role, from:

Royal Institute of Chartered Surveyors (RICS)

Royal Institute of British Architects (RIBA)

For help with mapping and understanding the risk see:

Defra (2010). Surface Water Management Plan: Technical Guidance. London, Defra.

The Environment Agency (2012). Guidance on surface water flood mapping for Lead Local Flood Authorities. Bristol, The Environment Agency

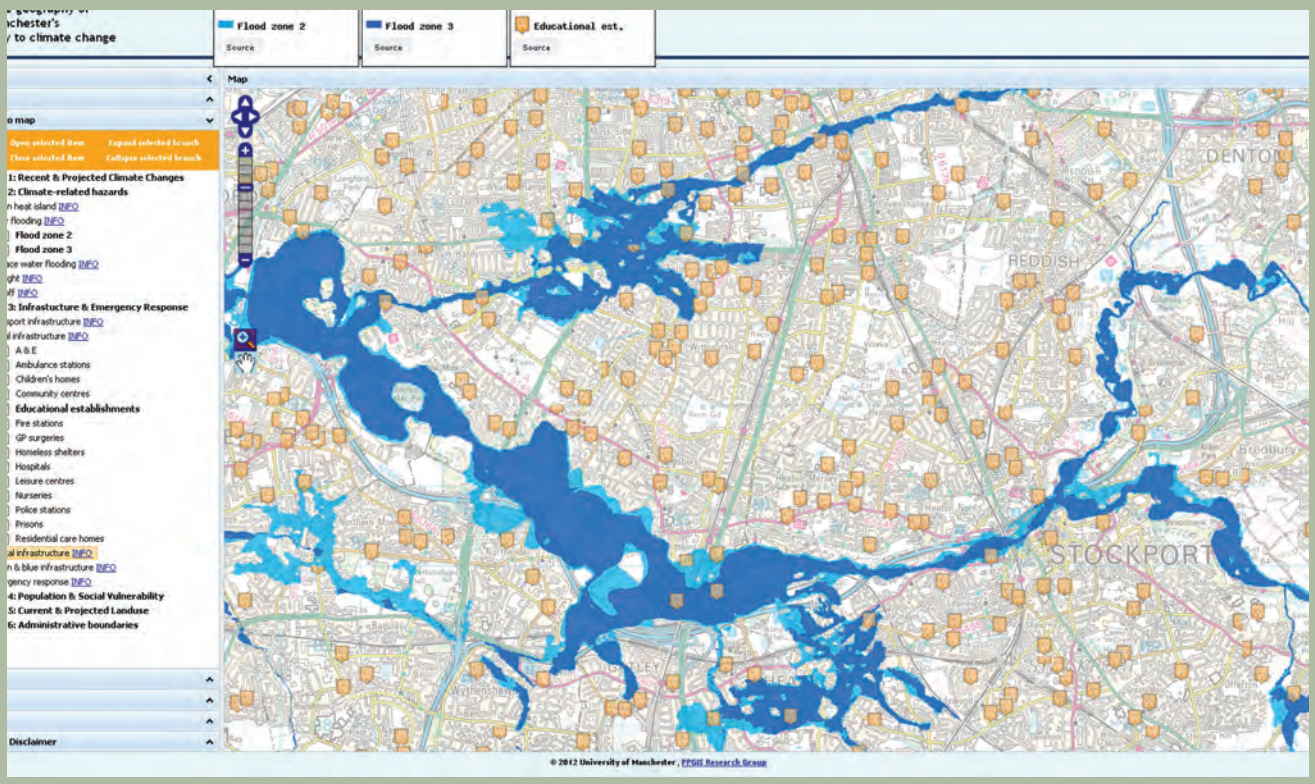
The Environment Agency, Capacity Building Module, Modelling and information 1
The Environment Agency, Capacity Building Module, Modelling and information 2
The Environment Agency, Capacity Building Module, Modelling and information 3

For understanding and mapping spatial data on climate change projections for local areas:

The United Kingdom Climate Impacts Programme UKCIP provides tools, data and resources on planning for future climate change and using UKCP data. Academic institutions can assist with research that uses climate data. For example, see the work done for Greater Manchester through the EcoCities project (Good Practice 1).

The Royal Haskoning Report (2012), details the economic benefits of property-level technologies in a report for the UK's Adaptation Sub-Committee's *Climate change – is the UK preparing for flooding and water scarcity?* The report contains detailed methodology on flood measures for different types of housing as well as assessing the costs for different building types and taking account of climate change.

## *Good Practice 1: Mapping vulnerability to climate change*




It is important to gain an understanding of where flooding is likely to occur and who and what are most vulnerable to it. The EcoCities spatial portal was developed to look at climate change impacts and projected climate change – including the risk of flooding.

This work was brought together in the spatial portal. This interactive platform displays spatial data and provides information to improve understanding of issues of climate change vulnerability in Greater Manchester. Climate change projections for the risk of flooding can be mapped onto data showing vulnerable physical assets (buildings, railway lines) and communities (for example, where there are high proportions of older people).

The portal is for all stakeholders, including community members, to help them visualise vulnerability, exposure and climate hazards within a particular location. Although the portal is based around Greater Manchester, the principles underlying its development are transferable to other locations. The website below contains all of the background data and methods for the project.

Source: The University of Manchester. See www.adaptingmanchester.co.uk

Image Source: Kingston, R. (2012) The EcoCities Spatial Portal, http://www.ppgis.manchester.ac.uk/ecocities/tool.html

# STEP TWO: PLANNING A SCHEME – FIRST CONSIDERATIONS

## Why this step is important

Following Step 1, individual systems and construction works may have been suggested as part of the flood risk mitigation survey. There is no 'one-size-fits-all' advice that can take account of local specificities. Step 2 scopes out the products and planning criteria for a specific scheme.

If there are a number of properties to be protected, a client can either use the same supplier for all of the measures or else open up procurement in order to give end-users greater product choice. The former means less companies to engage with and, arguably, is easier to manage. However, the second option may increase the end-user's acceptance by giving them more choice of measures that might work for them. It is good practice to get competitive quotes from more than one FRe manufacturer and to ask whether the manufacturer can provide testimonials for their products and/or case studies.

It is likely that a property will need a variety of measures in order to make it more resilient to flooding. The cost of a package of measures will also vary depending on the type of property. There is data to help ascertain the potential costs. Please see the links to further guidance at the end of this section.

An evaluation of previous projects also highlighted the importance of being aware of seasonality. Schemes that began in late summer resulted in rushed installations to meet an end of March deadline. This was subsequently hampered by delays due to poor weather during the winter months (EA/JBA Consulting 2012).

### *What FRe technologies are available?*

Perimeter technologies are more properly characterised as FRe 'systems' as these are engineer-designed, bespoke solutions that are aimed at the community or neighbourhood scale in order to keep water away from properties. These include demountable flood barriers with permanent fixings or they can be temporary, to be activated when a flood warning is issued (Bowker 2007).

Consideration should be given to how the measures will be deployed in an emergency situation, particularly if they are manual. Increasingly, automatic measures are coming to market although these are more expensive. Though often termed 'fit-and-forget', this terminology can be misleading as they still require maintenance and oversight.

