FLOOD FORECASTING CENTRE

A working partnership between Environment Agency | Met Office

22-25 November 2024

FFC Post Event Summary: Storm Bert

Introduction

The aims of this report are as follows:

- summarise flood risk from Storm Bert
- describe the conditions and flood guidance issued and verification of the events
- highlight learning points from an England and Wales flood forecasting perspective
- utilise contextual information from parent organisations

The language and definitions used (e.g. for flood impacts) follows those in the Flood Guidance Statement (FGS) User Guide (FFC 2022).

Summary

Storm Bert, the second named storm of the season, brought widespread heavy rainfall, strong winds and snowfall across England and Wales. Parts of South Wales and Dartmoor received over 150mm of rainfall. The 23 November was the wettest calendar day in the UK since 3 October 2020 and 12th wettest day in the UK series from 1891. Storm Bert followed a marked cold spell, with snow accumulations remaining up to the arrival of the storm. Prior to Storm Bert, river flows were normal or above normal for the time of year in South Wales and were notably to exceptionally high in most parts of the South of England and the Midlands, despite a dry October and second half of September. Parts of the South of England, the Midlands, West Yorkshire and South East Wales experienced significant inland flooding following a combination of snowmelt and heavy rainfall.

Whilst the Flood Outlook did not indicate an increased likelihood of flooding for this period, the text did state “Local river and surface water flooding impacts are possible across south and central England and Wales should persistent rainfall occur in mid to late November”. The Flood Guidance Statement first identified the risk of significant flooding on Wednesday 20 November, providing 4 days lead time for much of Wales and parts of the North and West of England. The overall flood risk moved up to MEDIUM (Significant Impacts, Amber) for parts of South Wales and the West Midlands on the day of the flooding, following an increase in the likelihood of the significant impacts, largely based on observations. However, for parts of the East Midlands, only minor river flooding impacts were forecast until the day of the flooding, when a change in the flood risk assessment led to a short notice escalation to significant flooding impacts and a MEDIUM (Significant Impacts, Amber) overall flood risk. A number of learning points have been identified and will be progressed. These are described at the end of this report.

Weather Forecast

Storm Bert, a deep Atlantic low pressure system (Figure 1), was a multi-hazard storm which brought heavy rainfall, strong winds and snowfall across England and Wales between the 22 and 25 November.

