



SEPA
Scottish Environment
Protection Agency
Buidheann Dion
Àrainneachd na h-Alba

FLOOD WARNING DEVELOPMENT FRAMEWORK 2022–2028

Introduction

Flood warning is SEPA's most immediate front-line flooding service, helping Scottish communities, businesses and civil contingency responders to take action to reduce the impact of flooding.

Recent devastating flooding events in Scotland¹ and across the world² have highlighted the increased risk of flooding due to climate change, which brings wetter winters, more intense summer storms and stormier weather, and this is happening now.

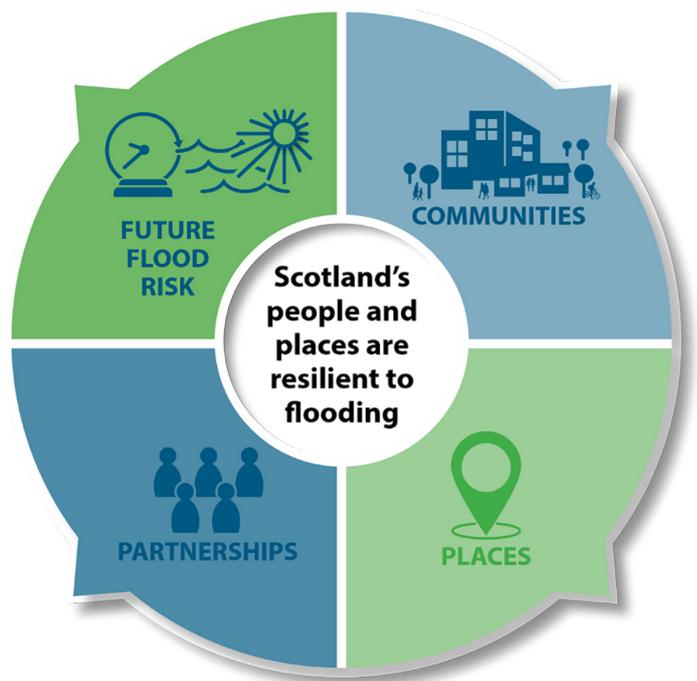
SEPA, and all partners involved in the preparation, emergency response and recovery phases of a flood, therefore need to be ready for extreme scenarios of flooding, whether its source is the sea, rivers or surface water. Flood warning is essential to achieve this, helping people to take action and protect themselves.

Our vision

SEPA is developing a long-term Flooding Services Strategy with a vision that *Scotland's people and places are resilient to flooding*. One element of this vision is that *we will warn and inform people so they are prepared for flooding*.

This Flood Warning Development Framework is part of the implementation of the SEPA Strategy and sits alongside other frameworks currently in development.

To achieve our vision, we want to ensure that our existing flood forecasting and warning services are well maintained and resilient. We also want to improve our services; improve them for our customers, who rightly expect accurate forecasts, timely warnings and clear messaging, but also improve them for our own staff who work tirelessly behind the scenes.



¹ [The flash floods of 11 and 12 August 2020 \(SEPA report, 2020\)](#)

² [Lessons learnt from the summer floods in Europe \(SEPA paper to Agency Board, 2021\)](#)

Our aims for the next six years

This Framework sets out how we intend to maintain and improve our services over the next six years. It is the third Framework we have developed, with the cycle in alignment with the Flood Risk Management planning process introduced by the Flood Risk Management (Scotland) Act 2009.

Over recent years, we have used such Frameworks to plan the expansion of our local coastal and river flood warning services – now delivered at 319 areas across Scotland – and introduce new products such as the Scottish Flood Forecast, our new public version of the daily Flood Guidance Statement we deliver to civil contingency partners.

The Framework defines the direction of travel for our flood forecasting and warning services around three aims:

- Aim 1: Maintain and improve existing, and deliver new, operational flood warning services.
- Aim 2: Upgrade capabilities through development and innovation.
- Aim 3: Deliver enhanced digital communications and an engaged and customer focused service.

