

# Property Flood Resilience Reflections and Recommendations Report

Pednormead End Property Flood Resilience Project



**Buckinghamshire  
Council**

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## Quality information

<b>Prepared by</b>	<b>Checked by</b>	<b>Verified by</b>	<b>Approved by</b>
Tamara Provencher Consultant	Nora Balboni Senior Engineer	Matt Tandy Associate Director	Matt Tandy Associate Director

## Revision History

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Prepared for:

Jed Ramsay  
Buckinghamshire Council  
County Hall  
Walton Street  
Aylesbury  
Buckinghamshire HP20 1UA

Prepared by:

AECOM Infrastructure & Environment UK Limited  
AECOM House  
63-77 Victoria Street  
St Albans  
Hertfordshire AL1 3ER  
United Kingdom

T: +44(0)1727 535000  
aecom.com

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# Executive Summary

	<p><b>THE PROBLEM</b></p> <p>The Pednornead End area in Chesham, Buckinghamshire has a history of flooding that extends over 100 years. Hydraulic flood modelling found that 105 properties are at risk of flooding caused by a range of sources, including excessive surface water, overtopping of the River Chess, and rising groundwater.</p>
	<p><b>THE SOLUTION</b></p> <p>Buckinghamshire Council commissioned the Pednornead End Flood Resilience Project, which includes increasing the culvert capacity under Church Street and offering Property Flood Resilience (PFR) packages to properties identified at residual risk of flooding. The PFR aspect of the project was delivered between 2019 and 2022. PFR provides property owners with practical and cost-effective measures which reduce the amount of water that can enter a building. The Pednornead End PFR scheme provides improved flood resilience to 33 residential properties, 1 public house, and one school (comprising of 5 buildings). For most properties, the scheme resulted in a Standard of Protection of 1% Annual Exceedance Event from combined sources of flood risk (surface water, river, groundwater). The PFR scheme enables property owners to be more self-sufficient and resilient during a flood event, resulting in enhanced peace of mind, reduced stress and improved quality of life.</p>
	<p><b>CHALLENGES AND OPPORTUNITIES</b></p> <p>This Reflections and Recommendations Report was produced by the project’s Managing Agent to capture the wide range of constraints, challenges, and opportunities faced by the project team. The scope of the report is to provide a transparent reflection of the project from varying stakeholders and provide a clear set of recommendations for the implementation of future PFR projects. The aim of the report is to harmonise with support of the existing industry guidance documents and contribute to the continuing improvement and streamlining of PFR implementation.</p>
	<p><b>REFLECTIONS AND RECOMMENDATIONS</b></p> <p>The project uncovered reflections and recommendations spanning all stages of a PFR scheme as set out in the PFR Code of Practice: hazard assessment, property survey, options development and design, construction, commissioning and handover, operation and maintenance. Stakeholder engagement and project management, programme, and budget were also covered. The key recommendations are summarised within this executive summary. For further detail please refer to the relevant section in the report.</p>

## Section

## Key Recommendations

### Stakeholder Engagement

**Tailored/Early Engagement:** Significant stakeholder engagement tailored to the needs of the community should be planned from the project inception, in particular for communities who have not directly experienced flooding in the recent past. The engagement should include information for residents about the risk of flooding, what the PFR measures will look like, and what the associated operational and maintenance requirements are. The reasons behind not being able to fit certain measures over others (e.g. flood barrier versus flood door) should also be clearly communicated.

**Community Flood Group:** Setting up/supporting a Community Flood Group is key to a successful project and should be prioritised in early engagement activities.

**Resident Uptake:** Measures to incentivise residents to join the scheme could be developed, for example a Flood Performance certificate linked to reduced insurance premiums/excesses.

**Guidance:** Stakeholder engagement should be included in industry guidance for PFR.

**Visual Impact of PFR Measures:** Engagement activities such as Flood Mobile visits, showing photos of completed PFR projects, and demonstrating example products to residents prior to installation is important to meet residents' expectations.

### Hazard Assessment

**Clear Communication:** Thorough and clear explanation of predicted flood risk and what it means for the community should be included in engagement activities and referenced in on-going communication.

**Verification of Flood Risk Information:** Baseline flood risk information such as hydraulic models should be reviewed and verified based on a localised approach to ensure accuracy and relativity.

**Standard of Protection (SoP):** The SoP that the PFR scheme is aiming to achieve should be agreed at the project outset. Where flood levels and depths vary across a community, a property-specific approach may enable provision of lower barriers in some instances.

### Property Survey

**Scope of Property Surveys:** Communicating the purpose of the Route of Ingress (ROI) surveys and reports to professional partners and property owners is important. The scope of those documents is to provide an outline design only, and this must be understood by all parties. The ROI reports provide an indication of the type of measures which could be implemented to protect the identified routes of ingress.

**Detailed Property Surveys:** Specialist input to property surveys would provide benefit to better identify required PFR measures, inform the feasibility of taking a property forward, and support communications with and expectations of property owners. For example: threshold levels, heritage/conservation, building fabric, etc.

**Routes of Ingress Survey Reports:** Two formats of the report could be considered to facilitate understanding of

Section	Key Recommendations
<a href="#">Options Development and Design</a>	<p>the information that is being conveyed: one for professional partners including full details and a non-technical summary report for property owners.</p> <hr/> <p><b>Design Responsibilities:</b> The design responsibilities for design accuracy and health and safety should be clearly set out and agreed at the project outset.</p> <hr/> <p><b>Design Change Log:</b> A design log should be kept up to date and shared with all professional partners. This would help facilitate review and agreement to the design proposals and could minimise the potential for disagreements about appropriate measures before they are installed.</p> <hr/> <p><b>Historic Buildings and Listed Building Applications:</b> The PFR surveyor, PFR installer, heritage specialists, and heritage officers should be involved early to ensure all parties agree with the proposals. Once approved, the proposals cannot be amended without re-submitting the listed building application with associated lengthy timescales.</p> <hr/> <p><b>Recoverability Measures:</b> There is a need for further training and guidance for both surveyors and installers around the suitability of PFR recoverability measures, particularly for historic buildings.</p>
<a href="#">Construction</a>	<p><b>Confirmation of Design Proposals:</b> The final proposals (set out in the Schedule of Works) should be accompanied with photos and/or physical demonstrations of what the installed measures will look like. This should be agreed and signed by the homeowner to avoid last minute cancellations or resident dissatisfaction during/following installation.</p> <hr/> <p><b>Installation Programme:</b> The installation programme should be kept to a minimum for each property to decrease disruption to the resident. All measures (including ancillary measures such as cover plates and storage racking units) should be available to install within the same installation visit unless this would not possible due to a bespoke fitting.</p>
<a href="#">Commissioning and Handover</a>	<p><b>Training of PFR Maintenance and Deployment:</b> The handover pack provided to residents should include a reminder of the ownership, maintenance requirements and warranty for all PFR measures. It should include detailed maintenance tasks including the required frequency and guidance on deployment. The handover process should include information for residents on the Community Flood Group and Flood Warning procedures. The handover pack should be given upon the point of commissioning.</p> <hr/> <p><b>Post Installation Flood Risk Reports:</b> Post Installation Flood Risk Reports should be simplified so that they are easily understandable to non-flood risk professionals. A template for this standardised for use across the industry could be useful.</p> <hr/> <p><b>Flood Warning and Informing:</b> A local approach for warning and informing should be developed as part of every PFR project in collaboration with the local Flood</p>

**Section****Key Recommendations**

Group, the Council, and the Environment Agency. The flood warning and informing information should include triggers of when to deploy the PFR measures.

