

Monmouthshire County Council

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Tintern

March 2020



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Version Control

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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 the 11 and 12 March 2020 in the village of Tintern, Monmouthshire.

From anecdotal reports it has been established that the primary source of flooding was tidal, with high tides backing up the River Wye from its mouth at the Severn Estuary and Bristol Channel, overtopping onto the A466, and flooding adjacent properties.

Residents have reported their concerns that the frequency of flooding in Tintern has increased in recent years. It is possible that more frequent flooding could be due to climate change; for tidal flooding, the rise in average global temperature is causing sea levels to rise due to thermal expansion, and the melting of ice sheets and glaciers.

At the time of preparing this report a total of 19 residential and commercial properties are reported to have flooded in Tintern on 11 and 12 March 2020.

Following the flood event officers from MCC visited the locations affected by the flooding and collected information on the event from residents and landowners to further understand the nature of the flooding.

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 Investigation

On the evening of the 11th and morning of the 12th March 2020, Tintern was impacted by a significant tidal flood event whereby the tidally driven water levels on the River Wye exceeded river bank levels at multiple locations along the A466 Main Road in Tintern.

This report has been prepared by MCC in response to the duties of the LLFA in Section 19 of the Flood and Water Management Act 2010, 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

The village of Tintern is in the east of Monmouthshire, on the right bank of the main River Wye. Tintern is approximately 16.5km upstream of the mouth of the Wye at the Severn Estuary which is in the Bristol Channel. The Severn Estuary has one of the largest tidal ranges on Earth with a spring tidal range of approximately 15m. The River Wye is the fourth largest river in the UK; upstream of Tintern the Wye's catchment is approximately 4,060km², and is predominately rural in nature, see Figure 2-1.

The 3 main tributaries of the Wye in and around Tintern are the Anghidi River, Cat Brook, and Limekiln Brook, these are shown in Figure 2-2. The A466 Main Road follows the path of the River Wye in Tintern and passes directly through the Tintern community. The A466 Main Road, adjacent properties, and St Michael's Church are at high risk of flooding and have experienced numerous flood events in the past. During flood events the road is closed to traffic. See Figure 2-3 for the flood investigation area location plan.

As well as residents and businesses, Tintern attracts tourists due to its picturesque landscape and its historical landmark Tintern Abbey, See Figure 2-4 and Figure 2-5.

Figure 2-1. FEH River Wye catchment



Figure 2-2. River Wye and its main tributaries around Tintern.

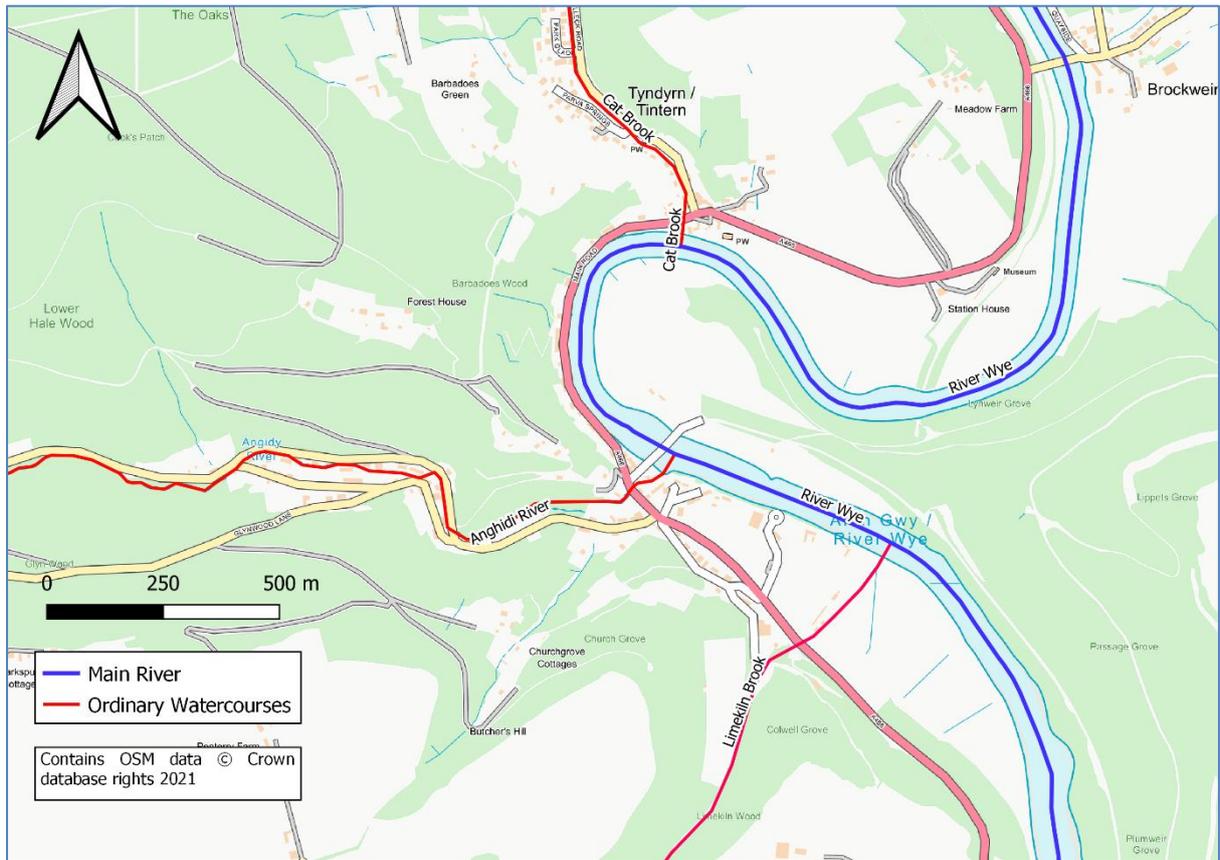


Figure 2-3. Flood Investigation Area location plan.