To develop the Framework, we have engaged and consulted with our staff who deliver the services, with the Met Office (our strategic partner for producing the daily Flood Guidance Statement and Scottish Flood Forecast) and also with a range of partners and stakeholders involved in managing Scotland's collective response to flood events.

By implementing the actions identified in this Framework, SEPA will continue to deliver a valued and resilient flood warning service across Scotland to help reduce the impact of flooding.



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1. Aim 1

Maintain and improve existing, and deliver new, operational flood warning services

SEPA currently operates 72 river-based and 8 coastal flood warning schemes throughout Scotland, delivering local flood warning services to 319 areas (see map in Appendix A) in addition to our early regional flood alerting services and daily guidance to responders.

These services use real time data from the Met Office and from our own hydrometric monitoring network and integrate all information in sophisticated forecasting and warning systems.

Delivering our services also relies on the expertise and commitment of our staff, the continuous evaluation of our performance, adapting to changes and listening to feedback from our partners and customers.

We have grouped all activities under Aim 1 in five themes.

Theme 1.1 – Deliver commitments made in the Flood Risk Management Plans 2022–2028

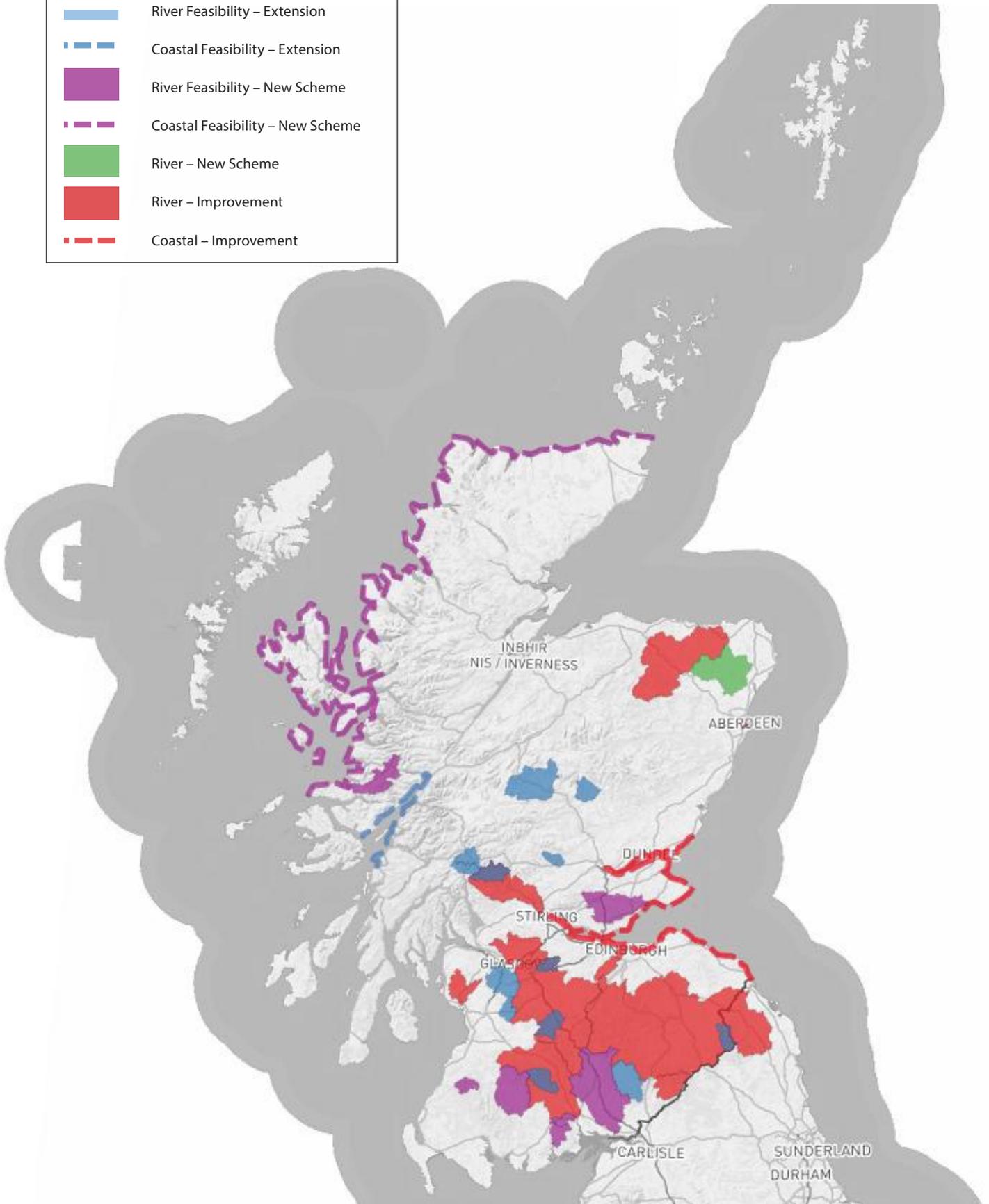
To deliver on our commitments made in the Flood Risk Management Plans for the second cycle, during delivery period 2022–2028 we will:

- Maintain infrastructure, systems and schemes that support our current services.
- Investigate and improve, where appropriate, 10 established schemes (as per list in Appendix B, and see Figure 1.1).
- Develop one new scheme for the River Ythan in Aberdeenshire (see Figure 1.1).
- Undertake 18 feasibility studies for future development and improvement (as per list in Appendix B, and see Figure 1.1). If deemed technically feasible, such scheme would be implemented in future Flood Risk Management cycles.

Outcomes:

More accurate flood forecasts, geographical expansion of our services, preparation of work beyond 2028.

Figure 1.1 – Location of new and improved schemes and feasibility studies



Theme 1.2 – End-to-end service performance monitoring and reporting

To be transparent with users of our service, identify where our schemes may require improvements and prioritise such work, we will:

- Develop a standard approach for evaluating performance at every stage of the process.
- Define a reporting format and structure.

Performance monitoring will enable a feedback loop into continual process, model and service improvement.

Outcomes:

Customer confidence, more accurate and robust flood forecasts.

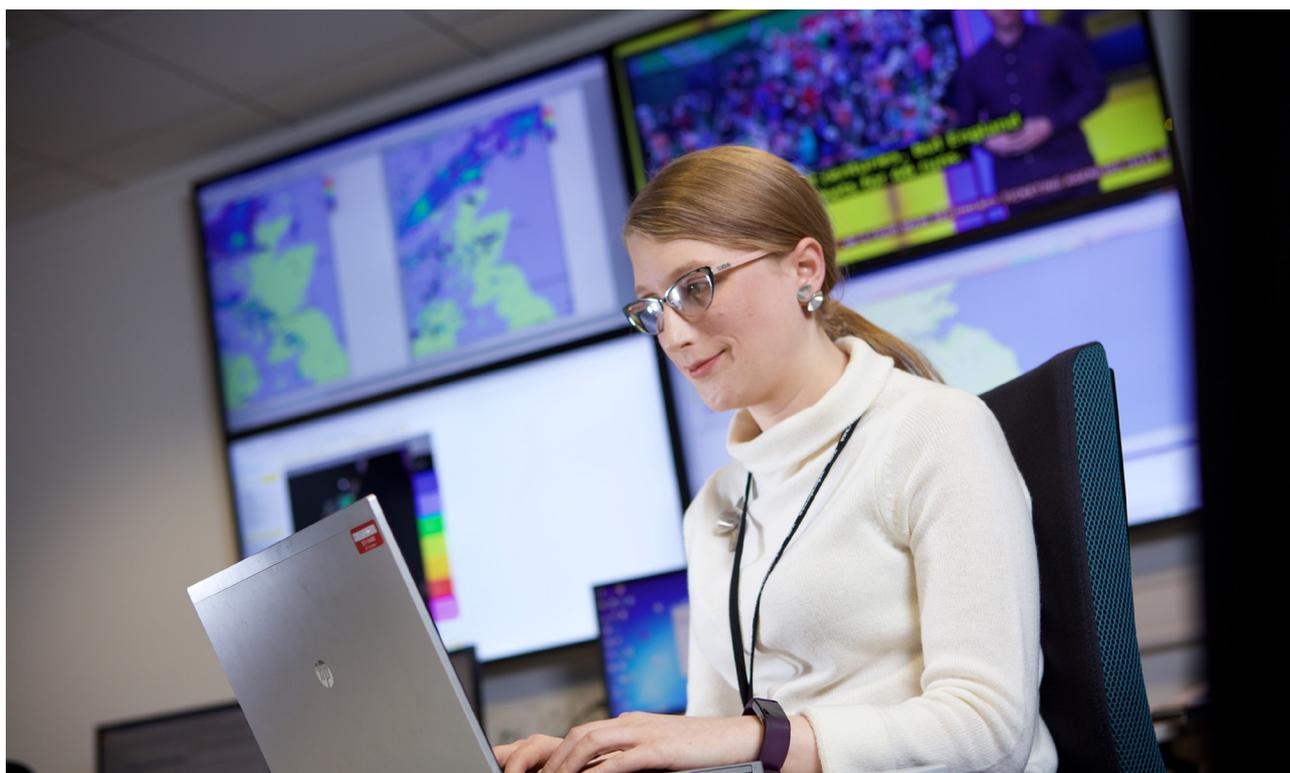
Theme 1.3 – Continual process improvement

We have identified the need to review and improve some of our existing processes to help our staff and be more effective in our service delivery. These include:

- Develop effective data hygiene management processes.
- Introduce resilient methods for capturing flood verification information.
- Ensure we have robust and documented business continuity processes.
- Streamline and automate some legacy inefficient processes.
- Continuously learn from our experience through audits, event debriefs and partners and customers feedbacks and then implement prioritised action plans.

Outcomes:

More effective and more resilient service delivery.



Theme 1.4 – Competent and confident staff

To ensure our staff continuously maintain their knowledge and enhance their skills to fulfil the challenges of a duty officer role, we will:

- Develop and deliver a complete training programme for both new and experienced staff, building on the work initiated over the last two years.
- Develop comprehensive, easily accessible information sources to aid decision making.
- Ensure effective wellbeing and technical support mechanisms are in place.

Performance monitoring will enable a feedback loop into continual process, model and service improvement.

Outcomes:

Engaged, competent and confident staff.

Theme 1.5 – Incorporate new data sources to help decision making

To ensure we manage forecast uncertainty where additional information is available to do so, we will:

- Introduce rainfall ensembles to our forecasts to better understand and manage uncertainty and to provide enhanced forecast guidance, i.e. best estimate and worse case scenarios.
- Incorporate snowmelt component into our models, where possible.
- Introduce five-day wave ensemble forecasts into our coastal flood forecasting models to provide enhanced forecast guidance, i.e. best estimate and worse case scenarios.

Outcomes:

More accurate forecasts; better decision making.



2. Aim 2

Upgrade capabilities through development and innovation

Development and innovation will be essential to maintain our state-of-the-art flood forecasting and early warning capabilities. It will build on the journey started during the last cycle and be based around five themes.

Theme 2.1 – Our future flood and incident messaging service (FFIMS)

FFIMS is set to replace our current Flood Warning Dissemination system from April 2023. The objective of FFIMS is to support and improve the existing dissemination of flood messages, support SEPA's business continuity messaging service but also consider future multi-hazard functionality.

Digital developments which are resilient will be at the heart of FFIMS and will include further development of the Scottish Flood Forecast, improved use of technology beyond a website; dynamic and location-based alerting; platform integration; inclusion of water scarcity; and assumption of digital first.