A flood group would help to ensure PFR measures are deployed across the community in advance of a flood, including for those residents who would struggle to deploy the measures because they are vulnerable, elderly, or not at home.

Operation and Maintenance

**PFR Storage, Maintenance, and Deployment:** The ability of residents to store and deploy PFR measures appropriately within their properties should be confirmed early in the project. A community storage location should be identified and confirmed if required. Thorough maintenance and deployment demonstrations and exercise opportunities should be provided to residents, immediately following installation and at subsequent regular intervals.

**Training:** Guidance and/or a specific training module in the PFR Code of Practice for Managing Agents/the Council management team would be beneficial. The significant project management requirements should be allowed for in the project budget and sufficient expert resource secured.

Project Management, Programme, and Budget

**Setting Objectives/Parameters:** A Statement of Work should be agreed with all professional partners before the start of the project, which clearly defines the goals, deliverables, and key design parameters of the project.

Project milestones should be agreed with all parties before the start of the project and should be associated with the contract arrangement.

**Recording Project Reflections:** Reflections on project execution should be recorded and kept up to date throughout the project with gateway meetings.

**Contingency:** The programme should include sufficient contingency to account for events outside of the project team's control. The programme should include a critical pathway, so it is clear what needs to be achieved by whom.

**Allocating Sufficient Budget:** Generally, PFR schemes do not receive sufficient funding to cover all activities. A PFR scheme is essentially made up of a separate project for each property with specific constraints and opportunities. The programme should include sufficient budget for Project Management, as it is generally higher on PFR projects due to the detailed nature of the works and stakeholder engagement needed for each property.

**Funding/Benefit Claiming:** The current funding mechanism could be reviewed to enable properties to be eligible for certain types of funding where the installation of some but not all PFR measures provides a betterment to flood risk. This would move away from the current 'all or nothing' approach.



# 1. Introduction

- 1.1 This Reflections and Recommendations Report provides a review of a PFR scheme that was delivered between 2019 and 2022 in the Pednornead End community in Chesham, Buckinghamshire.
- 1.2 PFR is an important part of the response to existing and predicted flood risk. This is particularly relevant in areas where it is not possible to protect communities by community/regional flood defences or where it is necessary to manage residual flood risk. PFR includes measures that reduce the risks to people and property, enabling households and business to reduce flood damage, speed up recovery and reoccupation of flooded buildings, and potentially obtain insurance cover more easily and affordably.
- 1.3 This report was produced by the project's Managing Agent (AECOM) and captures the wide range of constraints, challenges, and opportunities faced by the project team. Information to inform the report was obtained from the following stakeholders: residents, PFR surveyors (RAB Consultants), PFR installers (Lakeside Flood Solutions), the Environment Agency, and Buckinghamshire Council's Lead Local Flood Authority (LLFA) team. Residents were given the chance to provide more detailed feedback during the Community Flood Exercise Day held in October 2022. After the Community Flood Exercise Day, stakeholders were invited to complete a survey by email in October 2022 followed by a meeting with project members. The residents' survey received 13 responses, which corresponds to approximately 30% of property owners who took part in the scheme. Where outputs of the survey are provided of this report, they have excluded nil responses.
- 1.4 The PFR scheme was commenced prior to the publishing of the Code of Practice for Property Flood Resilience (CoP)<sup>1</sup>. The CoP sets the benchmark for those involved with PFR and includes six standards specifying what should be achieved during the delivery process. Aspects of the CoP are continuing to be embedded into the PFR industry and training is being developed. The Pednornead End PFR scheme applied best practice from the CoP where appropriate.

## Scope of Report

- 1.5 The scope of the Reflections and Recommendations Report is as follows:
  - Provide a useful case study of a complex PFR scheme delivered within a conservation area with several Grade II listed buildings. The findings and recommendations are anticipated to be useful for property surveyors; manufacturers, suppliers and installers of PFR measures; Flood Risk Management Authorities; planners, and developers specifying PFR for new build and retrofit situations.
  - Report on the project's successes, what issues were faced and how these were resolved, and what could be done differently for future projects.
  - Provide a transparent reflection of the project from varying stakeholders and, where appropriate, a clear set of reflections/recommendations for the implementation of future PFR projects.
  - Harmonise with support of the existing industry guidance documents and contribute to the continuing improvement and streamlining of PFR implementation.
- 1.6 This report has been set out in line with the stages of a PFR scheme as set out in the CoP Standards:
  - Hazard Assessment
  - Property Survey
  - Options Development & Design

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<sup>1</sup> Kelly, D. Barker, M., Lamond, J., McKeown, S., Blundell, E., and Suttie, E. (2020) Code of practice for property flood resilience. Edition 2. C790A, CIRIA, London

- Construction
  - Commissioning & Handover
  - Operation & Maintenance
- 1.7 In addition, this report will cover Stakeholder Engagement and Project Management, Programme, and Budget, which are not contained within the PFR CoP but are deemed important for a successful scheme.
- 1.8 For each section, the report reflects on 1) successes, 2) what issues were faced, and 3) what recommendations can be used for future projects.

## Project Background

- 1.9 Pednormead End is located in the west of Chesham in southeast Buckinghamshire. The River Chess, a chalk stream and designated Main River, runs through the area. Chesham is designated as a Chiltern District's Conservation Area<sup>2</sup>, denoted an area of special architectural or historic interest for which it is desirable to preserve or enhance the character or appearance. Many properties in Chesham are on the National Heritage List for England (Listed Buildings). Listed Buildings require consent for most types of work that affects their 'special architectural or historic interest'. The properties in the area are predominantly semi-detached or terraced housing.
- 1.10 Historical flooding at Pednormead End extends over 100 years, with the most extensive event recorded in 1918. More recent flood events occurred in 2001, 2006, and September 2014.
- 1.11 In 2015, Atkins, a consultancy group, was instructed by Buckinghamshire County Council to investigate a range of flood management options for Pednormead End. Atkins developed a hydraulic flood model in 2016 (revised in 2019) which found that over 100 homes are at risk of flooding in the Pednormead End area caused by a range of sources including excessive surface water, overtopping of the River Chess (fluvial flooding), and rising groundwater.
- 1.12 This resulted in the development of the Pednormead End Flood Resilience Project, led by Buckinghamshire Council. The scheme is a multi-million-pound flood management project to reduce future damage caused by flooding. The scheme includes increasing the culvert capacity under Church Street and offering PFR packages to properties identified at residual risk of flooding. This report covers the PFR aspect of the scheme.
- 1.13 Stakeholder engagement activities for the PFR scheme commenced in earnest from early 2019. Property surveys were offered to approximately 105 properties, with 90 accepting. Subsequently 33 households (thirteen of which are Grade II Listed Buildings), one public house, and one school (comprising of 5 buildings) agreed to progress with PFR installation. Most installation works were completed by Summer 2022, followed by a Community Flood Exercise Event held in October 2022 concluding the scheme.