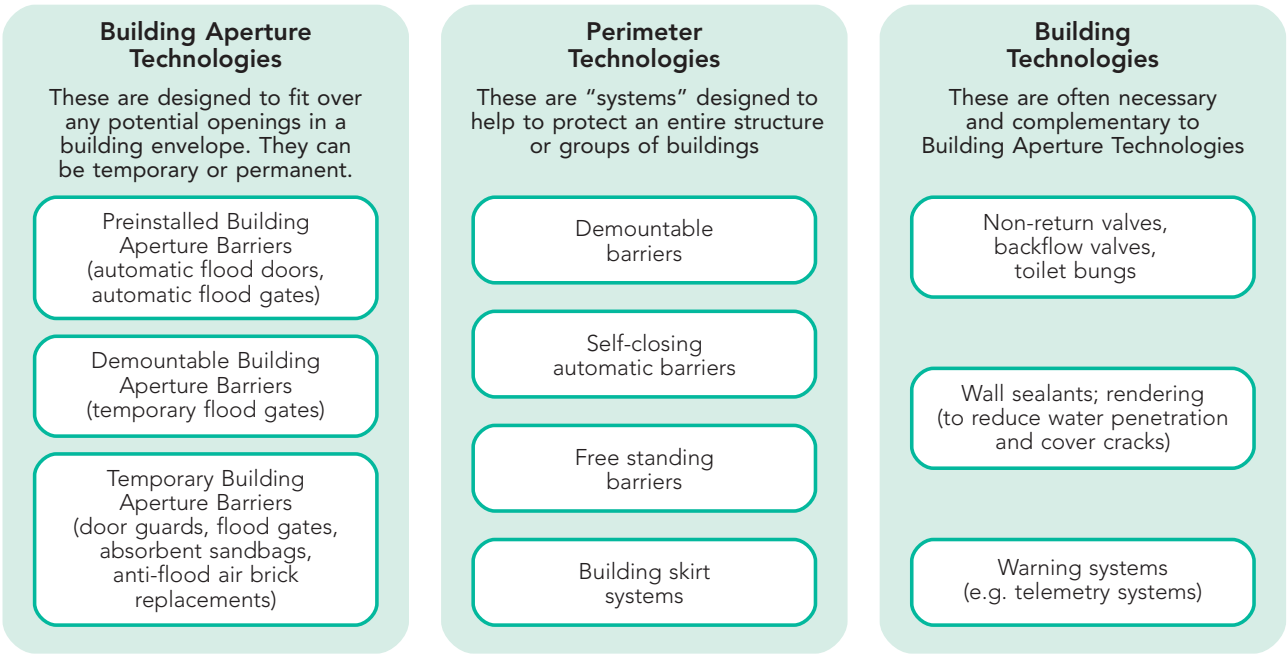



Figure 3: Types of FRe technologies (Source: Gabalda *et al* 2012).

It is important that clients consider the end-users' circumstances and their level of involvement in flood action groups as this will have implications for the deployment of products in an emergency situation. If a flood action group is not set up, then end-users should be supported to do so. In locations where a flood warning service is not available, clients should consider bespoke warning systems as part of an overall package.

It is also good practice for the client and/or end-user to consult potential insurers to understand what their concerns will be when they consider how to factor in any technologies when they come to price insurance. Even if a reduction on insurance cannot be secured, installation of such products can increase peace of mind for end-users (Cobbing and Miller 2012).

## *Considerations for Manual Measures*

- Manual measures require advanced flood warning if they are to be deployed in a timely fashion.
- There will be other operational considerations, such as correctly storing products, particularly if they are temporary.
- Demountables will require transportation and mobilisation once a flood warning is issued.
- However, if flash flooding is identified as a problem, there may be little advanced warning that a flood may occur (Adaptation Sub-Committee 2012).

### *Considerations for Automatic (Passive) Measures*

- Automatically deployed products may reduce some of the concerns around human involvement in product activation.
- Automatic measures may be more appropriate in certain communities, particularly where there are vulnerable residents/homeowners or working patterns and practices that require property owners to spend long periods from home.
- Automatic measures are often preferred by insurers because of the reduced human involvement in their activation so it will be worth asking end-users to check with insurance companies what their position is on this.
- Even so, temporary systems can sometimes be considered to be more versatile since they can be used in previously undefined locations and situations making them ideal for use within incident response scenarios (Ogunyoye *et al* 2011).

### *Further Considerations*

- Some products will cause more disruption during installation than others. For example, non-return valves entail a significant amount of work to sewer pipes. End-users may be reluctant to endure such disruption.
- Resources for operations and maintenance (Step 6) may need to be factored in when choosing whether to adopt manual or automatic measures.

There are many other guides that fully explore the pros and cons of various FRe technologies, with images. These are useful to consult when comparing specifications. There is more information in the 'Recommended tools and resources' section.

## Responsibilities

Manufacturers and installers should not engage in cold calling activities (whether face-to-face, by phone or electronic communication) if potential customers have indicated that they do not wish to be contacted.

Instead, Flood Fairs, open days, and expositions of work can be a good way of demonstrating the products (See Good Practice 2 and Good Practice 9). Testimonials to previous work should be provided and it should be made clear which of the manufacturer's product(s) they refer to.

It is often hard to convince end-users that the products 'work'. Manufacturers should ensure that clients and end-users are clearly provided with an indication of the level to which risk is reduced, and against which source of flooding.

There are previous schemes to draw attention to. Products installed in Appleby in Cumbria were tested in a subsequent flood. Here, the measures were judged to be generally successful because they kept out more water than sandbags previously had. Any leakage was dealt with using pumps and, consequently, properties were kept substantially dry and no evacuations were necessary (Harries 2010).

Testing and certification can provide some reassurance for the consumer. In the UK, some products are performance tested and carry the British Standards Institute (BSI) Kitemark (the relevant standard is PAS 1188). The Kitemark tests up to 900 mm and some leakage is permitted. The Kitemark standards are

covered in greater depth at design and specification stage (Step 4). Please note that there are similar worldwide standards that can be referred to, such as the FM Approvals documentation (FM Global Group 2006).

## Review of Step 2

By the end of this step, a client should have:

- Understood the different types of products available as well as approximate costs.
- Considered whether an adequate forecasting system is in place.
- Considered whether a community flood plan is adequate enough to integrate FRe technologies. If not, then these limitations should be addressed.
- Identified the operational systems already in place or what gaps need to be addressed.
- Weighed up the pros and cons of automatic or manual measures (or even a combination of the two) and whether the measures can be deployed.
- Considered the extent to which there is sufficient community capacity to deploy manual technologies in the event of a flood warning.
- Considered whether the project should be individual property-level interventions or whether it is worth considering protection for a group of buildings.
- Accessed technical guidance on quantifying the cost and benefits of flood protection measures. This is included in EA/ JBA Consulting report (2012).
- Accounted for climate change in the cost and benefit analysis. The research and technical annexes to the Adaptation Sub-Committee's (2012) Third Progress report may be helpful.
- Continued community engagement will be necessary to gauge whether or not the options are locally acceptable and whether it is feasible to deploy them (See Annex 2).
- Contact relevant organisations, such as the National Flood Forum or the Flood Protection Association, to help address any information gaps.
- Identified other community level schemes that can be worked in tandem with the property level protection scheme, for example, planned maintenance to social housing.
- Identified whether there are potential champions, for example, a local councillor, who can help to engender support and maintain momentum for a scheme.

## Step 2: Outcomes

Outcomes of Step 2 will be a clear and workable plan and schedule for a scheme, which can then be used to apply for funding, if required. All of the stakeholders identified in step 1 will be engaged and in consensus of the scheme. Any potential gaps in information and the human resources needed to pursue a scheme will be identified.

## *Good practice 2: Cornwall's Flood Fairs and Action Groups*

It is good practice to demonstrate products publicly. In November 2010, more than 100 properties were flooded in Cornwall. Alongside the impact of people and communities there were also significant damage to houses and businesses.

Cornwall Council received approximately £0.5 million in Defra grants to protect the areas in May 2011. As part of their communication strategy, the Council and the Environment Agency held a flood fair and flood surgeries to demonstrate the products available and give residents the chance to sign up to the scheme. Members of town and parish councils and flood wardens on the community flood recovery groups liaised with individual householders.

Over 150 households were subsequently fitted with a combination of measures including door guards, culvert improvements and flood screens. As part of this work, two Community Flood Recovery Groups and a Steering Group were established to deal with issues of policy and the direction of resources. Part of that success was down to the communication strategy and partnerships between Cornwall Council and the Environment Agency.

Subsequently, the Mevagissey Flood Action Group makes use of social media through a Facebook page to communicate in real time about the risk of flooding and, during one episode at the end of 2012, conveyed what areas were flooded, where people could go for help and also advice on dealing with 'rogue' traders when purchasing or paying for drying out.

## Recommended Tools and Resources

The Environment Agency's e-learning module on property level protection gives advice on roles and responsibilities, suppliers and products, and case studies of some schemes.

The European Union-funded SMARTeST project technical site looks at different methods of dealing with flood risk, provides details of some of the latest technologies and how they have been tested, along with models to support effective decision making on flood risk and resilience measures.

The National Flood Forum's Blue Pages Guide to FRe Products and Manufacturers.

The Flood Protection Association also has links to products and manufacturers.

The UK Office of Fair Trading operates the Trustmark Scheme as a not-for-profit organisation, licensed by Government and supported by consumer protection groups. Approved tradesmen can display their logo and can be found by sector and postcode on the Trustmark website.

### *Further Guidance*

Association of British Insurers and the National Flood Forum (2012). Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England. This document makes five recommendations that Local Planning Authorities need to take account of in flood risk areas.

A Homeowner's Guide to Flood Resilience contains information about FRe products and is available from www.knowyourfloodrisk.co.uk (a campaign for increased flood awareness).

