Monmouthshire County Council

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Skenfrith

Storm Dennis
February 2020

Version: FINAL

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Contents

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1. Executive Summary

In accordance with Section 19 of the Flood and Water Management Act 2010 (FWMA), Monmouthshire County Council (MCC) has a duty as Lead Local Flood Authority (LLFA) to investigate flooding within its area, insofar as it considers it necessary and appropriate. This report meets the requirements of Section 19 of the Act and provides a factual account of the flood event that occurred on 16 February 2020 at Skenfrith due to intense rainfall from Storm Dennis 15 and 16 February 2020.

February 2020 was the wettest February on record in Wales as well as the fifth wettest month ever recorded. Storm Dennis was the 4th named storm of the season and fell on ground that was already saturated from Storm Ciara 1 week prior, and an unnamed rainfall event on 12 and 13 February. Intense rainfall from Storm Dennis impacted river flows across South Wales and resulted in significant flooding to land and property.

From anecdotal reports the primary source of flooding at Skenfrith was fluvial from the River Monnow, and its tributary the Norton Brook.

Intense rainfall from Storm Dennis on the Monnow's catchment resulted in a rapid rise in water levels on the Monnow and the Norton Brook which both overtopped and caused flooding to residential and commercial property in Skenfirth. Surface water from land to the south and west of Skenfrith also contributed to the flooding.

Following the flood event officers from MCC visited the residents and properties affected to collect information on the event.

At the time of preparing this report 18 residential and 4 commercial properties are reported to have flooded in Skenfrith due to Storm Dennis.

Information has been shared between MCC, and Natural Resources Wales (NRW) as the Risk Management Authorities (RMA). Supporting information on weather patterns and rainfall at the time of the event has been gathered from the Met Office.

2. Introduction

2.1 Purpose of the Section 19 Flood Investigation

On 15 and 16 February 2020, Monmouthshire was impacted by a significant weather event named Storm Dennis which resulted in heavy and prolonged rainfall in the northern parts of the county and upper catchments of many ordinary watercourses and main rivers, including the River Monnow.

As a result, many areas across Monmouthshire flooded particularly in the north.

This report will focus on the flooding in Skenfrith.

The report has been prepared by MCC in response to the duties of the LLFA in Section 19 of the FWMA, which states:

(1) On becoming aware of a flood in its area, a Lead Local Flood Authority must, to the extent that it considers it necessary or appropriate, investigate:

(a) Which risk management authorities have relevant flood risk management functions, and

(b) Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must:

(a) Publish the results of its investigation, and

(b) Notify any relevant risk management authorities.

2.2 Site Location

Skenfrith is a village in the northeast of Monmouthshire. It's located on the western bank of the River Monnow, approximately 16km upstream of the Monnow's confluence with the River Wye at Monmouth.

Skenfrith comprises approximately 20 residential properties, a village hall, church, public house/hotel, and Skenfrith Castle which is early 13th century, see Figure 2-1 for Skenfrith location plan, and Figure 2-4 for an aerial image of Skenfrith. Many buildings in the village date back several centuries with a comparatively modern development of six houses from the 1950s in the north of the village.

The drainage system in Skenfrith is complicated. There are 3 watercourses, these are the main river Monnow, and 2 ordinary watercourses, the Norton Brook, and what is believed to be the remains of Mill Stream which historically powered Corn Mill by means of a now decommissioned weir adjacent to Skenfrith Castle, and discharged to the Monnow.

The Norton Brook has a catchment of approximately 12.5km2; its confluence with the Monnow is to the north-east of Skenfrith. To the south and west of Skenfrith are several land drainage ditches and watercourses, these overflow to the village and contribute to flooding. Surface water from higher ground to the west of the village also discharge along the roads through the village.

Upstream of Skenfrith the Monnow's catchment is approximately 395km² and is predominately rural in nature, see Figure 2-2. The main tributaries of the River Monnow are the Norton Brook, Escley Brook, River Honddu and the River Dore.

The River Monnow is crossed by Skenfrith Bridge, a 3 arch stone bridge, at the downstream end of the village carrying the B4521 across the Monnow, see Figure 2-3 for a picture of the bridge. Further east the road then continues as a causeway of approximately 300m in length across the flood plain of the Monnow and includes 2 flood relief arches shown in Figure 4-5.

The River Monnow falls within the Lower Wye Internal Drainage District (IDD) managed by Natural Resources Wales (NRW), see Figure 5-1. The boundary of the IDD also covers approximately 1km of the Norton Brook upstream of its confluence with the Monnow.

Figure 2-1. Location plan

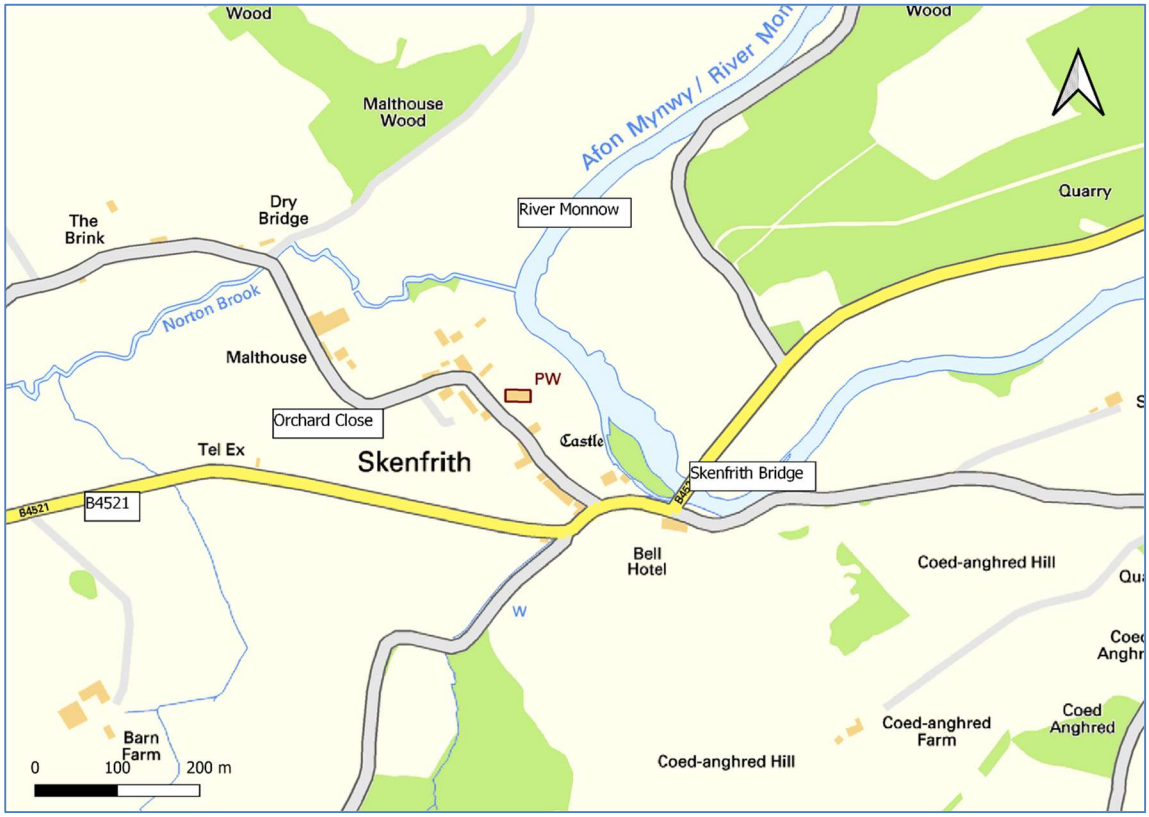


Figure 2-2. FEH River Monnow catchment at Skenfrith

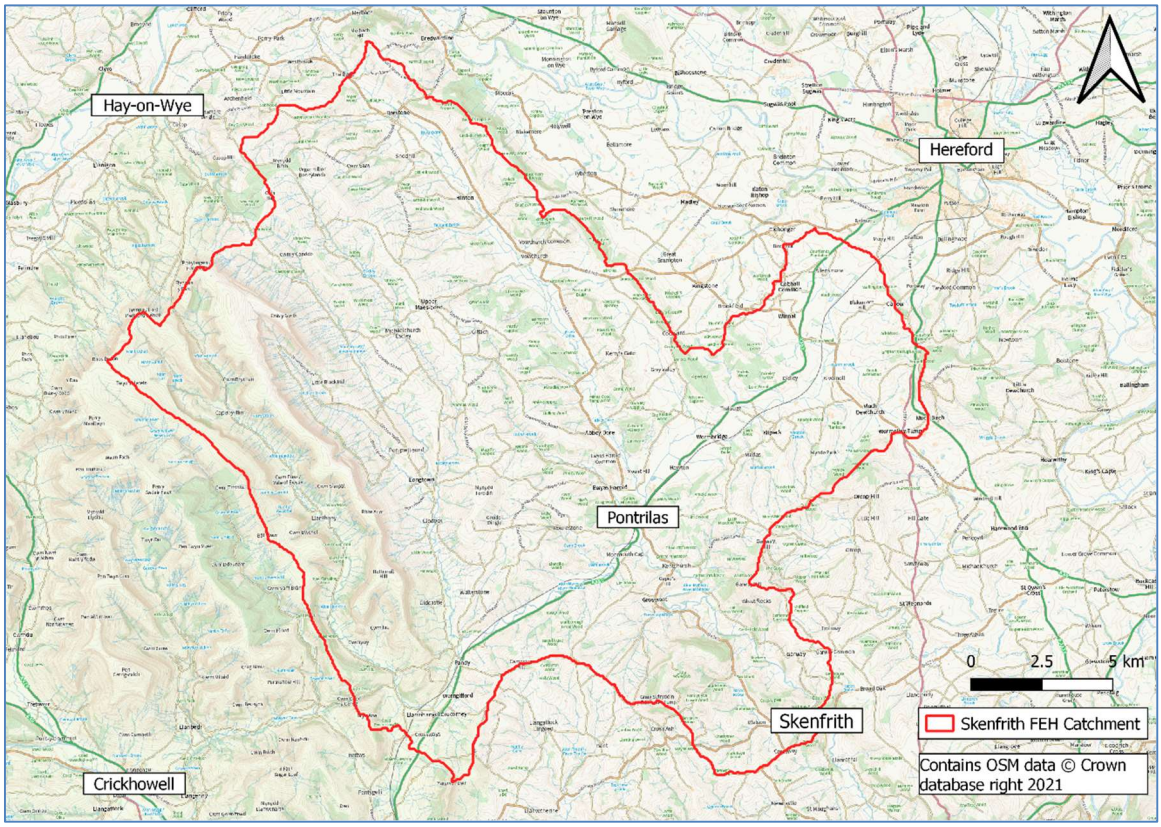


Figure 2-3. Skenfrith Bridge carrying the B4521 over the River Monnow, southeast Skenfrith, site visit May 2021

Figure 2-4. Flood Investigation Area aerial image

NRW flood maps show Skenfrith is at high risk of flooding from the River Monnow and the Norton Brook, and there are small areas at medium and low risk of flooding from surface water as shown in Figure 2-5 and Figure 2-6.

