Appendix E

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Storm Dennis –

Flood Investigation Area RCT17

January 2022

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This report should be read in its entirety

This report has been prepared in accordance with the requirements of section 19 Flood and Water Management Act 2010. The Council assumes no responsibility or liability from any person in connection with its contents or findings.

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EXECUTIVE SUMMARY

This report has been produced through the duties placed upon Rhondda Cynon Taf County Borough Council under Section 19 of the Flood and Water Management Act 2010. The Act states, “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”.

This Section 19 investigation provides a factual report of the storm event that occurred on the 15th and 16th of February 2020 within the Rhondda Cynon Taf County Borough Council area, focusing the investigation on the impacted areas of the Taff’s Well community (Flood Investigation Area RCT 17, Figure 1).

This report was undertaken to identify the mechanisms of flooding, establish which Risk Management Authorities have relevant flood risk management functions under the Flood and Water Management Act 2010 and ascertain if those Risk Management Authorities have undertaken or are planning to undertake actions related to those functions to manage the risk of flooding.

The flooding that affected RCT17 on the 15 and 16th of February 2020 was a result of an extreme rainfall event, designated by the Met Office as ‘Storm Dennis’. The storm event resulted in the internal flooding of at least 36 properties: including 25 residential properties and 11 non-residential properties. Significant flooding to the highway throughout the investigation area also occurred.

These impacts were identified through inspections made by RCT’s Flood Risk Management Team during the days following the storm event, as well as information collated by residents, RCT’s Public Health team, RCT’s Highway and Streetcare Depot, Natural Resources Wales and Dŵr Cymru Welsh Water.

It has been established from the evidence gathered within this report that the primary source of flooding in this incident was the overtopping of the main River Taf following persistent and heavy rainfall. River level gauge data from NRW’s Upper Boat monitoring station reveal that the River Taf was over four times its typical level during Storm Dennis, reaching a peak level of 5.49 metres; the highest river level recorded at the station since its opening in 2001.

A review of NRW's Flood Risk Assessment Wales Maps identifies the impacted properties within RCT17 at low risk of flooding from the main river due to the presence of formal defences along the eastern embankment providing a standard of protection up to Q200. A section of the northern riverbank was however identified as having no formal flood protection. This information, paired with accounts provided by residents, infers that the River Taf initially overtopped at this location, allowing significant conveyance of flood water to flow south behind the formal defences towards Cardiff Road, resulting in significant property flooding.

The investigation also identified surface water accumulation on the highway to have caused internal flooding to two non-residential properties, in addition to exacerbating existing fluvial flooding within RCT17.

NRW has been determined as the relevant Risk Management Authority responsible for managing the river flooding that occurred during Storm Dennis. In response to the flooding at investigation area RCT17, NRW have;

- Carried out their own post event investigative analysis work to understand the mechanism of flooding from the River Taf at Taff's Well;
- Completed inspection and restoration works to the River Taf embankment at Taff's Well;
- Commissioned a Lower Taf Flood Modelling Project, the outcomes of which will include an initial assessment of the viability of potential flood risk management options; and
- Developed a series of recommendations and a detailed action plan to address areas of improvement for future storm events, including the performance of NRW's Flood Warning Service and incident management response.

RCT as the Lead Local Flood Authority, Land Drainage Authority and Highway Authority has been determined as the relevant Risk Management Authority responsible for managing the surface water flooding that occurred during Storm Dennis. In response to the flooding at investigation area RCT17, RCT has;

- Carried out survey, jetting and cleansing operations to highway drainage infrastructure.
- Led on the development of a central Control Room to compliment the Council's Contact Centre and CCTV Centre; and to provide a comprehensive and informed response to residents during storm events;

- Exercised its powers, under Section 13 of the Flood and Water Management Act 2010, to engage with NRW and DCWW in relation to their responsibilities as Risk Management Authorities; and
- Working in partnership with NRW, the LLFA have expanded their interim Property Flood Resistance project offering expandable flood gates to those properties deemed at high risk of river flooding, as per NRW's determination.

The event that occurred on 15 and 16th February was extreme, and it is unlikely flooding from a similar event could be prevented entirely. It is concluded that Risk Management Authorities satisfactorily carried out their flood risk management functions in response to the flood event, however, further measures have been proposed by all RMAs to improve preparedness and response to future flood events.

ABBREVIATIONS

CaRR – Communities at Risk Register

DCWW – Welsh Water

FRMP – Flood Risk Management Plan

FWMA – Flood and Water Management Act 2010

LDA – Land Drainage Authority

LFRMS – Local Flood Risk Management Strategy

LLFA – Lead Local Flood Authority

NRW – Natural Resources Wales

Q – Return Period (1 in X chance of an event occurring in any given year)

RCT - Rhondda Cynon Taf

RCT17 – Flood Investigation Area RCT 17

RCTCBC – Rhondda Cynon Taf County Borough Council

RMA – Risk Management Authority

SAB – Sustainable Drainage Approval Body

SFRA – Strategic Flood Risk Assessment

SOC – Strategic Outline Business Case

SuDs – Sustainable Drainage Systems

TABLES AND FIGURES

1 INTRODUCTION

1.1. PURPOSE OF INVESTIGATION

On the 15th and 16th of February 2020, RCT was impacted by an extreme weather event which was named 'Storm Dennis' by the Met Office. Due to the extent of the event's impact, the LLFA opted to undertake a formal investigation.

The storm resulted in widespread residential and commercial flooding within the Rhondda Cynon Taf County Borough Council area. This report will focus on Flood Investigation Area RCT17, encompassing the Taff's Well community in the River Taf catchment.

The reason behind RCT's investigation is in response to the duties of the local authority regarding 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 the response to the flood."

2. "When 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 authority"[1]

The purpose of the investigation is to determine which RMAs have relevant flood risk management functions and which functions have been exercised in response to the flood event in question.

Specific details of Storm Dennis, such as rainfall analysis are covered within a separate overview report that covers the wider RCT area. The report is titled 'Storm Dennis February 2020 – Overview Report' and will be referred to as 'FRM – Storm Dennis – Overview Report'[2].

[1] Flood and Water Management Act 2010 – Section 19 - https://www.legislation.gov.uk/ukpga/2010/29/section/19
[2] Flood Investigation Reports | Rhondda Cynon Taf County Borough Council (rctcbc.gov.uk)

1.2. SITE LOCATION

The area investigated within this report covers the community of Taff's Well, located in the southern region of the county borough, to the south of Treforest. Taff's Well is situated within the River Taf catchment which bounds investigation area RCT17 to the west (Figure 1).

The steep topography to the east of RCT17 is drained by the catchment of the Nant y Brynau ordinary watercourse which is partially culverted beneath Taff's Well and discharges into the River Taf.