RAB Consultants (2011). Handbook of Flood Risk Mitigation for Existing Properties has similar comprehensive and detailed guidance on flood resilience products that covers their cost, ease of deployment, suitability for different types and depths of floods.

Environment Agency (2009). Prepare your property for flooding - A guide for householders and small businesses. An excellent short document including main bullet points about FRe technologies and what to protect in a house. See also the 'interactive house'.

Environment Agency and JBA Consulting (2012). Evaluation of the Defra Property-level Flood Protection Scheme. The evaluation includes advice on how to assess the costs and benefits of FRe technologies.

Tim Harries (2010). Review of the Pilot Flood Protection Grant. This research for Defra looked at how a scheme operated and worked in Appleby, Cumbria including a review of how it performed during a flood incident.

National Flood Forum. Video on Flood Protection and Case Studies on homeowners and businesses who have installed measures in and to their properties.

Ogunyoye, F., Stevens, R., Underwood, S. (2011). Temporary and demountable flood protection guide.

# STEP 3: PROPERTY SURVEYING

## Why this step is important

A product supplier will need to survey a property or site, particularly if the solutions are bespoke, in order to take measurements. This is distinct from the Flood Risk Mitigation Survey (Step 1) that will primarily look for potential entry points and suggest solutions.

Suppliers should contact end-users to carry out a detailed survey prior to submitting the final costing for scheduled works. If the second survey results in discrepancies, the client and/or project manager should ensure that these are queried and resolved before work is due to commence.

## What to expect

Most FRe technologies cannot be purchased 'off-the-shelf'. For example, perimeter technologies and 'systems' consist of specific components and materials which are put together on or off-site. The performance and durability of the installed 'system' is dependent on both the properties of the individual components and on the way in which they interact. This will vary depending on the specification, design and installation methodology of that system, which is why a bespoke survey is needed.

During the property appraisal, the manufacturer/ designer will visit the site. The sources of flooding will be re-assessed and further advice on appropriate FRe technologies will be given. Where possible, consideration should be given to future proofing, such as considering what happens should the property owner's ability to deploy the product changes or to what extent a changing climate may alter the hazard level.

For property-level FRe technology, this appraisal will closely investigate the type of building and its general condition. This is important as the points where water can enter (for example, through walls) can vary according to the quality of the structure. In some cases there will also be other work that needs to be completed in conjunction with the application of FRe technologies, such as repointing of chimney stacks or repairs to the damp-proof course. These remedial works should be highlighted in order to assist the effective implementation of FRe technologies.

## Responsibilities

It is important that the appraiser has full access to the site for measurement purposes. This will require liaising between the end-user and the client.

## Review of Step 3

For FRe technologies (particularly at building scale) this survey will need to:

- inspect potentially vulnerable points around the building services and infrastructure, such as service cables for washing machines;
- measure all apertures: doors, windows and other obvious openings such as letterboxes;
- inspect the brickwork for cracks and/ or where it may need maintained;
- make recommendations for remedial works, such as additional pointing maintenance to prevent seepage;
- inspect the current maintenance of drains and pipe work;
- considers the best – and most acceptable – way of preventing sewage backflow;
- check for low lying airbricks and vents that may not be immediately visible;
- consider the needs of the end-user and the extent to which they are fully capable of deploying, storing, and maintaining the product(s);
- consider the extent to which the product(s) can be visibly minimised or fit with the design of the overall property and site so that it is more aesthetically pleasing for the end-user (UK Flood Barriers 2013).

Within step 3 the following tasks are good practice:

- All recipients should be aware of the survey and know what to expect before it takes place.
- Measures identified following the appraisal survey must be technically and socially feasible, for example, by considering the needs of people with limited mobility and whether they can use any manual products.
- Liaise where needed to ensure that the product manufacturer can have access to the site.

## Step 3: Outcomes

An outcome of Step 3 will be a full property or site survey from which a detailed design and specification for component parts can be derived. This can build on the outcomes of Steps 1 and 2 where products may have been demonstrated to participants so that a supplier can be chosen with products that are acceptable to a property owner, whether that be for aesthetic, logistical or other reasons. A comprehensive specification for each property should be supplied to the project manager or resident.

Note that FRe technologies cannot prevent seepage of groundwater to the foundations of the property, to a cellar or basement or into the ground level floor of the property – sump pumps may need to be considered or the cellar or basement could be tanked. Neither can they prevent penetration of floodwater through a party wall from an adjacent property if it is flooded. Therefore, FRe technology should be considered alongside a combination of measures as well as taking account of all sources of flooding.

## Recommended Tools and Resources

The Construction Industry Research and Information Association (CIRIA) has well-regarded guidance on possible points of entry. The link takes you to their flooding website. Advice sheets 2 and 3 are particularly applicable.

The Flood Protection Association provides guidelines and a code of practice for products and their manufacturers.

Particular challenges were faced in designing solutions in rural Cornwall, which has a wide array of dwelling types. In addition to Good Practice 3 (below), Sustainability West Midlands describes an instance of good practice and why bespoke measures are often needed.

## *Good Practice 3: The Lower Thames Scheme*

It is good practice to ensure that the end-user understands the importance of the property survey, particularly if bespoke solutions are necessary. In the Lower Thames, there was on-going work to plan flood relief channels. Property-level FRe technologies were thought to be an effective short-term solution. Almost 1, 500 properties needed to be protected in the Lower Thames Valley with a wide range of building types. The strategy is notable because of the phased delivery and an initial pilot to seek out novel solutions to deal with the challenges. This included bespoke garden wall barriers in certain locations where it was not feasible to provide door barriers. A good communication strategy was critical to success. This included initial drop-in sessions allowing residents to find out more, and consultation throughout the survey and work to keep residents informed and happy with the measures.

The scheme has provided 57 properties with 147 barriers, 20 sump pumps and 215 air bricks resulting in an improved standard of protection of 1 in 75 years (1.3%).

Source: The Environment Agency, *Current*, Issue 17, p. 16.

# STEP 4: DESIGN AND SPECIFICATION

## Why this step is important

Following the survey is the Design and Specification stage. Many end-users will be keen to ensure that the products are as aesthetically attuned to their property as possible because they do not wish to devalue the cost of their property or advertise that they have been flooded before. Many manufacturers are trying to meet such recommendations with flood doors or unobtrusive fittings for temporary products. Extra time should be factored in to agree the package of measures with the end-users.

The performance criteria for the installed product/ system should be made clear in the specification. This should include how the FRe technologies operate, their potential life-span, their limitations and their robustness. It should also include the comprehensiveness of the overall package of installed measures on reducing flood risk. It should also consider how the FRe technologies integrate with the portfolio of measures undertaken as part of a broader flood risk management strategy.

Where possible, the product specification should include some form of future proofing (see Step 2). The specification should be communicated in terms that are easily understood by a lay person. This will help the client and/ or end-user to prepare for flood events and to instigate flood warning procedures should it become apparent that a flood event may exceed the specification.

The leakage rate should be specified for individual products. Although not all products or all manufacturers are covered by the BSI Kitemark PAS 1188, it is good practice to adhere to these testing standards. They are covered in Good Practice 4. Schemes that attract public funding are usually required to use products that are tested to these standards.

## Responsibilities

The initial flood risk mitigation survey (Step 1) should provide a clear and concise guide to the ideal products and their specifications. The specification of the work should be agreed between the surveyor, manufacturer and installer (following the detailed property survey in Step 3). The manufacturer(s) of any products are responsible for ensuring that products meet the specifications.

Contracts should be written in plain English and with due respect to consumer rights. Once the recommendations are accepted by the client and the end-user, a detailed quotation can be issued and a programme of works developed for installation.

A manufacturer must make customers aware of their right to terminate any visit or other contact and of any cooling-off periods which may apply. This must be done orally and/or in writing as appropriate.

Once the product has been designed, the manufacturer is responsible for communicating verbally, visually, and in print, installation instructions to a third-party installer.

## Step 4: Outcomes

Manufacturer(s) and installer(s) should be chosen with date(s) specified for product installation and duly agreed with the property owner. The manufacturer should ensure that product specifications and technical guidance is communicated to the installer.

## Review of Step 4

The Flood Protection Association's Code of Practice recommends the following procedures:

- Following, all of the work that is specified in the survey should be communicated to the supplier of the design. Ensure that samples of any materials are inspected and agreed in advance.
- Ensure that if a separate installer is being used for Step 5, that the manufacturer has communicated all of the relevant technical information to the installer.