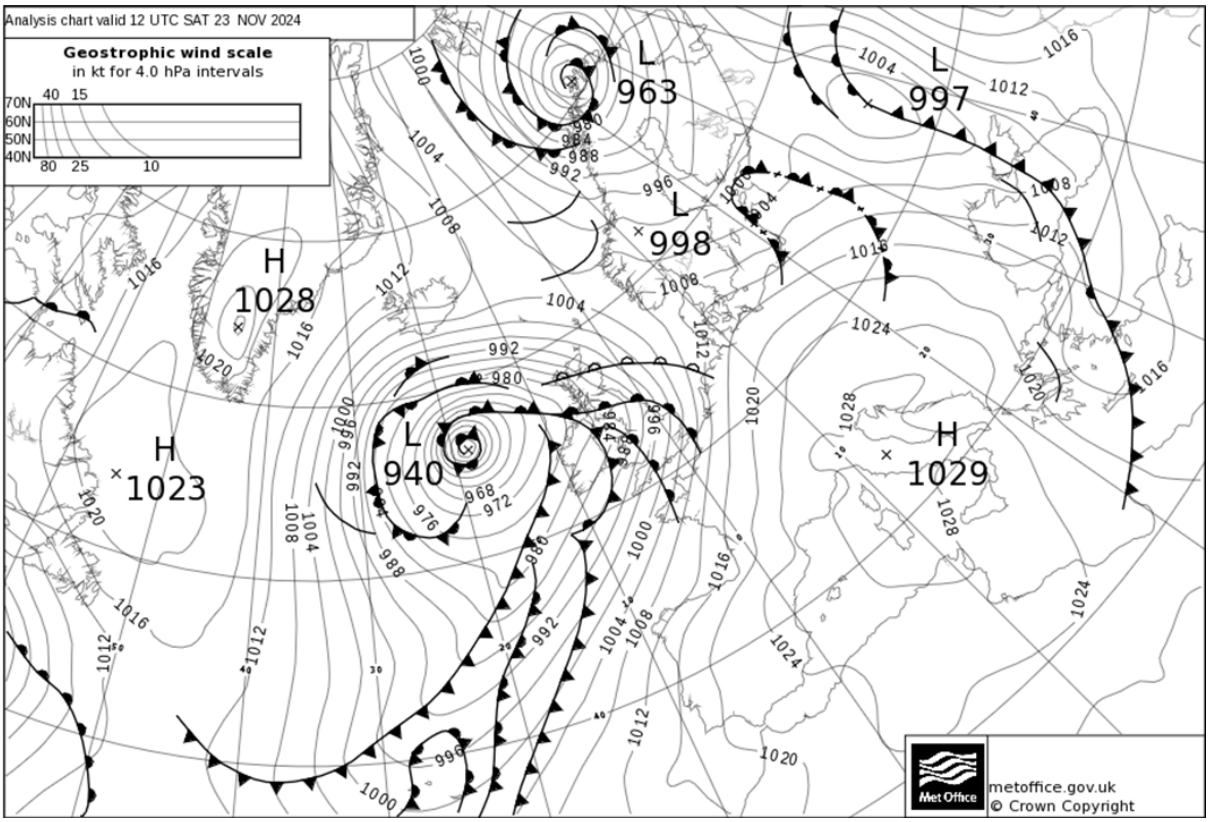

Figure 1: Met Office Analysis Chart at 1200 GMT Saturday 23 November 2024

Some lying snow was present ahead of Storm Bert, with further transient snow on the leading edge of the storm across Wales and the North of England. This initial snow soon transitioned to rain with any lying snow soon melting.

Widespread 40-60 mm of rainfall was observed over a 3 day period across most of England and Wales. Upland areas in England and Wales received over 100 mm of rainfall, with parts of South Wales and Dartmoor receiving well over 150 mm (Figure 2).