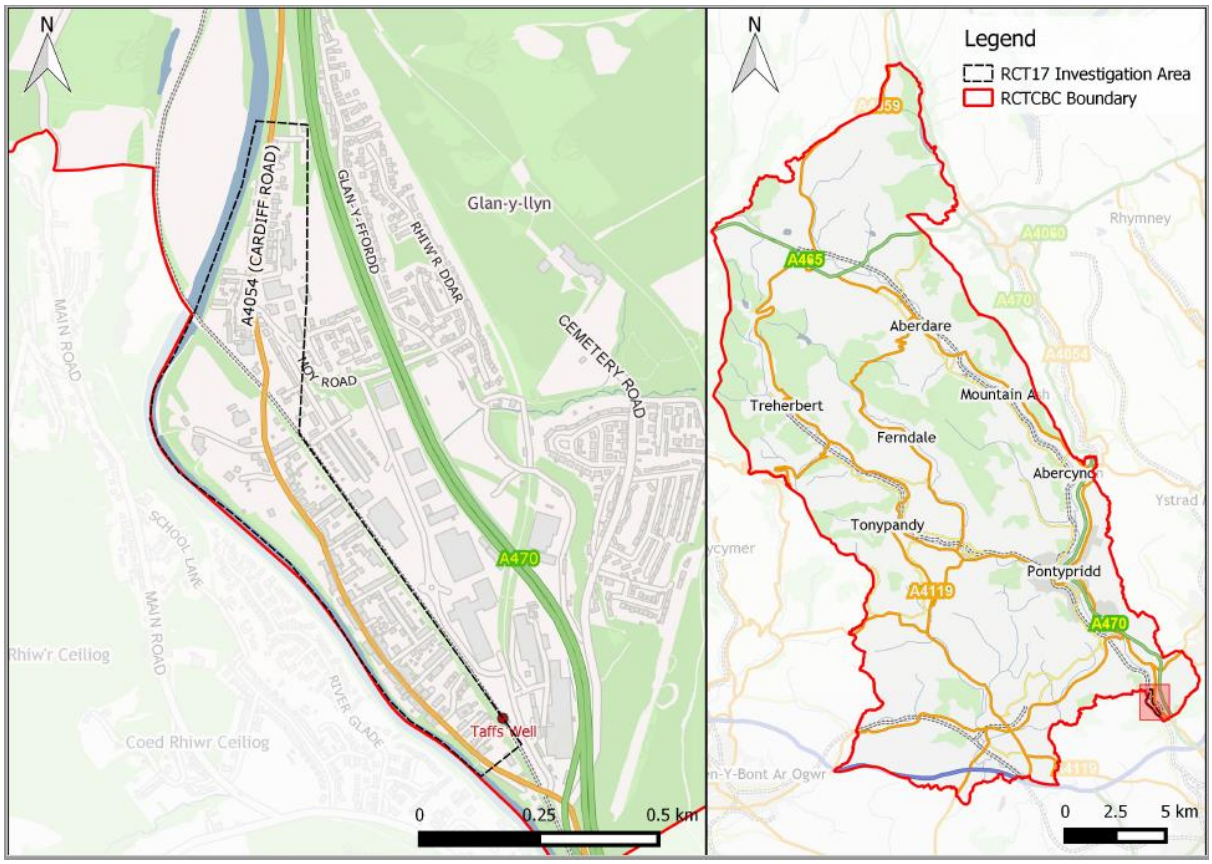

Figure 1: Flood Investigation Area RCT17 Location Plan

According to Welsh Government's CaRR, the community area of Taff's Well is ranked 198th for main river flooding and 151st for surface water flooding in Wales.

NRW's Flood Risk Assessment Wales (FRAW) map indicates that there are areas of low to high flood risk from both fluvial and surface water and ordinary watercourse sources within the investigation area. This is illustrated in Figure 2, which is an excerpt from the FRAW maps.

A low to high risk of flooding from the River Taf is noted across the investigation area and is largely confined to the west of the A4054 (Cardiff Road). Flood risk from surface water and ordinary watercourses is also noted within the investigation area, however less substantial. RCT's FRMP [3] suggests that historical surface water flooding incidents are associated with gully obstructions and resultant highway flooding. Within some areas adjacent to the main river, it is considered that people may be at risk from both surface water flooding and main river flooding.

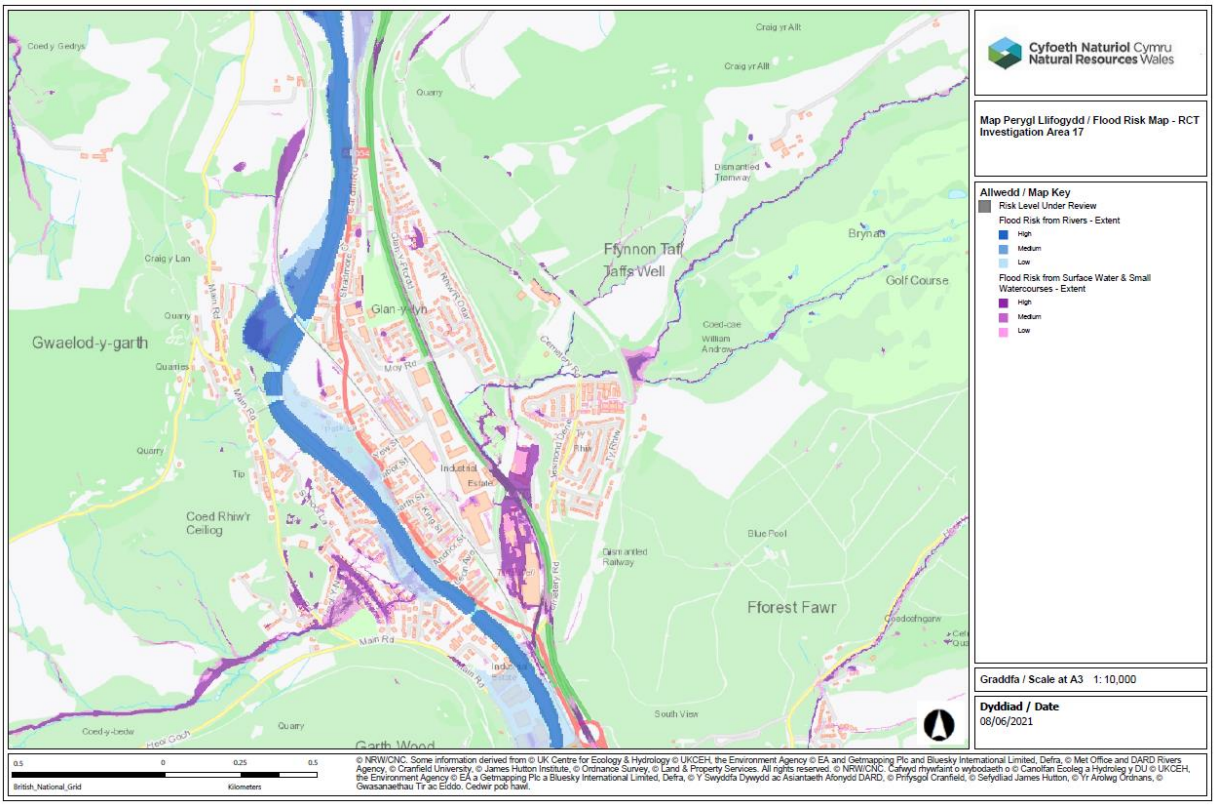

Figure 2: Natural Resources Wales' Flood Risk Assessment Water (FRAW) map for rivers and ordinary watercourse and surface water flood risk at investigation area RCT17. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

1.3. DRAINAGE SYSTEM

The surface water drainage systems that serve investigation area RCT17 are that of the highway drainage network designed to manage the surface water within the highway and public surface water sewer and combined sewer networks operated by Dŵr Cymru Welsh Water.

[3] RCT'S Flood Risk Management Plan (rctcbc.gov.uk)

1.4. Investigation Evidence

To support the investigation, a range of qualitative and quantitative evidence has been gathered from numerous sources, the summary of which is listed below within Table 1.

Table 1: Investigative evidence gathered in preparation of this Storm Dennis Section 19 report

Source	Data
Residents	Photos, videos, statements, email correspondence, public engagement survey responses
Responders' statements	Local responders' statements
CCTV Surveys	Internal surveys of the local drainage networks
Met Office Data	Weather Warning information (see FRM – Storm Dennis – Overview Report)
Rain Gauges	RCT and NRW operated gauge information (see FRM – Storm Dennis – Overview Report)
Natural Resources Wales	River Level and Flood Warning data
RCT Flood Risk Management Plan	Site specific information and data for each electoral ward in RCTC
Communities at Risk Register	Flood risk ranking and scores for all flood types based on community data in Wales
Flood Investigation Report (Redstart's FIR)	A summary of the source-pathway-receptors, culvert capacity assessment and hydraulic modelling work undertaken by Redstart. The Flood Investigation Report was commissioned by RCT prior to writing the Section 19 report.

Evidence sourced from the 'Flood Investigation Report', commissioned by RCT, will be further referred to as 'Redstart's FIR' throughout this report.

1.5. Public Engagement

Following the initial flooding event that occurred on the 15 and 16th of February during Storm Dennis, flood risk officers from RCT's Flood Risk Management department were deployed to areas across the borough to investigate reports of internal flooding by

residents. Residents engaged with the Flood Risk Management team to help determine the initial impacts caused by the flooding event and to investigate the potential source(s) and pathway(s) of flood water. Due to the volume of calls received by RCT's Out of Hours department, visits were prioritised to those areas experiencing significant internal flooding to residential properties.