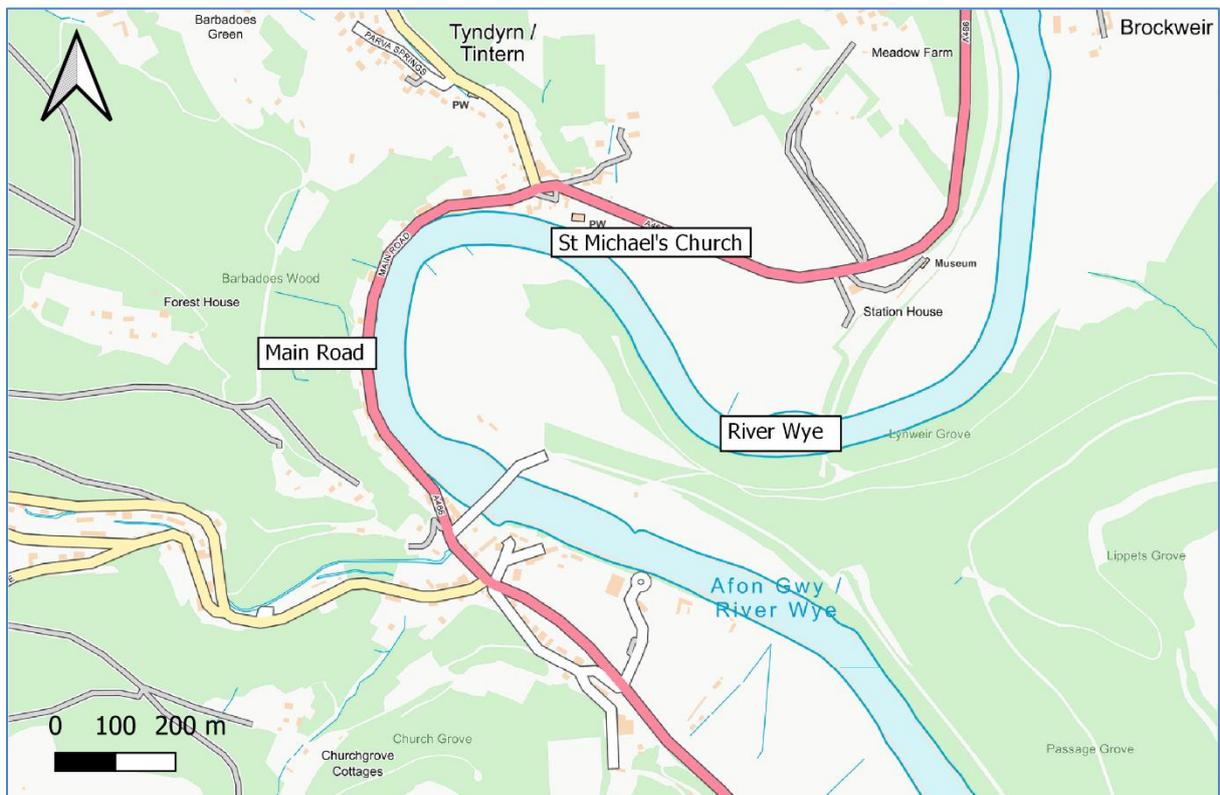
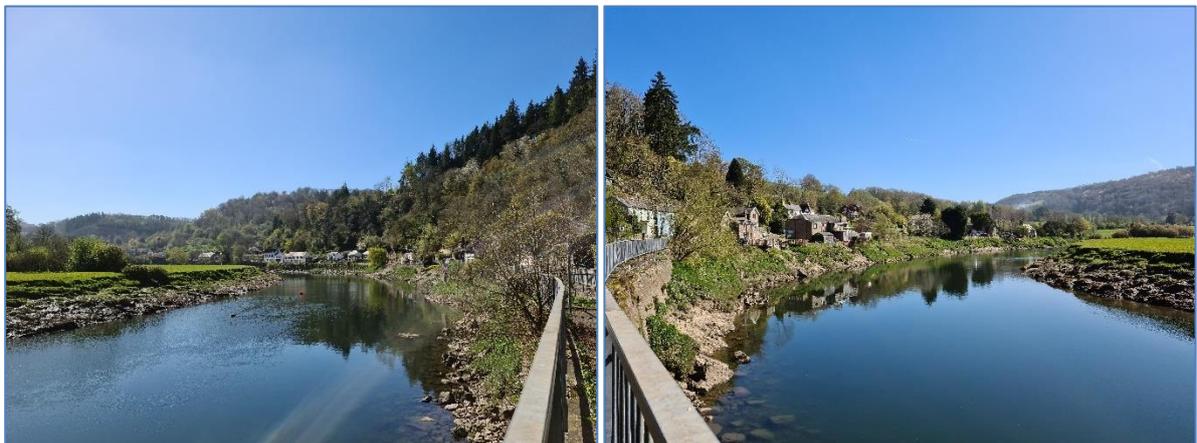


Figure 2-4. Tintern Abbey, site visit April 2021.



Figure 2-5. The Wye at Tintern, and surrounding rolling hills. Left looking downstream, right looking upstream. Site visit April 2021.



Natural Resources Wales (NRW) flood maps show Tintern is at high risk of flooding from the River Wye and the south of the village at risk of flooding from surface water as shown in Figure 2-6 and Figure 2-7.

Figure 2-6. Extract from Natural Resources Wales, Risk of Flooding from Rivers.

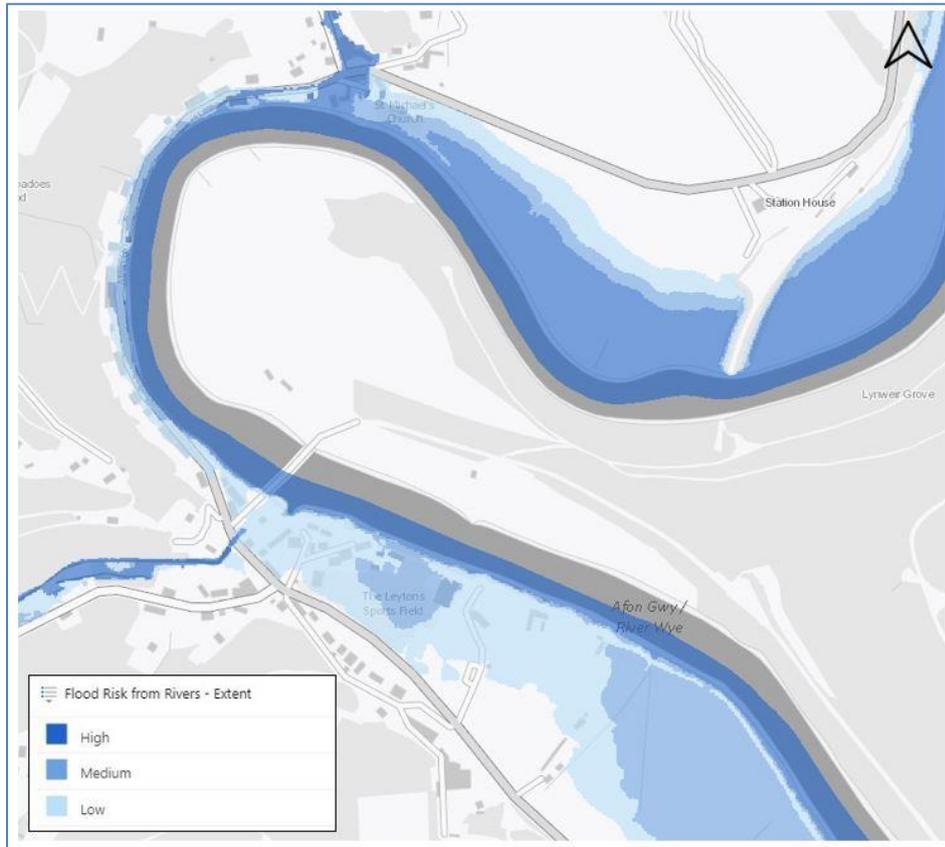
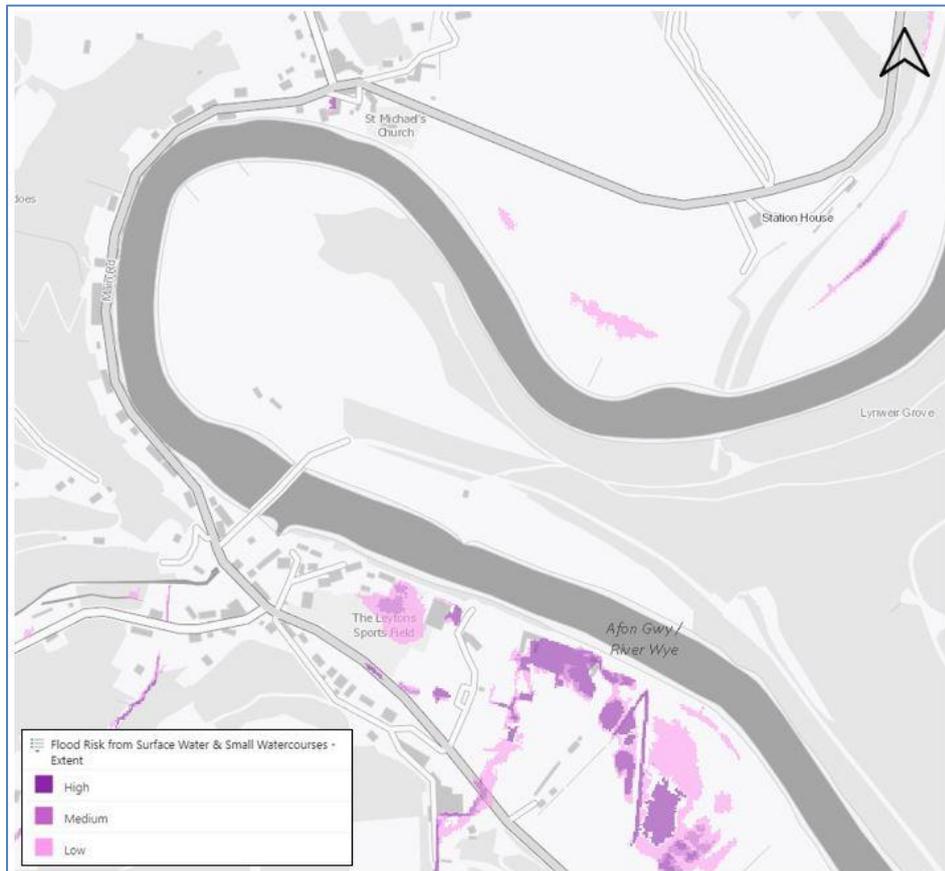