Figure 2-5. Extract from Natural Resources Wales, Risk of Flooding from Rivers

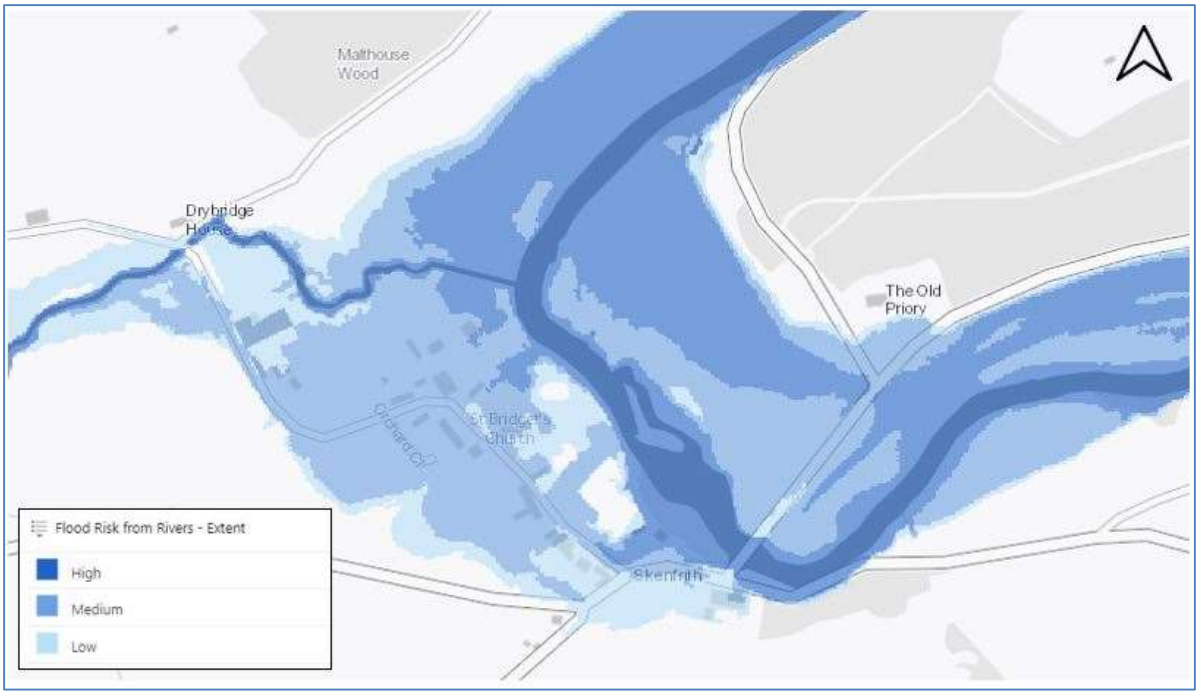
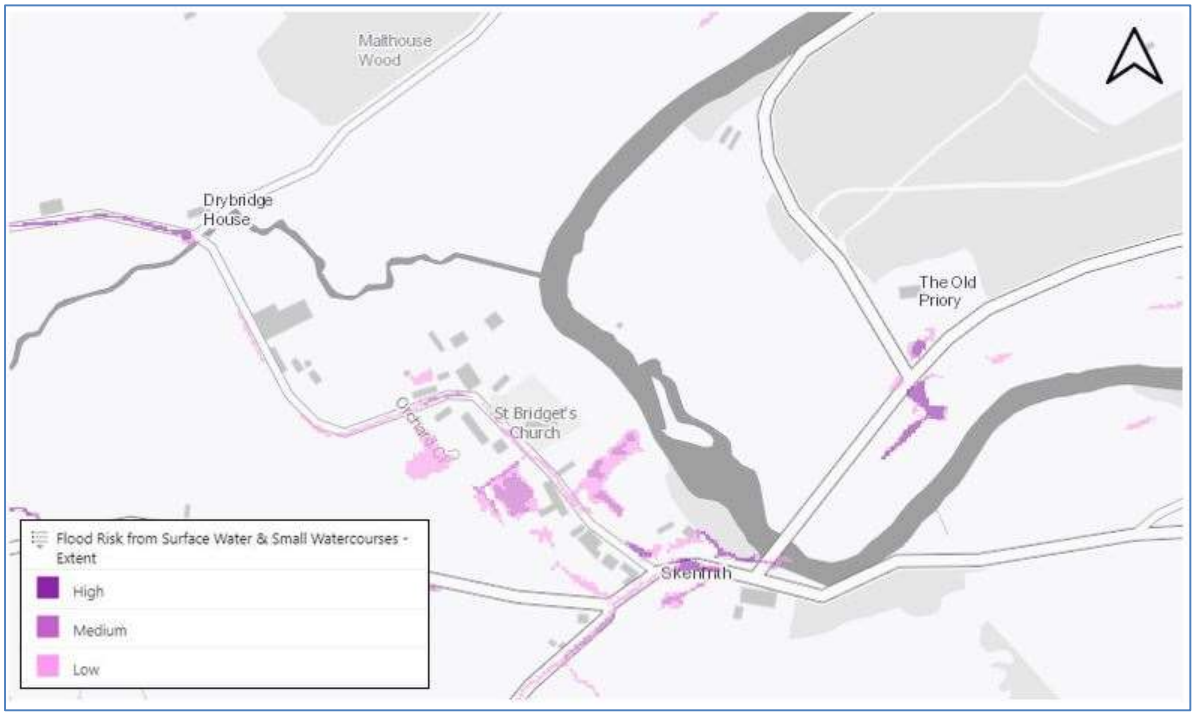


Figure 2-6. Extract from Natural Resources, Risk of Flooding from Surface Water



2.3 Investigation Evidence and Data

To support the investigation the following list of qualitative and quantitative evidence has been gathered:

- Anecdotal reports.
- Site inspections and photos.
- Met Office Data – Storm report and weather warnings.
- Natural Resources Wales – hydrometric data, report entitled *February 2020 Floods in Wales: Flood Event Data Summary.*
- Environment Agency – hydrometric data.
- Monmouthshire County Council – hydrometric data, asset database, Flood Risk Management Plan, Preliminary Flood Risk Assessment.
- Historic reports relating to flooding at Skenfrith:
  - *1998 Easter Floods Final Assessment by the Independent Review Team* – Volume 2, prepared by the Environment Agency on behalf of the Easter Flood Review Team September 1998. Product code GEHO0807BNAZ-E-E. This document will be referred to in this report as the *EA Easter Floods Report 1998*.
  - *Skenfrith Flood Alleviation Scheme, Pre - Feasibility Study, 2006*, Atkins on behalf of Environment Agency Wales (EAW). This document will be referred to in this report as *EAW Skenfrith Flood Alleviation, Pre-Feasibility Study 2006*.
  - *Section 19 Flood Investigation Report, Skenfrith, October 2019, Monmouthshire County Council.*

2.4 Anecdotal Evidence

Table 2-1 provides a reference to address points of local individuals consulted; a full table with a list of references and addresses can be found in Appendix A, however the appendix will be

redacted prior to report publication die to General Data Protection Regulations. Table 2-1 presents anecdotal evidence collected by telephone interview in June 2021, that compares flooding from Storm Dennis with flooding from Persistent Wet Weather October 2019. The table provides a reference to address points of local individuals consulted; a full table with a list of references and addresses can be found in Appendix A, however the appendix will be redacted prior to report publication due to General Data Protection Regulations.

It's noted that the same properties flooded in October 2019 and February 2020.

Table 2-1. Anecdotal evidence

Address ref	Notes
SK2020/01	February 2020 flood event: • Fewer people evacuated their properties in the February 2020 flood event than in the October 2019 flood event as they were getting used to flooding. • More debris was left in the February 2020 flood event than in the October 2019 flood event. • Flooding was due to flows from the Norton Brook and River Monnow. • No internal flooding to resident's property.
	October 2019 flood event: • Lots of people evacuated their properties in the October 2019 flood event as there had not been flooding for some time and it was a surprise. • Flooding started in the afternoon on the Saturday 26 October 2019 and continued until 23:30hrs. The road became blocked by the afternoon. • The onset of flooding was rapid. • Flooding was due to flows from the Norton Brook and the River Monnow. • The Norton Brook is very reactive to rainfall. • The Norton Brook overtopped its right bank from Dry Bridge to the confluence with the Monnow. • Flood depths at the church wall were 1.2m. • Not much debris left behind on the bridge. • The B4521 was raised in the 1950s / 1960s. Due to this water cannot flow as easily across the field and discharge to the Monnow. • No internal flooding to resident's property.
SK2020/02	February 2020 flood event: • The February 2020 flood event was almost identical to the October 2019 flood event. • February 2020 flooding was approximately 0.5m deeper than October 2019 flooding. • More debris was left behind in the February 2020 flood event. Flooding always deposits lots of silt and topsoil, this raises bed levels and the banks of the Monnow.
	October 2019 flood event: • There was a rapid ingress of flooding. Levels on the Monnow rose rapidly. • Internal flood depth reached approximately 1.9m. • The flood water is very dark and muddy and filled with silt and topsoil, this raises the bed on the Monnow and its banks. The left floodplain of the Monnow is 0.2 to 0.3m higher than 20 years ago due to debris deposition. • Trees on the banks of the Monnow are no longer coppiced. Coppicing had flood attenuation benefits. Skenfrith is a tree conservation area. • Prior to October 2019, flood depths were approximately 0.13 to 0.15m lower. • Works to the B4521 may affect flooding. • During flooding people wait in their houses as the flood water is fast flowing and deep, it is safer to stay in the house.

3. Flooding

3.1 Previous Flood Incidents

Reports of historical flooding in Skenfrith are recorded in Table 3-1. Historical information in the table has been collected from anecdotal reports, and the *EAW Skenfrith Flood Alleviation, Pre-Feasibility Study, 2006*, and the *EA Easter Floods Report 1998*.

Table 3-1. Recorded historic flood events

Date	No. properties flooded	Flood level (mAOD)
16 February 2020	22	Unknown
26 October 2019	22	Unknown
9 April 1998	21	42.71
1992	13 or 14	42.58
1990	3	Property thresholds
1979	21	42.81
1960	Unknown	42.47
1928	Unknown	42.58

3.2 Flood Incident

Storm Dennis was the 4th named storm of the 2019/2020 season and brought heavy and persistent rain across South Wales. The Met Office issued a Red Warning for rain across parts of South Wales and there was major and widespread flooding. See section 3.7 for further details on the Met Office sever weather warning.

Storm Dennis delivered heavy rainfall on 15 and 16 February 2020. The rain fell on saturated ground due to Storm Ciara 1 week prior, and an unnamed rainfall event on 12 and 13 February 2020.

MCC has anecdotal reports that the primary source of flooding was fluvial from the River Monnow, and the Norton Brook.

Intense rainfall from Storm Dennis on the upper catchment of the Monnow resulted in a rapid rise of water levels on the Monnow and the Norton Brook. The Norton Brook and River Monnow overtopped, merged, and caused flooding to property in the village.

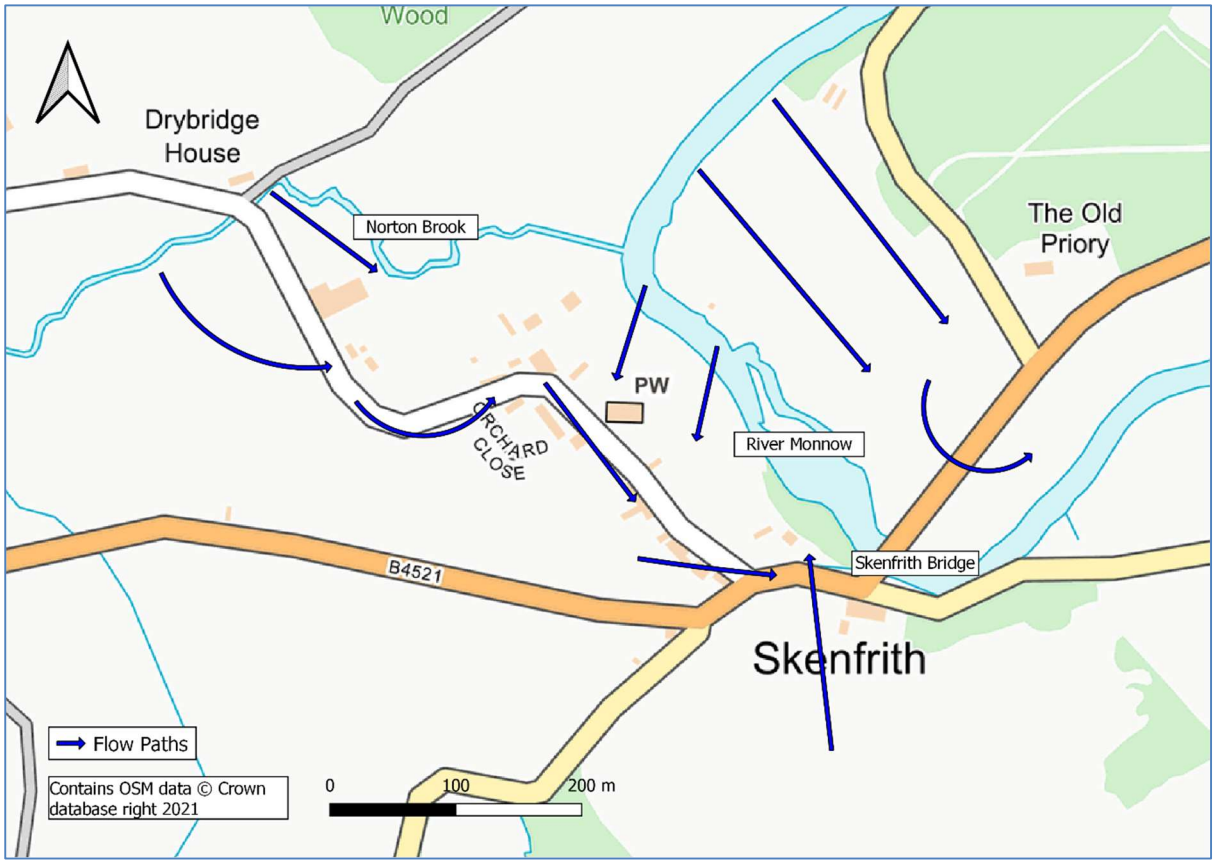
In addition to fluvial flooding, surface water from the south and west of Skenfrith channelled to the village via land, roads and the drainage system and contributed to flooding.

Debris accumulated on the Monnow at Skenfrith Bridge which may have held back flows.

There are anecdotal reports that historically, river levels have responded very quickly to rainfall, there is little time for residents to implement a flood response and evacuation plan, and many residents stay in their homes as it is dangerous to be outside due to fast flowing and deep flood waters. Anecdotal reports state that during the October 2019 flood event an off-duty ambulance driver was travelling through the village by chance and assisted the flood response.

At the time of preparing this report 18 residential and 4 commercial properties are reported to have flooded in Skenfrith on 16 February 2020 due to Storm Dennis.

Figure 3-1. Indicative flood flow paths from anecdotal evidence



3.3 Gauging Stations

The location of nearby NRW and EA river, rain, and tidal gauges are shown in Figure 3-2.

All gauges are NRW except Vowchurch rain gauge, Ross on Wye river gauge, and Avonmouth Portbury tidal gauge which are EA. All the listed river and tidal gauges are telemetered. Rain gauges are a mixture of telemetered and logger.