To support the flood investigations, a public engagement exercise was undertaken between the 4th and 25th of January 2021 by Redstart, on behalf of RCT. The aim of this exercise was to engage with local residents who were affected by the flood event to capture details on how they were impacted, the source and movement of flood water within the area, how receptors were impacted as well as drawing on local knowledge to query how local conditions could have exacerbated the event. This data is useful to help the LLFA better understand and validate our assessment of the flood event to support the investigation under Section 19 of the FWMA.

2 FLOODING HISTORY

2.1. PREVIOUS FLOOD INCIDENTS

Historical flood information and residents accounts captured by RCT's Flood Risk Management officers following Storm Dennis indicate that parts of the investigation area had not experienced flooding from the River Taf in over 40 years prior to Storm Dennis. The flooding experienced during Storm Dennis was noted as the most significant flood incident to impact Taff's Well since the floods of December 1979.

Previous incidences of surface water flooding to the highway have been recorded across the investigation area during smaller scale events, in particular along the A4054 Cardiff Road and Moy Road. Many of these flood incidences have been deemed the result of blocked highway drainage infrastructure. These events are not known to have impacted properties.

2.2. FLOOD INCIDENT

The flooding that occurred on the 15th and 16th February 2020 was a result of an extreme rainfall event, designated by the Met Office as 'Storm Dennis'. The rainfall event affected the majority of RCT and caused widespread flooding to communities.

Specific details of Storm Dennis, such as rainfall and river level analysis are covered within a separate overview report that covers the wider RCT area, referenced 'FRM – Storm Dennis – Overview Report'[2].

Post event inspections were undertaken by RCT's Flood Risk Management team and Public Health Wales during the days following the storm event. They identified 25 residential properties and 11 non-residential properties as internally flooded within the investigation area.

A summary of the source(s) and pathway(s) of flooding within the Taff's Well area during Storm Dennis have been outlined in Table 2 and further described throughout this section.

Table 2: Summary of the source, pathway and receptors affected during Storm Dennis within investigation area RCT17

Source(s)	Pathway(s)	Receptor(s)
The primary source of flooding for this incident was the River Taf, which flows adjacent to the investigation area, overtopping its banks.	The primary flow pathway, caused by the overtopping of the River Taf, saw the main river breach its eastern bank in the northernmost part of the investigation area, before conveying in a southerly direction towards Park Lane and eventually into the rear gardens of properties on Cardiff Road. The River Taf also overtopped directly into the rear of properties on Cardiff Road, exacerbating the fluvial flooding that had already occurred.	The overtopping of the River Taf resulted in the internal flooding of 25 residential and 9 non-residential properties on Cardiff Road and Park Lane. Taff's Well Park was also impacted by the River Taf.

Intense rainfall and subsequent surface water runoff from the surrounding area.	The accumulation of surface water on Cardiff Road resulted in the conveyance of pluvial flows towards lower elevations resulting in surface water ponding along Cardiff Road and Park Lane Additional pluvial flows were identified at Glan-Y-Llyn industrial estate.	A non-residential property on Cardiff Road, adjacent to Church Street, was internally flooded by surface water during Storm Dennis. Surface water flows contributed to the internal flooding of 2 residential properties impacted by main river flooding on Park Lane. A non-residential unit was reported to have internally flooded at Glan-Y-Llyn industrial estate.

On review of Table 2, the primary source of the recorded flooding within investigation area RCT17 was the overtopping of the main river, the River Taf, which flows north to south to the west of Taff's Well. The impacts of the overtopping were exacerbated due to intense rainfall and subsequent surface water flows throughout the investigation area.

During the early hours of Sunday 16th February 2020, RCT received several calls from residents at Taff's Well reporting the overtopping of the River Taf which was causing water ingress into properties at multiple locations. Several flow paths were observed as properties adjacent to the main river experienced internal flooding. These flow paths are illustrated in Figures 3 and 4.

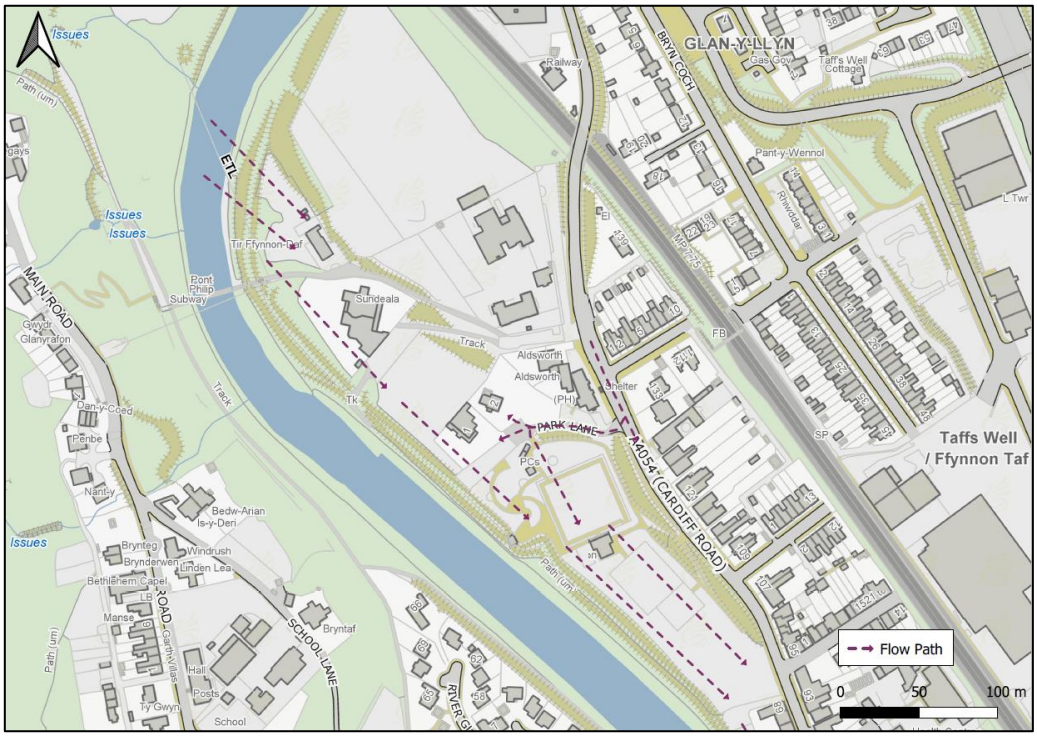

Figure 3: Observed flow paths during Storm Dennis in the north of investigation area RCT17

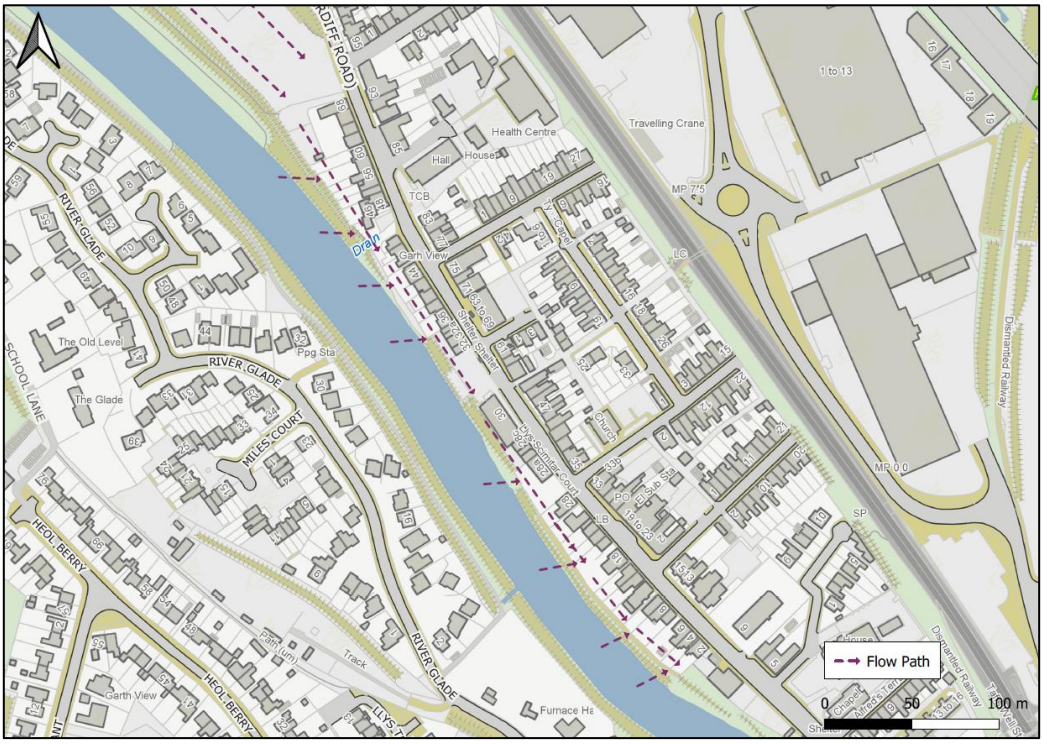

Figure 4: Observed flow paths during Storm Dennis in the south of investigation area RCT17

It was reported by residents that the River Taf initially overtopped its eastern riverbank to the north of the investigation area (depicted in Figure 3), resulting in between 1.5 metres and 2.5 metres of internal flooding to those properties situated on the floodplain at this location.