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<sup>2</sup> Buckinghamshire Council (2023) Conservation areas in Buckinghamshire. <https://www.buckinghamshire.gov.uk/planning-and-building-control/heritage/conservation-areas-in-buckinghamshire/>

## 2. Stakeholder Engagement

- 2.1 Stakeholder engagement is not covered specifically within the PFR CoP; however, it is a vital component of a successful scheme. Meaningful stakeholder engagement creates constructive relationship with efficient communication between various bodies and the community. It helps ensure residents are involved and engaged in decisions that affect their housing, such as understanding the flood risk to their property, understanding what the PFR measures will look like, and understanding the importance of having a flood group in place once the scheme is complete.

### Successes

**Resident Survey:** 67% satisfaction with the effectiveness of communication from the project team. 56% were 'very satisfied', another 11% were 'satisfied'.

**Resident Survey:** 50% were satisfied with the overall PFR scheme and 66% would recommend going ahead with a PFR scheme to others.

- 2.2 A Communications and Delivery Strategy<sup>3</sup> was developed at the start of the project in April 2019 (revised in October 2020), led by AECOM's stakeholder engagement team with input from Buckinghamshire Council. This document provided a clear strategy and approach for all communications and engagement to support the proposed PFR scheme in Chesham. The communications with the residents and different stakeholders were partially outsourced to the Managing Agent (AECOM), which helped reduce the burden on the Council's staff.
- 2.3 Significant stakeholder engagement activities were undertaken by the Council and Managing Agent in advance of and during project delivery. The team quickly adapted to Covid-19 restrictions and focused on inclusivity by providing varied forms of engagement to suit different needs and requirements. In addition, local Councillors were involved in the project from an early stage to provide reassurance to the community.
- 2.4 This significant engagement led to 90 properties signing up for an initial property survey. The activities undertaken during the project included the following:
- Regular site visits including door knocking
  - Emails
  - Letters
  - Phone calls
  - Project webpage set-up with regular updates
  - Face-to-face community events at the local Tennis club and online meetings

<sup>3</sup> AECOM (2020) Communications and Delivery Strategy – Buckinghamshire Council – Pednornead End.

## What Issues Were Faced

**Resident Survey:** Only 55% felt that the advantages and disadvantages of installing PFR measures were communicated well.

Reasons include: confusion between messaging from surveyors and installers; communications and paperwork could be briefer/more concise; and images shown in product brochures are misleading.

**Resident Survey:** Only 56% would be interested in joining a Community Flood Group.

- 2.5 The project faced a significant challenge in terms of residents progressing to PFR installation phase. Out of the approximately 105 properties which were identified at risk of flooding, a significant portion of households (around 90) signed up to the initial property survey. Only 39 properties (which includes 33 residential properties, one public house and five school buildings) chose to proceed to installation. This comprises a take up of around 40%. Reasons behind the difficulty of engaging residents to proceed to PFR installation are thought to include the following:
- Numerous years have passed since the last flood event in the area and most properties in the community have not directly experienced flooding, such that the perceived risk of flooding in the community is relatively low.
  - The Covid-19 pandemic prevented in-person engagement events for a significant portion of the project. During the pandemic, engagement was limited to phone calls, emails, and two virtual community events held online. This inevitably excludes some residents who would have benefitted from in-person visits and conversations.
  - Dissatisfaction with the visual impacts of the PFR measures, most notably the flood barriers and side posts, which residents felt they had not been sufficiently made aware of.
- 2.6 An active Community Flood Group can make a real difference for a PFR scheme to be successful for uptake and overall project. The key benefits of a flood group include helping to ensure that the deployment and maintenance of PFR works appropriately and that less-able members of the community are supported. Chesham has had a community flood group called the Chesham Flood Action Group (CFAG) for a decade, who were instrumental in opening the original discussion around flooding in the area; however, only half of the residents who responded to the project survey stated they would be interested in joining a Flood Group.
- 2.7 The project did not dispose of a dedicated [@buckinghamshire.gov.uk](mailto:@buckinghamshire.gov.uk) email address for the project from the start. When the email address was created, the Managing Agent did not have access to it, which meant that Buckinghamshire Council officers needed to arrange sending communications to residents. On occasion, this created a delay, and some emails were sent too late or at the wrong moment. Also, emails sent in bulk, for example to the residents, can end up in the junk mail folder.

## Recommendations

- 2.8 The key take-away recommendations regarding *Stakeholder Engagement* to inform future PFR project delivery are summarised in Table 1.

**Table 1: Recommendations – Stakeholder Engagement**

Recommendation	Detail
<b>Tailored/Early Stakeholder Engagement</b>	Significant stakeholder engagement tailored to the needs of the community should be planned for prior to project commencement. The demographic and socio-economic status of a community should be considered when defining the type and frequency of communication. Inclusivity should be a key concern when determining what engagement activities to undertake by providing varied engagement to suit a

## Recommendation Detail

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range of audiences in the community. For example, in-person and virtual events, communication by letter, email, phone call, and door visits.

Engagement activities should be undertaken at regular intervals with multiple offerings to capture as many residents as possible.

The engagement should include information for residents about the risk of flooding, what the PFR measures will look like, and what the associated operational and maintenance requirements are. The reasons behind not being able to fit certain measures over others (e.g. flood doors versus barriers) should be clearly communicated. This could be achieved through:

- Flood Mobile visits, where a specially adapted mobile home is brought to the community to showcase over 50 examples of different products<sup>4</sup>.
- Question-and-Answer sessions with the PFR Installer where the products are showcased.

Engagement activities would benefit from involving individuals who have experienced internal flooding at their property in the past to explain the impact of a flooded home, and the benefits of PFR.

A single point of contact should be identified for resident communication where possible. This could fall under the responsibilities of the Managing Agent.

A dedicated Council email should be used to accelerate the response rate and ensure communication is sent at the appropriate time. The email should be accessible by everyone who require access.

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<b>Community Flood Group</b>	Setting up and/or supporting a Community Flood Group should be included in the early engagement activities. Momentum should be kept throughout project delivery through to project completion and beyond. This may require collaboration with Elected members/local Councillors and active community members. The Environment Agency and LLFA are also well placed to support.
<b>Resident Uptake</b>	Measures to incentivise residents to join the scheme could be developed, such as a Flood Performance certificate linked to reduced insurance premiums/excesses, and/or creating a sponsorship with an insurance company offering reduced insurance premiums/excesses.
<b>Stakeholder Engagement Guidance</b>	Stakeholder engagement should be included in industry guidance for PFR. This could either be included in the next revision of the CoP or within a separate guidance document.
<b>Visual Impact of PFR Measures</b>	Engagement activities such as Flood Mobile visits, showing photos of completed PFR projects, and demonstrating example products to residents prior to installation is important to meet residents' expectations.

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<sup>4</sup> Environment Agency (2021) The Ox-Cam Pathfinder project - Introducing the Floodmobile  
<https://environmentagency.blog.gov.uk/2021/05/27/the-ox-cam-pathfinder-project-introducing-the-floodmobile/>

## 3. CoP Standard 1: Hazard Assessment

### **Code of Practice Context:**

A property level flood hazard assessment summarises the available hazard information to determine the likelihood and consequences of flooding from different sources. These details are used to inform the suitability of potential PFR measures. The hazard assessment shall include the likelihood of flooding in the property location (and surrounding areas), the nature of the flooding that could potentially occur, the likely frequency of flood events for the location now and in the future and the susceptibility of the property to flooding.