Figure 3-2. Local rain, river, and tidal gauges[1][2]

3.4 Gauge Monitoring

Table 3-2 provides a list of hydrometric data from NRW and the EA which has been assessed in the investigation. Gauges selected are telemetered as these provide readings at consistent 15-minute time intervals. Some gauge data has been excluded from the assessment due to known data accuracy issues.

The assessment has been carried out for 2 comparable storms which caused flooding in South Wales, these were the Met Office named events Persistent Wet Weather 25 and 26 October 2019, and Storm Dennis 15 and 16 February 2020. The hydrographs later in this chapter are for the following 2 periods covering these storms:

[1] Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.
[2] this uses Environment Agency rainfall data from the real-time data API (Beta).

- 15-day period 00:00 on 17 October 2019 to 23:45 on 31 October 2019.
- 15-day period 00:00 on 7 February 2020 to 23:45 on 21 February 2020.

Table 3-2. Hydrometric gauges included in the assessment

Data	Gauge name	Source
Rainfall	Tafalog	NRW
Rainfall	Vowchurch	EA
River Monnow	Grosmont	NRW
River Monnow	Skenfrith	NRW

Within the Monnow's catchment upstream of Skenfrith there are 2 telemetered rain gauges, Tafalog and Vowchurch. Thiessen Polygon analysis requires a minimum of 3 gauges and so cannot be carried out. The rain gauges are spread evenly over the catchment and so an equal weighting has been applied to them.

There is a river gauge on the Monnow at Skenfrith and another approximately 10.7km upstream at Grosmont.

The following graphs in Figure 3-3 to Figure 3-6 present river stage data, and rainfall data for the Monnow's catchment at Skenfrith and Grossmont. The same rainfall data from Vowchurch has been used for all hydrographs for ease of cross referencing between them. There is a time lag between rainfall on the catchment based on data from Vowchurch, and the response in levels on the Monnow, this is referred to as the time to peak.

Figure 3-3. Persistent Wet Weather October 2019 - Rainfall and river levels for the Monnow at Grosmont for the 15-day period 17 to 31 October 2019

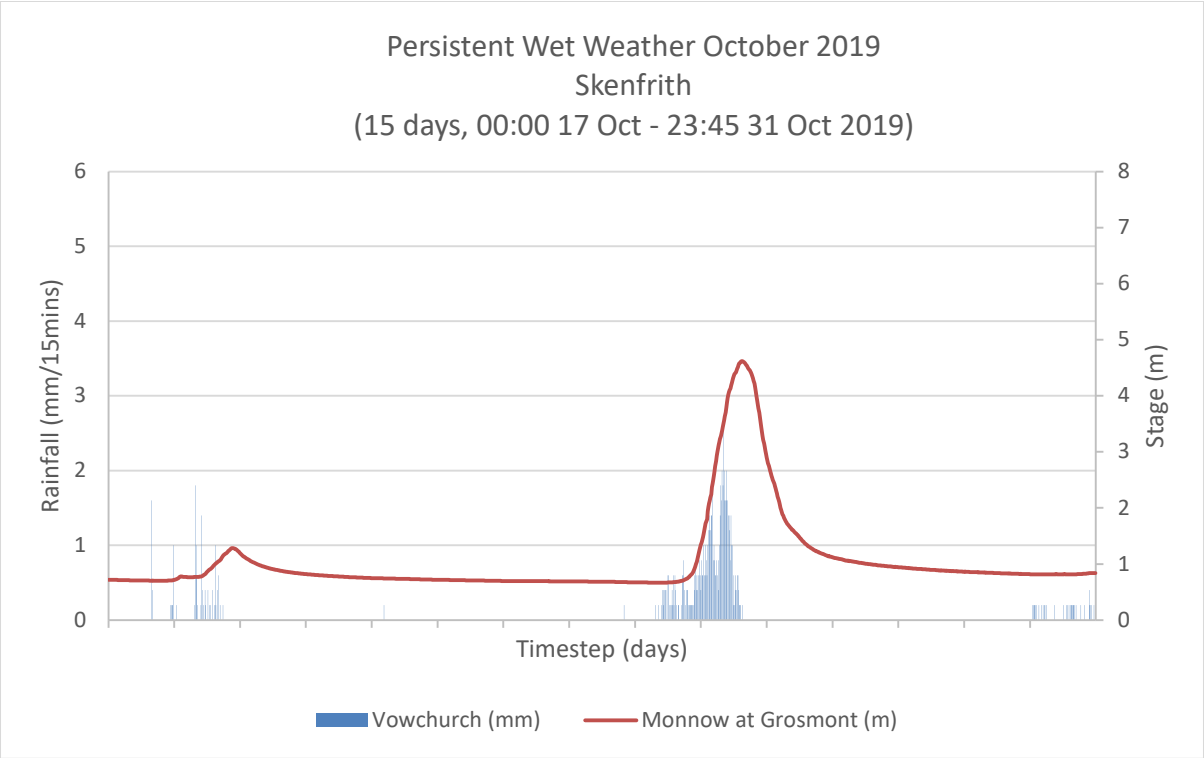


Figure 3-4. Storm Dennis - Rainfall and river levels for the Monnow at Grosmont for the 15-day period 7 to 21 February 2020

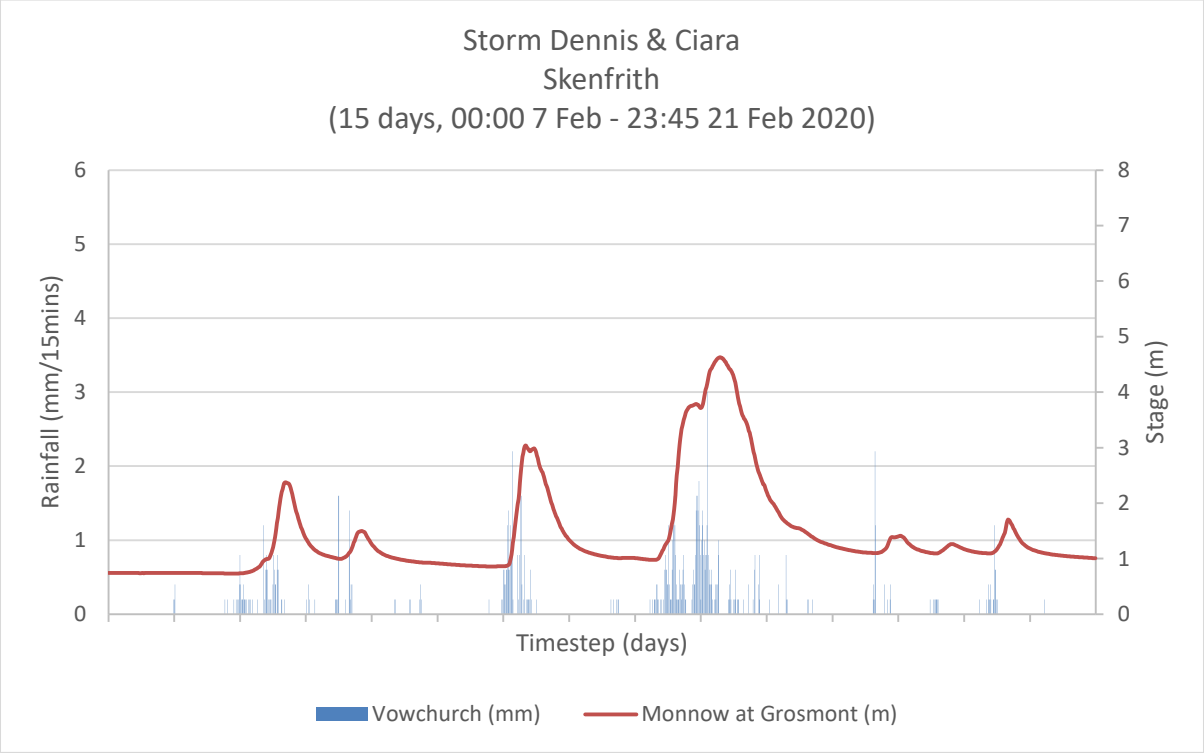


Figure 3-5. Persistent Wet Weather October 2019 - Rainfall and river levels for the Monnow at Skenfrith for the 15-day period 17 to 31 October 2019

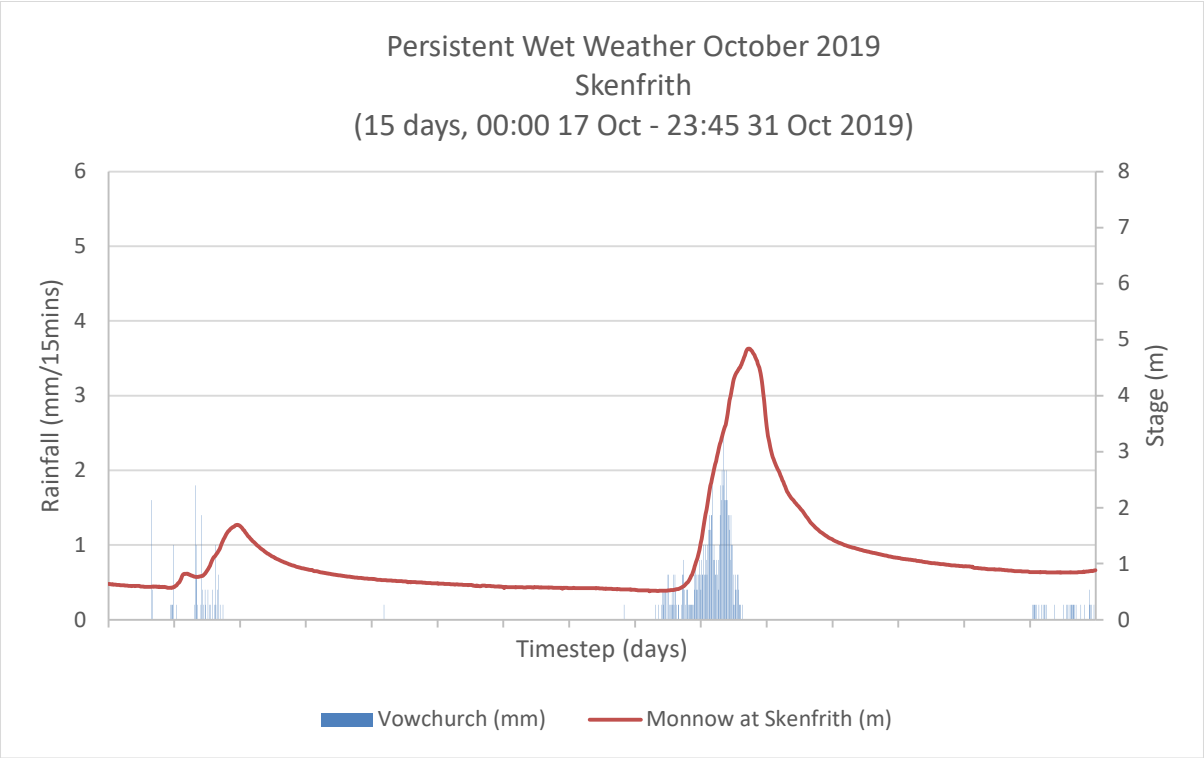
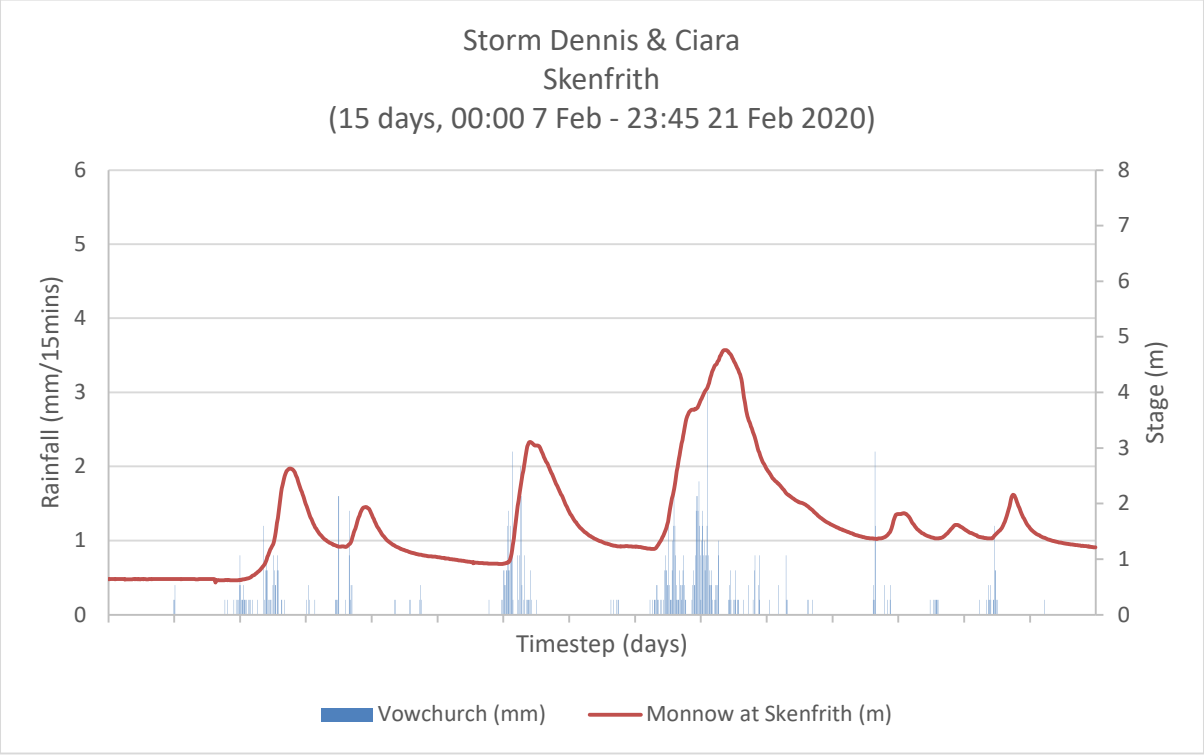


Figure 3-6. Storm Dennis - Rainfall and river levels for the Monnow at Skenfrith for the 15-day period 7 to 21 February 2020



The peaks in the hydrographs are used by flood risk authorities as triggers for flood warnings and to action emergency flood responses. Lead times are important in emergency flood situations; the earlier the warning, the longer property owners have to evacuate and protect their property, and the longer emergency services have to respond.