Other considerations include:

- Ensure that any outdoor work is planned predominantly for those seasons where better weather can be expected.
- Consider consulting with the Flood Protection Association or the National Flood Forum to advise on product operations and what end-users can expect.
- Clients and end-users should be made aware of the performance limitations of the products.
- Consider whether those identified as the operators and deployers of FRe technology (i.e. the property owner, a flood warden, and so on) can lift or install the products (This is particularly applicable to temporary products).

## Recommended Tools and Resources

For more information on the types of products and their suppliers see:

The European Union-funded SMARTeST project technical site

The National Flood Forum's Blue Pages Guide

The Flood Protection Association links to products and manufacturers.

For assessing where certain products are more beneficial see:

Wilson, G. and Burton, R. (2010). Handbook of Flood Risk Mitigation for Existing Properties: A living document. Lichfield, RAB Consultants.

Bowker, P. (2007). Flood resistance and resilience solutions: an R & D scoping study.

Ogunyoye, F., Stevens, R., and Underwood, S. 2011. Temporary and Demountable Flood Protection Guide.

BRE Digest 523, Flood resilient construction, Parts 1 and 2, (2012). Available for purchase at the BRE bookshop: http://www.brebookshop.com.

## *Good Practice 4: Look for the BSI Kite Mark*

PAS 1188 (BSI 2009) is an industry driven standard, which provides a benchmark for flood resilience technologies. It has been developed by the British Standards Institution (BSI) in association with the Environment Agency. Testing involves static water, waves and currents. PAS 1188 is a publicly available specification and so can be used by other accreditation bodies.

### Part 1: Building aperture products

This includes parts of the building which allow people to enter or provide ventilation to the building (e.g. windows) up to a width of 2,400 mm. The products are tested in conditions for static flood water rising up to a level between 600 mm and 900 mm above ground level. There is a permissible leakage rate that is set at one litre per hour per metre of seal under the designated maximum water depth (DMWD).

### Part 2: Temporary products

A temporary flood protection product is for use away from buildings but may be sealed against structures or buildings at section ends.They can also help to reduce the seepage of groundwater into the lower foundations and ground floor level of the property. The maximum leakage rate is 40 litres per hour per metre of product measured along its base where it forms a seal.

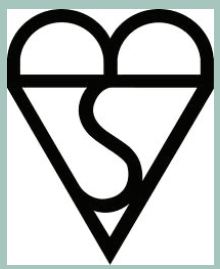
### Part 3: Building skirt systems

These systems are intended for the temporary sealing of the above ground external faces of buildings and properties, in the event of flood water rising up to a level between 600 mm and 900 mm above ground level. They are designed to "wrap around" a property in order to ensure that water does not penetrate the building fabric. There is a permissible leakage rate that is set at one litre per hour per metre of base length of the product.

### Part 4: Demountable products

A demountable flood protection product is capable of being removed and reinstalled on permanent mountings. It is for use away from buildings and may be sealed against structures or buildings at section end. The leakage rate is 40 litres per hour per metre of product measured along its base where it forms a seal.

For more information please visit the British Standards Institute website
Please note that PAS 1188 is currently under review.



# STEP 5: INSTALLATION

## Why this step is important

Making sure that a product is installed correctly is one of the most important steps. Good organisation is crucial as the different professionals involved may operate at different time scales. A client should continue to engage with the end-users in order to ensure that installation goes smoothly and to act as a liaison point.

## Responsibilities

The installer is ultimately responsible for understanding and implementing the manufacturer and surveyors guidance on the FRe product/system. Installers can only carry out activities which the client/ end-user(s) have consented to, either orally or in writing.

All installers should,  on initial contact, disclose their identity to all customers by showing an identification document along with details of their employer or other person they are acting on behalf of (where applicable) and provide a full explanation of the specific services they are providing.

Installers are covered separately from manufacturers in the Flood Protection Association's Code of Practice since sometimes the installation is carried out by a third party. If this is the case, then it is good practice for the installer to be well-briefed (as outlined in Steps 3 and 4). This is crucial, particularly if there is additional work on the building fabric that accompanies specific aperture products. Ideally, the installer will have worked with a particular manufacturer before.

Details of the work must be agreed in advance with the property owner and/or site manager. There are examples of schemes where properties fitted with FRe technologies subsequently flooded. It is difficult to fully attribute responsibility in such cases. It could be because of product failure. However, it may also have been due to poorly maintained pointing rather than a product failure.  Therefore, supervision of the installation is imperative. Where funding for this is not possible to obtain, then an installer could self-certify the work by recording visual data of the installation process.

As part of Step 5, the surveyor who recommended the measures in Step 1 should carry out a post-installation inspection as soon as possible and check the installation work – particularly the seals around doors and whether other remedial work has been satisfactorily completed. If the installation is carried out by a third-party, the manufacturer should also ensure that installation is carried out to their specification and to their satisfaction. Details of this should be included in the procurement contract.

The Environment Agency has worked with a number of organisations, including insurers, to develop a report template to assess flood risk after FRe technologies have been put in place. Lead Local Flood Authorities and Environment Agency teams are encouraged to complete a report that summarises the FRe technologies and any further measures that have been undertaken. When completed, the report should be given to the resident for them to present to insurers. Please note that this will not guarantee that a reduction on insurance premiums will follow.

Flood Risk Report template

It is essential that end-users are made aware of the level of residual flood risk and that there may be types and intensities of flooding that they remain susceptible to, for example ground water flooding when the water table is high (such as was experienced in the UK during 2012).

## Review of Step 5

During step 5, the following tasks will be completed or considered:

- Recipients of FRe measures should be briefed well in advance about the timing of installation and the duration of any disruption.
- Supervision of the installation should be agreed. Alternatively, visual data of the installed measures should be provided once the works are completed.
- Identify any community resources, such as flood wardens, or prominent and trusted community representatives, who can provide additional support for recipients of the measure (for example, through a home visit). Alternatively, identify other resources that may be beneficial such as a telephone cascade, social media page, and so on.
- Following installation, a final inspection should be carried out with the property owner, to ensure that the installation is fully in accordance with the surveyor's recommendations, the manufacturer's technical guidance and that the products are in full working order.
- It is good practice to get both the client and the end-user to sign off the works.
- Installers can demonstrate to the end-user, particularly with manual measures, how the product is to be deployed.
- The end-user should be provided with a durable package of information that can be communicated to future owners should a property be sold.
- The risk to the property should be reassessed by a surveyor (preferably the same person employed during Step 1). A flood risk report should be filled out and handed to the end-user.

## Step 5: Outcomes

The FRe technologies should be adequately installed. There should be visual data of the completed works and a post-installation survey. The residual flood risk should be reassessed and properly communicated to both the client and the end-user.

## Recommended Tools and Resources

The Flood Protection Association and the National Flood Forum are a good point of contact to recommend installers and to provide detailed testimonials.

Should any recipients of the measures have cause for complaint, a Local Trading Standards Office or Citizens Advice Consumer Centre may be able to help. Also, the Office of Fair Trading's Trustmark Scheme has clear guidance on the steps to take in the event of a dispute and can support both consumers and business where this is the case.

## *Good Practice 5: Bodenham Parish Flood Protection Group*

Bodenham Parish Flood Protection Group is extremely pro-active. Their activities are a good example of what can be achieved through the establishment of flood action groups. Over thirty properties had FRe technologies funded. A private contractor project-managed the scheme and the Group liaised between them and local residents.

Following installation, there were two visits by representatives from the project managers, the surveyors and the product suppliers to check equipment. Householders were asked to sign an agreement with the project managers that indicated that they were happy with the installation and agreed to the terms and conditions of the installation.

The Chairperson of the flood group liaised between the project managers and those householders who had outstanding queries before signing off the work.

The Bodenham Flood Protection Group undertake a range of fund-raising activities and also contribute to reducing flood risk by regularly helping to clear drains and watercourses and to fill and stockpile sandbags.

Please visit their website to see the range of activities.

# STEP 6: MAINTENANCE AND OPERATION

## Why this step is important

The ability to operate and maintain products is critical whether they are automatic or manual. Labelling products as 'fit-and-forget' can be counter-productive as it can translate into 'forget-to-maintain'. Anecdotal stories are abundant: with examples of cat flaps cut out of flood doors or products installed by one local authority subsequently found for sale on an online auction site.

## Responsibilities

Property owners are responsible for protecting their possessions from flooding. Consequently, end-users are responsible for maintaining a product, particularly if their insurance stipulates this as a requirement. Most manufacturers recommend annual or biannual inspections. In practice, those who have had these measures installed will probably also check their products when a flood warning is issued.