Figure 2-7. Extract from Natural Resources Wales, Risk of Flooding from Surface Water and Small Watercourses.



2.3 Investigation Evidence and Data

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

- Anecdotal evidence collected after the event, and by telephone consultation in May 2021.
- Site inspections and photos.
- Natural Resources Wales flood warnings data.
- Natural Resources Wales – hydrometric data.
- Monmouthshire County Council – rain gauge data, asset database, *Flood Risk Management Plan 2016*, *Preliminary Flood Risk Assessment 2011*, *Preliminary Flood Risk Assessment Addendum 2017*.

2.4 Anecdotal Evidence

Table 2-1 presents anecdotal evidence collected following the flood event on 12 March 2020, and by telephone consultation in May 2021. The table provides a reference to address points, a full table with a list of references and addresses can be found in Appendix B, this table will be redacted prior to report publication due to General Data Protection Regulations.

Table 2-1. Anecdotal evidence.

Address ref	Notes	Flooded (Y/N)
TIN2020/01	Lowest floors flooded by around an inch (approximately 0.03m) of water rising from river through drains.	Y
TIN2020/02	Lowest floors flooded by around an inch (approximately 0.03m) of water rising from river through drains.	Y
TIN2020/03	Lowest floors flooded by around an inch (approximately 0.03m) of water rising from river through drains.	Y
TIN2020/04	Badly flooded.	Y
TIN2020/05	Conservatory and kitchen flooded on this occasion from Wye. Flooded from Cat Brook during Storm Dennis.	Y
TIN2020/06	Cellar flooded to 6 feet (approximately 1.83m) depth. Normally only floods as deep as 3 feet (approximately 0.91m) so some damage caused.	Y
TIN2020/07	Full internal flooding.	Y
TIN2020/08	Overtopped flood board and came through floors. About 1 foot (approximately 0.3m) through the house.	Y
TIN2020/10	No one home. Likely flooded throughout.	-
TIN2020/11	A very small amount of water entered building.	Y

TIN2020/12	4 to 6 inches (approximately 0.1m to 0.15m) clear from being flooded.	N
TIN2020/13	Flooded throughout.	Y
TIN2020/14	Full internal flooding.	Y
TIN2020/15	Internal flooding. Flooded many times before and is resilient.	Y
TIN2020/16	N/A.	Y
TIN2020/17	<p>Flooded throughout.</p> <p>The resident provided a detailed account of the flood event timeline:</p> <ul style="list-style-type: none"> • 10 March – Flood warning received at 21:19hrs, water then came onto Main Road. • 11 March - High tide came onto road at 09:08hrs. The road level is 8.5mAOD. • 11 March - Tide level at the at the Anchor, and Rose and Crown at 21:17hrs was 9.36mAOD. • 11 March - Power went off at 21:23. Water came over the fence at 9.44mAOD, over 0.08m in 5 minutes, highest level recorded. <p>The resident is concerned that the frequency of flood events at Tintern has been increasing over time. Tidal impacts are key, and the large-scale weather effects on tides (pressure, wind speed, direction). Apart from tidal impacts and high flows on the River Wye, the resident stated development and loss of flood plain, has increased flooding downstream due to increased runoff.</p> <p>There is slippage on right bank of the river due to scour/erosion, the left bank shows multiple slips and has been moving back at quite a rate: 2m in 7 years.</p> <p>The left bank floods before the right bank during flood events. The level on the left bank is 0.7m lower than property threshold.</p> <p>Internal flooding to the resident's property also occurred in January 2014.</p>	Y
TIN2020/18	Flooded by 6 to 12 inches (approximately 0.15m to 0.3m) of water throughout.	Y
TIN2020/19	Flooded throughout – stock lost as they had not expected levels so high.	Y
TIN2020/20	Cellar flooded.	Y
TIN2020/21	Internal flooding.	Y
TIN2020/22	Flooded.	Y
TIN2020/23	Only garage flooded. House reported to be a couple of inches (approximately 0.05m) above flood level.	N

Table 2-2 provides timings of flood event milestones from anecdotal reports and MCC.

Table 2-2. Flood event milestones from anecdotal reports.

Milestone	Time and date
Flood warning received; water then came onto the road.	10 March at 21:19
High tide onto the road (8.5mAOD) in the morning.	11 March at 09:08
The river water level rose to the road (8.5mAOD), flooding The Anchor and The Rose and Crown. Power went off when the river level reached 9.36mAOD.	11 March at 21:17
Water level reached 9.44mAOD.	11 March 21:23
Flooding until morning of 12 March 2020.	12 March (am)

3. Flooding

3.1 Previous Flood Incidents

Tintern can experience regular flooding due to high tides which mainly affect the A466 in the centre of the village. Temporary road closures are installed during these times. Anecdotal reports of significant historical tidal flooding in Tintern that has affected properties are recorded in Table 3-1. In addition to the events in the table MCC understand that tidal flooding in Tintern is frequent enough that it is often not reported. Flood events that were not tidal have not been included in the table.