Table 3-3 and Table 3-4 present river level peaks from the above graphs for flooding due to Persistent Wet Weather October 2019, and Storm Dennis.

Table 3-3. Persistent Wet Weather October 2019 - Hydrograph peaks for the period 17 to 31 October 2019

River and gauge	Level (m)	Time (GMT, hrs), Date
Peak on the Monnow at Grosmont	4.622	14:45, 26 Oct, 2019
Peak on the Monnow at Skenfrith	4.841	17:15, 26 Oct, 2019

Table 3-4. Storm Dennis - Hydrograph peaks for the period 7 to 21 February 2020

River and gauge	Level (m)	Time (GMT, hrs), Date
Peak on the Monnow at Grosmont	4.624	06:45, 16 Feb, 2020
Peak on the Monnow at Skenfrith	4.762	09:15, 16 Feb, 2020

The following observations have been made on the hydrographs included in the assessment and the 2 tables above:

- Of the 2 storms Persistent Wet Weather October 2019 has the highest peak at Skenfrith.
- Both storms have approximately the same peak levels at Grosmont and Skenfrith.
- For both storms there are 2hrs 30 mins between the peak on the Monnow at Grosmont and the peak on the Monnow at Skenfrith.
- The catchments were saturated at the onset of Storm Dennis generating very fast runoff.
- Levels on the Monnow at Grosmont and Skenfrith were notably higher at the onset of Storm Dennis. At the onset of Persistent Weather October 2019, the level on the Monnow at Grosmont was 0.668m, and the level on the Monnow at Skenfrith was 0.515m. At the onset of Storm Dennis the level on the Monnow at Grosmont was 0.977m, and the level on the Monnow at Skenfrith was 1.186m.
- The peak level during Storm Dennis at Grosmont was a new record high for the gauging station as noted in Table 5 of the NRW report entitled *February 2020 Floods in Wales: Flood Event Data Summary.*

The maximum levels on the Monnow at Skenfrith were very similar for both events, however the exact flow paths, accumulation of flows, and maximum depths at different locations within the village will vary from storm to storm depending on where flows are directed to and how they drain away. This is one possible explanation for the reported 0.5m difference in flood depths between the 2 events recorded in the anecdotal evidence table in section 2.4.

The graphs in Figure 3-7 to Figure 3-12 show cumulative rainfall totals for the 4-day period with the storms beginning on day 2, for Tafalog and Vowchurch rain gauges, and for their equally weighted average; the cumulative totals are presented in Table 3-5.

Table 3-5. Cumulative rainfall totals

Rainfall gauge	Persistent Wet Weather October 2019 (mm)	Storm Dennis (mm)
Tafalog	94.4	93.0
Vowchurch	78.8	62.0
Tafalog Vowchurch average	86.6	77.5

Figure 3-7. Persistent Wet Weather October 2019 - Rainfall totals Tafalog (mm/15mins), and cumulative rainfall (mm) for the 4-day period 24 to 27 October 2019

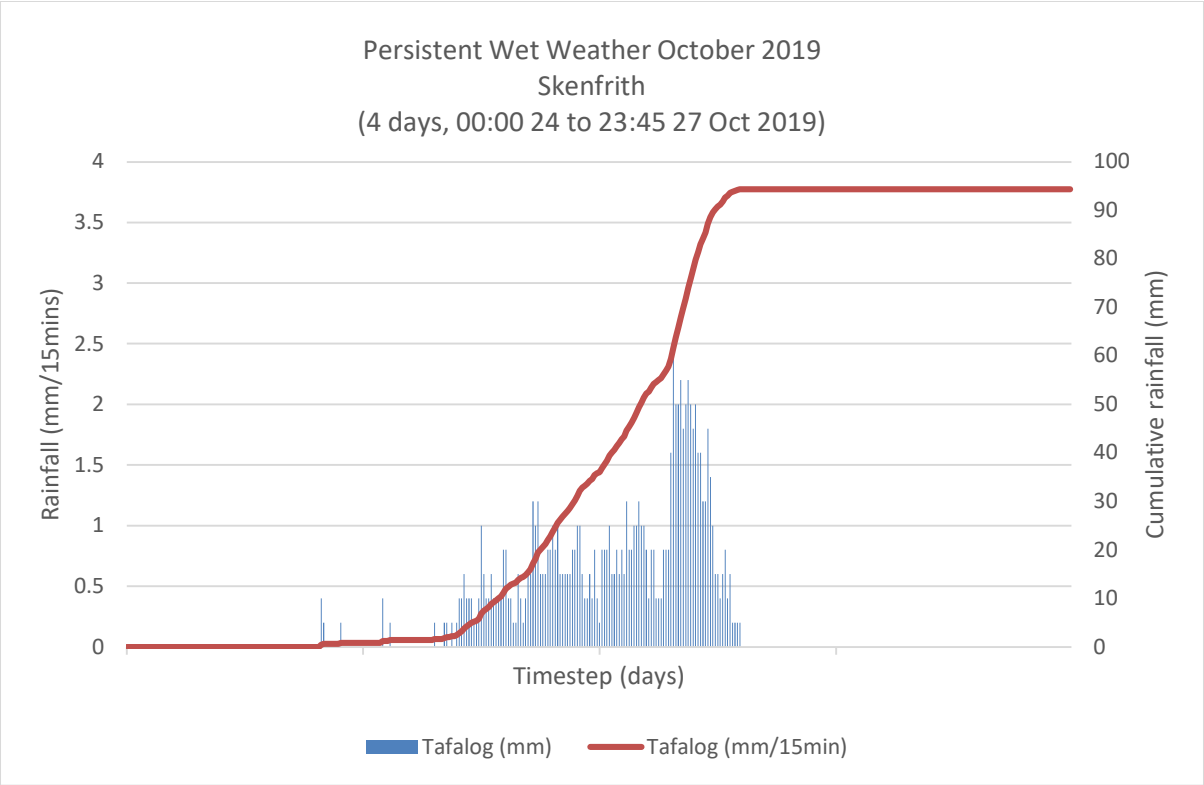


Figure 3-8. Storm Dennis - Rainfall totals Tafalog (mm/15mins), and cumulative rainfall (mm) for the 4-day period 14 to 17 February 2020

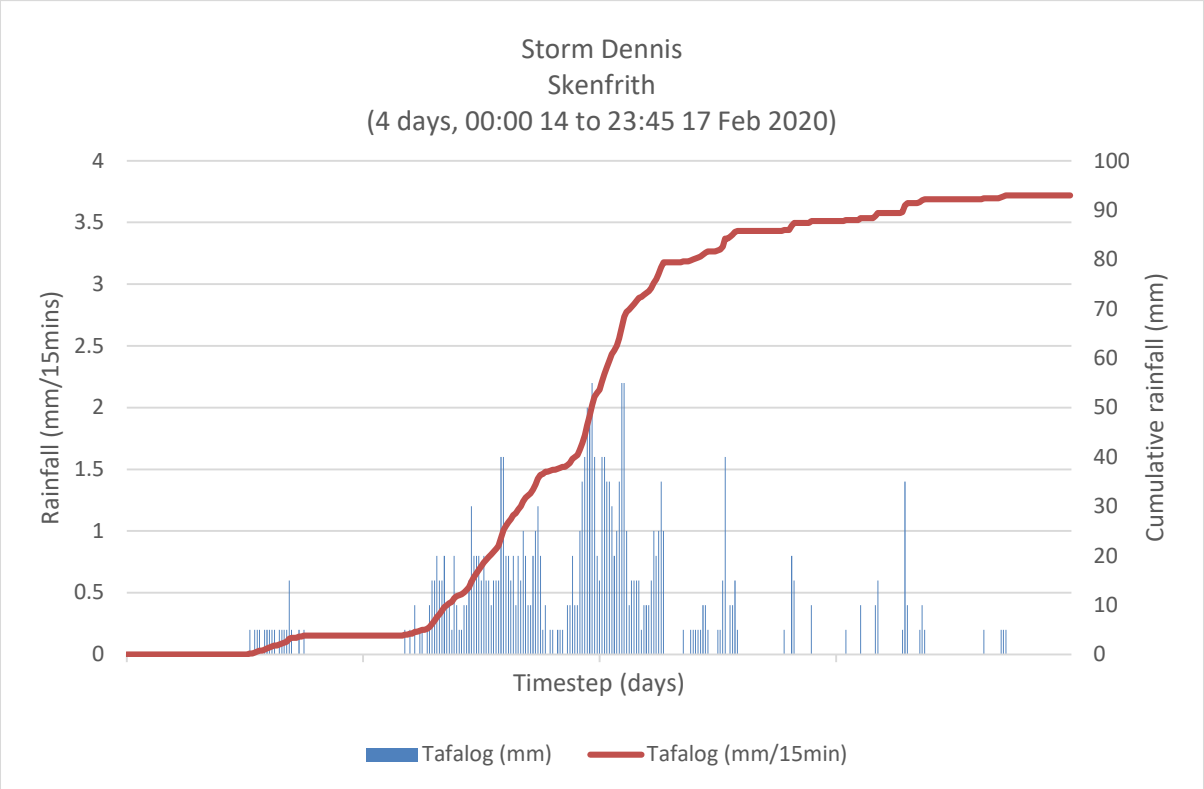


Figure 3-9. Persistent Wet Weather October 2019 - Rainfall totals Vowchurch (mm/15mins), and cumulative rainfall (mm) for the 4-day period 24 to 27 October 2019

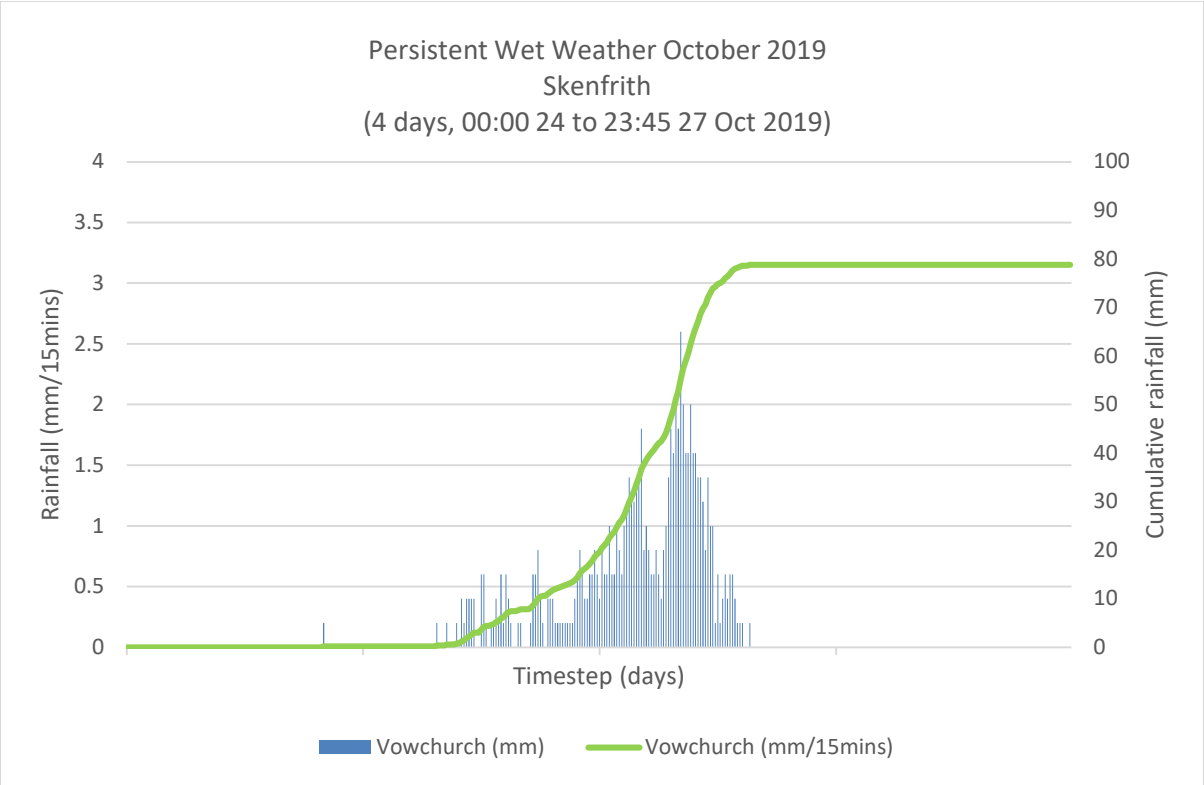


Figure 3-10. Storm Dennis - Rainfall totals Vowchurch (mm/15mins), and cumulative rainfall (mm) for the 4-day period 14 to 17 February 2020