Following the overtopping, large amounts of fluvial flood water conveyed south along the riverbank towards Park Lane and Taff's Well Park. On its course of flow, a further two residential properties at Park Lane were internally flooded. The affected residents reported flood depths of between 1.5 and 2.5 metres due to the properties being positioned at localised low points.

Surface water is also considered to have contributed to the internal flooding of two properties at Park Lane, with resident accounts highlighting pluvial flows that originated from overwhelmed highway drainage on Cardiff Road and conveyed downhill towards the impacted properties in accordance with local topography.

Beyond Taff's Well Park, river flood water continued to convey south adjacent to the embankment towards the rear gardens of properties along Cardiff Road. Based on residents' reports captured by RCT's Flood Risk Management team post event, it is estimated that flood water travelled approximately 800 metres from the point of riverbank breach. Indicative flow paths of water are illustrated in Figure 4.

The River Taf was also observed to have overtopped its embankments directly into the rear gardens of adjacent properties along Cardiff Road, exacerbating the flooding that was already ongoing due to the initial flow path depicted in Figure 3. Figure 5 shows the complete submergence of the river embankment to the north of Cardiff Road during the storm event.

Once flood water had entered the rear gardens of properties on Cardiff Road, it was unable to recede due to the difference in height between the gardens and the existing flood defences, as depicted in Figure 6. This resulted in up to 2.5 metres of fluvial flood water becoming trapped in the rear gardens of properties on Cardiff Road for approximately 12 hours during the storm event.

A total of 25 residential and 9 non-residential properties were internally flooded by the River Taf, with several properties on Cardiff Road reporting basement flooding of between 1.5 and 2 metres in depth.

Figure 5: Image showing the overtopping of the River Taf to the rear of Cardiff Road which submerged the rear gardens and ground floor of several properties during Storm Dennis (image provided by resident)

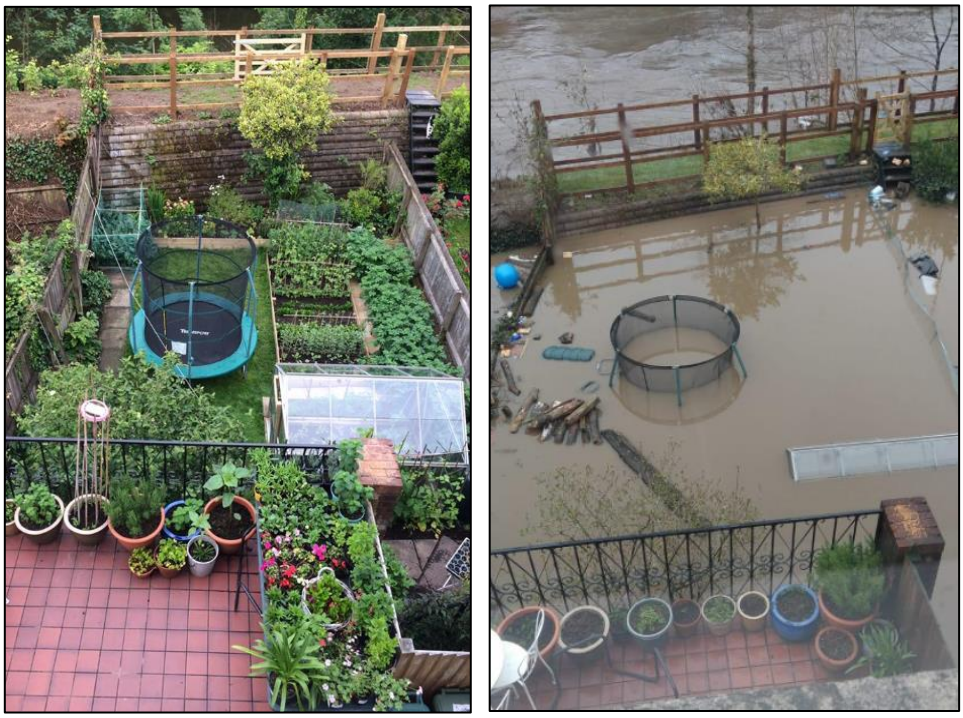

Figure 6: Images capturing the rear garden of a property on Cardiff Road before (left) and during Storm Dennis (right) (images provided by resident)

Emergency rescue efforts by the Fire Service were in operation following the overtopping of the River Taf on the 16th February 2020 to evacuate residents from their homes (Figure 7).

Figure 7: Image capturing the rescue efforts by the Fire Service to evacuate residents at Park Lane on 16th February 2020 (image provided by resident)

An isolated incident of surface water flooding occurred to the south of the investigation area, where a non-residential property on Cardiff Road experienced internal flooding during the storm event as a result of nearby highway drainage infrastructure becoming overwhelmed.

Furthermore, a commercial property located at Glan-Y-Llyn Industrial Estate, to the north of the investigation area, reported internal flooding during Storm Dennis. Whilst the source of flooding is unconfirmed, the isolated nature of the incident and the distance of the site from the River Taf (approximately 140 metres) suggests that internal flooding was also caused by localised surface water flooding.

2.3. RAINFALL ANALYSIS

See RCT's 'Overview Report' of Storm Dennis, reference 'FRM – Storm Dennis – Overview Report'[2], for a detailed analysis of the rainfall and ordinary watercourse response.

3. Possible Causes

3.1. Culvert Conditions

There is no evidence from this investigation to suggest that culverted ordinary watercourses within investigation area RCT17 significantly contributed to the recorded flooding of properties in RCT17 during Storm Dennis.

As such, the condition of culverted ordinary watercourse infrastructure within the investigation area has not been investigated as part of this investigation.

3.2. Ordinary Watercourse Conditions

There are multiple ordinary watercourses, such as the Nant y Brynau and Nant Cwmllwydrew, that convey into the River Taf within or near to the investigation area; however, there is no evidence to suggest that ordinary watercourses contributed to the recorded flooding of properties in RCT17 during Storm Dennis.

As such, the condition of ordinary watercourse infrastructure within the investigation area has not been investigated as part of this investigation.

3.3. Main River

The designated main river, the River Taf, flows in a southerly direction through Taff's Well. The investigation area itself is situated on the eastern bank of the river (Figure 1).

3.3.1. Main River Levels and Flood Warnings

The hydrograph in Figure 8 illustrates the significant rise in the River Taf's levels in response to rainfall between the 14 – 17th February 2020. River level data was captured at NRW's Upper Boat monitoring station, located approximately 3km northwest of the northern boundary of the investigation area.

NRW issued a 'Flood Alert' (indicating possible flooding) for the entirety of the River Taf at approximately 13:30 on the 15th of February; at which point the main river was over 2 meters in depth and continuing to rise at Upper Boat station. At approximately midnight on the 16th February the River Taf began to rise again, reaching a peak level of 5.49 meters at 06:00 on 16th February; the highest level recorded for the River Taf at Upper Boat since 2001.

The green bar displayed on the hydrograph shows the typical level of the River Taf at the Upper Boat station, ranging between 0.2 and 1.2 meters. The river level was above this green line for over 48 hours, highlighting the severity of the storm event and its unprecedented nature. At its peak, the River Taf at Upper Boat was over four meters higher than its average level.