Table 3-1. Recorded historic flood events.

Flood date
January 2014
March 2020

3.2 Flood Incident

On 11 and 12 of March 2020, high tides in the Bristol Channel and Severn Estuary resulted in the River Wye backing up to Tintern, overtopping and causing flooding to the A466 and 19 residential and commercial properties in the village.

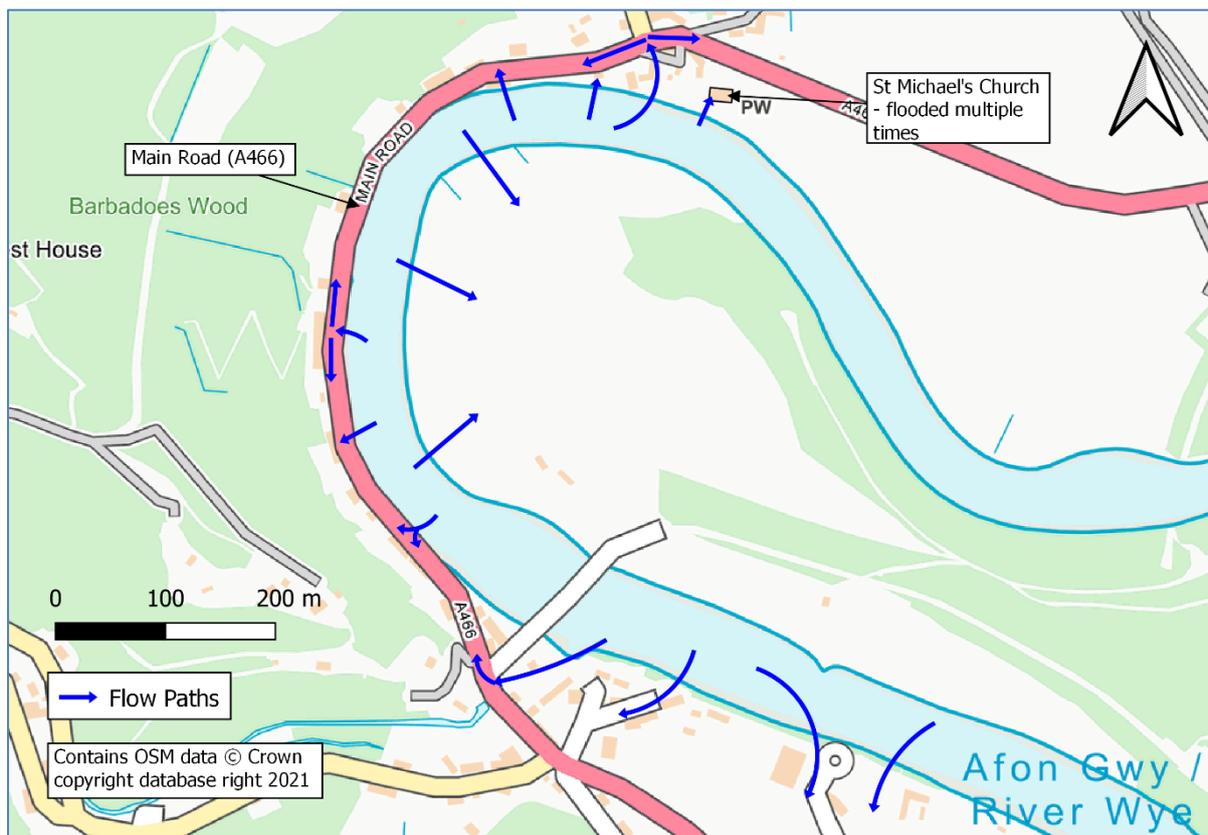
The reported maximum flood depth to ground floors was 0.3m, and there was a reported maximum flood depth of 1.8m in a cellar.

A flood warning was issued at 21:19hrs on 10 March 2020 and the A466 flooded shortly after. There were further high tides at 09:08hrs and 21:23hrs on 11 March, with a maximum river level of 9.44mAOD. On a site visit after the flood event, MCC recorded that there was flooding from a further high tide on 12 March 2020. Further information on NRW and Met Office weather warnings can be found in section 3.7.

Although most residents report the primary source of flooding was the River Wye overtopping its banks due to the high tide, there were reports that at least one property was flooded by groundwater; it's very likely that water rose through the ground due to high river levels on the Wye. Residents also reported flooding from surcharging drains within the sewer network; it's very likely these drains surcharged as they were unable to discharge to the Wye, also due to high river levels.

Figure 3-1 shows flood flow paths in the event.

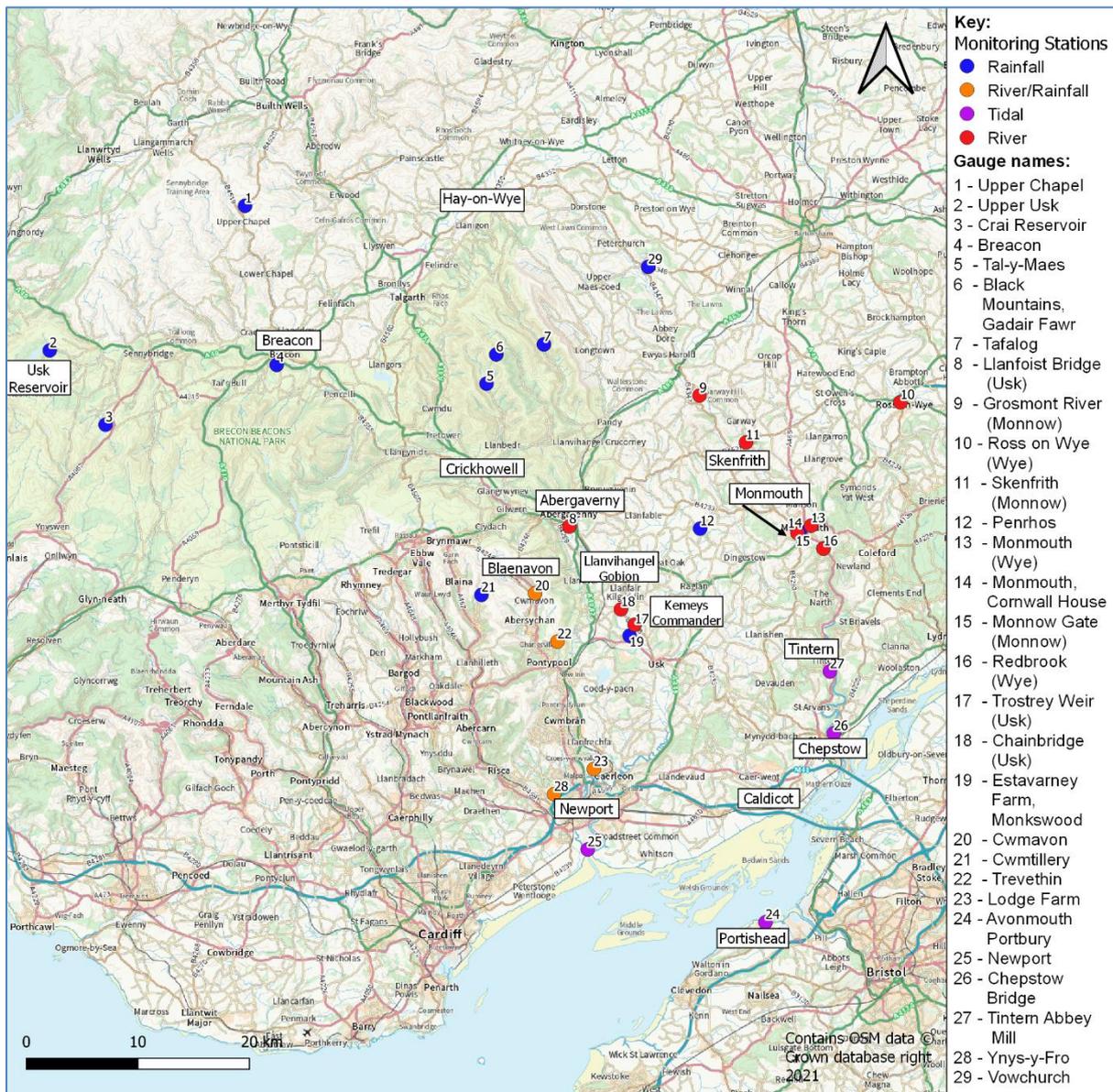
Figure 3-1. Tintern flood incident plan showing indicative flow paths.