Outcomes:

A multi-hazard early warning service that build on our flood forecasting and warning services and increases our service capability through digital transformation.

Theme 2.2 – Supporting improved detection of flooding (rainfall river level and sea level)

Understanding high or flood flow measurements is crucial for underpinning our flood warning service and flood forecasting capabilities. We know that measuring high flows can be challenging as is maintaining our high flow calibrations.

Research in evaluating new, low cost, and rapidly developing technology for continuous river flow measurement is being considered including an imaging technique to allow measurement of flood flows in a range of river types.

This theme will also include further work to explore the role of improved rainfall detection across Scotland using weather radar.

Review and progress new and innovative coastal monitoring capabilities for tide levels, nearshore wave height and wave overtopping, allowing us to develop our understanding of coastal flood processes and to verify our coastal flood forecasting models.

Outcomes:

New and innovative approaches to measuring the sources of flooding across Scotland's rivers and coast.

Theme 2.3 – Improving science behind our flood forecasts

We are continually looking to improve our flood forecasting capabilities.

Areas which we know need improvement are catchments affected by reservoir impoundment; snowmelt; the need for improved nowcasting for flashy catchments; wave overtopping.

We will aim to work with research institutes to help improve some of our flood forecasting capabilities including ongoing research with the Centre of Expertise for Waters into improved reservoir inflow forecasting, working with the Met Office on improving short range rainfall forecasts in our hydrological models and supporting the UK Hydrology Roadmap.

We would also like to explore new approaches to flood forecasting in more challenging locations such as flashy catchments where it is hard to provide warnings with enough lead time or where the infrastructure is not available to support traditional methods. This may include considering further use and development of our countrywide flood forecasting hydrological model, for community-based flood warning and supporting more resilient transport infrastructure.

Outcomes:
Improved capabilities to provide accurate flood forecasts and timely warnings.

Theme 2.4 – Scoping an impact-based forecasting capability

We often don't readily know what impacts are likely to be when forecasting flooding. Tools such as our countrywide hydrological model uses flow statistics (return periods) to define the severity of flooding.

We aim to make better use of our flood hazard risk information by integrating it with existing forecasting approaches to inform our assessment of minor, significant and severe flooding impacts in our daily Flood Guidance Statement. A similar approach could also be adopted for community-scale forecasts.

Impact-based forecasting could also link to transport assets to support climate resilient infrastructure and exploring the use of real time inundation mapping.

Outcomes:
Improved understanding of the potential impacts of flooding, leading to better flood guidance by us and decision making by responders.

Theme 2.5 – Delivering a long-term approach to surface water flood forecasting

Surface water flood forecasting remains the most challenging aspect of our service and recent events in Scotland³ and across the world have highlighted the increased risks and impacts of surface water flooding due to climate change. Surface water forecasting capabilities are growing, as demonstrated with the UK's first operational surface water risk forecast (with a 24-hour lead time) that we delivered for the Commonwealth Games in Glasgow, but further work is needed to define the future service.

We will build on the research we conducted in 2019⁴ and a Discovery project conducted in 2021-2022 to define staged developments of capabilities including sector-specific approach and maximising the use of emerging meteorological science developments.

Outcomes:
New capabilities that support decision making and preparedness for surface water flooding for the public and transport sectors.

³ [The flash floods of 11 and 12 August 2020 \(SEPA report, 2020\)](#)

⁴ [Flash flooding is a serious threat in the UK – here's how scientists are tackling its prediction \(theconversation.com, 2019\)](#)

3. Aim 3

Deliver enhanced digital communications and an engaged and customer focused service

We want an increased customer focus in everything that we do to help people reduce the impact of flooding on their lives. To achieve this we will need clearer, effective communication, and stronger engagement with the public, and our existing and new partners. As part of this we also want to improve our digital communication, using continuously evolving technological capabilities to deliver a more accessible and flexible service which reflects modern life.