The manufacturer and/or installer should communicate any maintenance procedures applicable to the product(s) to the client and/or end-user, ideally in a written format. In addition, where products are manually operated, the manufacturer(s) and/or installer(s) should train the end-user, in person, on how to operate the product(s) in the event of a flood warning being issued. Some FRe manufacturers/installers do provide extended guarantees and maintenance contracts; however, it is important that the client/ end-user understands the full implications of these (for example, if a company goes out of business).

End-users should agree to maintain, store and correctly fit any portable items provided. Options to encourage good maintenance and storage of product(s) include:

- Drafting up legal agreements (although this depends on the capacity to monitor them). See Good Practice 6.
- A client could insist that the end-user is able to access some form of insurance, and that this specifies regular maintenance, before they receive products.

End-users should sign up for the local Flood Warning System. There should be a strong emphasis placed on undertaking 'dry-run' exercises to ensure that the operation of flood resilience systems and plans are effective. This was done on a large scale, for example, through Exercise Watermark in 2011 (See Good Practice 7) and on a smaller scale in Buckingham (See Good Practice 9).

After a flood, deployed products will need to be properly cleaned and restored in accordance with the manufacturer's recommendations.

## *Good Practice 6: Legal agreements*

A local authority in Somerset instructed its legal team to draw up a maintenance agreement to be given to property owners as part of their agreement to have the measures installed.

It sets out what is expected from each party prior to and after the completion of the work. This worked because there were only ten properties involved and the council kept good open links with them. It may not be possible in larger schemes.

If a Local Authority has put forward a scheme, additional funds may need to be sourced for an annual inspection regime. It may be possible to identify people within the local community who can highlight any issues that property owners may experience when maintaining the effectiveness of any FRe technologies. Continued engagement will be crucial, particular when residents in a property move and, perhaps, do not communicate information regarding the measures.

Wiltshire council have undertaken a number of strategies to ensure that property owners are made aware of activities relating to floods in their area and are reminded to check equipment periodically. Good Practice 8 describes some of their initiatives and may provide a case study of effective community engagement throughout the six step process.

Property owners will also need to be made aware that these products will not provide defence from all types of flooding. The Environment Agency has a dedicated website to help plan and prepare for floods. Local authority emergency planners can be contacted to give advice on the content of emergency plans and provide local contact details for support during a flood. End-users should be encouraged to join a community resilience or flood group.

## *Good Practice 7: Exercise Watermark*

Exercise Watermark was held between the 6th and 11th March 2011 in accordance with the Pitt Review's recommendations to test emergency preparedness. It was Britain's biggest ever civil emergency exercise, designed to test the country's response to floods and was split into three sections to include: the 'core responders' (at national level); a 'bolt-on' exercise that included local government and emergency responders; while the third part covered community level activities.

After the exercise, feedback suggested that communities who took part felt more informed about the risk of flooding and believed that they were better prepared as a result. The final reports, recommendations and guidance on planning similar activities can be found on the Environment Agency website including a summary for communities with case study examples. It is good practice to periodically undertake similar exercises – from a property owner in their own home to larger community-wide preparations.

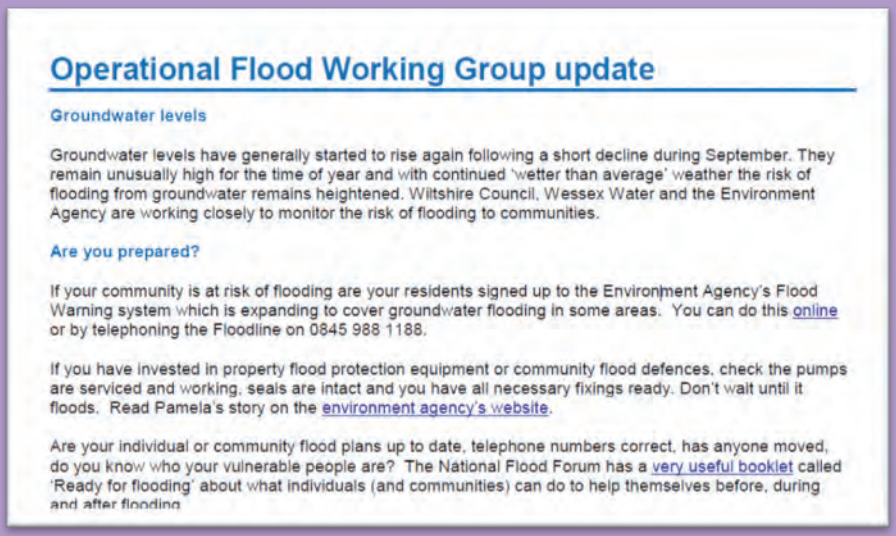

Images from Exercise Watermark, March 2011 (courtesy of the Environment Agency).

## *Good Practice 8: Wiltshire Council – Reminding owners to maintain FRe technologies*

Following flooding in 2010, Wiltshire Council set up two Operational Flood Working Groups. The groups mirror the river catchment areas operated by the Environment Agency and are a forum for stakeholders with diverse interests to consider the issues relating to flooding and drainage within their respective catchment areas.

The Flood Working Groups have a number of tasks, including working with business owners to ensure business continuity, and to communicate with members of the public. The Wiltshire Magazine and a Parish newsletter (both online and in print), provided information on the Operational Flood Working Groups is given alongside other community news such as the opening of a new hall or information on local elections. The newsletter advises people to check that their flood protection equipment is working. This was combined with a Flood Event, in partnership with the National Flood Forum and the Environment Agency, to allow communities to review their flood plans in light of recent weather.

For more information on Wiltshire County Council's work please visit their website



### Operational Flood Working Group update

**Groundwater levels**

Groundwater levels have generally started to rise again following a short decline during September. They remain unusually high for the time of year and with continued 'wetter than average' weather the risk of flooding from groundwater remains heightened. Wiltshire Council, Wessex Water and the Environment Agency are working closely to monitor the risk of flooding to communities.

**Are you prepared?**

If your community is at risk of flooding are your residents signed up to the Environment Agency's Flood Warning system which is expanding to cover groundwater flooding in some areas. You can do this online or by telephoning the Floodline on 0845 988 1188.

If you have invested in property flood protection equipment or community flood defences, check the pumps are serviced and working, seals are intact and you have all necessary fixings ready. Don't wait until it floods. Read Pamela's story on the environment agency's website.

Are your individual or community flood plans up to date, telephone numbers correct, has anyone moved, do you know who your vulnerable people are? The National Flood Forum has a very useful booklet called 'Ready for flooding' about what individuals (and communities) can do to help themselves before, during and after flooding

Sample from Wiltshire Council's online Parish Newsletter, November 2012.

## Review of Step 6

By the end of this step, the extent of operation and maintenance should have been reviewed with end-users. The following tasks can also be undertaken:

- The recipient of a product should be made aware of operational instructions – verbally and in written format. This should include a demonstration (where applicable), the proper maintenance of the product and cleaning instructions in the event of product deployment during a flood.
- Ensure that property owners are provided with clear instructions for all products including operation, storage and maintenance requirements.
- Where products are temporary, there will need to be clear plans in place for ensuring its correct activation. Please see Ogunyoye *et al* 2011.
- Revise community emergency plans to take account of the operation and maintenance of FRe technologies.
- The client should identify resources and funding to support on-going aftercare and maintenance of the FRe technologies.

Other questions to be considered at this point may include:

- Are end-users aware that they will not necessarily receive a reduction on their insurance premium? Have resources and information sources been identified that can assist property owners in finding adequate insurance cover?
- Are end-users aware and periodically reminded that FRe technologies will not protect them from all types and all depths of flooding and that they will need to make adequate emergency plans in this case?
- Are there measures in place to ensure that instructions can be passed on easily in areas where there are a high number of tenanted properties or turnover of residents?
- Is there a Multi-Agency Flood Plan in place? Under the Civil Contingencies Act (2004), local authorities and other agencies are responsible for developing emergency plans, contingency plans and business continuity plans.
- Community-wide flood plans or personalised individual flood plans should be encouraged.

## Recommended Tools and Resources

Gloucestershire County Council (2007, updated 2012). Your essential flood guide: information and forward planning.

National Flood Forum website: case studies.

National Flood Forum (2011). Ready for Flooding

The Environment Agency: Planning and Preparing for Flooding (for homes).

The Environment Agency: Planning and Preparing for Flooding – Checklist (for businesses).

Environment Agency: Guidance on Multi-Agency Flood Plans for Local Resilience Forums.