### 3.1 Pednormead End project steps:

- The community and Buckinghamshire Council were generally aware of existing flood risk issues in Pednormead End due to historic flooding incidents.
- Publicly available flood risk mapping shows that parts of the area are located in Environment Agency Flood Zones 2 and 3<sup>5</sup>, and in areas at risk of surface water flooding.
- A hydraulic flood model was developed by Atkins in 2016 and revised in 2019 which assesses the combined risk of flooding from groundwater, surface water, and fluvial (river) sources.

## Successes

- 3.2 The hazard assessment was supported by detailed hydraulic modelling in addition to publicly available flood risk mapping. This provided detailed flood extent and level information which was used to inform the flood risk at each property and the anticipated flood level.
- 3.3 The updated flood model supported the need for a flood risk management scheme to improve the culvert in Church Street as well as PFR measures to manage the residual risk.

**Resident Survey:** The project raised awareness about flooding. Before the scheme, 10% of respondents were concerned about flooding. After the scheme, 44% are concerned.

## What Issues Were Faced

**Resident Survey:** 85% have not experienced flood at or near their property.

- 3.4 Awareness of flood risk within the community was understandably low at project inception, as most residents in the area have not yet suffered internal flooding. It is thought that this was one of the reasons for the low uptake of the PFR scheme.
- 3.5 There were several potential uncertainties around the flood model results, including:
- The flood model predicts significant flood depths across the community, with some predicted to exceed 1 metre in the 1% Annual Exceedance Event (AEP) scenario. Due to the limited history of recorded flooding, it was difficult for the Pednormead community to agree with potential flooding of this severity.

<sup>5</sup> Environment Agency (2021) Get flood risk information for planning in England. <https://flood-map-for-planning.service.gov.uk/>

- The hydraulic model was around seven years old at the time of the PFR delivery. Since then, methods of numerical models and hydrological analysis have changed.

## Recommendations

3.6 The key take-away recommendations regarding Hazard Assessment to inform future PFR project delivery are summarised in Table 2.

**Table 2: Recommendations – Hazard Assessment**

Recommendation	Detail
<b>Clear Communication of Flood Risk</b>	Thorough and clear explanation of predicted flood risk and what it means for the community should be included in engagement activities and referenced in on-going communication.
<b>Verification of Flood Risk Information</b>	Baseline flood risk information such as hydraulic models should be reviewed and verified based on a localised approach (thresholds/calibration/highways/etc). Flood risk for properties near roads should consider vehicles causing bow waves during floods.
<b>Review Risk/Hazard Classification for Funding</b>	<p>There is the potential to improve the risk/hazard assessment at the feasibility stages of the project led by the Environment Agency and LLFA, for example during the Initial Assessment (IA) and/or Outline Business Case (OBC) stage.</p> <p>Part of the funding for PFR schemes often comes from Environment Agency Grant in Aid (GiA). The Outcome Measures 2 (OM2) classifications determine the flood risk categories which a PFR scheme must achieve for each property so that it can be <i>claimed</i> for the funding. PFR schemes differ from traditional capital flood management schemes in that for some properties it can be technically difficult to protect all routes of water ingress, which means that a reduction in flood risk (i.e. a move from one flood risk category to a lower category) is not able to be achieved. For example, a certified PFR product / measure may not exist for a route of ingress, or the resident decides not to go forward with a specific measure. In the current mechanism these properties would not be eligible for the funding. The classifications could be revisited and tailored specifically to PFR to capture properties where not <u>all</u> routes of ingress are protected but a flood risk betterment is still provided by the provision of <u>some</u> measures.</p>
<b>Standard of Protection (SoP)</b>	The SoP that the PFR scheme is aiming to achieve should be agreed at the project outset. Where flood levels and depths vary across a community, a property-specific approach may enable provision of lower barriers (e.g. 300mm versus 600mm) in some instances.

## 4. CoP Standard 2: Property Survey

### **Code of Practice Context:**

The CoP requires that an appropriate survey of each building and structure at the property be carried out. The purpose of the survey is to assess the current level of flood resilience of the property to provide the necessary information for the identification of the PFR options suitable for the property. The design, materials, condition, orientation, and exposure of buildings will vary greatly and a survey, unique to each building, is a critical element to identifying suitable resilience measures.

#### 4.1 Pednornead End project steps:

- The PFR Surveyor assessed the flood risk and routes of water ingress at each property during the Route of Ingress (ROI) property survey.
- The PFR Surveyor issued a ROI report which summarises the findings of the survey and identifies recommended PFR measures to protect the identified routes of ingress.

### Successes

- 4.2 Most properties (approximately 90 out of 105) signed up to the property survey.
- 4.3 Communications to arrange specific visit dates/times were led by the Surveyor which minimised the burden on the Council and Management Agent.
- 4.4 The hazard assessment and ROI survey outputs were combined into one report with an itemised table of measures.

### What Issues Were Faced

- 4.5 Property threshold levels were not included in the property survey scope, potentially over-estimating the predicted flood depths.
- 4.6 In some instances, the property survey did not identify all property specific constraints, such as:
  - The make-up of the existing building fabric, which has implications on the measures which are most suitable e.g. type of mortar to use for re-pointing/re-rendering or the practicalities of installing a flood door.
  - Presence of physical obstructions preventing installation of a flood barrier side post.
  - Implications on footpath widths due to protruding PFR measures.
  - Potential risk to archeology for below ground PFR measures (e.g. sump and pump).
- 4.7 There was a need to revisit the ROI survey recommendations for some properties on numerous occasions following input from specialist surveyors, which then required reissuing of the survey reports to property owners. This led to confusion with property owners and some disengagement with the project.
- 4.8 Survey reports were described by some property owners as being lengthy and confusing to understand. This is also thought to have contributed to disengagement with the project.

### Recommendations

- 4.9 The key take-away recommendations regarding *Property Survey* to inform future PFR project delivery are summarised in Table 3.



**Table 3: Recommendations – Property Survey**

Recommendations	Detail
<b>Scope of Property surveys</b>	<p>ROI surveys are often thought to cover a range of disciplines and provide a detailed design which can be taken forward for construction. However, without further input from specialists the scope of the ROI surveyor is limited to providing an outline design only. The recommendations in the ROI survey provide an indication of the type of measures which could be implemented to protect the routes of ingress. A final measurement survey by the PFR Installer is required subsequently to confirm the exact measures which are suitable for the property. The limited scope of the ROI surveys and reports should be clearly communicated to the professional partners and property owners to manage expectations of the ROI survey outputs and project timescales.</p>
<b>Detailed Property Surveys</b>	<p>Specialist input to ROI property surveys would provide benefit to identify required PFR measures, inform the feasibility of taking a property forward, and support communications with and expectations of property owners. This could include:</p> <ul style="list-style-type: none"> <li>• Property threshold levels in comparison to modelled flood depths when determining the flood risk to properties.</li> <li>• The identification of all investigations that might be required to inform the options development (e.g. heritage/conservation surveys, gas safety surveys, HETAS engineer surveys, structural engineer, building survey, etc).</li> <li>• The identification of the existing building fabric, which could help to determine the type of PFR measures suitable, particularly for historic buildings with lime-based mortar and the application of wall sealants.</li> <li>• Identification of boiler type and age to confirm whether the flue can be raised.</li> <li>• In-depth investigation (for example lifting manholes) would provide indication to the installer that the proposed measures can be correctly installed.</li> </ul> <p>There is a need to balance the risk of abortive cost from undertaking surveys at the Property Survey stage or the Options Development stage. A phased approach to the former would provide an opportunity to identify where specialist input is required, however this is heavily reliant on the ROI surveyor having the necessary skills/experience to do so.</p>
<b>ROI Survey Reports</b>	<p>Two formats of report could be considered:</p> <ol style="list-style-type: none"> <li>1) for the professional partners which contains full details of the hazard assessment and survey findings.</li> <li>2) a non-technical report or summary for property owners which provides the key findings, recommended measures and next steps.</li> </ol>