Aim 3 is built around three themes.

Theme 3.1 – Communication including digital enhancements

We will enhance our digital communications, making our information and data more readily available and easier to access. We will launch and promote the Scottish Flood Forecast – a daily, online, easily understandable three-day look ahead of flood risk across all parts of Scotland. The initial phase in 2022 provides a national page; later phases will integrate other information such as water levels data, local information pages and a move towards dynamic alerting. We will also make sure we gain feedback for improvements.

We will promote better ways to share our water and flood warning data to help partners and communities use our information on their channels for water safety and flooding awareness purposes.

We will improve our online information and guidance and make it easier to sign up for free Floodline messages and manage accounts.

A dedicated flooding Twitter channel will be launched to improve user access to flooding information, to give people local and live information, raise awareness of our flooding role and responsibilities, and inform people about sources of flooding and the actions to prepare.

The Floodline service will continue to be promoted by delivering an integrated, inclusive, multi-channel campaign with campaign bursts to support weather events, flood warning schemes, service improvements and updates.

To ensure communications are customer focused, we will invest in research to understand how effective our communications are and how our customers want to receive information and be engaged. A customer feedback mechanism will be developed for customers for flood warning messages.

Outcomes:

A better understanding of our customers' needs with improved products and services which help them access, understand and act upon flood warnings.



Theme 3.2 – Working with partners

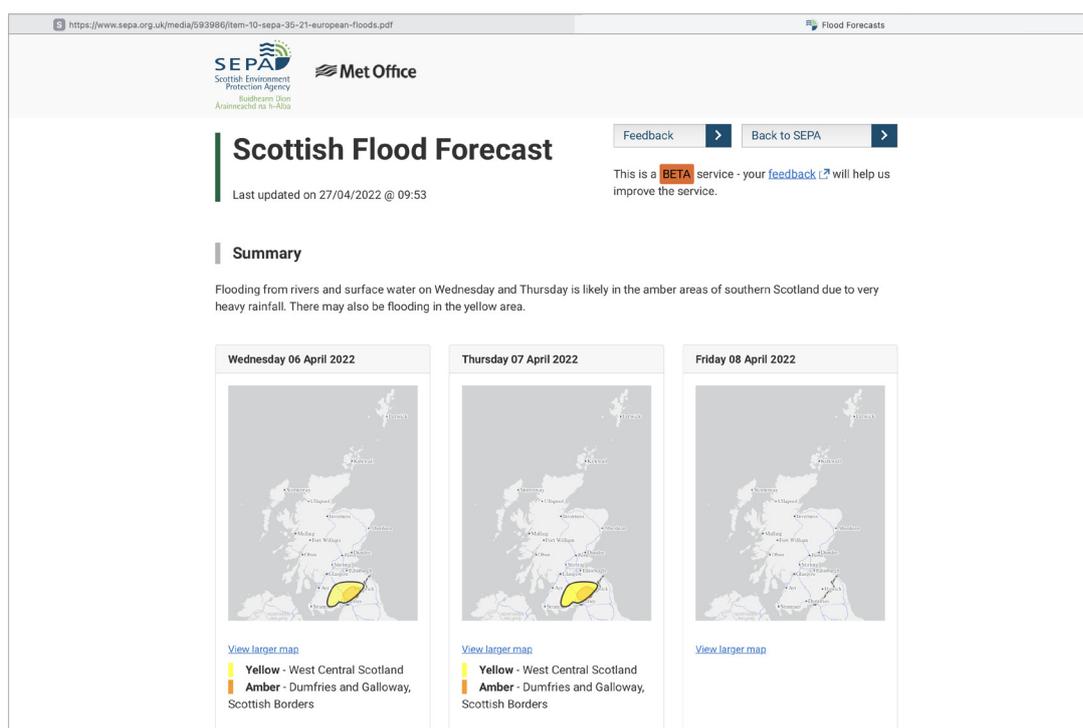
We will continue to regularly engage with partners on a range of flood warning and informing issues. We will do so primarily using existing groups, including, but not restricted to: the Scottish Flood Forecasting Service, Flood Risk Management planning forums, resilience partnerships and direct engagement with local authorities. We will strive to reinforce existing and build new relationships, and through these we aim to:

- develop nationally consistent processes for communicating and engaging with resilience partnerships, so input to multi-agency flooding response arrangements are clear and our resources are managed effectively in particular during large-scale events;
- deliver joint training and exercising so Resilience Partnership members can participate in flooding exercises; offer tailored training sessions and materials to our partners so they understand our products and services and how to use them. This will include working with local authorities, contributing to Police Scotland Emergency Procedures Advisor and Scottish Fire and Rescue Service leadership training programmes, and working alongside the Met Office to deliver joint training;

- work with the Scottish Fire and Rescue Service to include flooding information within their Water Safety and Home Safety Visit development plans, so local visits can consider flood risk and advice or refer to SEPA services effectively;
- work with UK Floodline partners Natural Resources Wales and the Environment Agency to develop common language to be used in our service messages and other public communication;
- collect and share information on impacts of flooding in real time and post flood events;
- actively collaborate in the Water Safety Scotland partnership to help flood risk be included and well explained in public safety materials and campaigns other organisations deliver.

Outcomes:

Partners know how to use our products and we help them be ready for future flooding; the public will benefit by receiving flood warning information from trusted sources.



Theme 3.3 – Working with communities

We will improve how we engage communities in our flood warning services, both on the ground and digitally, ensuring inclusivity which reflects the diversity of the people of Scotland, to help understand and meet the needs of communities at risk of flooding. We will focus efforts on ways to support community resilience and promote actions which can most benefit local communities and individuals.

This will include making the Floodline customer journey easier, improving our information, responding to enquiries and feedback received and engaging directly with communities affected by flooding.

To help reach those communities effectively with useful advice and guidance on our flooding products and services, we will work collaboratively and locally.

Wherever possible we will identify, work with and support local delivery by partners, adding value to existing or new activities, channels and methods popular with local communities. This will involve collaborating with the Scottish Flood Forum and other community resilience and safety partnership organisations to support the delivery of:

- community alerting, local resilience groups, and property-level protection activities;
- messaging, media and other information services by community safety partners;
- education and awareness materials and activities for younger people, including Safer Community events alongside other agency partners.



We will also provide information, materials, guidance and advice around our Floodline service to reach more communities, with flood warning advice and information. This will include establishing routes to help more vulnerable people access flood risk and flood warning services, and delivering more awareness activity, including through the daily Scottish Flood Forecast.