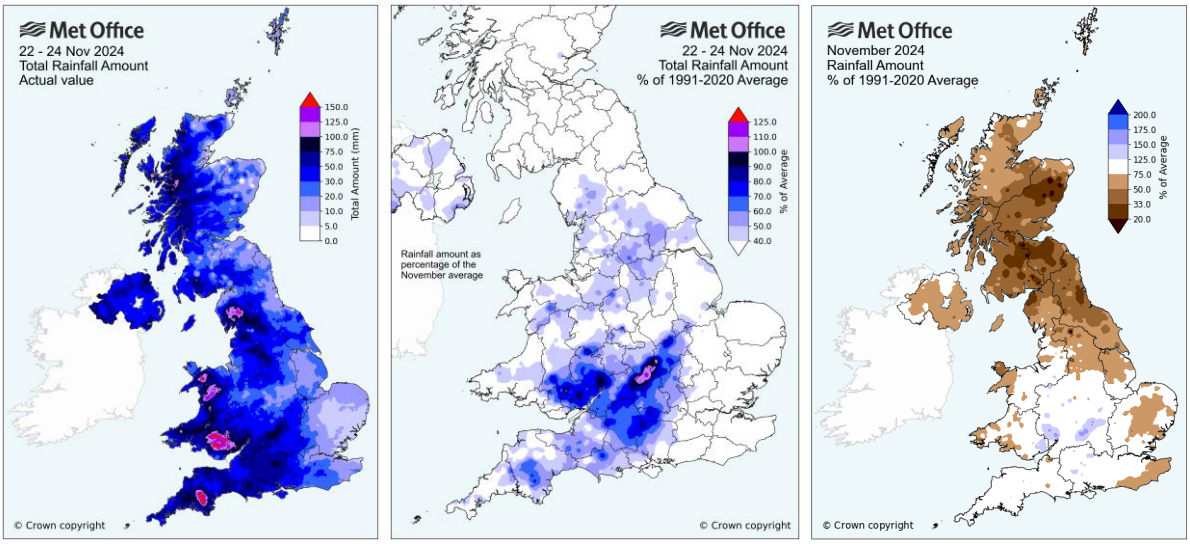

Figure 2: 3 day total rainfall accumulations from Storm Bert (left), 3 day total rainfall amount as a percentage of 1991-2020 average (middle), and November 2024 rainfall amount as percentage of 1991-2020 Average (right), (Met Office data).

The potential for widespread impactful weather over the weekend of the 23 and 24 November was communicated well in advance through the provision of Best Estimate (BE) and Reasonable Worst Case (RWC) rainfall scenarios to Natural Resources Wales and the Environment Agency. The RWC scenario for South Wales issued on Wednesday 20 November, catered for accumulations above 100mm across the high ground, with isolated maximums of more than 150mm (Figure 3). This initial RWC forecast turned out to be very close to the total observed rainfall, even at 4 days lead time.

The Hydromet Guidance issued to NRW alongside the BE and RWC rainfall scenarios signalled the uncertainties in rainfall intensities and amounts due to the timing of the cold front clearance during Sunday 24th November, with this uncertainty signalled in the guidance issued on Friday 22nd and Saturday 23rd November. For example, the morning issue of Hydromet Guidance on 23rd November stated, "The main uncertainty is the detail of the embedded convection on the cold front tonight and Sunday morning and any potential wave development which could act to slow the clearance somewhat".

Within this overall forecast, rainfall intensities towards the end of the forecast period were observed as high (circa 22mm-32mm/hr). This highlights the potential importance of understanding the rainfall profile and may account for the rapid rate of river rise reported in some catchments. Improved rainfall forecasting capabilities capturing such details would likely highlight potential tipping points in flood forecasting. These rainfall profiles are not uncommon, with an example being prolonged frontal rainfall followed by a period of intense ‘line convection’. Broad subjective interpretations of rainfall are unable to resolve this sort of detail which can make the difference between minor, and significant or even severe flooding.