3.3 Gauging Stations

The location of nearby NRW and Environment Agency (EA) river, rain and tidal gauges are shown in Figure 3-2. All gauges are operated by NRW except Vowchurch rain gauge, Ross on Wye river gauge, and Avonmouth Portbury tidal gauge which are operated by the 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.



3.4 Gauge Monitoring

The hydrograph in Figure 3-3 shows tidal river stage data for the Wye at Tintern and rainfall data for the Vowchurch rain gauge located within the Wye’s catchment 38.25km to the northwest of Tintern, for the period 3 March to 17 March 2020.

Based on data at the Vowchurch rain gauge, rainfall on the catchment preceding the 11 and 12 March 2020 flood event did not impact maximum river levels on the Wye at Tintern, and therefore rainfall was not a source of the flooding.

The primary source of flooding at Tintern on 11 and 12 March 2020 was tidal.

Timings of high tides from the hydrograph are recorded in Table 3-2, and correlate closely to high tides reported anecdotally in Table 2-2.

Figure 3-3. River Wye stage data at Tintern and local Vowchurch rainfall data.

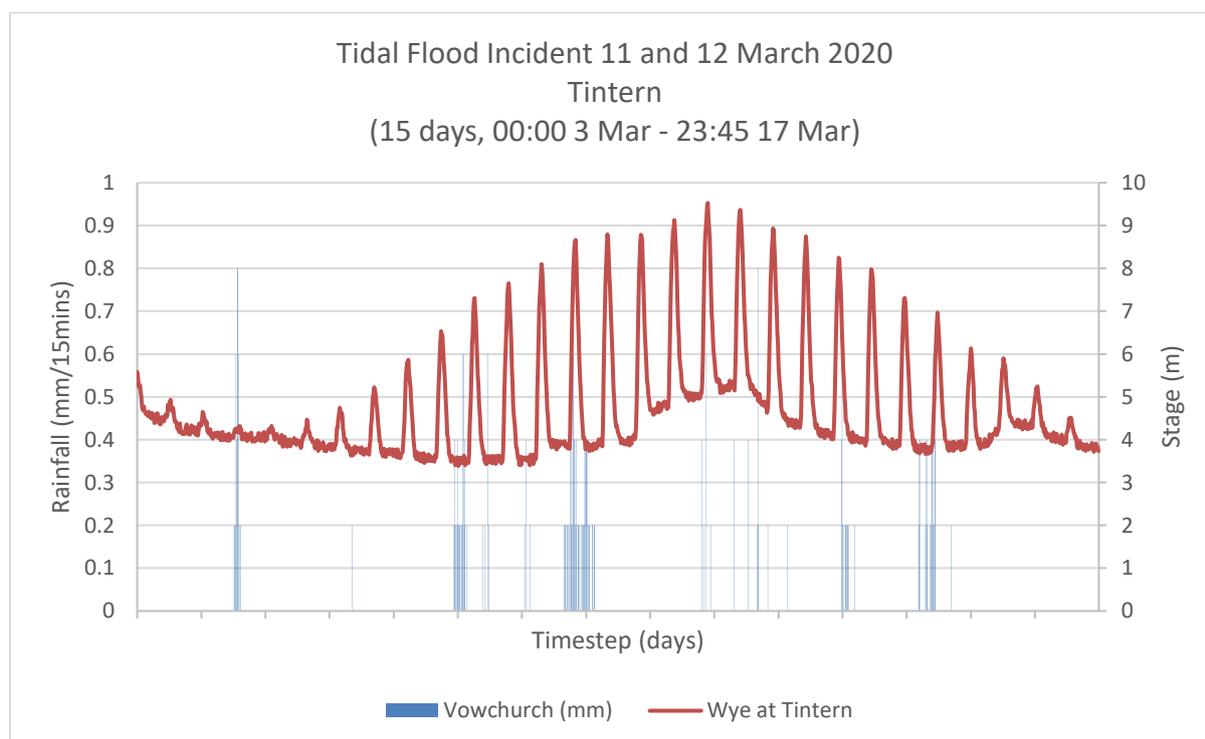


Table 3-2. High spring tides over 8.5mAOD, from 10 to 13 March, NRW tidal gauge at Tintern Abbey.

Level (mAOD)	Time GMT (hrs)	Date	Time period level was over 8.5mAOD
8.79	08:00	10 March 2020	08:00 - 08:15
8.79	20:30	10 March 2020	20:15 - 21:00
9.13	09:00	11 March 2020	08:15 - 09:30
9.53	21:30	11 March 2020	20:30 - 22:15
9.37	09:45	12 March 2020	09:00 - 10:15
8.94	22:00	12 March 2020	21:45 - 22:15
8.75	10:15	13 March 2020	10:15 - 10:30

MCC provides forecasts of the timings of high tides at Tintern on the council web pages when they could affect the A466. Forecasted timings for the high tides expected on 10, 11, 12 and

13 March 2020 were last updated on the MCC website on 9 March 2020 and are presented in Table 3-3. The timings are approximately consistent with the observed timings in Table 3-3.

Table 3-3. Forecasted high spring tides at Tintern for 10 March 2020 to first daily high tide 13 March 2020.

Date	Approximate Time Window, (GMT)
10 March 2020	08:10 – 08:40hrs
10 March 2020	20:35 – 21:05hrs
11 March 2020	08:55 – 09.25hrs
11 March 2020	21.15 – 21.45hrs
12 March 2020	09:35 – 10:05hrs
12 March 2020	21.55 – 22.25hrs
13 March 2020	10.15 – 10:45hrs

Along with the forecasted high tides, the MCC webpage also details planned temporary road closures of the A466 between the junction of Trelleck Road and junction of the Royal George due to tidal flood water on the highway.