## 5. CoP Standard 3: Options Development and Design

### **Code of Practice Context:**

The CoP requires that the PFR measures options for each property be discussed with the end user and the most appropriate options are selected based on criteria such as costs and benefits, end user needs, maintenance, operation and performance. Each option must be designed and specified as a series of measures for implementation. The options for PFR should consider the use of measures that restrict water entry to the building under defined conditions, materials that are recoverable after water contact, and services, fixtures and fittings that are recoverable by their location and/or ability to resist water damage. Where possible, and where relevant, specified PFR measures shall make use of products and processes that are compliant with a recognised industry standard and/or are subject to a warranty.

### 5.1 Pednormead End project steps:

- The PFR Surveyor set out recommended PFR measures and some specialist surveys in the ROI report following the initial property survey.
- The PFR Installer undertook a more detailed final measurement survey to specify the exact PFR products and arranged for specialist surveys to be undertaken.
- The PFR Installer developed a Schedule of Works (SoW) which was discussed and agreed with the resident.
- For Listed Properties, the PFR Installer submitted a Listed Building application to obtain approval for the works.

## Successes

- 5.2 The project delivery team had weekly progress meetings to discuss design opportunities and constraints for all properties. The dedicated resources from all key organisations had the combined aim of finding the best solution for residents given technical and legislative constraints. Where necessary the project delivery team undertook numerous site meetings to collaboratively overcome challenges and meet with property owners.
- 5.3 The properties were taken forward in three batches. This meant that the option development and design stage could be progressed for those property owners that were ready to commit to the measures, whilst allowing others more time to decide to sign up to the scheme. The Listed Properties were delivered in a separate batch to take into account the lengthy timescales required to obtain listed building consent.
- 5.4 A design change log between the PFR surveyor and PFR installer facilitated recording and agreeing changes in the proposals appropriately.
- 5.5 A wide range of specialists were consulted to provide advice on matters such as heritage, lime-mortar, structural stability, gas safety, electrical safety, and compliance with highways standards and disability requirements.
- 5.6 Products used were certified to the relevant British Standards and Kite Marked, where applicable. This was one of the first PFR schemes in England which a flood barrier tested to the new British Standard 851188 was installed.
- 5.7 Innovative products were developed to overcome technical constraints. For example, slim flood barrier posts and rounded flood barrier cover plates were developed to reduce the risk of injury

of a flood barrier post protruding into the public footway and implications for partially sighted footway users.

- 5.8 The Council team went above and beyond to provide residents with ancillary measures such as flood barrier side post cover plates and storage racking units. These measures are not strictly required for flood protection but improve the useability and visual impact implications of the PFR measures.

## What Issues Were Faced

**Resident Survey:** "Product brochures are misleading, giving the impression of more discreet barriers."

- 5.9 There were some instances where key technical constraints were not picked up within the ROI property survey and/or within the subsequent final measurement survey. This resulted in the need for additional PFR surveyor/installer visits and additional changes to mature design proposals. Some examples of constraints include:
- DPC vents which needed to remain in-situ due to ventilation concerns;
  - Boiler vents/flues which could not be raised above the flood level; and
  - The presence of a telecom box preventing installation of a flood barrier post.
- 5.10 Some residents noted that a lot of surveys were undertaken on their properties on multiple days, and they were not always aware why. This also led to disruption for property owners and some disengagement with the project.
- 5.11 Drafting detailed scopes of works to procure the various specialist surveyors was challenging due to the need to have an understating of a broad range of disciplines. Similarly, specialist surveyors have limited experience of working with PFR projects so were not familiar with the scopes of work or desired outcomes.
- 5.12 Works to a listed property require a Listed Building Consent (LBC) and the application process requires numerous technical documents. The determination period for an application is eight weeks and includes statutory consultation, which needs to be appropriately included in the programme with some contingency. Conservation officers had a challenging task to manage numerous LBC applications in addition to their workload and extensions to determination periods were required. During the design process there was a need to revisit the final PFR proposals for some listed buildings. Any departure from the approved LBC needed a re-submission of an application, which impacted on programme.
- 5.13 During the project there was a change in conservation officers reviewing the LBC applications which led to some differences of professional opinion of the approach and proposed works. This required additional work and an extension to the contract to accommodate.
- 5.14 The available PFR measures for listed buildings was limited by conservation and technical constraints. In many cases, the ideal flood door for the appearance of listed buildings would be of timber construction; however, at the time of project delivery there were no certified timber flood doors available on the market which were suitable from a heritage and constructability perspective. The alternative flood doors are of uPVC or composite material, which would not be fitting with the character of listed buildings. This issue was compounded by listed buildings generally not having standard door openings, making manufacturing and fitting of flood doors more difficult. The product deemed most suitable in balancing conservation and flood resilience were flood barriers which come with cover plates in a preferred colour to match the property. Several residents have provided feedback that they would have preferred a flood door to the flood barrier due to visual impacts to their property. In some cases this was a contributing factor for a resident deciding not to proceed with the project.
- 5.15 Several conservation specialists were consulted regarding the lime-mortar re-pointing and re-rendering works required to historic buildings. There appeared to be a general lack of agreement around the correct product specification and the best approach for colour-matching and

application. It was also challenging to find conservation specialists with a knowledge of lime-mortar specifications.

- 5.16 Without input from additional PFR Installers, installers are likely to propose PFR products from their catalogue which can lead to limited product selection options.
- 5.17 Agreement of design responsibility and liability between the PFR surveyor, PFR Installer, and the Council was at times challenging, leading to a reluctance to make final design decisions.

## Recommendations

- 5.18 Key take-away recommendations regarding Options Development and Design to inform future PFR project delivery are summarised in Table 4.