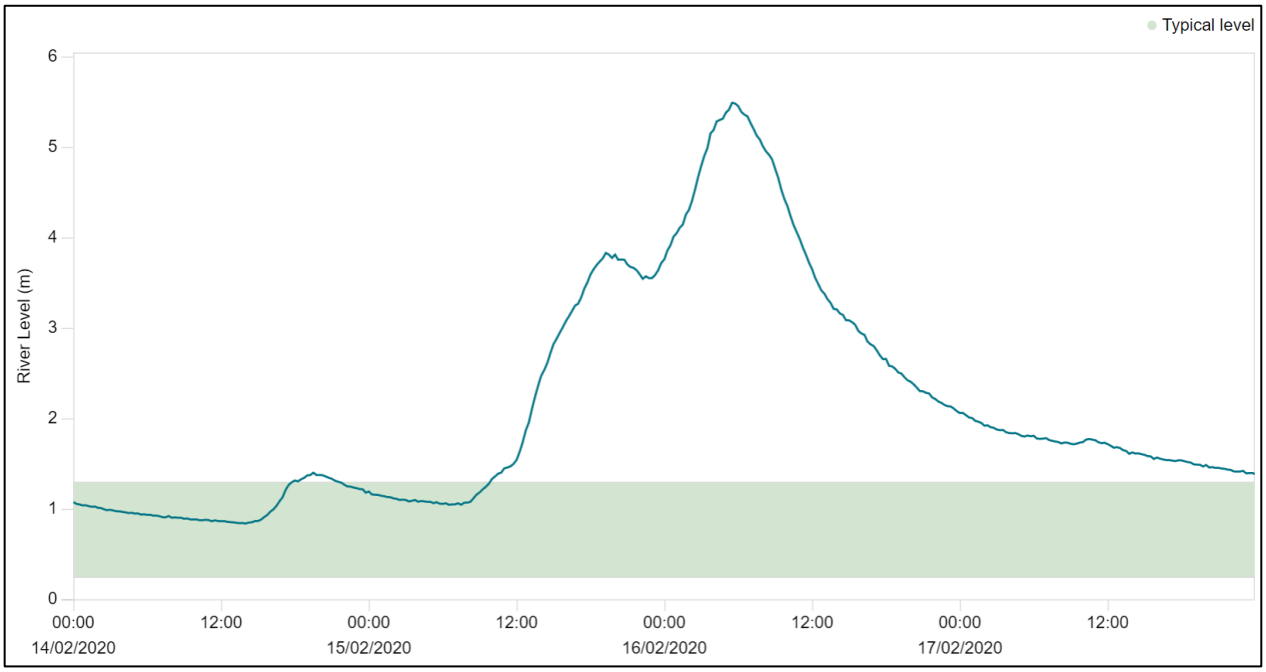

Figure 8: The River Taf levels at Upper Boat station between the 14th and 17th February 2020 (Natural Resources Wales)

Investigation area RCT17 falls within NRW's Taff's Well and Industrial Areas of Gwaelod y Garth Flood Warning Area. The Flood Warnings issued by NRW, and associated river levels at Upper Boat gauging station (i.e., nearest gauging station to RCT17), for the River Taf at investigation area RCT17 during Storm Dennis are shown in Table 3.

Table 3: Flood Warnings issued by NRW for the River Taf at RCT17 during Storm Dennis

Flood Warning Type	Location	Start Time	River Level (m) at Upper Boat
Flood Alert	River Taf	13:27 15/02/2020	2.24
Flood Warning	River Taf at Taff's Well and Industrial Areas of Gwaelod y Garth	20:52 15/02/2020	3.754

NRW issued a 'Flood Warning' alert (indicating flooding is expected) for the River Taf at Taff's Well at 20:52 on the 15th of February, prior to the overtopping of the main river.

A 'Severe Flood Warning' alert (indicating Community-wide flooding and possible risk to life) was not issued by NRW for the River Taf at Taff's Well during the storm event.

A ‘Severe Flood Warning’ was issued by NRW for the River Taf at Pontypridd at approximately 06:30 on the 16th February; at which point the River Taf at Upper Boat was 5.358 metres in height. According to residents, significant main river flooding had already commenced at several locations along the River Taf by this time, including at Taff’s Well.

NRW have acknowledged within their ‘Flood Incidence Response Review’[4] that the operation of the Flood Warning Service “came under significant pressure during February and at times became overwhelmed”, resulting in flood warnings being issued late (after the onset of flooding) or not issued at all. At this location (RCT17), this is in reference to the ‘Severe Flood Warning’ alert that was not issued for Taff’s Well.

Improvements to their flood forecasting and warning services are being internally investigated by NRW and where feasible implemented to deliver the recommendations outlined within their Flood Incident Response Review[4].

3.3.2. Main River Flood Risk

As outlined in Section 2, the fluvial flooding that occurred at RCT17 during Storm Dennis reached external depths of up to 2.5 metres in the worst affected areas of Park Lane and Cardiff Road.

Figure 9 is an excerpt from NRW’s Flood Risk Assessment Wales (FRAW) mapping exercise which depicts the main river flood risk extents for the ‘Defended’ scenario, i.e., with the presence of flood defence assets. The darker shading identifies areas at higher risk of flooding (more frequent/less extreme rainfall events) and lighter shading showing the lower risk areas (less frequent/more extreme rainfall events).

The majority of the affected properties within RCT17 fall within an area of low main river flood risk. A low risk of flooding means that an area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%) each year. Considering Storm Dennis was probably in excess of a 1 in 200 annual probability (Q200) flood event[4], the area of flooding during Storm Dennis compared to the low flood risk extents, depicted in Figure 9, are considered to be underestimated, suggesting that Storm Dennis impacted a wider area than identified within the FRAW.

Whilst the FRAW map depicts the ‘Defended’ scenario, NRW’s Flood Hazard maps (Figure 10) represents the ‘Undefended’ scenario. The Flood Hazard map indicates

[4] February 2020 Floods in Wales: Flood Incident Management Review (cyfoethnaturiol.cymru)

that the flooded area within investigation area RCT17 is in fact at high risk of flooding from the main river without the presence of flood defences. A high risk of flooding means that an area has a chance of flooding greater than 1 in 30 (3.3%) each year. This highlights the potential impact of the overtopping of the River Taf at Taff's Well during extreme storm events.

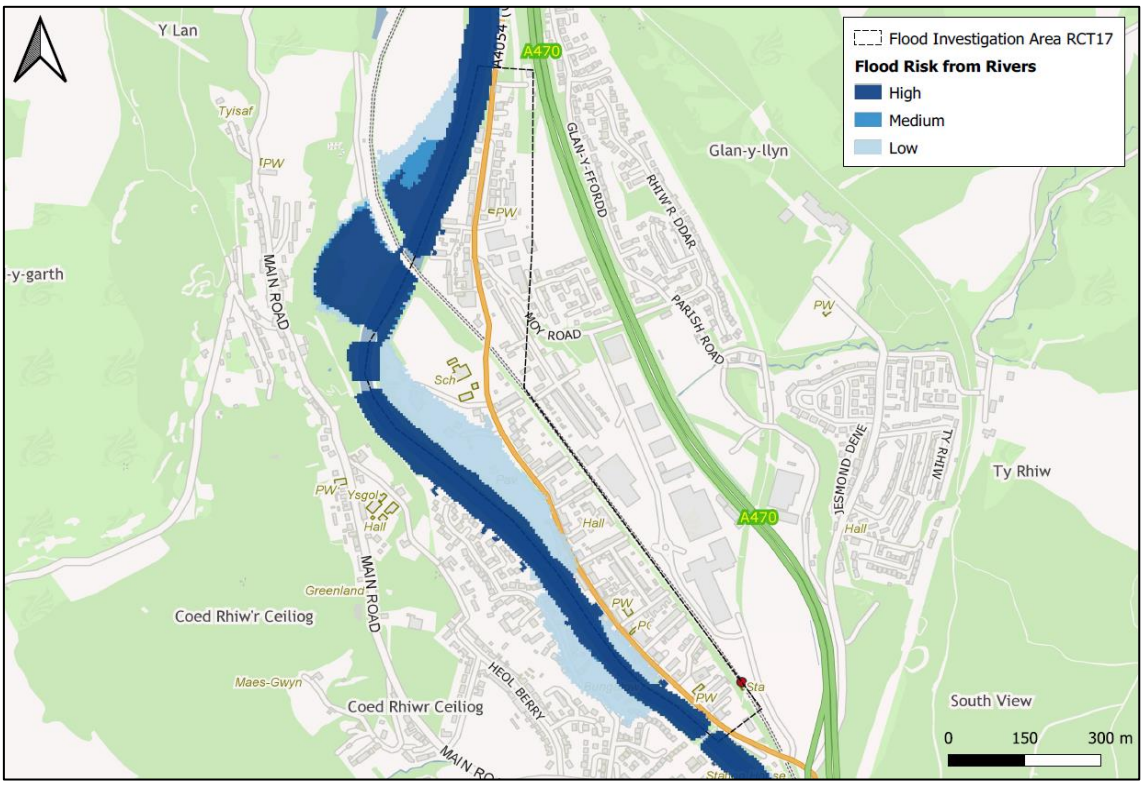

Figure 9: NRW's Flood Risk Assessment Wales (FRAW) map for River sources. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