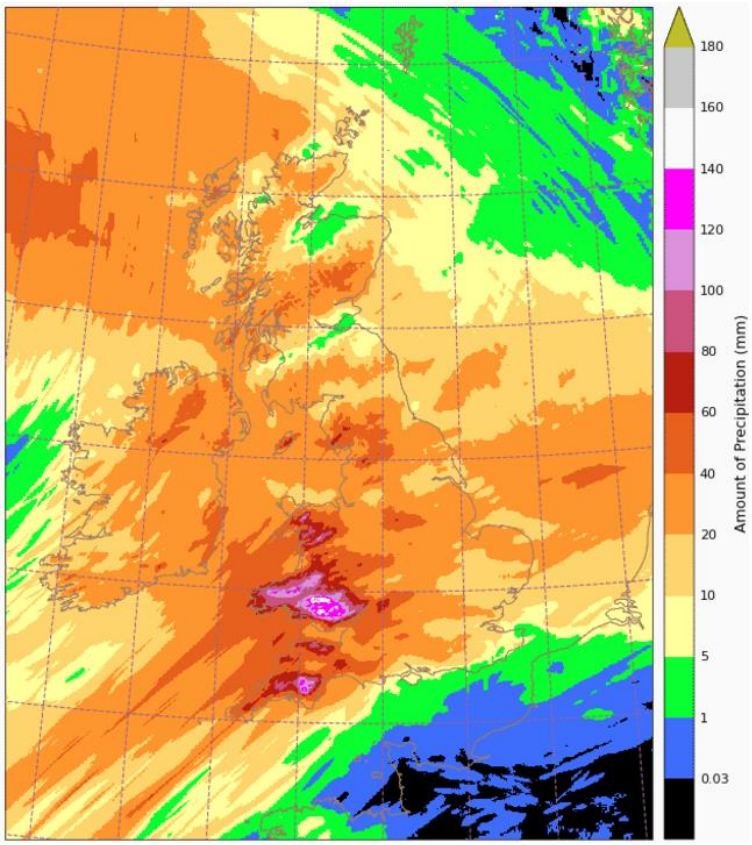

Figure 3: RWC rainfall for Wales issued on Wednesday 20 November (24hr accumulation at 0600GMT Sunday 24 November, from the UKV 1500GMT 19 November).

In the period between the 20 November and the 23 November there was considerable variation in the spatial and temporal detail in the model, as is typical when considering a county scale forecast. However, the RWC rainfall scenario was broadly consistent for South Wales throughout this period, maintaining the raised awareness of the potential for impactful rain and supporting the assessment for significant flooding impacts under the RWC. Further escalation of the flood risk to medium or high likelihood of significant impacts (Amber) was not deemed possible until 24 November, when it was escalated based on rapid rate of river rise and observed impacts, the RWC scenario was effective in maintaining a steady assessment for the potential for significant impacts, which was communicated to the responder community with good lead time through the FGS.

Flood Guidance Statement (FGS)

Significant flooding impacts were first identified on the FGS on Wednesday 20 November, providing 4 days lead time for much of Wales and parts of the north and west of England (Figure 4).