The British Damage Management Association (BDMA) advise on flood recovery and restoration practitioners. They can be contacted on 07000 8432362.

## *Good Practice 9: Flood Action 4 Buckingham*

If technologies are to work, then community support will be needed throughout the process. Many communities are sometimes confused as to what it all means, what the agenda is, how it works and just what property level flood resilience technologies look like.

Very simple action plans can ensure that when technologies are fitted, it all goes smoothly, and everyone is protected. Good practice in supporting the process of implementing flood resilience can be found in Buckingham where funding had been granted to install property level flood resilience technologies in 2010. With support and guidance from the National Flood Forum, a group of people who had previously been affected by flooding was established – Flood Action 4 Buckingham (FA4B). An existing charity, in this case 'Churches Together' was also used to support the plan.

FA4B works with relevant official agencies and authorities on a 'rolling' action plan to collectively address on-going community flood concerns. Messages, information and discussions are fed into the group and they take responsibility to ensure that the wider community is kept informed. An emergency plan for the community was made alongside 'Churches Together' who have non-flooded members and, usefully, are aware of the skills of their membership. The plan is implemented when required and supports those that do flood. To date, FA4B has organised a dry-run of their plan, held a flood fair in Buckingham to enable residents to gain information, learn more about the emergency plan, speak of flood concerns they may have, and view a platform of flood resilience technologies. It is anticipated that such dry-runs will be undertaken yearly and FA4B volunteers are about to embark on a flood training day through the National Flood Forum's training programme.

Dry-run and Flood Fair, Buckingham, 2012
(Source: The National Flood Forum).

# ANNEX 1: GUIDANCE ON FUNDING

Central Government has moved to partnership funding arrangements that will match contributions raised locally, for example, through local businesses and contributions from property owners. While this opens up the opportunity for control over where money is spent at a local level, potentially at a lower overall cost to the taxpayer, it has to be sought with increasingly limited resources. Obtaining some funding from owner-occupied properties or from landlords of tenanted properties can also increase the sense of ownership for the end-user, particularly with regard to the future maintenance and storage of the product(s) (Step 6).

There are a number of routes to raising money locally in order to apply for Government funds. One source is the Local Levy that can be raised by a Regional Flood and Coastal Committee. Elected members of these Committees can agree a levy to be paid by County and Unitary authorities for works which do not attract a sufficiently high priority for funding by national government, but are nonetheless cost effective and of local importance. This is supported by the Department of Communities and Local Government (CLG). It allows locally important flood defence projects, including property level flood resilience measures, to go forward. The Levy is agreed annually and monies can be carried over annually. However, any local schemes suggested that wish to use the Levy will need to ensure that it is in line with the regional priorities as set out by the Regional Flood and Coastal Committee.

The Defra Flood Defence Grant in Aid (FDGiA) is administered through the Environment Agency. Individual property owners are not able to apply for the funding themselves. Property owners are advised to contact their local authority or the Partnerships and Strategic Overview Team in their local Environment Agency office for more information. A Local Authority will need to liaise with Environment Agency Area teams when they have a scheme planned. The relevant form is the MTP.

There are two criteria to qualify for this funding:

- For river and coastal flooding, floodwater must have entered the selected properties at least once since 2000 and the area must have an annual chance of flooding of at least 1 in 20 (i.e. 5%).
- For surface or ground water flooding, floodwater must have entered the selected properties at least twice since 2000 and reached ground level for a 'significant' number of properties. For remaining properties in a proposed scheme, flood water penetration must result in the need for remedial action (Environment Agency 2012).

A decision-making support tool is available to help local authorities to target the funding streams open to them dependent on their area characteristics and needs. It gives practical approaches and a selection of case studies where joint funding has led to reduced local flood risk.

## *For advice on funding see:*

Defra (2012). Partnership funding and collaborative delivery of local flood risk management: a practical resource for LLFAs

Environment Agency. Guidance on the Partnership Funding

Environment Agency (2012). Flood Defence Grant in Aid 2013/14 ALLOCATION PROCESS MEDIUM TERM PLAN (MTP) GUIDANCE AND TEMPLATE

Environment Agency. Capacity Building Module: Funding

## *For case studies of schemes that have joint funding see:*

Maslen Environmental (2011). Coastal Schemes with Multiple Objectives and Funders (FD2635) Lessons Learnt and Guidance Report Final

# ANNEX 2: COMMUNITY ENGAGEMENT

Engaging with the local community will be part of every step and there may be a number of organisations involved. A previous assessment note that schemes succeed when the quality of engagement is sustained to a high level and there is a close relationship between local authorities, property owners, businesses and professional surveyors, suppliers and installers (JBA Consulting/ Environment Agency 2012). Even if all of the answers cannot be provided, people can be directed towards information and organisations that might help. The National Flood Forum is a recognised and active charitable body who can provide additional support.

If more than one household or property is involved, a lead local resident should be identified to represent collective interests and to try and secure the buy-in of residents who may be more reluctant to accept FRe technologies. Much of this relates to social and cultural issues, such as differing perceptions and expectations of flood risk and what FRe technologies can do. These include:

- Unwillingness to accept the level of risk or placing low priority on flood risk with respect to other household issues.
- A fear that accepting FRe measures, particularly where these are overt, will advertise the risk of flooding and, thus, devalue the property.
- Being unconvinced that FRe technologies result in tangible gains, for example reducing insurance premiums.

During all of the steps, clients, such as Local Authorities, can play a pivotal role in liaising between stakeholders, from the Environment Agency, to the utilities companies and to local business and property owners. Some local authorities have an identified 'champion' at the strategic level of policy making or a pro-active local councillor to make links across different departments, such as emergency management, spatial planning, transport, environment and sustainability, public health, and so on.

It is good practice to engage groups who might be closer to the community for other reasons, such as a place of worship, a Black and Minority Ethnic support network, community centre, and so on. Through engagement you may be able to ascertain the level of acceptability and appetite for FRe technologies in the area as well as identifying and communicating with potentially vulnerable groups. Given the possible disruption incurred, potential recipients will need to be contacted through a variety of means – including social and conventional media.

## *Hard-to-reach Communities*

There are a number of distinct communities with whom extra resources may be needed to engage. Obviously, this will depend on the area since rural communities have a different social and economic make-up from highly urbanised areas. Before Step 1, a stakeholder mapping exercise should identify those who may require extra time and resources should be identified.

Population demographic statistics can help to identify particularly vulnerable people, groups of people, or physical assets. Incentive schemes may be needed to encourage people to participate. Where possible, an intermediary organisation that is already active in the community can be recruited early on in the process (at Step 1) to assist with the communication strategy.

The list below gives some considerations and also some ideas about incentivising uptake of property level protection.

- Communities may be resistant to accepting any measures that may disrupt their daily lives in any way or regard it as an intrusive measure.
- Properties in highly deprived areas may not weigh the risk of flooding highly.
- Extra education may be needed for the (vast majority) of the population who do not know of the technologies or the intimate details of geography and hydrology.
- Private landlords, particularly where they do not live in the area, may be a difficult group to find and convince of the suitability of intervention measures.
- Social landlords may be easier to engage with if there is one group; however, they may work to different timescales and will have to be closely involved in the beginning.
- People who have second homes will need to be traced and more time may be required for the measures to be implemented.
- There may need to be extra help and assistance for people who live in caravans.

Incentives may increase the acceptance of schemes. Incentives can include: fruit and vegetable travel, subsidised public transport, and free access to local college courses. See Erik Bichard and Nirooja Thurairajah (2011). Resilient Homes (Phase 2): The Timperley Green Homes trial on methods to motivate home-owners to address property-level effects of climate change. A report for Trafford Borough Council and the Environment Agency.

## *For further advice on community engagement, please refer to:*

CIRIA (2013). RP975. Guidance on Communicating Local Flood Risk.

The Environment Agency, Capacity Building Module: Flood and Coastal Risk Management, Community Engagement.

The Environment Agency, Capacity Building Module: Flood and Coastal Risk Management, Collaborative Working.

Local Government Association (2010). Community Engagement in Plan Making.

We recommend exploring the Community planning portal which has innovative methods, tools, and case studies for community engagement in planning from across the world.

The Catchment Management Hub also has good links and ideas on how people can be creatively brought together. Please visit their website, which includes information on surveys, crowd sourcing, and using social media.