The following hydrographs in Figure 3-4 and Figure 3-5 show river levels of the Wye at Tintern for the year 2019 to 2020, and for the year 2020 to 2021 respectively. There is a period of no data between April and July 2019. The spring tide of March 2020 was the highest tide for the 2-year period.

Figure 3-4. River Wye levels at Tintern Abbey for the year 2019 to 2020, Shoothill GaugeMap.



Figure 3-5. River Wye levels at Tintern Abbey for the year 2020 to 2021, Shoothill GaugeMap.



3.5 Return Period

3.5.1 Rainfall

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

The flooding at Tintern on 11 and 12 March 2020 was a tidal flood event and not due to rainfall.

3.5.2 River Flow

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

The flooding at Tintern on 11 and 12 March 2020 was due to tidal water from the Bristol Channel backing up the Wye, and not due to flows from upstream in the Wye's catchment.

3.5.3 Tidal

Within the anecdotal reporting in section 2.4 there is concern by one resident that the frequency of flooding in Tintern is increasing over time. Table 3-1 indicates that flooding has only occurred twice since 2014, however it is believed that not all tidal flooding events that affect properties in Tintern are reported to MCC or NRW.

The low point of the A466 at Tintern is 8.5mAOD. From a series of NRW river level data for the Wye at Tintern Abbey from 1 September 2019 to 31 March 2021, periods of high tides exceeding this road level are presented in Table 3-4. Based on this short historical period, flooding of the road occurs 38 times in 578 days, which is on average approximately once every 15.21 days, and occurs approximately 24 times a year, (return period of 24 times in 1 year).

Assuming a kerb height of 0.12m, property threshold of 0.15m, and no Property Flood Resilience measures (PFR), the frequency of high tide events flooding property on the A466 in the location where it floods regularly from the Wye, for the period 1 September 2019 to 31 March 2021 is 12; over the 578 days this is an average of once every 48.17days, and an occurrence of approximately 8 times a year, (return period of 7 to 8 times in 1 year).

It is noted here that internal flooding to property does not happen immediately as it takes time for flood water to permeate building exteriors, and so internal property flooding is also dependent on the duration of levels over a threshold.

Due to varying threshold levels, existing PFR measures and the lack of reporting of property flooding, the actual frequency of flooding to properties is anticipated to be much less.

It is also noted that the tidal cycle is not consistent, and that levels are heavily influenced by varying weather patterns and atmospheric pressure. In 2021 no tides were forecasted to reach the level of the A466 in Tintern or affect properties. During this period MCC Operational staff attended the site on four separate occasions due to minor surges, with a small quantity of water reported on the road on one occasion. No issues to properties were reported.

Table 3-4. High tides of elevation 8.5mAOD and greater for the period 1 September 2019 to 31 March 2021, NRW river levels at Tintern Abbey.

Level (mAOD)	Time GMT (hrs)	Date	Time period level was over 8.5mAOD	Max. duration level was over 8.5mAOD (mins)
8.623	21:15	1.9.19	21:15 – 21:30	30
8.503	19:15	28.9.19	19:15	15

8.805	07:45	29.9.2019	07:30 – 08:15	60
8.894	20:15	29.9.2019	20:00 – 20:30	45
8.960	08:45	30.9.2019	08:15 – 09:00	60
9.327	21:00	30.9.2019	20:15 – 21:30	90
8.948	09:15	1.10.2019	09:00 – 09:45	60
8.673	07:45	28.10.2019	07:45	15
8.747	20:00	28.10.2019	19:45 – 20:00	30
8.546	08:15	29.10.2019	08:15 – 08:45	30
8.776	09:15	11.2.2020	08:45 – 09:15	45
8.753	21:45	11.2.2020	21:30 – 22:00	45
8.703	10:00	12.2.2020	09:45 – 10:15	45
8.618	22:30	12.2.2020	22:15 – 22:30	30
8.599	10:15	13.2.2020	10:15 – 10:30	30
8.669	20:00	9.3.2020	19:45 – 20:00	30
8.793	08:00	10.3.2020	08:00 – 08:15	30
8.787	20:30	10.3.2020	20:15 – 21:00	60
9.128	09:00	11.3.2020	08:15 – 09:30	90
9.527	21:30	11.3.2020	20:30 – 22:15	120
9.368	09:45	12.3.2020	09:00 – 10:15	90
8.936	22:00	12.3.2020	21:45 – 22:15	45
8.749	10:15	13.3.2020	10:15 – 10:30	30
8.628	20:30	8.4.2020	20:00 – 20:30	45
8.826	08:30	9.4.2020	08:30 – 09:00	45
8.737	21:00	9.4.2020	20:45 – 21:15	45
8.613	09:15	10.4.2020	09:15 – 09:30	30
8.586	21:45	10.4.2020	21:45	15
8.552	20:45	20.8.2020	20:45	15
8.574	21:15	21.8.2020	21:15 – 21:45	45
8.566	21:15	19.9.2020	21:00 – 21:15	30
8.748	20:00	17.10.2020	20:00 – 20:15	30
8.673	08:30	18.10.2020	08:30 – 08:45	30
8.755	21:00	18.10.2020	20:30 – 21:15	60
8.595	09:15	19.10.2020	09:15	15
8.633	07:30	15.11.2020	07:15 – 07:45	45
8.536	08:15	16.11.2020	08:00 – 08:15	30
8.735	20:30	16.11.2020	20:15 – 20:45	45

3.6 Storm Report

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

The flooding at Tintern on 11 and 12 March 2020 was a tidal flood event and not due to intense rainfall.

3.7 Met Office Weather Warning, and Flood Warning

The Met Office issued 2 Flood Guidance Statements via the Flood Forecasting Centre relating to coastal flood risk on 11, 12, and 12 March 2020 at the coast where the Wye discharges to the Severn Estuary.

The 1st warning in these statements was for tidal flood risk on 11 and 12 March 2020, this forecast was Green (very low flood risk) and was issued at 10:30hrs on Sunday 8 March 2020. The statement showed the location of this Green flood risk along the section of coastline labelled L, see Figure 3-6. The colour coding of the warning in terms of flood risk is described in Figure 3-7.

The warning was escalated to Yellow (low flood risk) at 10:30am on 11 March 2020; this 2nd statement forecast tidal flood risk on 11, 12 and 13 March 2020 along the coast where the Wye discharges to the Severn Estuary.

Figure 3-6. Flood Guidance Statement, Flood Forecasting Centre, flood risk on the coast of the UK on Thursday 11 and Friday 12 March 2020.