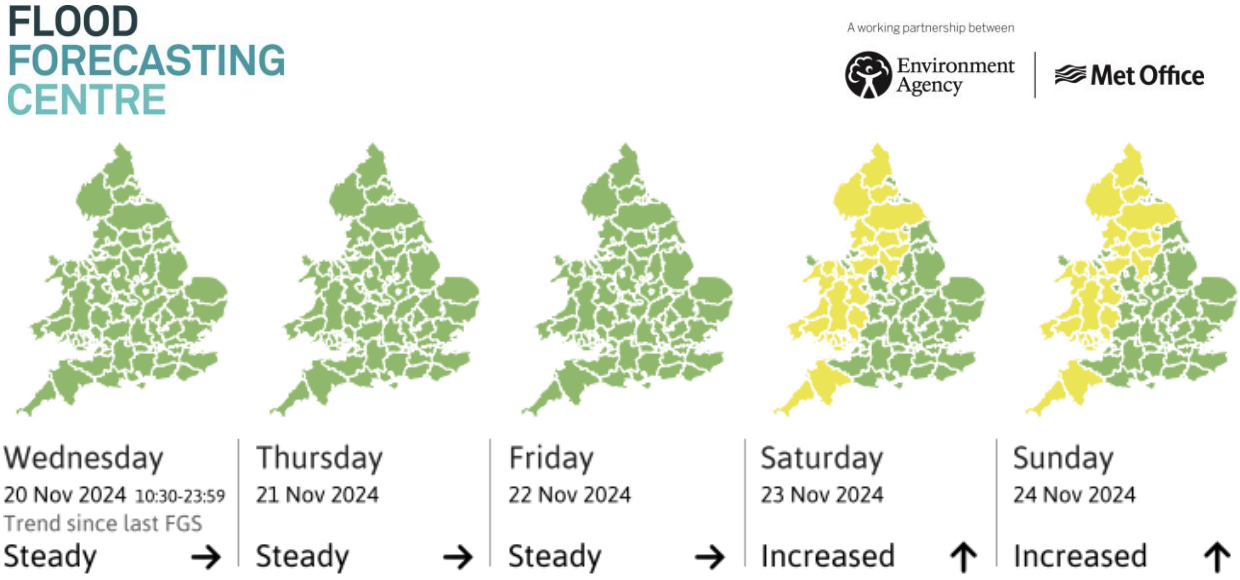

Figure 4: FGS headline maps from Wednesday 20 November

A consistent narrative around the LOW (Significant Impact, Yellow) overall flood risk was maintained as the flood event drew closer, with significant impacts forecast under the RWC scenario. Some geographical changes were made to the areas at risk in the FGS issued on Friday 22 November and Saturday 23 November, including an eastward extension of the risk in the South West of England and a refinement of the risk in the North of England to parts of Lancashire, Greater Manchester, South Yorkshire and southern parts of Cumbria (Figure 5). For many central parts of England, including the East Midlands, flooding impacts were assessed as minor at low likelihood, giving an overall VERY LOW (Green) flood risk. The following sections detail the local escalations to MEDIUM (Significant Impacts, Amber) flood risk.

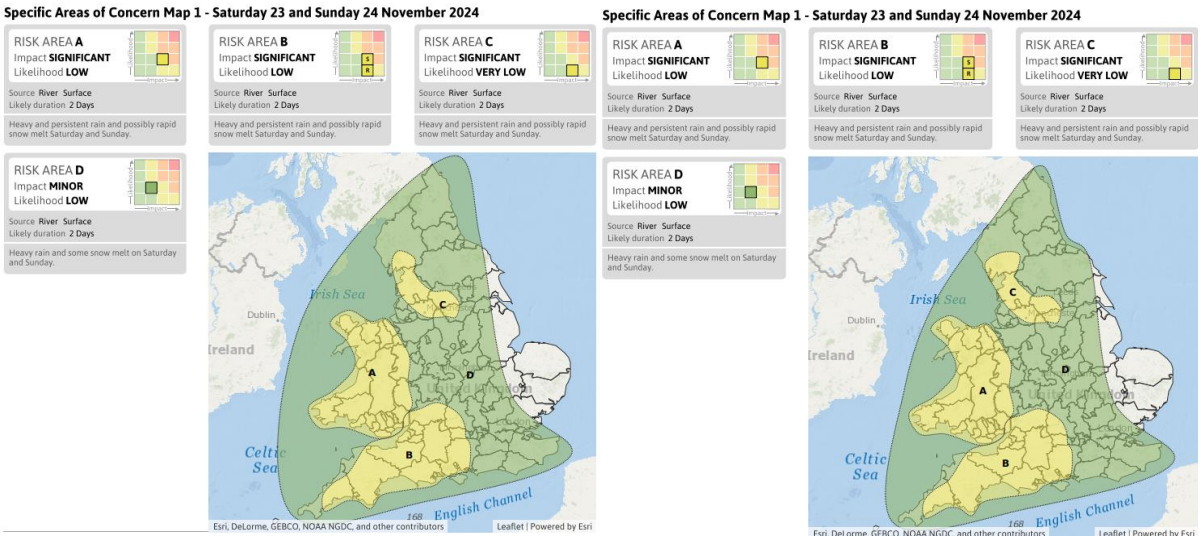

Figure 5: Specific Areas of Concern Map from FGS issued on Friday 22 November (left) and Saturday 23 November (right)

South Wales

Following rising river levels in parts of South East Wales, observed impacts and the potential for further significant impacts, the overall flood risk was escalated to MEDIUM (Significant

Impacts, Amber) on Sunday 24 November (Figure 6 left image). This was a change on the Flood Risk Matrix from low likelihood of significant impacts to a high likelihood of significant impacts for parts of South East Wales. This is shown on a Flood Risk Matrix in Figure 7.