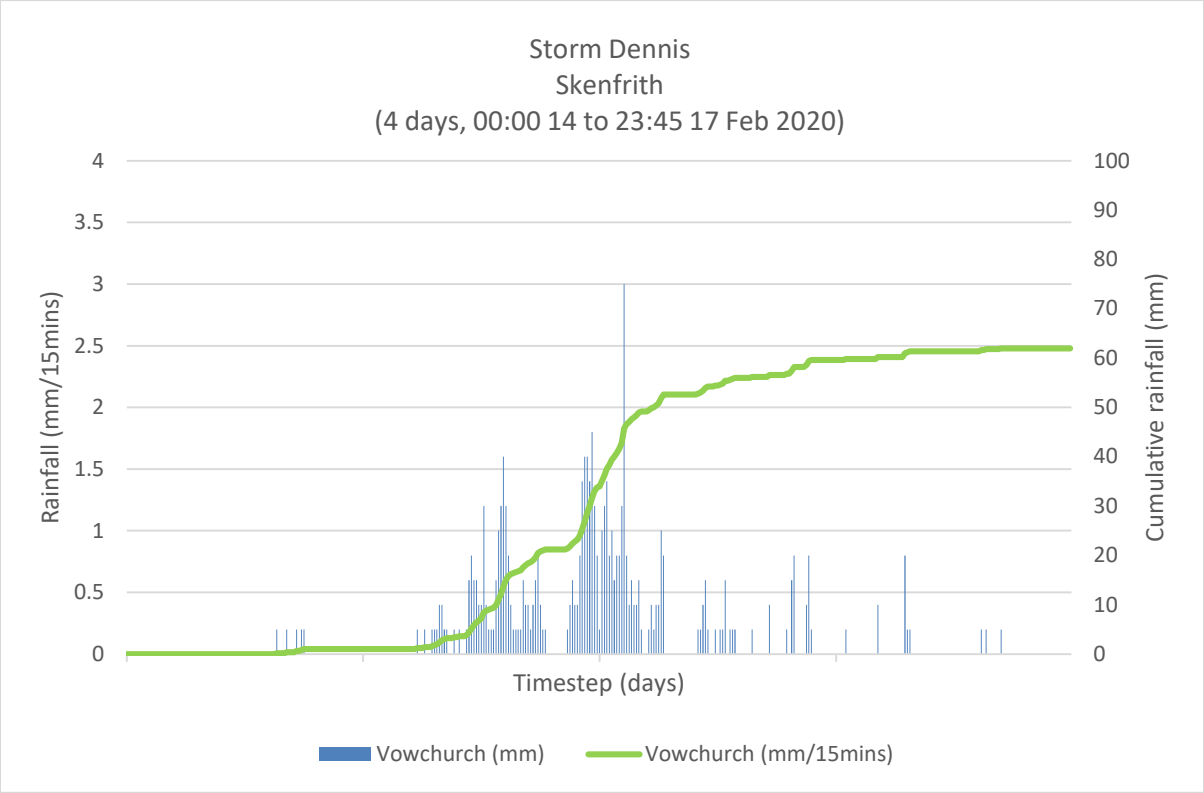


Figure 3-11. Persistent Wet Weather October 2019 - Rainfall totals Tafalog Vowchurch average (mm/15mins), and cumulative rainfall (mm) for the 4-day period 24 to 27 October 2019

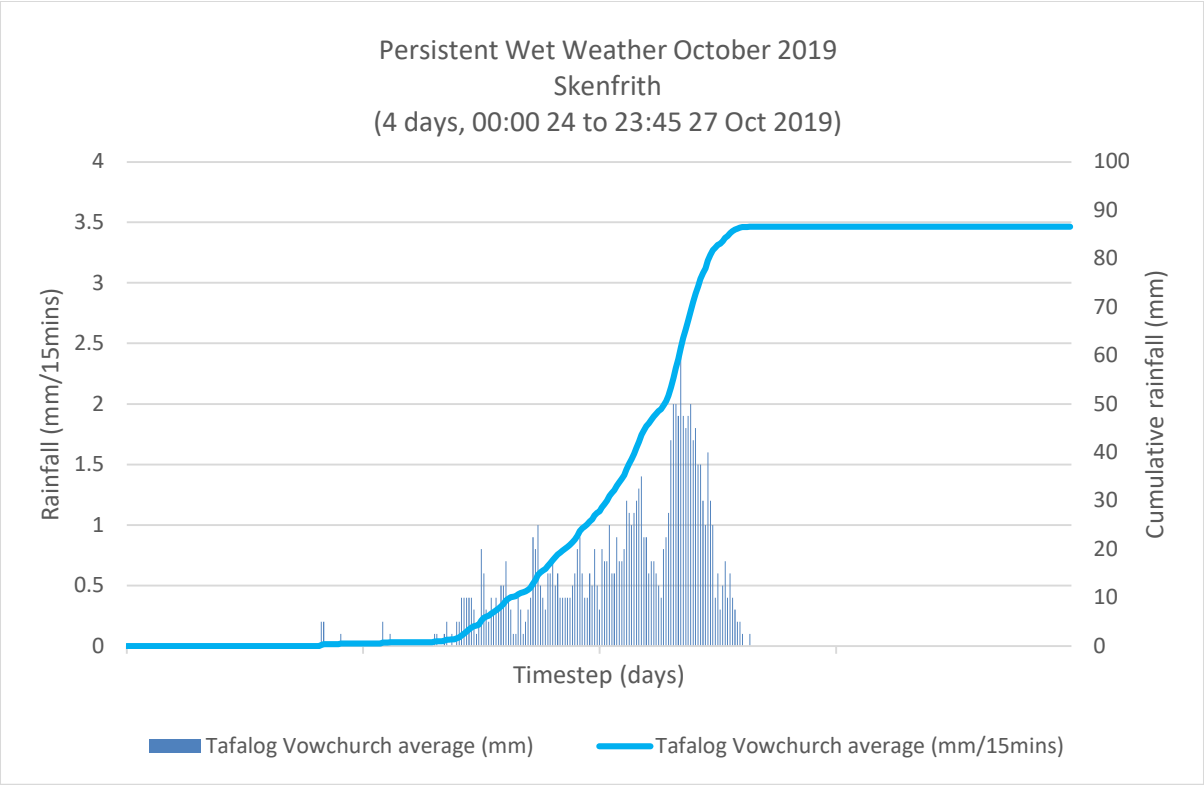
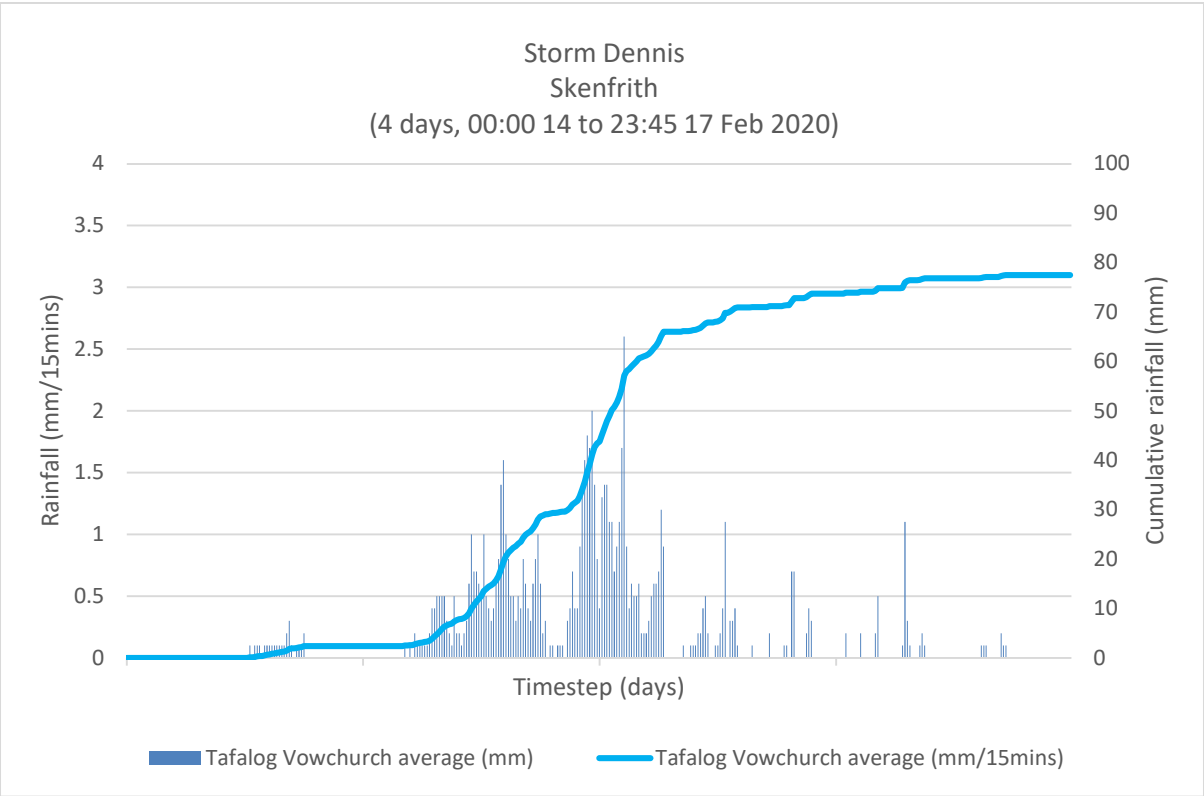


Figure 3-12. Storm Dennis - Rainfall totals Tafalog Vowchurch average (mm/15mins), and cumulative rainfall (mm) for the 4-day period 14 to 17 February 2020



3.5 Return Period

3.5.1 Rainfall

The Met office document *Wales: Climate, Updated 10 October 2016* reported that most parts of Wales experiences daily totals of 50mm or greater at least once every 2 years.

In the NRW document *February 2020 Floods in Wales: Flood Event Data Summary*, NRW reported that Storm Dennis resulted in substantial and intense rainfall with significant impacts on river flows, river levels and flooding in South Wales. Nant yr Ysfa rain gauge, situated between the Cynon and Rhondda Fach catchments, received 130.4mm of rainfall in 24 hours, equivalent to 72% of an entire month's rainfall in a single day. At the top of the Rhondda Fawr catchment, Tyn Y Waun rain gauge received 132.4mm of rainfall in 24 hours, this equates to 62% of a month's rainfall in a single day.

In Pontypridd, the River Taff reached its highest level since records began in 1968. Peak flow passing through Pontypridd was estimated at 805m3/s, enough to fill an Olympic sized swimming pool in just over three seconds. This river level was 78cm higher than the previous record-level set during the 1979 floods.

The rainfall return period is the average interval a storm of at least a specified magnitude will occur on a catchment. The higher the return period the greater the storm.

The rainfall return period has been calculated for the Monnow's catchment at Skenfrith using the Flood Estimation Handbook (FEH), at point 345900, 220250, see Table 3-7. Average rainfall depth and duration data was used from Tafalog and Vowchurch rain gauges. The rain gauge depth and duration data used is presented in Table 3-6, and shows how rainfall varied between the 2 gauges.

Table 3-6. Rainfall depth and duration data.

Rain Gauge	Storm	Period	Duration (hrs)	Rainfall Depth (mm)
Tafalog	Persistent Wet Weather October 2019	09:30hrs 25 Oct to 14:15hrs 26 Oct	28.75	92.2
Tafalog	Storm Dennis	06:30hrs 15 Feb to 06:30hrs 16 Feb	24	74.4
Vowchurch	Persistent Wet Weather October 2019	10:00hrs 25 Oct to 14:30hrs 26 Oct	28.5	77.8
Vowchurch	Storm Dennis	07:00hrs 15 Feb to 06:30hrs 16 Feb	23.5	51.2

Table 3-7. FEH return period in years.