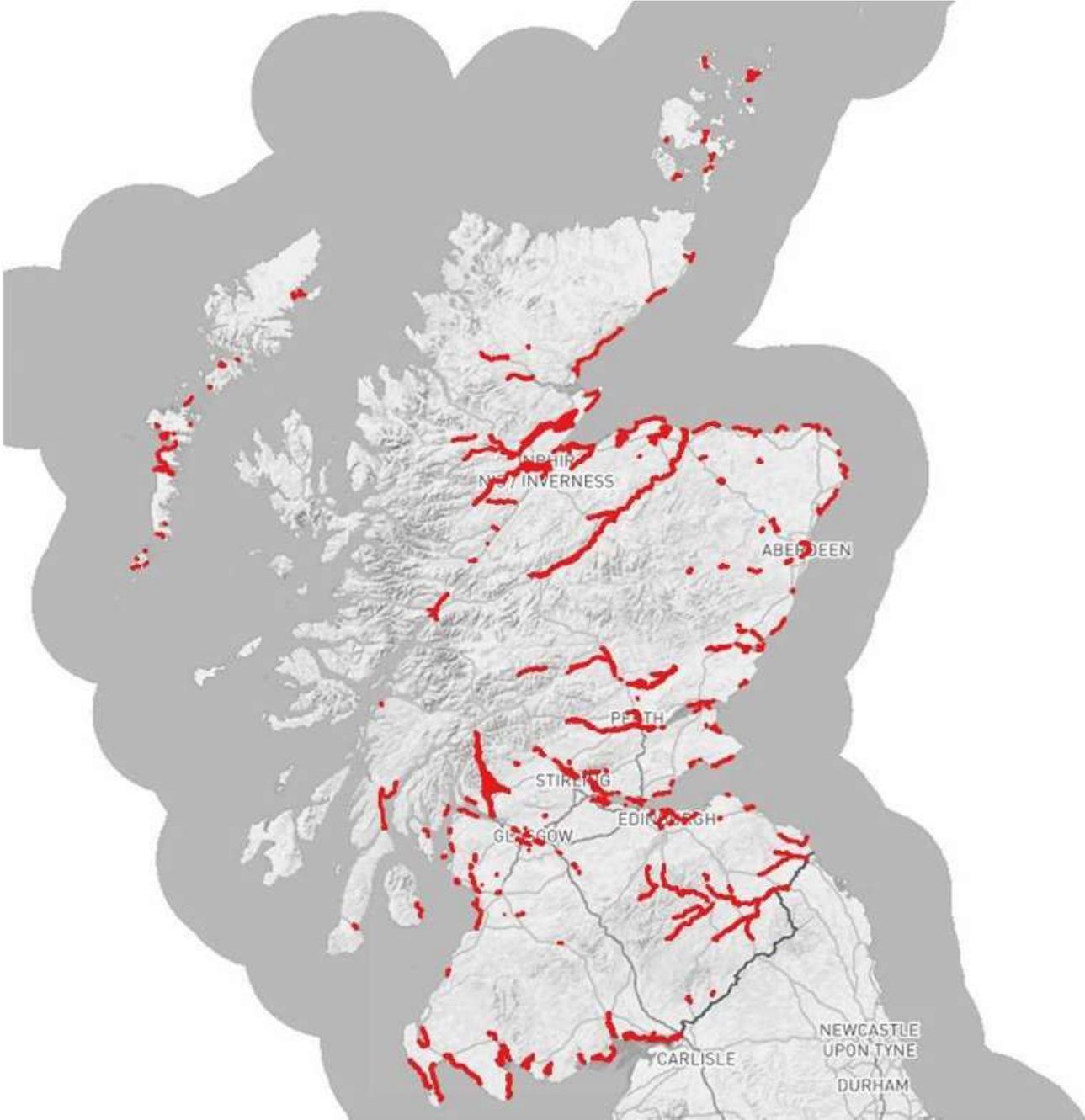
Where we have water level monitoring and gauging, we will explore ways to make its data more accessible and its purpose as part of a local community safety better understood.

Outcomes:

Flood-vulnerable communities know how to use our products and services, take preparation and timely response action to protect themselves and become more resilient to flooding.

Appendix A

Map of existing flood warning areas



Appendix B

List of work identified in Flood Risk Management Plans 2022-2028

Improvements to existing schemes:

1. Upper Forth (Callander to Stirling)
2. Borders (Tweed catchment)
3. Clyde (non-tidal)
4. River Nith
5. Water of Leith
6. River Deveron
7. Firth of Forth and Tay (FOFAT)
8. River Kelvin
9. River Garnock
10. River Dee at Riverside Drive in Aberdeen

New schemes:

1. River Ythan (Ellon)

Feasibility studies for the following coastlines and catchments:

New schemes:

1. Northwest Coast
2. River Leven (Fife)
3. River Annan
4. Urr Water
5. River Dee (Solway)
6. River Stinchar
7. River Shiel

Extensions to existing services:

1. Firth of Lorn and Loch Linnhe
2. River Nith
3. River Esk (Solway)
4. Upper Forth
5. River Irvine
6. River Tay
7. River Earn
8. River Tweed
9. River Clyde
10. Loch Lomond
11. White Cart Water

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