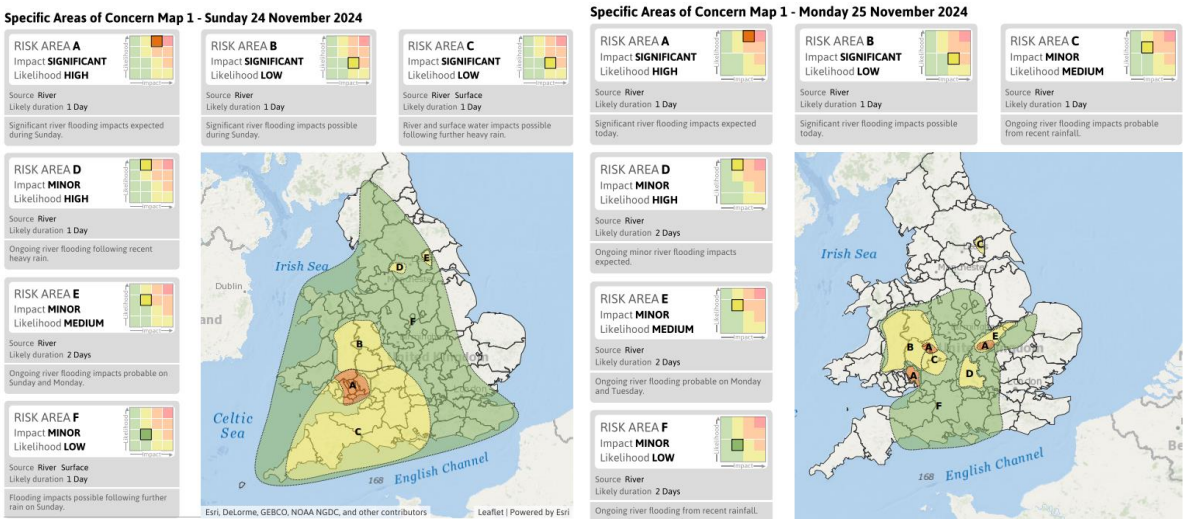

Figure 6: Specific Areas of Concern Map from the FGS issued on Sunday 24 November (left) and from the FGS on Monday 25 November (right)

The potential for severe flooding impacts was first considered on the 20 November, and reviewed routinely after that, with agreement across the forecasting partner organisations for significant flooding impacts under the RWC Scenario.

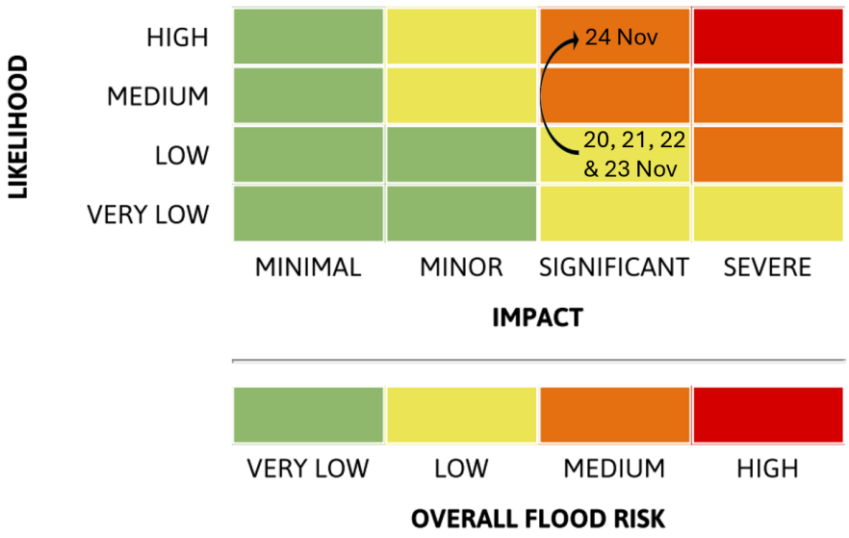

Figure 7: Flood Risk Matrix showing the consistency in flood risk assessment for South East Wales in the lead up to Storm Bert and the escalation on 24 November.