**Table 4: Recommendations – Options Development and Design**

Recommendations	Detail
<b>Design responsibilities</b>	<p>The design responsibilities should be clearly set out and agreed at the project outset.</p> <p>PFR schemes would benefit from thorough ROI and specialist surveys early in the project to minimise the risk of rework at the design stage. This should include identifying potential constraints and opportunities which could impact installation of all recommended PFR measures.</p>
<b>Design Change Log</b>	<p>A design change log should be kept up to date and shared with all professional partners (Council, Managing Agent, designers, installers, heritage specialists and heritage officers where appropriate). This would help facilitate review and agreement to the design proposals and could minimise the potential for disagreements about what measures are or are not appropriate before they are installed.</p> <p>The design change log should be a live document that is reviewed/agreed through construction to record any issues and constraints and agreed next steps. This would also minimise the need for snagging and follow-up queries during the post-installation survey stage.</p>
<b>Historic Buildings and Listed Building Applications</b>	<p>For Listed Buildings, the PFR surveyor, PFR installer, heritage specialists, and heritage officers should be involved early in the design to ensure all parties agree with the proposals. This is particularly important as once approved the proposals cannot be amended without re-submitting the application and associated lengthy timescales.</p> <p>A more directive input from the Heritage team at the Council in terms of suitability of PFR products would help accelerate the project programme.</p> <p>There is a need for improved awareness, training, and guidance around PFR requirements for old/historic buildings (Listed and Non-Listed). For example:</p> <ul style="list-style-type: none"> <li>the need to identify properties that require lime-mortar for re-pointing/re-rendering works and the importance of specifying the correct product and colour at each property including expert application.</li> <li>the need for old DPC vents to remain in-situ as they cannot be replaced (due to structural considerations) or covered (due to ventilation considerations).</li> <li>official testing should be undertaken for a timber flood door, which would create a new passive PFR measure available for historic properties.</li> </ul>
<b>Recoverability Measures</b>	<p>The project team consulted with several sub-consultants to obtain proposals for a recoverability scheme; however, it became apparent that there is a lack of knowledge and skills in the industry. The proposals received varied greatly, often including intrusive works such as tanking the entire ground floor. There are significant risks associated with implementing such measures, such as impacting on the breathability of the buildings, uncovering asbestos or other aspects that are not up to current legislations such electrical and gas safety. These risks were deemed prohibitive by the project team. In addition, residents had significant reservations about the impacts of the works. As such recoverability strategies were not taken forward in the scheme.</p> <p>There is a need for further training and guidance for both surveyors and installers around the suitability of PFR recoverability measures, particularly for historic buildings.</p>

## 6. CoP Standard 4: Construction

### **Code of Practice Context:**

The quality of construction will help to ensure that the PFR measures installed will deliver the levels of resistance and recoverability required to meet the needs of both the buildings and end users. This will then provide confidence to the end user and those providing insurance and/or maintenance to the building(s). Standard 4 of the CoP ensures that the construction works deliver the specified PFR measures to the required standard and with the desired outcomes.

### 6.1 Pednornead End project steps:

- Before construction/installation, residents reviewed and agreed to the proposed SoW by signing a legal agreement to confirm their understanding of the works and associated ownership, maintenance, and operational responsibilities.
- For some properties, the need for additional surveys and specialist investigations was only uncovered during construction. These were arranged by the PFR Installer as required.
- Installation of PFR measures.

## Successes

**Resident Survey:** “Very satisfied, from survey to installation. Tradesmen were very efficient, quick and tidy.” “Work was carried out swiftly and professionally.”

- 6.2 The PFR Installer had experience delivering PFR projects across the UK. For the most part, the PFR Installer managed to maintain the same installation teams across the scheme to provide continuity for the community.
- 6.3 The PFR Installer was imbedded within the project delivery team which facilitated discussions and collaborative problem solving.
- 6.4 Resident feedback was generally positive around the quality of the work and communication during the construction/installation phase.

## What Issues Were Faced

- 6.5 There was a requirement for the PFR Installer to commission additional sub-consultant to provide specialist knowledge, for example for the lime-mortar specification for historic buildings.
- 6.6 Some installation works could only be undertaken in certain weather conditions, for example re-pointing with lime-mortar and pouring concrete cannot be undertaken in severe weather.
- 6.7 Installation faced several delays, including Covid-19, weather, and resident and operative availability. Delayed installation of flood barrier post cover plates impacted resident satisfaction of the scheme as the bare aluminium side posts were deemed unsightly.
- 6.8 Some constraints to installing certain PFR measures were only uncovered during installation, for example, the presence of a telecoms box preventing installation of a flood barrier post.
- 6.9 Several health and safety near misses were recorded during the scheme, including: presence of below ground utility cables when excavating channels for flood barrier construction; and electric cables for sump pumps laid too shallow below ground.

- 6.10 Another challenge was the dissatisfaction of some residents during the installation phase, mainly around the visual impact of PFR measures, concern around where to store the products, inability to choose flood doors over flood barriers (for some properties), and perceived complexity of deploying barriers. This resulted in last-minute cancellations and disengagement from the project.

## Recommendations

- 6.11 The following are the key-take away recommendations regarding Construction to inform future PFR project delivery:

**Table 5: Recommendations – Construction**

<b>Recommendations</b>	<b>Detail</b>
<b>Confirmation of Design Proposals</b>	To avoid last minute cancellations or resident dissatisfaction during/following installation, the final proposals (as stated in the SoW) should be supplemented with photos or physical demonstrations of what the installed measures will look like. This should be agreed and signed by the homeowner.
<b>Installation Programme</b>	The installation programme should be minimised as much as possible for each property to minimise disruption to the resident. All measures (including ancillary measures such as cover plates or storage racking units) should be available to install within the same installation visit unless this would not possible due to a bespoke fitting.

## 7. CoP Standard 5: Commissioning and Handover

### **Code of Practice Context:**

PFR Standard 5 ensures that the completed PFR construction work will operate effectively as designed, and that the end user has all relevant information and has been instructed in any deployment, operation and maintenance requirements.

#### 7.1 Pednornead End project steps:

- The PFR Installer completed installation and provided the residents with a demonstration of how to deploy, maintain, and store the products.
- The resident signed a 'sign off sheet' to confirm all works have been completed as per the SoW. At this point the ownership of the PFR measures moved across to the resident.
- The PFR Installer provided the resident with a handover pack which includes further information around the deployment and maintenance of PFR measures.
- The PFR Surveyor undertook a post-installation survey to check if all measures have been adequately installed and to identify any snagging.
- The PFR Surveyor produced a Post Installation Flood Risk Report (PIFRR) for each property which confirms the standard of resilience provided subject to adequate installation of all measures and resolution of any identified snagging. The PIFRR was issued to the resident and can be used in discussions with insurance companies to demonstrate the increased resilience to flooding.
- The Council organised a Community Flood Exercise Day, held in October 2022, which included 1-1 session with residents to practice deploying the PFR products as well as a presentation by the project team comprising Buckinghamshire Council, the Managing Agent, the installer, the surveyor, and the Environment Agency.

## Successes

**Resident Survey:** One resident reported achieving a reduced insurance premium as a result of the PFR measures.

- 7.2 The PFR Surveyor, PFR Installer, and Managing Agent worked closely together to ensure identified snagging is resolved as swiftly as possible.
- 7.3 Property owners engaged with the Community Flood Exercise Day to deploy their PFR measures and ask questions where uncertainties remained.
- 7.4 After the PFR measures were installed, a flood risk activity was done at the Thomas Harding School to practice deployment of the active PFR measures.

## What Issues Were Faced

**Resident Survey:** 86% do not feel they understand what the Post Installation Flood Risk Report (PIFRR) is telling them.

**Resident Survey:** 70% do not feel they understand the responsibilities around ownership and maintenance of the PFR measures.