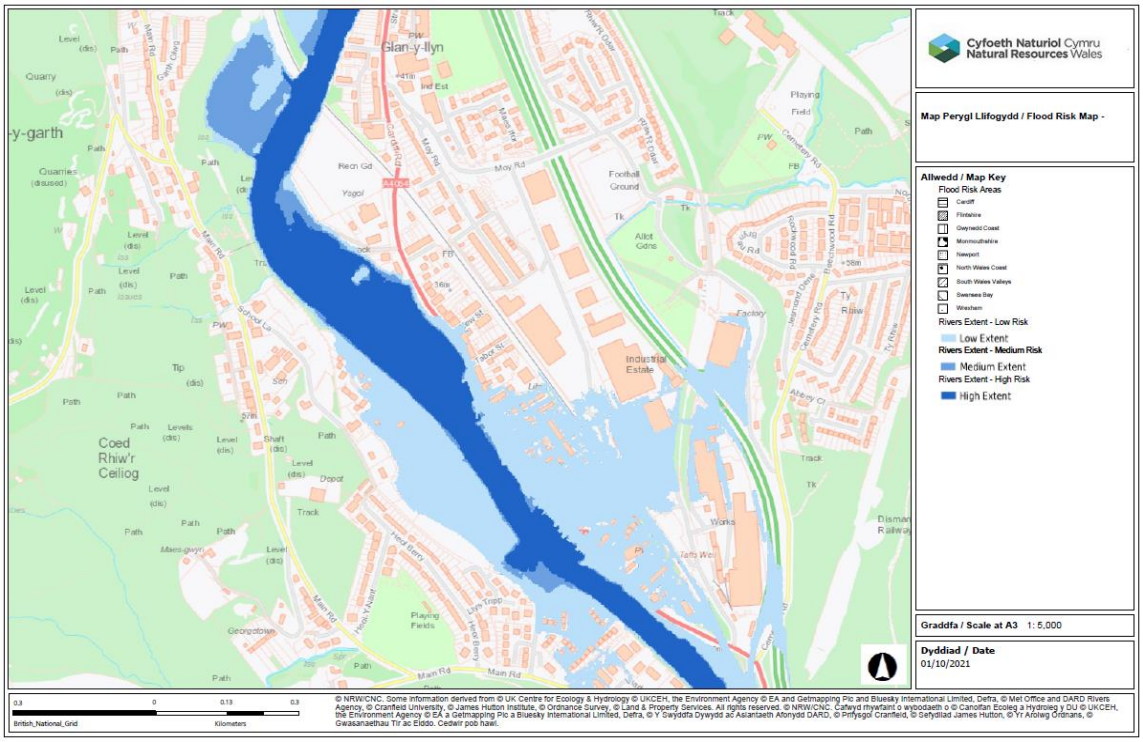

Figure 10: NRW's Flood Risk Assessment Wales (FRAW) map for Medium Risk River Flood Depth in RCT17. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved

3.3.3. Main River Flood Defences

As illustrated in Figure 11 (demarcated by a bold red line), there are approximately 1.5 kilometres of formally designated flood defence infrastructure along the eastern bank of the River Taf at RCT17. This infrastructure is operated and maintained by NRW.

According to NRW, this infrastructure provides a Standard of Protection (SOP) of 1 in 100+ annual probability flood event (Q100+) to the majority of the impacted properties within the investigation area (black hatched area in Figure 11).

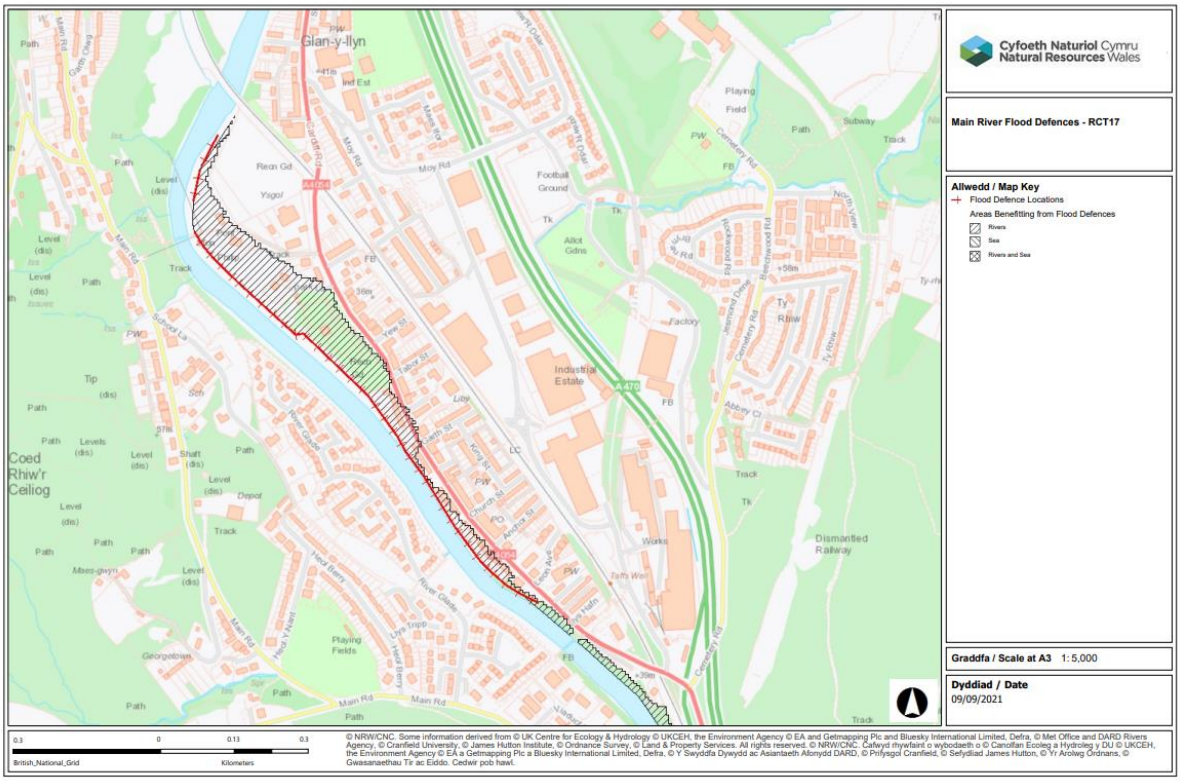

Figure 11: Natural Resources Wales' map for Main River Flood Defences and areas benefiting at RCT17. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved

The current indicative design standard of protection for flood defences on a main river is 1 in 100 annual probability (Q100) flood event plus, for new schemes, an allowance for climate change. This is stated within the Welsh Government's National Strategy for Flood and Coastal Erosion Risk Management which encourages main river flood alleviation schemes to provide a SOP up to Q100[5]. It is thereby inferred that the current SOP of flood defence infrastructure at RCT17 is in accordance with current indicative standards.

Whilst the majority of the investigation area is shown to be protected against a 1 in 200 annual probability (Q200) flood event, a section of the northern riverbank, adjacent to where Pont Sion Phillip footbridge connects Taff's Well with Gwaelod y Garth, has no formal flood defence. Based on accounts provided by residents, it is considered that the River Taf overtopped at this location, allowing significant conveyance of flood water to flow south behind the formal defences towards Park Lane and Cardiff Road.

Although this provides an explanation to the main river flooding that occurred throughout Taff's Well, several residents at Cardiff Road also reported flood defences

[5] National Strategy for Flood and Coastal Erosion Risk Management in Wales (English) (gov.wales)

at the rear of their gardens being overtopped by flood water during the peak intensity of the storm.