## *Checklist*

- Identify, using population demographics, any social issues that may need to be addressed and the barriers to implementing FRe technologies and systems.
- Areas where population density is high (cities and towns) may benefit from a stakeholder mapping exercise to lay the basis for sustained engagement through meetings, workshops or other activities.
- Diagnose and pre-empt any problems: What are particular community concerns? What are their priorities? What are the barriers to implementing FRe technologies and systems?
- Establish community flood groups or identify individuals and groups in the community who are concerned about flooding before you begin to plan the scheme.
- Technical solutions depend on having good supporting operations – for example, flood warnings and emergency preparedness plans can support this.

# ANNEX 3: BUILDINGS OF ARCHITECTURAL OR HISTORICAL INTEREST

English Heritage should be the first point of contact for listed buildings that are at risk of flooding and their regional offices will be best placed to advise on protecting listed properties, particularly where this involves implementing specific measures. Even when the solution is a temporary measure, fitted only when a flood warning is in place, the fittings required may detract from the visual appearance of the building.

English Heritage produced an advice note on Flooding and Historic Buildings following the 2007 UK floods. It remains an essential port of call for any older structures, even those that are not listed on the statutory National Heritage List for England. Below, their advice has been extracted to consider how it fits in with each of the six steps outlined in the flood resilience guidance.

**STEP 1:** A flood risk mitigation survey should be undertaken by a surveyor or architect who has good knowledge of the local area (topography, development, and so on) as well as typical construction of building types in that area. Older buildings change over time and may have elements dating from different periods. A good surveyor will be aware of the implications of different forms of construction and how it impacts on the structure.

**STEP 2:** At this stage, some buildings may require planning consent to install measures, particularly where the measures are permanent and/or the properties are located in a conservation area. In this case, a Conservation Officer should be consulted early on in the process.

**STEP 3:** English Heritage notes that FRe technology need not be an anathema to buildings of special interest and can be cost-effective. However, the integrity of the building needs to be maintained and solutions will need to be bespoke and tailored to fit the building. This will need to be considered during the manufacturer's property survey and English Heritage should be consulted during Step 3.

**STEP 4:** With listed buildings, temporary features are regarded as less intrusive but their fixings need to be discrete. If implementing permanent solutions, measures recommended for listed buildings will need to be particularly sensitive. The English Heritage guide gives some example illustrations of barriers for doors and sash windows.

**STEP 5:** The installer should be made aware of the context surrounding the building, the recommendations of the survey and any other advice sought from conservation authorities.

**STEP 6:** General maintenance is critical for older buildings. Where flood risk is identified, property owners should be encouraged to vigilantly check for blocked drains, gulleys, pipes and ditches. Masonry pointing needs to be kept in good order. English Heritage also recommends making an internal and external visual record of the building in the event of future damage.

Maintaining any FRe technologies should be integrated into existing practices and schedules for routine maintenance of a building.

## *Further Information:*

English Heritage. 2009. Flooding and Historic Buildings

The English Heritage Local Office Contact List

Register of Architects Accredited in Building Conservation (AABC): The AABC holds a register of architects who have been assessed as to their individual knowledge and experience of conservation work.

The Royal Institute of British Architects (RIBA)

# GLOSSARY

| | |
|---|---|
| Awareness | The awareness of risk means for an individual to realise and to accept vulnerability to a hazard. |
| Certification | Confirmation of certain characteristics and quality of a product or its installation. This confirmation is often, but not always, provided by some form of external review or assessment. |
| Cost benefit analysis | The process of assessing the relationship between the cost of an undertaking and value of the resulting barriers. |
| Cost effectiveness analysis | Analysis of at least two or more alternatives in order to identify the option with the highest input/ output ratio. The aim is to either achieve the maximum output or the result with the minimum input or costs. |
| Damp-proof course | The damp-proof course is a horizontal barrier (or cavity system) that is designed to stop water from seeping into a structure through capillary action (colloquially known as rising damp when on the inside of the building). Older buildings (e.g. Georgian and Victorian buildings) do not always contain a damp-proof course. |
| Design Standard | A performance indicator that is specific to the engineering of a particular defence to meet a particular objective under a given loading condition. Note that the design standard will vary with the load, that is, there will be different performance requirements under different loading conditions. |
| Dry proofing | Water is prevented from entering a property by sealing the building or using flood alleviation products. |
| Event (Flood) | An event is the occurrence (at source) of one or more variables, such as a particular wave height threshold being exceeded at the same time as the specific sea level (receptor). |
| Failure | Inability to achieve a defined performance criteria/ threshold. |
| Flood Forecasting System | A system designed to forecast flood levels and locations before they occur. See also *Telemetry*. |
| Flood resilience | The ability to cope with flooding and the ability to recover from flooding. |
| Flood resilience measures | A plan, or course of action, which provides resilience to flooding. This includes products and technologies as well as human factors. |
| Flood resilience product | A product that provides resilience to flooding. |

| | |
|---|---|
| Flood resilience systems | A set of things working together as parts of a mechanism. An interconnecting network which facilitates resilience to flooding. "System" is an all-embracing term covering urban flood under various flood type scenarios and embracing all flood management systems (warning systems, emergency service systems, drainage systems, flood risk models, resilience and protection systems, societal and stakeholder issues, flood risk management and governance, etc.) and over various scales from house to street to neighbourhood to city to conurbation to region to country. |
| Flood resilience technologies | Technology which provides resilience to flooding, e.g. technologies with the ability to resist flooding and to enable protection to/from flooding. |
| Flood risk management | Continuous and holistic societal analysis, assessment and mitigation of flood risk. |
| Future Proofing | Taking measures in order to ensure that a given product, policy, or document is designed to be flexible and adaptable enough to be changed easily given uncertain future conditions or to anticipate future failure. |
| Kitemark | The Kitemark is a registered certification mark owned and operated by the British Standards Institute. PAS 1188 covers flood resilience products and systems. |
| Mitigation | The action of reducing the severity, seriousness or painfulness of a risk. |
| Pathway | Route that a hazard takes to reach Receptors. A pathway must exist for a Hazard to be realised. |
| Performance Criteria/ Indicator | The well-articulated and measurable objectives of a particular project or policy. These may be detailed engineering performance indicators, such as acceptable wave overtopping rates, rock stability, or conveyance capacity or more generic indicators such as public satisfaction |
| Preparedness | The ability to ensure effective response to the impact of hazards, including the issue of timely and effective early warnings and the temporary evacuation of people and property from threatened locations. |
| Probability | A measure of our strength of belief that an event will occur. For events that occur repeatedly the probability of an event is estimated from the relative frequency of occurrence of that event, out of all possible events. |

| | |
|---|---|
| Receptor | Receptor refers to the entity that may be harmed (a person, property, habitat etc.). For example, in the event of heavy rainfall (the source) floodwater may propagate across the flood plain (the pathway) and inundate housing (the receptor) that may suffer material damage (the harm or consequence). The vulnerability of a receptor can be modified by increasing its resilience to flooding. |
| Resilience | The ability of a system/community/society/defence to react to and recover from the damaging effect of realised hazards. |
| Resistance | The ability of a system to remain unchanged by external events. |
| Retrofitting | Retrofitting describes the upgrading of an existing building to increase safety by adding or replacing items. |
| Risk mapping | The process of establishing the spatial extent of risk (combining information on probability and consequences). Risk mapping requires combining maps of hazards and vulnerabilities. The results of these analyses are usually presented in the form of maps that show the magnitude and nature of the risk as well. |
| Risk perception | Risk perception is the view of risk held by a person or group and reflects cultural and personal values, as well as experience. |
| Sealing | Sealing is a dry proofing technique where the floodwater does not reach the interior of the building as the external walls and openings are sealed and used to hold back the floodwater. |
| Smart technologies | Technology that responds to and reacts to flood incidents with minimal human intervention. Smart technology has defined uses and performance measures and should be assessed through recognised testing methods and quality assurance. |
| Stakeholder engagement | Process through which the stakeholders have power to influence the outcome of the decision. Critically, the extent and nature of the power given to the stakeholders varies between different forms of stakeholder engagement. |

| | |
|---|---|
| System | An assembly of elements, and the interconnections between them, constituting a whole and generally characterised by its behaviour. Applied also for social and human systems. Here, the term "system" is an all-embracing one covering urban flood under various flood type scenarios (riverine, pluvial, flash, coastal, groundwater, etc.) and embracing all flood management systems (warning systems, emergency service systems, drainage systems, flood risk models, resilience and protection systems, societal and stakeholder issues, flood risk management and governance, etc.) and over various scales from house to street to neighbourhood to city to conurbation to region to country. |
| Telemetry | Highly automated communications process by which data are collected from instruments located at remote or inaccessible points and transmitted to receiving equipment for measurement, monitoring, display, and recording. In relation to floods, this helps with forecasting when water levels are reaching critical points. Though traditionally transmitted over wires or by radio, modern communication systems, such as wifi or mobile phone networks, are expanding the possibilities of telemetry as a flood forecasting device. |
| Wet Proofing | The water is allowed to enter the building but the building fabric and the contents are "waterproofed" by application of flood resistant materials. |

Adapted from the SMARTeST project glossary (Lawson 2011).