- 7.5 The post-installation survey uncovered snagging requirements for most properties, which resulted in the need for an additional visit by the PFR Installer (and sometimes additional specialist surveys) to address these. This had an impact on resident satisfaction and programme.
- 7.6 The visual impact of PFR products was a significant concern for some residents. The main concerns included:
- Flood barrier side posts (which remain in-situ) deemed unsightly.
  - Flood barrier side post cover plate colours not matching the property exteriors.
  - Construction of concrete steps required for some properties to facilitate barrier installation deemed unsightly.
  - Re-pointing/re-rendering not matching the existing property exteriors.
  - Sump and pump systems requiring lifting of existing flooring and creating a sump inside the property deemed too intrusive.
  - Raising boiler/wood burner vents above the flood level deemed too intrusive.
- 7.7 The handover pack focuses on the most prominent PFR measures such as flood doors and barriers but did not include specific maintenance requirements for ancillary PFR measures such as the Non-Return Valves.

## Recommendations

- 7.8 The key take-away recommendations regarding Commissioning and Handover to inform future PFR project delivery are summarised in Table 6.

**Table 6: Recommendations – Commissioning and Handover**

Recommendation	Detail
<b>Demonstration/ Training of PFR Maintenance and Deployment</b>	<p>The handover pack provided to residents should include a reminder of the ownership and maintenance requirements for <u>all</u> PFR measures. The pack should include detailed maintenance tasks including the required frequency and step-by-step guidance on deployment.</p> <p>The warranty provided on PFR measures should also be clearly specified.</p> <p>The handover process should include information for residents on how to get involved with a Community Flood Group and the Flood Warning procedures.</p>
<b>Clarity of Post Installation Flood Risk Report</b>	<p>PIFRR reports should be simplified so that they are easily understandable to non-flood risk professionals or include a non-technical summary. A template for this standardised for use across the industry could be useful.</p>



## 8. CoP Standard 6: Operation and Maintenance

### **Code of Practice Context:**

To ensure a level of protection to a property, the PFR measures installed should be operated and maintained following the guidance provided in the handover pack. Standard 6 of the CoP ensures that the completed PFR construction works are properly operated and maintained, and that any demountable equipment is stored correctly.

#### 8.1 Pednornead End project steps:

- Following sign-off and handover, the responsibility for operation and maintenance of the PFR measures is passed onto the resident.
- The handover pack provided to residents by the PFR Installer provides information around the operation, deployment, and maintenance of the PFR measures.

### Successes

- 8.2 The project included provision of storage racks for the barriers to aid residents with storage of their PFR measures.
- 8.3 Ideally a flood warning system will be in place so that the PFR measures can be deployed in advance of a flood. The project team worked with the Environment Agency to develop a guidance note around the flood warning systems which are relevant to the Pednornead End community.

### What Issues Were Faced

**Resident Survey:** 70% do not feel confident in deploying their PFR measures. Only 11% have signed up to the Environment Agency Flood Warning System.

- 8.4 A PFR scheme only works as intended if the measures are stored, maintained, and deployed correctly. Significant challenges were encountered for each of these aspects:
- Many residents stated that they have no space to store the barriers and associated tools required for deployment. If stored incorrectly, there is a risk that the barriers are liable to be stolen or damaged.
  - Most responses to the resident project survey stated that they do not feel confident about the ownership and maintenance of the PFR measures.
  - Most responses to the resident project survey stated that they do not feel confident in deploying their PFR measures, most notably the flood barriers if alone or elderly. The same concerns were observed during the Community Flood Exercise Day where residents were offered the opportunity to practice deploying their measures.
  - Most responses to the resident project survey stated that they have not yet subscribed to the Environment Agency Flood Warning System or the Met Office Weather Warning.

## Recommendations

8.5 The key take-away recommendations regarding Operation and Maintenance to inform future PFR project delivery are summarised in Table 7.

**Table 7: Recommendations – Operation and Maintenance**

Recommendations	Detail
<b>Flood Warning and Informing</b>	<p>A local approach for flood warning and informing should be developed as part of every PFR project. This could include a one-page poster or similar showing key flood warning information and triggers to deploy the PFR measures.</p> <p>A flood group should be put in place and kept active through collaboration between Elected Members and local residents, with support from the Environment Agency and Council as appropriate. A flood group would help to ensure PFR measures are deployed across the community in advance of a flood, including for those residents who would struggle to deploy the measures because they are vulnerable, elderly, or not at home.</p>
<b>PFR Storage, Maintenance &amp; Deployment</b>	<p>The ability for residents to store PFR measures appropriately within their properties should be confirmed at the project outset. If required, a community storage location should be identified and confirmed.</p> <p>Thorough maintenance and deployment information, demonstrations, and exercise opportunities should be provided to residents, both immediately following installation but also at subsequent regular intervals.</p> <p>The PFR Surveyor should consider verifying the capacity of residents to deploy measures prior to recommending them, for example checking if a less mobile resident can lift several flood barriers. If a resident is considered unable to deploy PFR measures, no alternatives are available, and a flood group is not established, this may lead to a property being excluded. This could however be considered discriminatory and the wider PFR industry needs to consider how to overcome such challenges.</p> <p>The PFR measures should be reviewed periodically to ensure that they continue to meet the needs of the end user (e.g. capabilities change, property owners change) and that the nominated person can continue with their obligations.</p>
<b>Property ownership/resident changes</b>	<p>There is currently little requirement for property owners to pass on, train and demonstrate PFR measures to future owners or residents. This can lead to the project benefit period of 20 years not being achieved and properties becoming vulnerable again. It should be considered whether PFR measures could be returned on a land search during property purchases to help overcome this.</p>

## 9. Project Management, Programme and Budget

9.1 The Pednornead End project delivery team was made up of the following parties:

- Managing Agent: AECOM on behalf of Buckinghamshire Council
- Project Partner: Environment Agency
- PFR Surveyor: RAB Consultants
- PFR Installer: Lakeside Flood Solutions
- Specialist Surveyors: Various

9.2 A PFR scheme is essentially made up of a separate project for each property with site-specific constraints and opportunities. The Managing Agent must therefore have a holistic view and understanding of the technical, legislative, and stakeholder engagement aspects of the scheme. For the Pednornead End scheme, the responsibilities of the Managing Agent included day-to-day management of the scheme, communication between stakeholders, technical advice, and programme/budget management. The Managing Agent was resourced for between 1 to 2.5 days per week during project delivery.

### Successes

9.3 The Managing Agent organisation provided dedicated project management resource with flood risk and PFR experience throughout the whole duration of the project. This level of expertise would be difficult to obtain through formal training alone.

9.4 Survey responses from the PFR surveyor, PFR installer, and the Environment Agency found the presence of a Managing Agent positive, with the key benefits identified including:

- Helping to relieve the Council from administrative and management tasks, for example by reviewing invoices and liaising with contractors/surveyors;
- Managing liaison between various stakeholders, such as improving community engagement and communication between the installer and the surveyor;
- Leading the day-to-day activities including keeping track of property specific details that are important to delivery;
- Providing independent expert advice on various aspects of the projects;
- Continuous drive for best practice and adherence to industry standards; and,
- Ensuring momentum with project meetings and follow-up actions.

9.5 The diverse delivery team comprising multiple organisations facilitated the creation of new relationships between stakeholders, all working towards the same objective. A productive working relationship was maintained through regular progress meetings and an ongoing actions tracker.