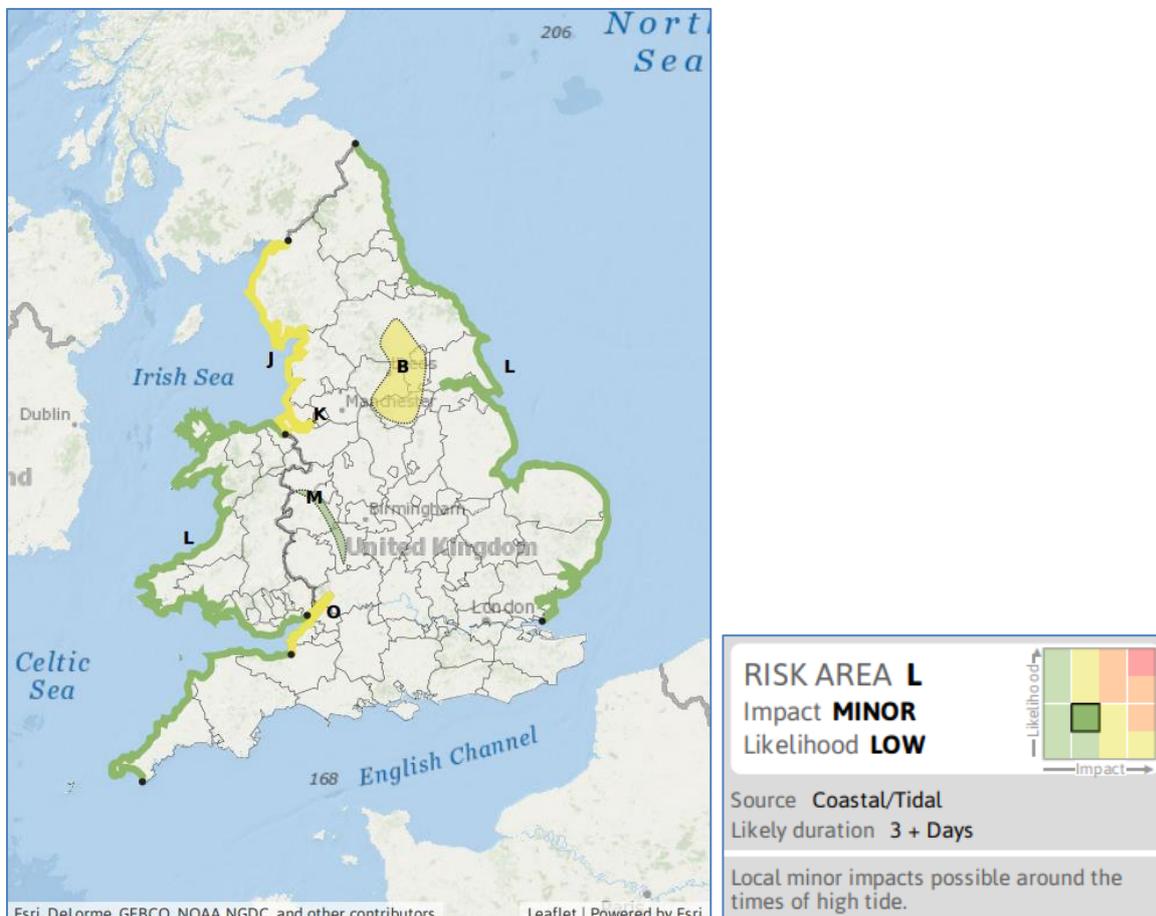
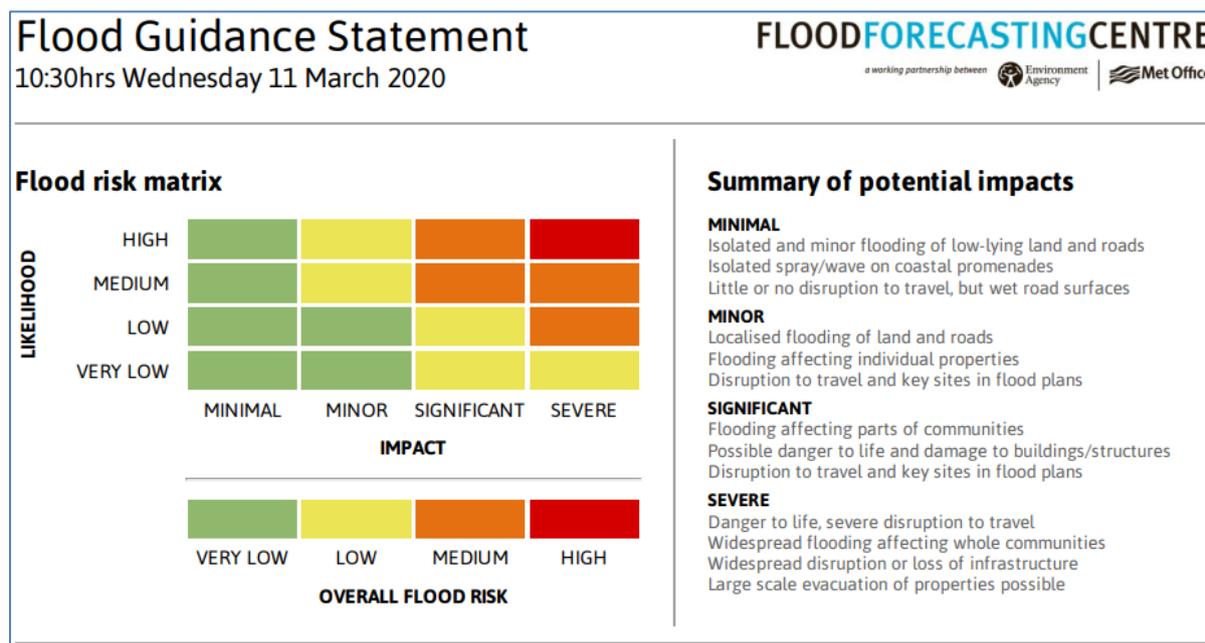


Figure 3-7. Flood Guidance Statement, Flood Forecasting Centre, Flood Risk Matrix.



4. Sources of Flooding

4.1 Fluvial Flooding

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

The flooding at Tintern which occurred on 11 and 12 March 2020 was due to high Spring tide.

4.2 Groundwater

There are anecdotal reports that at least 1 property in Tintern experienced groundwater flooding during the 11 and 12 March 2020 tidal flood event, this was due to high tidal river levels on the Wye.

4.3 Tidal

Tides are long-period waves caused by the gravitational forces exerted by the moon and sun. Spring tides are high tides, and occur when the Sun, Moon and Earth are in alignment and their gravitational force is strong, these tides occur twice a month. Neap tides are lower than spring tides, they occur when the Moon faces the Earth at a right angle to the Sun, and the gravitational force is less strong. Neap tides occur twice a month in between spring tides.

Tides originate in the oceans and travel toward the coastlines where they appear as the regular rise and fall of the sea surface. The difference in height between the high tide and the low tide is called the tidal range.

The tidal range of the River Severn is one of the largest in the world, with the range of spring tides spanning approximately 15m. Before the construction of locks and weirs, the effect of the tide could reach as far up the Severn as Worcester.

The primary source of flooding in Tintern was tidal, with the River Wye backing up from high sea levels in the Severn Estuary.

The River Wye overtopped its banks and flooded the A466 and 19 residential and commercial properties on 11 and 12 March 2020.

The photo in Figure 4-1 is from MCC's *Flood Risk Management Plan 2016* and shows the A466 flooding in Tintern from a previous tidal event. The *Flood Risk Management Plan 2016*, Table 3.2 Number of Residents at Risk of Main River and Sea Flooding, states that 266 residents and 113 properties are at low (1 in 1000 return period) risk of flooding from rivers and the sea. It's noted that these resident numbers relate to the whole Tintern community council area, and not just the village itself.

Figure 4-1. Previous tidal flooding of the A466 in Tintern. MCC Flood Risk Management Plan.