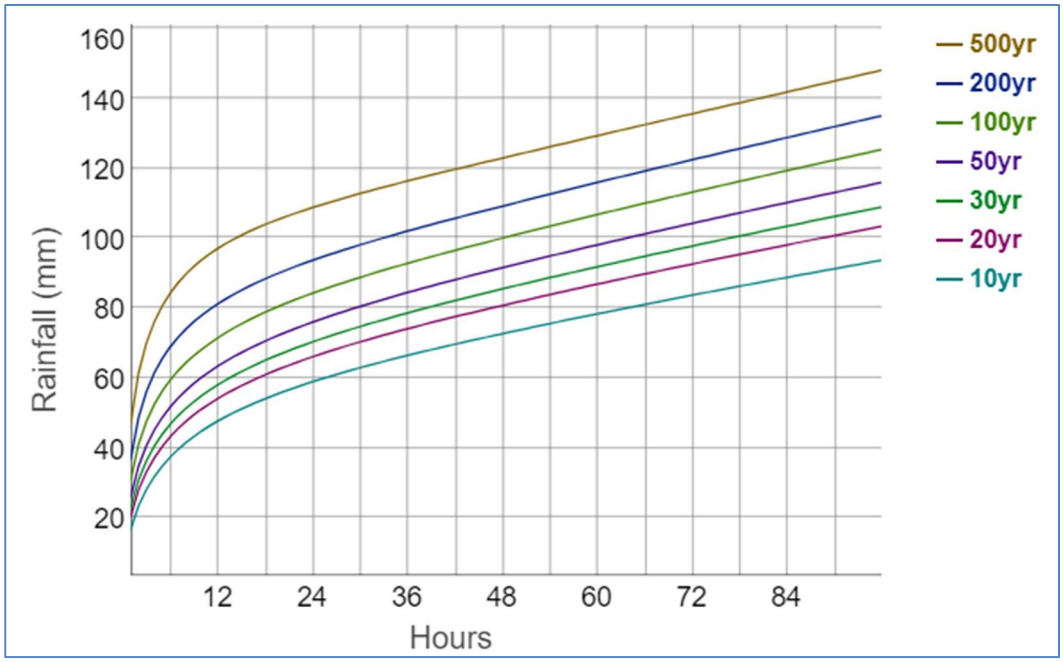
Storm	Duration (hrs)	Rainfall Depth (mm)	Return Period in Years
Persistent Wet Weather October 2019	28.63	85	80
Storm Dennis	23.75	62.8	15

Storm Dennis has a lower FEH return period than Persistent Wet Weather October 2019. The difference in return period between the 2 storms is primarily due to Persistent Wet Weather 2019 having a 26%, or 22mm higher rainfall depth. Persistent Wet Weather October 2019 also had a longer storm duration than Storm Dennis by 17%, or 5 hours. Additionally, rainfall density can vary significantly over a catchment, and may have been higher in ungauged areas, generating a higher return period for the catchment as a whole for Storm Dennis.

The Depth Duration Frequency curves in Figure 3-13 show the relationship between rainfall depth and storm duration for set return periods for the Monnow's catchment at point 345900, 220250. Between 0 and approximately 24-hours, rainfall depths increase at a decreasing rate, and for storms of approximately 24-hour duration and greater, the relationship between storm duration and rainfall depth is linear.

Whilst Storm Dennis has a lower return period for the Monnow's catchment at Skenfrith, river levels were already high at Skenfrith at the onset of Storm Dennis, and the catchment was already saturated due to Storm Ciara and an unnamed rainfall event on 12 and 13 February 2020 generating very fast runoff to the rivers and a high peak in the hydrograph; these were major contributing factors to the flooding. See section 3.4 for further details on antecedent conditions and factors contributing to flooding.

Figure 3-13. FEH Depth Duration Frequency, Monnow catchment, point 345900, 220250.



3.5.2 River

River flow data for the catchment is required for calculation of the river flow return period. This data is not currently available for the Monnow at Skenfrith.

3.5.3 Tidal

This section is not applicable to this report, it is retained for consistency with other FWMA Section 19 reports.

There is no tidal influence on the Monnow at Skenfrith.

3.6 Storm Dennis Across South Wales

South Wales has an oceanic climate and experiences low pressure weather systems moving eastwards from the Atlantic with the polar jet stream. It is also characterised by mountainous terrain. Rivers drain radially from the Brecon Beacons to the coast via main rivers.

Orographic uplift rainfall occurs when air is forced from a low elevation to a higher elevation as it moves across rising terrain. The combination of weather systems arriving from the Atlantic and the orographic lift over the extensive mountainous ranges in South Wales leads to notable storm events.

A Met Office review of the persistent heavy rainfall across Wales and England on 15 and 16 February 2020 (see section 10) reported that Storm Dennis brought 100 to 150mm or more rain across high ground of the Brecon Beacons and South Wales valleys. Storm Ciara 1 week earlier brought 100mm of rain across high ground of Snowdonia, and high rainfall in South Wales. For the 9-day period from 8 to 16 February 2020, most of the UK received the February whole month average rainfall, East Wales received 150%, and parts of Herefordshire received 200%, see Figure 3-14 and Figure 3-15.

Figure 3-14. Rain radar images indicating heavy rain and persistent rainfall over South Wales 12:00 UTC 15 February 2020 and 00:00 UTC 16 February 2020

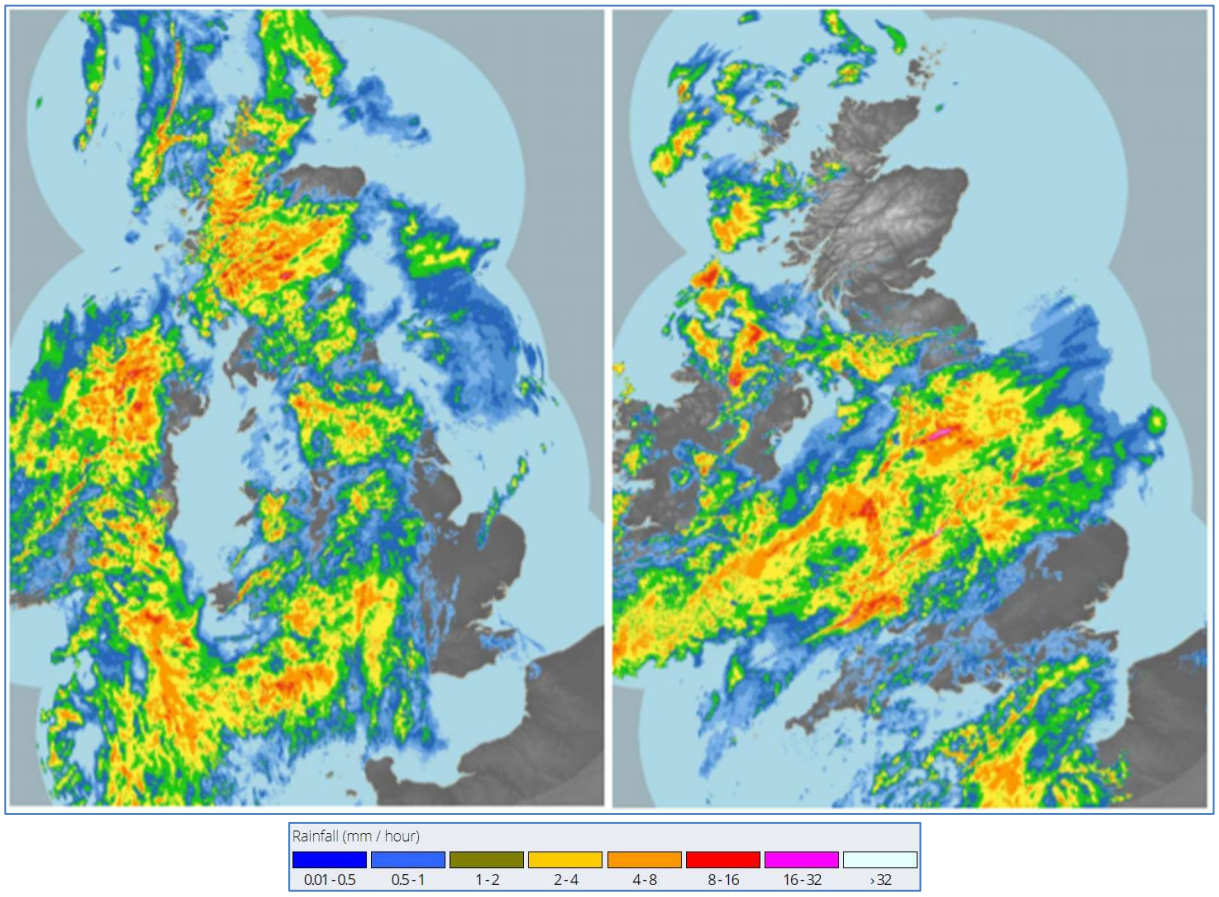
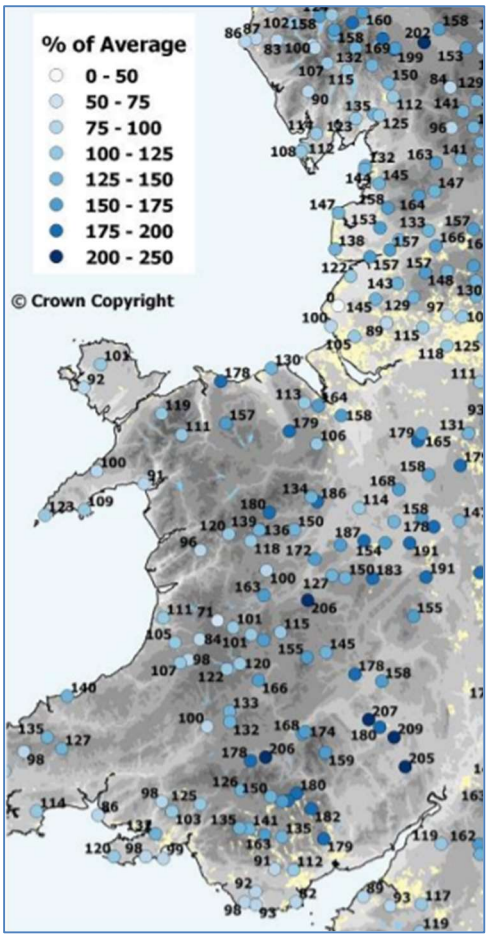
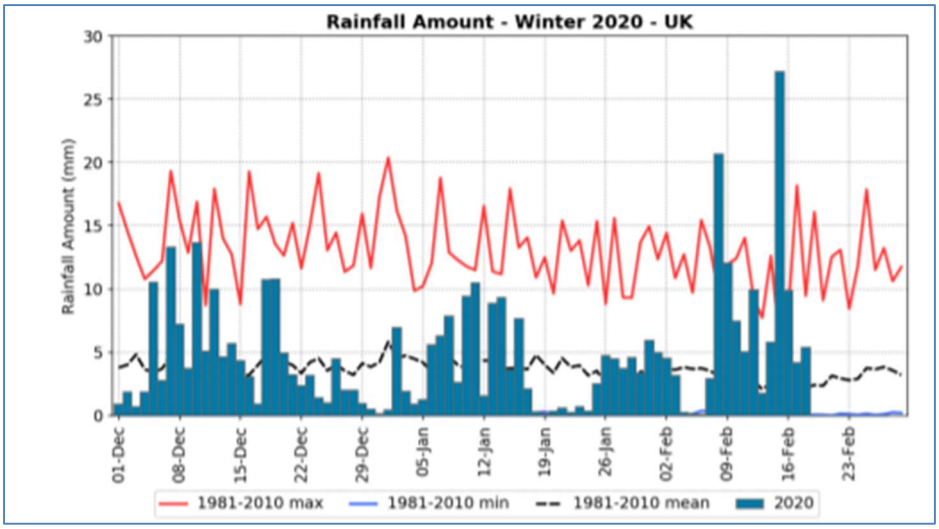


Figure 3-15. Rainfall Totals at Individual Rain Gauges for Storms Ciara and Dennis Combined as % of 1981-2010 February Long Term Average.



The chart below in Figure 3-16 shows the UK areal-average rainfall totals for each day of winter between 1 December 2019 and 18 February 2020, with the exceptionally wet days of 8 and 15 February associated with storms Ciara and Dennis. The red line shows the maximum rainfall for these days between 1981 and 2010, both storms Ciara and Dennis are above the maximum rainfall for any day within this period between 1981 and 2010.

Figure 3-16. UK areal-average daily rainfall totals for 1 December 2019 to 18 February 2020.



3.7 Met Office Weather and Flood Warning

The NRW report *February 2020 Floods in Wales: Flood Event Data Summary*, reported that February 2020 became the busiest month on record for issuing Flood Warnings in Wales; 243 Flood Alerts, 181 Flood Warnings and 6 Sever Flood Warnings were issued. These warnings reached 55,784 individuals, helping people to prepare and take action to save themselves and protect their property. However, due to the intense nature of events, a small number of flood warnings were issued late, or not at all.

The NRW report entitled *February 2020 Floods in Wales: Flood Event Data Summary*, reported that a total of 3,130 properties were flooded during February 2020 in Wales. These included 224 properties flooded during Storm Ciara, 2,765 properties during Storm Dennis, and 141 during Storm Jorge. Of these an estimated 2,527 were households, with an average claims data from the insurance industry valuing around £81 million of flood damage.

Due to Storm Dennis many rivers reached historically high levels, exceeding the 1979 levels which caused extensive flooding and damage across South Wales. However, although significant flooding still occurred, it is estimated that NRW defences across South Wales protected over 19,000 properties.

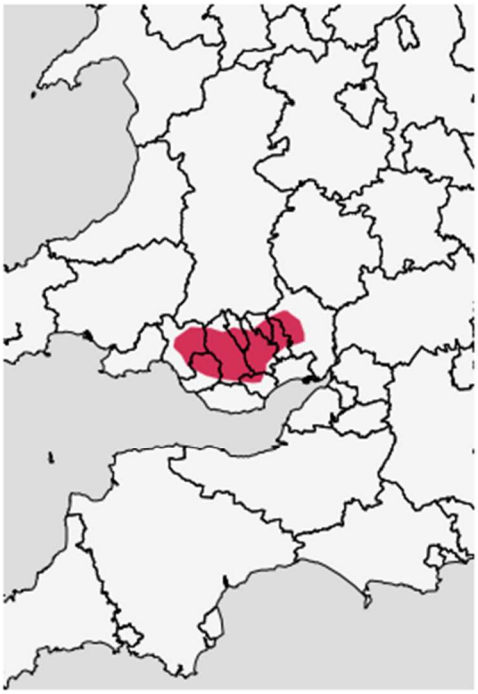
On 11 February 2020 the Met Office issued a Yellow weather warning for disruption to travel in Wales and England due to very strong winds from Storm Dennis on 15 and 16 February 2020. On 13 February 2020 in addition to disruption to travel the Yellow weather warning predicted very heavy rain from Storm Dennis. At 06.10 on 16 February 2020 a Red weather warning was issued for Monmouthshire, in this Storm Dennis was predicted to bring further heavy rain on the morning of 16 February 2020, with it there was a warning of danger to life and high impacts as shown in Figure 3-17.