West Midlands

On the afternoon of Sunday 24 November the overall flood risk for the River Teme through parts of Herefordshire, Shropshire and Gloucestershire was increased from LOW (Significant Impacts, Yellow) to MEDIUM (Significant Impacts, Amber) with an increase in the likelihood of significant flooding impacts from low to high. Significant impacts were forecast for this area with 4 days lead time.

East Midlands

A short notice escalation in the flood risk assessment was seen in Northamptonshire for flooding from the River Nene. Ahead of the flooding, the overall flood risk was assessed as VERY LOW (Minor Impacts, Green), with a low likelihood of minor river flooding impacts consistently messaged from Wednesday 20 November onwards. Local forecasts suggested the Northampton Washland reservoir would be close to full under the RWC rainfall scenario, however, any flooding impacts were expected to be isolated. In reality the washland reservoir exceeded capacity and a Severe Flood Warning was then issued by the Environment Agency on 25 November for the Billings Aquadrome Residential Caravan Park. This was reflected on the FGS with a high likelihood of significant river flooding impacts for Northamptonshire on 25 November (Figure 6 right image).

Flooding Impacts and FGS Verification

Significant river and surface water flooding impacts were reported across Wales and England between 23 and 25 November. These are provided at a county scale in Figure 8. Impacts included flooding of properties (including caravan sites) and businesses as well as major disruption to the transport network, with flooding of inter-city rail links and the motorway network.

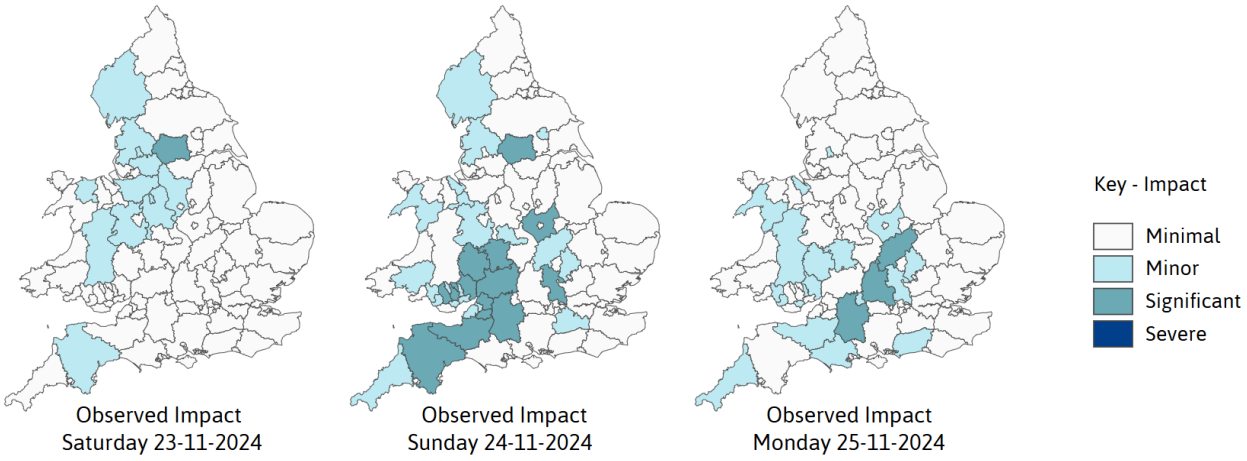

Figure 8: Observed flooding impacts by county between 23-25 November 2024

Flooded property numbers for the worst affected communities are listed below (note numbers are the best available at the time of writing):

- 600 at Billing Aquadrome, Northamptonshire (pictured in Figure 11)
- 311 in Pontypridd, Rhondda Cynon Taf (pictured in Figure 9)
- 114 in Chippenham, Wiltshire
- 100 in Yate, Gloucestershire

- 105 in Blaenau Gwent
- 89 in Monmouthshire
- 50 in Calderdale (14 of which in Todmorden), West Yorkshire
- 28 in Tenbury Wells, Worcestershire (pictured in Figure 10)
- 28 across Devon

Figure 9: Flooding in Pontypridd, Rhondda Cynon Taf [ii]

28 properties flooded at Tenbury Wells, Worcestershire, due to a wall collapsing as the Kyre Brook levels rose (Figure 10).