4.4 Land Drainage

There are land drains, small unnamed watercourses and springs which discharge to the Wye and tributaries of the Wye, one discharges to the Wye beneath the A466 in the centre of the village. Named tributaries of the Wye in and around Tintern are the Anghidi River, Cat Brook and Limekiln Brook. These watercourses and springs can back up from the Wye and contribute to flooding during tidal flood events.

4.5 Surface Water Drainage

It was reported that several properties in the north of Tintern were flooded internally from drains backing up and surcharging due to high river levels on the Wye. Some highway gullies along the A466 also back up during high tidal events typically just before overtopping of the river bank occurs.

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, MCC visited the affected area shortly after the flood event. A consultation with the residents was also carried out by telephone in May 2021.

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 take 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 7 January 2019. In this role they are responsible for both approving the original design of the SuDS and where applicable 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 the flood investigation area included a range of Response and Recovery functions:

- Officers investigated the flooding and have produced this report in line with Section 19 of the 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 flood risk.

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 where it enters into 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 possesses rights over and responsibilities for the stretch of a watercourse that forms the boundary of their property. A riparian owner is anyone who owns a property where there is a watercourse within or adjacent to the boundaries of 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 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 Risk Management Authority, Lead Local Flood Authority (LLFA) or Natural Resources Wales (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.

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.

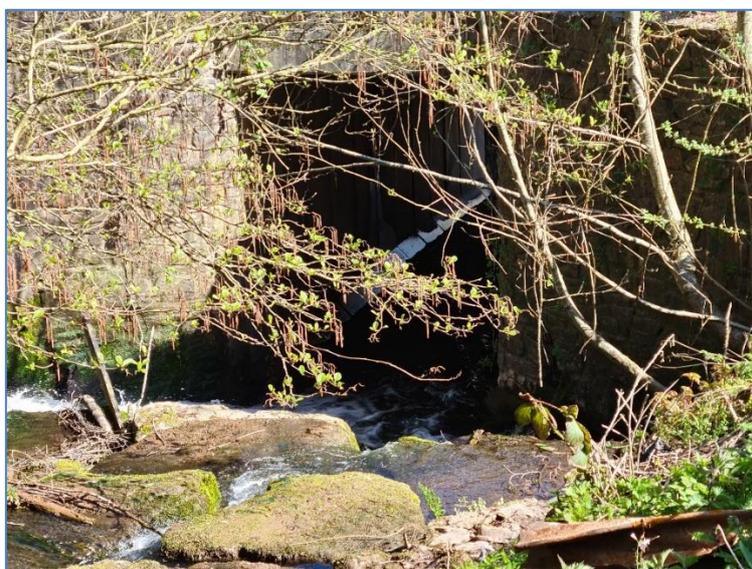
7. Flood Alleviation Schemes / Drainage Improvements

Previous flood alleviation and drainage improvement schemes in Tintern, including those outlined in MCC's *Flood Risk Management Plan 2016*, are outlined in Table 7-1.

Table 7-1. List of historical local flood alleviation schemes, including those outlined in MCC's Flood Risk Management Plan, February 2016.

Date	Measures to mitigate flood risk in Tintern Community Area
1996/1997	A significant flood event in 1993 with widespread damage following a severe rainstorm over the catchments of the Cat Brook, Limekiln Brook and Anghidy River. In response to severe flooding in Tintern from this event, in 1993 the Tintern Flood Alleviation Scheme involved works on the Anghidy River adjacent to and under the A466, carried out and completed in 1996/1997. The scheme was designed to provide a 1 in 100 standard of defence from the Wye up to the bridge crossing Chapel Hill. It was not possible to include the areas of the Cat Brook or Anghidy above the Chapel Hill area as the benefit to cost ratio of works was too low to qualify for grant funding.
Not stated	Tintern Flood Alleviation Scheme involving works on the Limekiln Brook and subsequent additions to deal with high volumes of debris. CCTV camera installed to view screens remotely.
Not stated	Pre-feasibility study of Anghidy River culverts (private) near "Rushbrook." Inclusion in list of potential schemes to Welsh Government.
Not stated	Fountain Inn, Trellech Grange, flood investigation of culvert and watercourse alignment. Now resolved following local works.
Not stated	Investigation of culverts, including those under Gothic Cottage and Trellech Road, where flooding occurred from private culvert beneath property.
2014	Installation of a trash screen and CCTV monitoring on the Cat Brook upstream of the Trellech Road/Parva Springs junction culvert. Works also included clearance of impediments to flow within the watercourse.

Figure 7-1. Tintern surface water flood alleviation scheme 1996/1997, MCC, Anghidy river, underpass to the A466 discharging to the Wye. Site visit April 2021.



8. Conclusion

This FWMA Section 19 flood investigation into flooding which occurred in Tintern on 11 and 12 March 2020, has determined that the flooding was the result of high tides backing up the River Wye from its mouth at the Severn Estuary in the Bristol Channel. The River Wye exceeded its capacity in Tintern, overtopped and flooded the A466 and adjacent low-lying properties.

At the time of preparing this report 19 residential and commercial properties are reported to have flooded in this location during the flood event.

Assessment of historical levels on the Wye suggest that the A466 floods regularly and that low-lying properties adjacent to the A466 with no Property Flood Resilience measures are also at risk of regular flooding.

There are also anecdotal reports that the frequency of flood events in Tintern has been increasing over time. This may be due to climate change; for tidal flooding, the rise in average global temperature is causing sea levels to rise due to thermal expansion, and the melting of ice sheets and glaciers.

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.

Table 9-1. Recommendations from the Section 19 Flood Investigation at Tintern March 2020.

Reference	Recommendation	RMAs
TN01 (Flood Risk)	<p>Undertake an initial assessment of options to reduce flood risk from the River Wye using current Welsh Government Flood and Coastal Erosion Risk Management (FCERM) Business Case Guidance.</p> <p>The assessment should include but not be limited to the following:</p> <ul style="list-style-type: none"> An assessment of potential mitigation measures to reduce flood risk to residential and commercial property, including engineered options and Property Flood Resilience. 	NRW/MCC
TN02 (Land Drainage)	Record detail, ownership and maintenance responsibility of all land drainage and flood asset features and ensure such features are maintained to the required standards.	MCC/NRW
TN03 (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
TN04 (Community Flood Plan)	Consider the requirement for a Community Flood Plan to inform and aid the emergency response to future flood events. This should include community engagement, awareness raising and training to enable the community to monitor, interpret, act and respond to river trigger levels on the Wye. Plans should also raise awareness and understanding of flood risks and Property Flood Resilience measures. This will give the community more ownership of the flood plan. The plan should also include details of assistance and support available to the community including what financial support might be available following flood events.	MCC/NRW
TN05 (Flood Warning Service)	Raise awareness and understanding of the flood warning service "Floodline" and review take up in Tintern.	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>
- Lle, A Geo-Portal for Wales
<https://lle.gov.wales/catalogue/item/HistoricFloodWarningsAndFloodAlerts/?lang=en>

11. Table of Acronyms

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

Table 11-1. Table of acronyms.

Full text	Acronym
Environment Agency	EA
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.