Figure 3-17. Met Office weather warning for South Wales issued 06:10 Sunday 16 February 2020.

Met Office — National Severe Weather Warning Service

Red warning
Rain

Between
06:10 Sun 16 Feb 2020 and
11:00 Sun 16 Feb 2020



Storm Dennis is expected to bring further heavy rain for a time on Sunday morning, increasing the likelihood of high impacts.

What to expect

- Danger to life from fast flowing or deep floodwater
- Extensive flooding to homes and businesses is likely
- Collapsed or damaged buildings or bridges
- Road closures and bus and train service delays and cancellations
- Dangerous driving conditions because of spray and flooded roads
- Loss of power and other essential services, such as gas, water, mobile phone service
- Communities could be completely cut off by floodwater, perhaps for several days

Further details

Prolonged, heavy rain will continue until mid-morning, easing slowly into the middle of the day. This rain will bring event totals to between 100 and 140mm over higher ground in south Wales.

High likelihood of high impacts

All regions & authorities affected

Wales

Blaenau Gwent Bridgend Caerphilly Cardiff Merthyr Tydfil Monmouthshire Neath Port Talbot Rhondda Cynon Taf Torfaen

4. Sources of Flooding

4.1 Fluvial Flooding

From anecdotal reports the primary source of flooding was fluvial from the River Monnow and the Norton Brook. Intense rainfall from Storm Dennis on the Monnow's catchment resulted in a rapid rise in water levels on these rivers.

From the confluence of the Norton Brook and River Monnow in the northeast of Skenfrith, high levels on the Monnow caused water to back up the Norton Brook to Dry Bridge and overtop the right bank along this stretch of the watercourse. These overland flows then channelled southeast along Norton Road to Skenfrith. The River Monnow then overtopped its right bank downstream of the confluence, and the overland flows merged with those from the Norton Brook causing flooding to property in the village.

There are numerous land drainage ditches and watercourses in Skenfrith as shown in Figure 4-1. The details within the figure were collected by MCC on a site visit following flooding to Skenfrith in October 2019. This detail has been recorded on MCC's flood and drainage asset database in accordance with its duties as Lead Local Flood Authority.

Anecdotal reports and detail in the *EAW Skenfrith Flood Alleviation, Pre-Feasibility Study 2006* state that in times of flooding to Skenfrith, overland flows from higher ground to the south and west of the village are channelled to the War Memorial via land, roads, and drains. There is a section of stone culvert under the War Memorial that channels flows past the old Corn Mill before discharging to the Monnow. It is possible the culvert forms part of the remains of Mill Stream, the old leat which historically powered Corn Mill and was connected to the old weir located 180m upstream of the 3 arch stone bridge, an image of the remains of the old weir is in Figure 4-4. The images in Figure 4-2 and Figure 4-2 indicate that the culvert is not able to discharge via its outlet. Details of Mill Stream can be found in the *EA Easter Floods Report 1998*.

There is another section of culvert under the road at Castle View to the southwest of the War Memorial. There is also a culvert outlet of approximately 600mm diameter on the right bank of the Monnow, downstream of the 3 arch stone bridge, no information has been found on what drains to this outlet.

The *EAW Skenfrith Flood Alleviation, Pre-Feasibility Study 2006* states that the area of land drainage to Skenfrith from the west and south, not including the Norton Brook catchment is approximately 0.65km2.

There are further anecdotal reports from one resident that 1/3 of tree cover in the upper catchment of the Monnow has historically been removed since the resident's father owned the property they live in, this resident also reported that land management practices have changed from pastural to arable, both factors which may have contributed to the fast response of the catchment to rainfall.

Figure 4-1. Skenfrith land and surface water drainage features

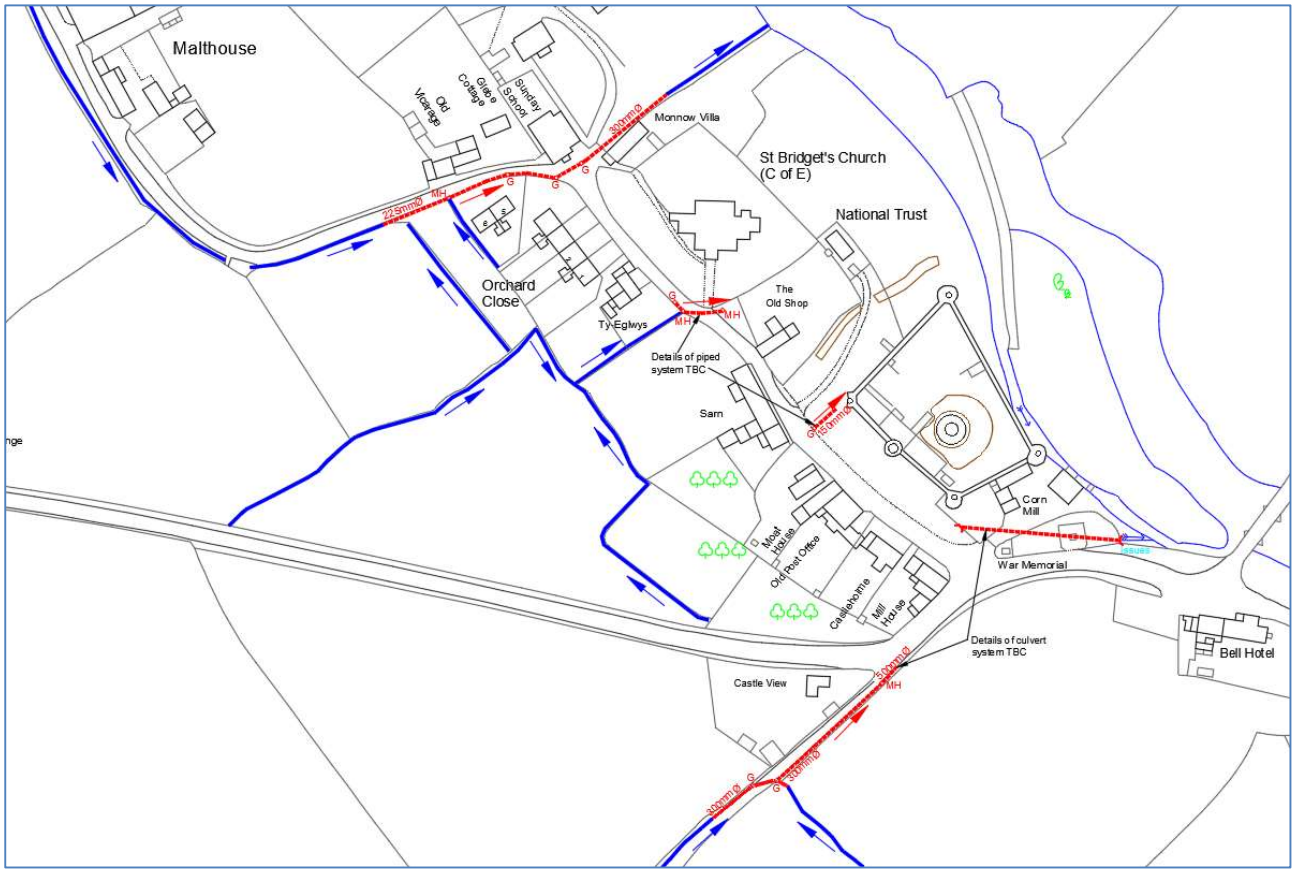


Figure 4-2. Watercourse culvert inlet, War Memorial, site visit May 2021

Figure 4-3. Watercourse culvert outlet, War Memorial, site visit May 2021.

Figure 4-4. Decommissioned weir, site visit May 2021

4.2 Ground Water

Historically during flooding, many residents have experienced water rising through floors within the properties. This is due to high water levels on the Monnow.

4.3 Tidal

This section is not applicable to this report, it is retained for consistency with other FWMA Section 19 reports.

There is no tidal influence on the Monnow at Skenfrith.

4.4 Land Drainage

There is a network of land drainage ditches which channel flows in a south-easterly direction from Dry Bridge along Norton Road to Skenfrith. The network passes the north of Skenfrith before discharging to the Monnow, this network is marked on the plan in Figure 4-1, pictures of the network are in Figure 4-6 and Figure 4-7.

There is another land drainage network along Skenfrith's western perimeter behind residential properties, this drains fields on higher ground west of Skenfrith.

As noted in section 4.1, surface water flows from the land to the south and west of Skenfrith drain down to the War Memorial, via land, roads, and drains. In times of flood this system becomes overwhelmed and contributes to flooding.

The land drainage system within Skenfrith is not designed to manage out of bank flows from the Norton Brook and Monnow and in large flood events the capacity of the land drains is exceeded.

East of Skenfrith there are 2 flood relief arches under the causeway that carries the B4521 over 300m of the Monnow's flood plain. These arches convey flows from the fields east of the village to the Monnow south of the village, a picture of the arches is in Figure 4-5 below. The *EA Easter Floods Report 1998* refers to historical anecdotal evidence related to the 1960 flood at Skenfrith which states the causeway was raised, and that flood waters which would previously have overflowed the road are now prevented from doing so. The EA report also states that further investigation would be required to confirm this effect.

Figure 4-5. Flood relief arches of the B4521 to the east of Skenfrith, site visit May 2021

Figure 4-6. Land drainage channel adjacent to the road to Skenfrith, looking southeast from Dry Bridge, site visit May 2021

Figure 4-7. Land drainage channel upstream of the junction with Orchard Close, site visit May 2021

4.5 Surface Water Drainage

Within the centre of Skenfrith there is a limited highway surface water drainage system which drains Norton Road through the centre of the village. This drainage system also conveys flow from the land drainage ditches on the western perimeter of Skenfrith. The systems typically consist of small pipes and culverts which quickly become overwhelmed during larger flood events as they are not designed to accommodate additional volume from larger watercourses. Details of this drainage network can be seen in Figure 4-1.

In times of flood, surface water from the higher ground to the south and west of the village is also channelled to Skenfrith along the roads contributing to flooding.

5. Rights and Responsibilities of Risk Management Authorities

5.1 Lead Local Flood Authority

Under the FWMA 2010, MCC has been established as the Lead Local Flood Risk Authority (LLFA) for its administrative area.

In its role as LLFA, following the flood event officers from MCC visited the properties affected by flooding and collected information on the event from residents and landowners.

As defined in the Act, MCC is responsible for 'Managing' what is termed, its 'local flood risk'. This includes the risk of flooding from ordinary watercourses, surface runoff and groundwater.

Local Authorities have always had certain responsibilities in relation to ordinary watercourses, and in practice most Local Authorities took the lead in dealing with surface water flooding incidents prior to the changes contained within the Act.

The Act places statutory duties on Local Authorities in their new role as LLFAs including:

- The preparation of local flood risk management strategies;
- A duty to comply with the National Strategy;
- To co-operate with other authorities, including sharing data;
- A duty to investigate all flooding within its area, insofar as the LLFA consider it necessary or appropriate;
- A duty to maintain a register of structures and features likely to affect flood risk;
- A duty to contribute to sustainable development; and
- Consenting powers on ordinary watercourses.

In addition to these, each LLFA has a number of permissive powers. These are powers that allow them to undertake certain activities to manage flood risk, they are discretionary and include:

- Powers to request information;
- Powers to designate certain structures or features that affect flood or coastal erosion risk;
- The expansion of powers to undertake works to include broader risk management actions; and
- The ability to cause flooding or coastal erosion under certain conditions.

LLFA's in Wales have also taken on the role of the Sustainable Drainage Systems (SuDS) Adopting and Approving Body in relation to sustainable drainage systems as of the 7th January 2019. In this role they are responsible for both approving the original design of the SuDS and adopting and maintaining the finished system in accordance with Welsh Government's National Standards for Sustainable Drainage.

The function of the LLFA during and after the flooding at Skenfrith included a range of Response and Recovery functions:

- Officers investigated the flooding and have produced this report in line with Section 19 FWMA 2010.
- Officers contacted residents affected by flooding to offer support and advice to assist in the recovery following the event.
- Officers coordinated the response to the flooding with Emergency Services

- Asset information collected during the flood event has been incorporated into the LLFA Asset Register.

5.2 Natural Resources Wales

Under the Flood and Water Management Act 2010 and The Water Resources Act 1991, NRW have discretionary powers to manage the risk of flooding from main rivers and the sea. They are also recognised as a coastal erosion risk management authority under the Coast Protection Act 1949.

Their strategic oversight role is about having a Wales-wide understanding of all sources of flooding, coastal erosion and the risks associated with them, on a consistent basis across Wales to help inform the RMAs and the public.