NRW's 'Flood Incidence Response Review'[4] outlines that no flood defences failed in the lower Taf region and that the flooding was the result of river flows exceeding the construction design standard.

3.4. HIGHWAY DRAINAGE CONDITIONS

Park Lane was primarily flooded by the overtopping of the River Taf during Storm Dennis. The resultant fluvial flows deposited mud, silt and debris across the impacted area These sediments are assumed to have entered the highway drainage system, leading to blockages and a reduction in the hydraulic capacity of the surface water network. Figure 12 depicts the deposits of mud left behind following the receding river water.

Figure 12: Photo shows deposits of mud blocking the surface water drainage infrastructure at Park Lane following the flooding during Storm Dennis (image provided by resident)

Resident accounts also highlighted the surcharging of highway drainage in central and southern regions of the investigation area, such as on sections of Cardiff Road above Park Lane and Taff's Well Park. Given the intensity of rain falling on a largely impermeable catchment, it is considered that sections of highway drainage infrastructure in RCT were overwhelmed by surface water during the storm event, resulting in exceedance surface water flows along the highway as well as localised surface water ponding.

Highway drainage is not designed to manage overland flows from private areas, parks or open space, nor is it designed to accommodate fluvial flows that may arise during storm events. In this instance, the capacity of the highway drainage in RCT17 was exceeded at different locations as a result of main river and surface water flows entering the network. The maintenance condition of the highway drainage infrastructure is not considered to have significantly impacted the flooding experienced.

3.5. DCWW Apparatus Conditions

There is no evidence from this investigation that DCWW apparatus contributed to the flooding that occurred during Storm Dennis within investigation area RCT17.

DCWW reported no issues within RCT17 during Storm Dennis and it is not believed that any DCWW infrastructure was damaged during the storm event. Whilst DCWW have concluded that their assets performed well during Storm Dennis, the majority of drainage infrastructure within the investigation area is comprised of combined sewer networks which are likely to have become overwhelmed during the storm event for the reasons outlined in Section 3.4.

3.6. SURFACE WATER

RCT17 has a large topographic watershed (Figure 13) and a high potential for significant overland flows; however, the investigation area is separated from the watershed by the A470 dual carriageway. With the A470 acting as a barrier to the conveyance of surface water, it is believed that the majority of surface water flooding within Taff's Well during Storm Dennis was localised and not a consequence of the predominant valley gradient.

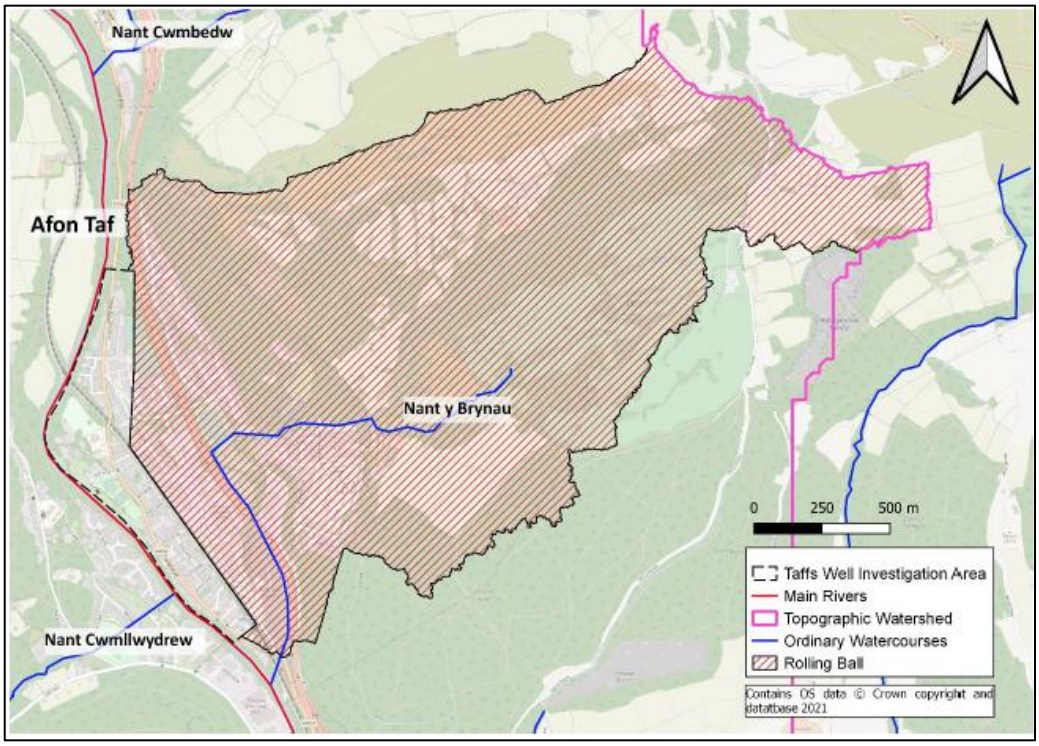

Figure 13: Topographic Watershed above investigation area RCT17

As outlined in Section 3.4, surface water flows generated by intense rainfall is believed to have caused localised surface water ponding as a result of highway and private surface water drainage systems becoming overwhelmed during the storm event. This is considered to have been the primary cause of internal flooding to two non-residential properties within RCT17; one at Glan-Y-Llyn Industrial Estate and the other situated at a low point along Cardiff Road.

3.7. SUMMARY OF POSSIBLE CAUSES

The above sections have identified and described the possible causes of flooding within RCT investigation area 17 during Storm Dennis which occurred on the 15th and 16th of February 2020. A summary of the identified source(s) and possible cause(s) of flooding (issue) has been outlined below in Table 4.

Table 4: Summary of source(s) and possible cause(s) of flooding in RCT17 during Storm Dennis (15-16th February 2020)

Ref No	Asset (Source)	Issue	Asset Owner	Type of Flooding
1	River Taf	Unprecedentedly high river levels within the River Taf resulted in the main river overtopping its banks at several locations and flood water conveying into neighbouring properties.	Natural Resources Wales	Main River
2	River Taf	Unprecedentedly high river levels within the River Taf resulted in the main river overtopping its banks to the north of the investigation area, resulting in flood water conveying south towards several properties.	Private Landowner	Main River
3	Surface water drainage network across RCT17	Intense rainfall across RCT severely overwhelmed highway drainage infrastructure, resulting in the accumulation of surface water on many streets throughout Taff's Well.	Rhondda Cynon Taf CBC Highway Authority	Surface Water Flooding

4. Risk Management Authority Actions

A Welsh Risk Management Authority is defined in Section 6 of the Flood and Water Management Act 2010 as NRW; a LLFA, a district council for an area where there is no unitary authority, or a highway authority wholly in Wales; an internal drainage board for an internal drainage district that is wholly or mainly in Wales; a water company that exercises functions in relation to an area in Wales. As the LLFA, RCT has the responsibility to coordinate the management of flood risk and the interaction of Risk Management Authorities across Rhondda Cynon Taf.

An overview of the relevant Risk Management Authority in relation to flood type is provided in Table 5. For further details of the roles and responsibilities of individual Risk Management Authorities in managing flooding, refer to the Welsh Government's National Strategy for Flood and Coastal Erosion Risk Management, Section 4 'Roles & Responsibilities'[5], and RCT's 'FRM – Storm Dennis - Overview Report'[2].

Table 5: Risk Management Authority with relevant functions to manage the risk for different flood types

Type of Flooding	Risk Management Authority
Flooding from Main River, reservoirs and the sea (including coastal erosion).	Natural Resources Wales
Flooding from ordinary watercourses, surface water and groundwater	Lead Local Flood Authority
Flooding from water and sewage systems	Water Companies (Dŵr Cymru Welsh Water)
Flooding from the highway	Highway Authority
Flooding from the highway (motorways and major trunk roads)	Welsh Government Trunk Road Agency

Risk Management Authorities have direct flood risk management functions under the Flood and Water Management Act 2010, as well as the Water Resources Act 1991, Land Drainage Act 1991 and the Highways Act 1980. Through analysis of the flooding that impacted RCT17, the flood risk management functions exercised or proposed to be exercised by relevant RMAs were recorded pursuant to Section 19 of the Flood and Water Management Act 2010, which states:

"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 the response to the flood."