Sources include: Flood Mapping Manual Editorial Group Glossary (FMMEP) (Pasche 2007); the FLOODsite glossary (Samuels and Gouldby 2009); The Urban Flood Management Glossary (C.Zevenbergen *et al* 2011).

# REFERENCES


The Adaptation Sub-Committee (2012). *Climate change – is the UK preparing for flooding and water scarcity?* ASC Third Progress Report. Available at: http://www.theccc.org.uk/reports/adaptation/2012-progress-report

Association of British Insurers and the National Flood Forum (2010). *Flood resistant homes, factsheet.* Available at: www.abi.org.uk/content/contentfilemanager.aspx?contentid=24922

Association of British Insurers and the National Flood Forum (2012). *Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England.* Available at: http://www.abi.org.uk

Building Research Establishment (2012). *Bre digest 523. Flood resilient construction. Parts 1 and 2.*

Bowker, P. (2007). *Flood resistance and resilience solutions: an R & D scoping study.* Available at: http://archive.defra.gov.uk/environment/flooding/documents/manage/frrs-scope.pdf

BSI Kitemark (2009). *Kitemark Flood Protection Products and PAS 1188.* https://bsigroup.com/upload/Product%20Services/KM%20Flood%20Protection%20FAQs-%20PS1494.pdf

CIRIA (2005). *Improving The Flood Performance of New Buildings – Flood Resilient Construction.* Report Number WP2c – Review of Existing Information and Experience (Final Report). Available at: http://www.ciria.org.uk/flooding/pdf/WP2%20Literature%20Review.pdf

Cobbing, P. and Miller, S. (2012). *Property Level Protection and Insurance.* Bewdley, National Flood Forum. Available at: http://nationalfloodforum.org.uk/wp-content/uploads/PLP-and-Insurance-Report-FINAL.pdf

Communities and Local Government (2007). *Improving the Flood Performance of New Buildings: Flood Resilient Construction.* CLG, London. Available at: http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

Communities and Local Government (2012). *Technical Guidance to the National Planning Policy Framework.* London: CLG. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf

Defra and the Environment Agency (2011). *The National Flood and Coastal Erosion Risk Management Strategy for England.* Available at: http://www.official-documents.gov.uk/document/other/9780108510366/9780108510366.pdf

Environment Agency & JBA Consulting (2012). *Evaluation of the Defra property flood protection scheme.* Available at: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0312bwdv-e-e.pdf

Environment Agency (2012a). *Flood Defence Grant in Aid 2013/14 allocation process medium term plan (MTP) guidance and template.* Available at: http://www.environment-agency.gov.uk/static/documents/Research/FRM1_MTP_2013_14_Guidance_v2.pdf

Environment Agency (2012b). *Prepare your property for flooding – a guide for householders and small businesses.*

Evans, E.P., Ashley, R., Hall, J. W., Penning-Rowsell, E.P., Saul, A., Sayers, P.B., Thorne, C.R. and Watkinson, A.R. (2004). *Foresight Future Flooding, Scientific Summary: Volume 1: Future risks and their drivers.* Office of Science and Technology, London.

FM Global Group (2006). *FM Approval Standard for Flood Abatement Equipment.* Class Number 2510. Available at: http://www.fmglobal.com/assets/pdf/fmapprovals/2510.pdf

Gabalda, V., Koppe, B., Kelly, D., Hunter, K., Florence, C., Golz, S., Diez, J., Monnot, J.V., Marquez, P. (2012). *Tests of Flood Resilient Products.* Report to the EU Commission, SMARTeST.

Harries, T. (2010). *Review of the Pilot Flood Protection Grant*. Available at: http://evidence.environment-agency.gov.uk/fcerm/en/Default/HomeAndLeisure/Floods/WhatWereDoing/IntoTheFuture/ScienceProgramme/ResearchAndDevelopment/FCRM/Project.aspx?ProjectID=73f1f745-5d08-42dc-8093-145afae754ea&PageID=e5888436-7c89-44e5-aa88-1ab9405f8bfd

Ingirige, B., Proverbs, D. and Wedawatta, G. (2012). *Impacts of flooding on SMEs and their relevance to Chartered Surveyors. Royal Institute of Chartered Surveyors.* Available at: http://www.rics.org/Global/Impacts_Flooding_SMEs_050912_dwl_aj.pdf

Kazmierczak, A., & Connelly, A. (2011). *Buildings and flooding – a risk response case study*. The EcoCities Project, The University of Manchester. Available at: http://www.adaptingmanchester.co.uk/documents/buildings-and-flooding-risk-response-case-study

The Long-Term Initiatives for Flood Events (Life) project (2009) [online]. Available at http://www.lifeproject.info/

Lawson, N. *The SMARTeST Project – Glossary*. Available at: http://www.floodresilience.eu/images/smartestglossary.pdf

McBain, W, Wilkes, D, Retter, M. (2010). *Flood resilience and resistance for critical infrastructure*. CIRIA.

Ogunyoye, F., Stevens, R., Underwood, S. (2011). *Temporary and demountable flood protection guide*. Available at: http://evidence.environment-agency.gov.uk/fcerm/en/Default/HomeAndLeisure/Floods/WhatWereDoing/IntoTheFuture/ScienceProgramme/ResearchAndDevelopment/FCRM/Project.aspx?ProjectID=94162dd3-3ff2-49b9-b7f3-a8b8ee087392&PageID=fcdbadbd-03c9-4263-a8a4-482686506f00

Pasche, E. (2007) *Flood Mapping Manual Editorial Group Glossary*. Hamburg University of Technology, TUHH.

Royal Haskoning (2012). *Assessing the economic case for property level measures in England*. A report for the Adaptation Sub-Committee. Available at: www.hmccc.s3.amazonaws.com/ASC/2012 report/Royal Haskoning PLM Report Final.pdf

Royal Institute of British Architects (2009). *Designing for Flood Risk*. London: RIBA. Available at: http://www.architecture.com/Files/RIBAHoldings/PolicyAndInternationalRelations/Policy/Environment/2Designing_for_floodrisk.pdf

Royal Institute of Chartered Surveyors (2012). *The impacts of flooding on SMEs and their relevance to chartered surveyors*. Available at: http://www.rics.org/Global/Impacts_Flooding_SMEs_050912_dwl_aj.pdf

Salagnac, J-L *et al*. (2012). *D3.2 Report on FRe systems analysis*. Project report for the EU, SMARTeST, October 2012.

Samuels, P. and Gouldby, B. (2009). *Language of Risk – Project Definitions* (Second Edition) www.floodsite.net

Speller, G. (2005). *Improving community and citizen R&D Technical Report SC040033/SR3*. Defra and the Environment Agency.

UK Flood Barriers. (2013) Survey and Installation [online]. UK Flood Barriers. Available at: http://www.ukfloodbarriers.co.uk/survey.aspx?id=3

Wilson, G. and Burton, I. (2010). *Handbook of flood risk mitigation for existing properties: a living document.* Rab Consultants. Available at : http://www.rabconsultants.co.uk/uploads/Handbook%20of%20Flood%20Risk%20Mitigation%20for%20Existing%20Properties%20Issue%201%20Low%20Resolution.pdf

White, I., O'Hare, P., Garvin, S., & Lawson, N. (2012). *Barriers to Flood Resilience – a discussion document*. Centre for Urban and Regional Ecology & Bre, Manchester. Available at: http://www.sed.manchester.ac.uk/research/cure/research/documents/Findings-from-the-data-SMARTeST-UK.pdf

Zevenbergen, C., Cashman, A., Evelpidou, N., Pasche, E., Garvin, S. and Ashley, R. (2011). *Urban Flood Management*. Taylor and Francis, London.

*This Guidance is endorsed by the following organisations*

The Association of British Insurers

Department for Environment, Food, and Rural Affairs (Defra)

The Environment Agency

The Flood Protection Association

The Local Government Association

The National Flood Forum

ABI

defra
Department for Environment Food and Rural Affairs

Environment Agency

FPA

Local Government Association

National Flood Forum
Supporting and representing flood risk communities