NRW is the internal drainage board or carries out the functions of the internal drainage board, for the Internal Drainage Districts (IDDs) in Wales. It is granted powers under the Land Drainage Act 1991 to carry out works to manage the risk of flooding from ordinary watercourses and to regulate obstructions to ordinary watercourses within the IDD. Their main role is the management of water levels in ordinary watercourses in areas where there is a special need for drainage, including flooding.

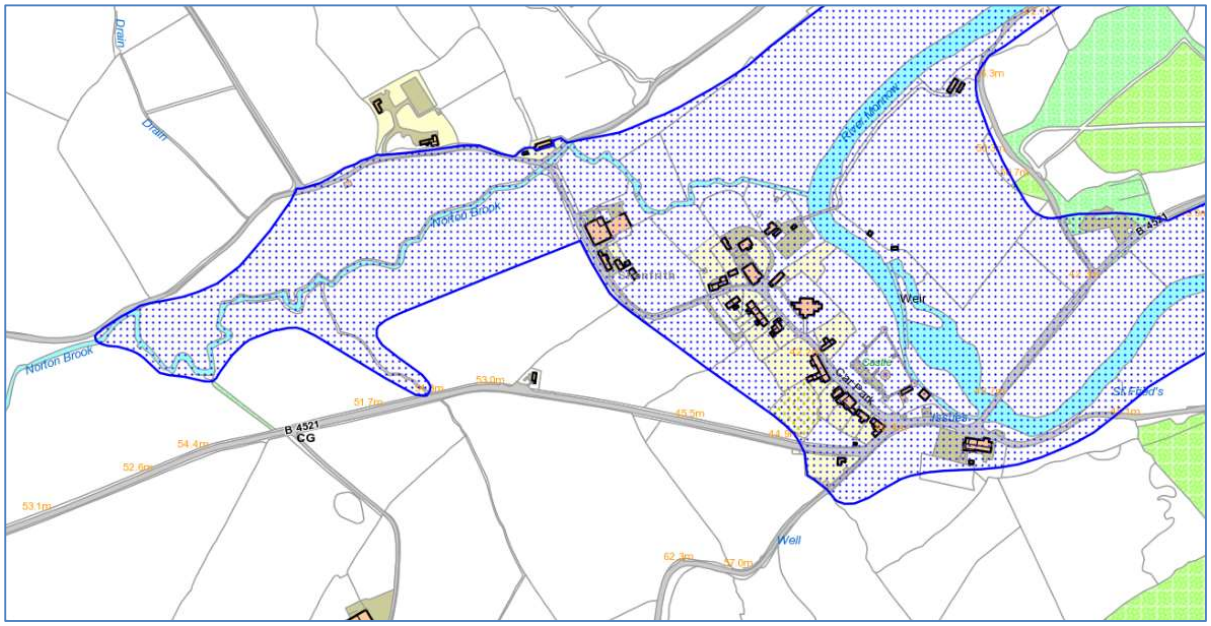
NRW as the Risk Management Authority can use its permissive powers to carry out work in several ways:

- By building new flood defences and other structures such as sluices and pumping stations.
- By maintaining defences and structures once built, keeping them in good condition subsequently, and repairing or improving them if and when required.
- By maintaining main river watercourses, removing obstructions, vegetation and silt or gravel, to keep water flowing and remove significant flooding risks.

Skenfrith is in the Lower Wye IDD as shown in Figure 5-1 and Figure 5-2.

Figure 5-1. IDD boundaries for southern Wales

Figure 5-2. Lower Wye IDD boundary, Skenfrith



5.3 Water / Sewerage Company

Sewerage undertakers are responsible for maintaining the public sewerage systems, including adopted sewers carrying surface water run-off.

In flood conditions, the sewer systems can often become overloaded with a mixture of floodwater and sewage leading to overflow and flooding. Where applicable, Sewerage undertakers are responsible for the removal of surface water from impermeable surfaces through their sewerage system. Where there is frequent and severe sewer flooding, sewerage undertakers are required to address this through their capital investment plans which are regulated by Ofwat. To prevent further flooding, water and sewer companies have a responsibility to monitor levels, prevent overloading of the sewer systems, and maintaining and repairing drainage pipes as necessary. This investigation has not identified any assets or infrastructure belonging to a water or sewage company that may have contributed to the flood event.

5.4 Network Rail

Network Rail has an operational responsibility as a riparian owner and is required to undertake regular maintenance of all assets that pose a risk to flooding. This investigation has not identified any assets or infrastructure belonging to Network Rail that may have contributed to the flood event.

5.5 Highways Authority

The Highway Authority is responsible for ensuring the highway is clear of obstructions and has a drainage system that controls direct surface water falling onto the highway.

MCC is the Highways Authority for all highways in Monmouthshire apart from Trunk Roads which are managed by the Welsh Government. Highways Authorities are also Risk Management Authorities in their own right according to the FWMA 2010 and must adhere to all the responsibilities of Risk Management Authorities.

Under the Highways Act 1980, the Highways Authority has a duty to maintain the highway. This includes ensuring that highway surface water drainage systems are clear and free from blockages.

5.6 Riparian Landowners

A riparian owner is anyone who owns a property where there is a watercourse within or adjacent to the boundaries of their property. A riparian owner possesses rights over and responsibilities for the stretch of a watercourse within or adjacent to their property. A watercourse includes a river, stream or ditch. Riparian owners, (householders and businesses) are responsible for maintaining their rivers, streams, ditches, pipes culverts and bridges.

Riparian landowners are legally responsible under common law for the maintenance of the land generally up to the centreline of any watercourse adjacent to their property. This includes the maintenance of the bed, banks and any boundary features e.g. vegetated strips such as hedging, with routine clearance of debris and/or blockages.

This does not mean that the owner must remove all debris from the watercourse, but it does require the owner to maintain it as far as it does not pose a risk or 'nuisance' to a neighbour. Any works to modify the watercourse by the landowner will first require the necessary consents or permits from the relevant RMA, LLFA, or NRW.

Landowners are responsible for ditches and land drainage assets upon their land. NRW has permissive powers to maintain watercourses which are designated as main rivers and MCC has permissive powers to maintain the ordinary watercourses respectively.

This investigation has not identified any defects with watercourses (Main River or Ordinary Watercourse) under riparian ownership which would have contributed to the flooding.

5.7 Residents and Property Owners

Residents and property owners are responsible for the maintenance and operation of drainage assets and connecting pipework falling within their ownership. They are also responsible for the protection of their own properties against flooding. Where safe to do so, they should take measures to protect themselves and their property from flooding. Residents and property owners have the right to defend their property as long as they do not subsequently increase the risk of flooding to other properties.

6. Permissive Powers of Risk Management Authorities

Natural Resources Wales has permissive powers under the Flood and Water Management Act 2010 and Water Resources Act 1991 to carry out works to manage the risk of flooding from main rivers. These discretionary powers include the ability to undertake works to clear watercourses, as well as developing and implementing flood alleviation schemes when justifiable.

MCC also has similar permissive powers under the Land Drainage Act 1991 on ordinary watercourses.

7. Flood Alleviation Schemes / Drainage Improvements

There are currently no formal flood defences in Skenfrith or plans to implement a formal flood defence scheme.

Some properties have flood barriers, but these are largely ineffective at protecting against large flood events and many residents have experienced water rising through floors within the properties.

The *EAW Skenfrith Flood Alleviation, Pre-Feasibility Study 2006* considered the following options to reduce flood risk:

- Do nothing (baseline case).
- Do minimum (localised land drainage improvements).
- Attenuation storage within the floodplain upstream of Skenfrith.
- River channel conveyance improvements.
- Replace bridge (River Monnow).
- Installation of raised defences and significant land drainage improvements.
- Improvements to local land drainage alone.
- Flood warning system.
- Individual property protection.

The preferred option was a combination of raised defences along the right bank of the River Monnow and Norton Brook, and improvements to local land drainage systems. The defences typically consisted of raised earth embankments and stone faced reinforced concrete walls. Proposed land drainage improvements included the construction of new ditches to intercept runoff from higher ground, enlarging existing ditches, laying new pipework and a small pumping station to discharge to the River Monnow.

An economic assessment of the preferred option concluded that the benefit cost ratio was below unity and therefore the flood alleviation scheme was not economically viable at that time.

The study also concluded there were issues with the accuracy of the hydraulic modelling which would need to be resolved to undertake a full assessment of possible flood alleviation options, including the consideration of conveyance improvements in the location of the flood relief arches carrying the B4521 to the east of Skenfrith.

Given the advancement in hydraulic modelling techniques and changes to the methodology used to assess potential flood schemes in Wales since the study, it is recommended a new study is undertaken using current Welsh Government guidance. Such a study and initial assessment of options would be promoted by Natural Resources Wales as Risk Management Authority.

8. Conclusion

The NRW report *February Floods in Wales: Flood Event Data Summary* states that the consensus from climate change scientists is that extreme weather events, such as Storm Dennis and other storms that impacted Wales in February 2020, are becoming more frequent. Climate change is increasingly impacting the way we live and work around rivers, catchments and the coast, and the way we manage water. Therefore, we need to understand how to adapt the way we live and work in these locations.

This FWMA Section 19 flood investigation into flooding which occurred at Skenfrith on 16 February, has determined that the flooding was the result of heavy and persistent rain during Storm Dennis which fell on ground that was already saturated from Storm Ciara and an unnamed rainfall event on 12 and 13 February 2020. The rain fell across the Monnow's catchment resulting in a rapid rise in levels on the Monnow and Norton Brook.

From anecdotal reports the primary source of flooding at Skenfrith was fluvial from the River Monnow, and its tributary the Norton Brook.

Surface water from 0.65km2 to the south and west of Skenfrith channelled to the village over land, roads and via the land drainage system, and contributed to the flooding.

At the time of preparing this report 18 residential and 4 commercial properties are reported to have flooded in Skenfrith on 16 February 2020 due to Storm Dennis.

Between 1928 and the present day there are records of internal flooding to Skenfrith on 8 occasions suggesting that flooding occurs at a relatively low return period.

The FEH rainfall return period analysis has calculated that Storm Dennis had a lower return period than Persistent Wet Weather October 2019. The high flood impact of Storm Dennis despite the lower return period is due to antecedent catchment and river conditions. The catchment was saturated at the onset of Storm Dennis generating very fast runoff and resulting in a high peak in the hydrograph. Additionally, river levels were already high from Storm Ciara and the unnamed rainfall event on 12 and 13 February, rainfall from Storm Dennis increased river levels even further and caused severe flooding.

The most recent flooding to property at Skenfrith was less than 4 months prior on 26 October 2019, and residents had not fully recovered when Storm Dennis arrived.

9. Recommendations

In accordance with Section 19 of the FWMA 2010, as LLFA, MCC has investigated this flood event and identified which RMAs have relevant flood risk management functions. As a result of the findings of this investigation the following recommendations have been made. The following recommendations in Table 9-1.

Table 9-1. Recommendations from the Section 19 Flood Investigation

Reference	Recommendation	Responsible Risk Management Authority(ies)
SK01 (Flood risk)	Undertake an Initial Assessment of options to reduce flood risk from main river using current Welsh Government FCERM Business Case Guidance and updated hydraulic modelling. The assessment should include a review of all previous historic studies and consider natural flood management options.	NRW
SK02 (Flood assets and land drainage features)	Record detail, ownership and maintenance responsibility of all flood assets and land drainage features and ensure such features are maintained to the required standards.	MCC/NRW
SK03 (Surface water)	Record detail, ownership and maintenance responsibility of all highway surface water drainage features and ensure such features are maintained to the required standards.	MCC
SK04 (Community flood plan)	Consider the requirement for a multi-agency Community Flood Plan to inform and aid the emergency response to future flood events.	NRW/MCC
SK05 (Local protection)	Consider the requirement and location of a local sandbag store (and other equipment) which could be easily accessed by local residents.	NRW
SK06 (Norton Brook telemetry)	Consider the addition of a gauge station on the Norton Brook to aid forecasting and monitoring of water levels.	NRW/MCC
SK07 (Flood warning service)	Raise awareness and understanding of the flood warning service “Floodline” and review take up within the village.	NRW

10. Useful Links and Contacts

- Monmouthshire County Council Flood Pages:
  www.monmouthshire.gov.uk/flood-risk-management

- Natural Resources Wales:
  www.naturalresources.wales/flooding

- Welsh Government:
  www.gov.wales/flooding-coastal-erosion

- Blue Pages
  www.bluepages.org.uk

- Flood Re (Insurance):
  www.floodre.co.uk

- Met Office, Past Weather Events
  https://www.metoffice.gov.uk/weather/learn-about/past-uk-weather-events#y2020

11. Table of Acronyms

Table 11-1 is a list of acronyms used in the report.

Table 11-1. Table of acronyms

Full text	Acronym
Environment Agency	EA
Environment Agency Wales	EAW
Flood and Coastal Erosion Risk Management	FCERM
Flood and Water Management Act 2010	FWMA 2010
Flood Estimation Handbook	FEH
Internal Drainage District	IDD
Lead Local Flood Authority	LLFA
Monmouthshire County Council	MCC
Natural Flood Management	NFM
Natural Resources Wales	NRW
Property Flood Resilience	PFR
Risk Management Authority	RMA

Appendix A – Anecdotal evidence

This appendix has been redacted.