Figure 10: Flooding at Tenbury Wells [iii]

Approximately 600 hundred properties flooded at Billing Aquadrome, Northamptonshire (Figure 11), with around 1,000 people evacuated.

Figure 11: River flooding at Billing Aquadrome [iv]

Learning Points Identified

The following learning points have been identified:

1. **Best Rainfall Forecasts –** Whilst the full rainfall forecast is available at the FFC, neither NRW nor the EA are making best and full use of the information available in the local assessment of risk. BE and RWC rainfall scenarios are provided manually to NRW. EA services have moved to a data-led approach, meaning FFC rainfall scenarios are directly uploaded to EA river models through the EA's Incident Management Forecasting System (IMFS). Services to NRW remain the same as those provided to the EA prior to IMFS, requiring more subjective human interpretation to translate static rainfall numbers into suitable inputs for river models. Improvements would provide significant time efficiencies for forecasters and more confidence that the RWC rainfall inputs to local river models were more realistically representing the spatial and temporal detail of the forecast rain. More specifically, the most skilful rainfall forecasts should be used to drive flood forecasting models, capturing the details and the uncertainties (ensembles), and we should look to collectively identify how these can be applied to operational models quickly. This event provides a good operational case study to investigate the benefits and help make the case for the necessary investment.

2. **Flood Risk Communications -** Whilst observed flooding impacts matched forecast RWC impacts in many of the worst affected areas, the forecast likelihood of those impacts meant the overall risk remained LOW/Yellow. Whilst well practiced incident management processes and briefings meant the responder community was aware of the impact assessment, further work is required on the Flood Risk Matrix to address the tendency for some users to act primarily on the FGS colour/overall flood risk (rather than the full risk assessment and position in the matrix which overlooks that a 'yellow FGS' can represent three distinctly risk scenarios (medium or minimum, low of sig, to very low severe impacts).

3. **Improve shared understanding of operational forecasting and warning services and ways of working** related to FGS feedback, by re-establishing training and shadowing opportunities for Hydrometeorologists and Monitoring and Forecasting Duty Officers. Shared understanding will improve consistency and awareness of decisions feeding into the operational calls with MFDOs. This should be two way and highlights that all FFC Hydrometeorologists should have the opportunity to shadow MFDOs and spend a period of time with Area teams during the first 12-24 months in the FFC.

4. **Caravan Parks** – There was some confusion in terms of the risk assessment process for the different types of caravan parks at risk of flooding, whether permanent/temporary and how best to communicate risks clearly and consistently across forecasting teams and to responders would be a good development of the service as these areas often appear prone to frequent flooding.

Notes and Contacts:

This report was produced with contributions from the Environment Agency, Met Office and Natural Resources Wales from information available at the time and is subject to change. Much of the data contained is from live observation systems and has not been quality controlled. More detailed local information may emerge post event which may update that currently available nationally.

For more information on this national overview contact the FFC.

FFC contact: Duty Hydrometeorologist

Telephone: 0330 125 4400 (24 hours)

Flood Forecasting Centre ffcenquiries@environment-agency.gov.uk

References

FFC, 2022, FGS User Guide

[i] Met Office Summary of Storm Bert. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2024/2024_09_storm_bert.pdf

[ii] Photograph of flooding in Pontypridd https://www.itv.com/news/wales/2024-11-25/storm-bert-flooding-devastates-parts-of-wales-as-pontypridd-suffers-again

[iii] Photograph of flooding in Tenbury Wells https://www.bbc.co.uk/news/articles/cp3ngzg250wo

[iv] Photograph of flooding in Billing Aquadrome in Northampton https://www.bbc.co.uk/news/articles/c245jv3086yo