9.6 The project involved a host of Small and Medium Enterprises (SMEs) and local companies, including Lakeside Flood Solutions, RAB Consultants, structural engineers, gas safety engineers, electricians, and surveyors.

### What Issues Were Faced

**Resident Survey:** 25% of residents and the PFR Surveyor and PFR Installer felt the duration of the PFR scheme was too long.

9.7 The PFR installation programme was extended multiple times throughout project delivery resulting in an installation programme of 2+ years. Major impacts on the project budget and delivery were minimised with rigorous record keeping and document control. Nonetheless, several challenges were faced including:

- Resource changes within the Managing Agent, Council, PFR Installer, and PFR Surveyor organisations over the programme.
- Main point of contact for resident communication changed multiple times.
- Several residents sold their properties during the project which prevented the ability to complete the PFR installation. There is also currently no requirement to pass on knowledge of operation/ maintenance/ ownership to subsequent owners.
- The agreed budget allowance for the scheme had to be spread across multiple financial years.

9.8 The long duration of the scheme was a result of a variety of factors, including:

- Homeowner availability, delays in homeowners' response rate, and delays in signing-up to the project. Homeowner engagement was low following the initial property survey stage and many months were spent trying to drive installation uptake.
- Local contractor availability and capability (gas safety engineers, electricians, bricklayers, etc).
- Listed buildings requiring LBC and the associated lengthy lead-in time to determination (approximately 3 months).
- Delays in product delivery, in particular for bespoke items such as flood doors and flood barrier cover plates.
- The need to consult with many organisations and their associated response timescales. Third party engagement took place with Transport for Buckinghamshire, Buckinghamshire Disability Service, Buckinghamshire Heritage, Archaeological Society, Chilterns Society, and a host of local contractors, residents, and local Councillors.
- Delays due to Covid-19 illnesses and lockdowns.
- Delays due to environmental/weather conditions. For one property, works could only be completed in spring when the adjacent river was less likely to be high. Working through winter months increases the likelihood of rain/inclement weather, causing delays to installation. For example, lime mortar can only be applied in relatively dry/mild weather.
- Delays due to unplanned work, such as snagging that was not identified in the initial surveys.

9.9 The cost of PFR per property (on average, approximately £8,000 excluding VAT) exceeded what was originally budgeted for (approximately £5,000 excluding VAT). Note this includes solely the cost of the PFR products and installation, not the associated surveys and management. Many factors could be responsible for the increase of cost per property, such as:

- Instances where further surveys resulted in the requirement for additional PFR measures than those initially outlined in the Route of Ingress (ROI) survey.
- The design of PFR measures for historical/listed properties was more complex than originally anticipated.
- Development of innovative solutions to provide residents with the best possible solution including slimmer barrier posts and bespoke cover plates, with increased costs.
- Availability and cost of raw materials due to global events.

- Project Management costs were important due to the detailed nature of the works and extensive stakeholder engagement needed for each property.

9.10 Other aspects which impacted the overall project budget included:

- Abortive survey and management costs for properties which chose not to go through with installation.
- A blanket approach of 600mm high flood barriers was adapted across the community (unless flood levels were higher). In some instances, the predicted flood level at the property was lower than 600mm, which meant that in some instances a lower barrier could have provided the required protection at a lower cost and less impactful on the building. However, properties near a road should be assessed for the risk of bow waves during a flood, which might overtop the predicted flood level.
- The final number of properties which agreed to have PFR measures installed and if all routes of ingress could be mitigated.

## Recommendations

9.11 The key take-away recommendations regarding Project Management, Programme, and Budget to inform future PFR project delivery are summarised in Table 8.

**Table 8: Recommendations – Project Management, Programme, and Budget**

Recommendations	Detail
<b>PFR Project Management Training</b>	Guidance and/or a specific training module in the CoP for Managing Agents / the Council project management team would be beneficial. The significant project management requirements should be allowed for in the project budget and sufficient expert resource secured. Alternative methods of managing the project could be considered, based on community needs, such as the Flood Grant approach which would allow eligible homeowners to apply directly for the scheme. In this way, the works would be predominantly homeowner-led however certainty of project outcomes would be lower and there is a higher risk of homeowner participation due to PFR delivery complexities and the time required.
<b>Setting Objectives/ Parameters</b>	A Statement of Work agreed with all parties at the start of the project, which clearly defines the goals, deliverables, and key design parameters of the project is useful. Project milestones should also be agreed with all parties then monitored, evaluated, and updated throughout the project.
<b>Recording project reflections</b>	Keep up to date with reflections on project execution throughout the programme with gateway meetings including relevant stakeholders.
<b>Early Engagement for Consenting</b>	Early engagement with third parties relevant to consenting (e.g. Transport for Buckinghamshire teams for barriers facing public footpath/carriageway, Council Heritage/Planning teams for Listed Buildings).
<b>Contingency</b>	The programme should include sufficient budget and programme contingency to account for events outside of the project team's control, such as weather, unforeseen events, and product delivery timescales.
<b>Allocating Sufficient Budget</b>	Generally, PFR schemes do not receive sufficient funding to cover all activities. A PFR scheme is essentially made up of a separate project for each property with site-specific constraints and opportunities. The programme should include sufficient budget for Project Management, as it is generally higher on PFR projects due to the detailed nature of the works and stakeholder engagement needed for each property.
<b>Planning for Product Delivery Challenges</b>	Careful planning for the products with a high risk of delivery delay (notably for flood doors) should be prioritised. This could be achieved by pre-ordering products which are not available 'off-the-shelf' and finding opportunities to diversify the supply chain.
<b>Funding/ Outcome Measures</b>	Part of the funding for PFR schemes often comes from Environment Agency GiA. As discussed under the 'hazard assessment section', a requirement of this funding is to protect all identified routes of water ingress into a property, which is not always possible due to a variety of reasons. For example, a certified PFR product /

## Recommendations Detail

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measure may not exist for a route of ingress, or the resident decides not to go forward with a specific measure.

The current funding and outcome measure mechanism could be reviewed to enable properties to be included in the scheme where the installation of some PFR measures provide a betterment to flood risk, and health and well-being benefits. This would move away from the current 'all or nothing' approach, which excludes:

- properties where technical constraints/product availability prevent the protection of all routes of ingress;
- properties attached to neighbours who do not proceed with the installation;
- properties at elevated risk of groundwater flooding but are unwilling/unable to install intrusive works such as tanking; and
- residents who do not wish to have all measures installed.

An update to the current PFR funding process would also be beneficial given the uncertainty around how many properties can be protected given low resident uptake. As a minimum, the project budget should include a risk value for potential properties which will not be able to be protected.

During the project funding stage (OBC), contacting at least two PFR suppliers should be considered to determine the average current costs per PFR item (considering the type of properties in the community and geographic location). This would provide a more realistic initial cost assumption. It could be beneficial to undertake property surveys during the OBC stage to estimate the costs and resident appetite for the scheme more accurately. The potential for early/abortive costs would need to be considered.

During PFR project delivery, regular reviews of expenditures and changes in budget should be undertaken with the Managing Agent, Environment Agency, and the Council's financial team to ensure forecasts and budgets are monitored across organisations.