Through the investigation process, the source(s) and possible cause(s) of flooding in RCT17 during Storm Dennis have been previously identified and summarised within Table 4. The Risk Management Authorities responsible for managing that flooding have been listed in Table 6 below, along with a series of recommendations put forward by the LLFA.

Table 6: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in RCT17 (as per Table 4)

Ref No	Asset (Source)	Asset Owner	Type of Flooding	Relevant Risk Management Authority	Recommendations	
1	River Taf	Natural Resources Wales	Main River	Natural Resources Wales	R1A	NRW to "complete detailed investigative analysis work to understand the mechanisms of flooding in areas known to have flooded from main rivers", including the River Taf at Taff's Well. Aligns with recommendation 'Action FD2' within NRW's Flood Incident Management Review.

					R1B	NRW to investigate the standard of protection provided by flood defences throughout RCT17 and “consider improvements to NRW flood alleviation schemes and structures on a priorities basis”. Aligns with recommendation ‘Action FD3’ within NRW’s Flood Incident Management Review.
					R1C	NRW to review its flood warning service provision, especially for extreme events. This will form part of NRW’s Flood Warning Service Review Implementation Programme and aligns with the recommendations set out in their ‘Flood Incidence Management Review’.
2	River Taf	Private Landowner	Main River	Natural Resources Wales	R2A	NRW to work with the landowner to assess and review the risk of flooding from the River Taf at the location known to have overtopped during the event to identify the viability

						of risk management options.
3	Surface water drainage network across RCT17	Rhondda Cynon Taf CBC Highway Authority	Surface Water	Highway Authority and Lead Local Flood Authority	R3A	The Highways Authority to jet and cleanse the highway drainage network and action repairs accordingly.
					R3B	The LLFA and Highway Authority to evaluate surface water management options to alleviate pluvial flooding at locations across the investigation area.

4.1. LEAD LOCAL FLOOD AUTHORITY

In review of Ref 2 of Table 6, the LLFA has been determined as the relevant Risk Management Authority in relation to the ordinary watercourse and surface water flooding which occurred at investigation area RCT17 during Storm Dennis.

The LLFA exercised the following functions in response to the flooding at investigation area RCT17:

- Officers investigated the initial flooding and have produced this report in line with Section 19 of the Flood and Water Management Act 2010.
- Officers contacted residents affected by flooding to offer support and advice to assist in the recovery following the event.
- A public engagement exercise carried out by Redstart, on behalf of RCT as the LLFA, was undertaken in order to gain further local insight and anecdotal evidence to support the flood investigation.
- The LLFA has exercised its powers, under Section 13 of the FWMA, to request information and co-operation from NRW in relation to their responsibilities as a RMA in response to Storm Dennis.
- The LLFA has set up a central Control Room, to compliment the Council's Contact Centre and CCTV centre which is based at the Council's offices, to provide a comprehensive and informed response to the residents of RCT as appropriate during storm events.
- The LLFA, working in partnership with NRW, have expanded their interim Property Flood Resistance project offering expandable flood gates to those properties deemed at high risk of flooding from the main river, as per NRW's determination.

The LLFA also propose to exercise the following functions in response to the flooding at RCT17:

- The LLFA and LDA intend to clarify drainage asset owners and management responsibilities to make them aware of their personal risk. To ensure landowners manage the risk in compliance with the relevant legislation, a team of Flood Enforcement Officers including legal support is to be appointed.

- The LLFA and LDA will work with landowners and property owners to manage their personal flood risk through local measures, such as property resilience and resistance measures.
- As part of RCT's comprehensive review of the County Borough's most at risk communities, the LLFA are proposing to undertake a formal SFRA of the Lower Taf catchment area to better understand the overall risk from ordinary watercourse and surface water flooding in order to target investment to areas of highest risk. The SFRA also aim to encourage whole catchment measures, including working with natural processes, to alleviate flood risk in those areas of highest risk. **(R3B)**
- The LLFA will cooperate and collaborate with NRW to ensure a detailed study of the investigation area is completed and that appropriate actions to mitigate the impacts of river flooding are undertaken in accordance with NRW's Flood Incident Management Review.

4.2. NATURAL RESOURCES WALES

In review of Ref 1-2 in Table 6, NRW has been identified as the relevant Risk Management Authority in relation to the main river flooding from the River Taf during Storm Dennis.

NRW have exercised the following functions in response to the flooding at RCT17:

- NRW have carried out post event data collection including an assessment of the properties impacted by main river flooding and a survey of wrack marks, i.e. the marked high-water level.
- Following Storm Dennis NRW undertook an inspection of the River Taf at Taff's Well, removing debris and vegetation from the NRW flood embankment.
- NRW undertook a T98 inspection of the main river embankment and undertook restoration works. Following restorations, further ground investigations were undertaken to determine the embankment's structural integrity.
- NRW specifically outline that "more Severe Flood Warnings should have been issued based on the flooding impacts experienced" in the Lower Taf region. Utilising post event data and information, NRW have reviewed the Resultant Thresholds for the River Taf at Taff's Well and Industrial Areas of Gwaelod Y Garth Flood Warning Area. This is critical for assessing the performance, timeliness and accuracy of the warning service after a flood. **(R1C)**.
- NRW has introduced improved digital services to provide comprehensive flood risk, river level and rainfall information to households, businesses and communities across Wales. The improved service was launched in September 2020 on the NRW website and will improve how live flood warning and water level data is shared before and during flood events. **(R1C)**
- NRW have commissioned a Lower Taf Flood Modelling Project which is currently ongoing. **(R1A)**
- Following the flooding events of February 2020, NRW published a review of its incident response to Storm Ciara and Dennis in October 2020[6]. This review contains several recommendations for improvements to their ways of working and services which NRW are in the process of implementing through an internal delivery programme.
- NRW have developed a detailed Implementation Programme to address the areas of improvement work required to deliver the recommendations of the

[6] Natural Resources Wales / Our response to Storm Ciara and Storm Dennis

Flood Warning Service Review carried out by NRW in 2018. Several of the recommendations directly link to the recommendations set out by NRW within their Flood Incident Management Review **(R1C)**.

NRW also propose to exercise the following actions in response to the flooding at RCT17:

- Following the completion of NRW's Lower Taf Flood Modelling Project, NRW propose to undertake an initial assessment of the viability of potential flood risk management options. Greatest consideration should be given to areas at high risk of flooding from rivers on a prioritised basis. **(R1A, R1B)**
- Following the completion of NRW's Lower Taf Flood Modelling Project, NRW propose further threshold work and flood warning area amendments. **(R1A, R1C)**
- NRW will undertake a review of the modelled outputs and adopt changes to their maintenance program within the investigation area if required. **(R1A)**
- NRW to undertake scheduled T98 inspections of the embankment on a 6-monthly basis.

4.3. Water Company

Dŵr Cymru Welsh Water were not identified as a relevant authority in relation to the flooding at investigation area RCT17 during Storm Dennis. DCWW do not propose to undertake any actions in relation to the event within the investigation area.

4.4. Highway Authority

During the investigation into the flooding at investigation area RCT17 during Storm Dennis, the Highway was identified as flooding from a combination of sources at different locations, most notably as a result of surface water runoff and main river flooding from the River Taf.

Ref 3 of Table 6 identifies the Highway Authority as a relevant Risk Management Authority in relation to the surface water flooding that occurred along the highway across RCT17.

RCT as the Highway Authority have exercised the following functions in response to the flooding within investigation area RCT17:

- The Highway Authority assisted with the emergency response during the event by supplying equipment and sandbags, some to individual properties and using sandbags to redirect flood water away from properties.
- The Highway Authority exercised their functions under Section 100 of the Highways Act 1980, to arrange for all gullies and open drains in the highway to be inspected and cleansed following the influx of fluvial flood water to ensure the safety of the highway post event. **(R3A)**

RCT as the Highway Authority propose to undertake the following function in relation to the storm event at RCT17:

- The Highway Authority intend to increase their resource capacity by establishing a dedicated ‘Pluvial Drainage Team’ to focus entirely on the refurbishment and maintenance of RCT’s existing and enhanced highway drainage infrastructure.

USEFUL LINKS/CONTACTS

Blue Pages – property Resilience - http://bluepages.org.uk/

Flood Re – Flooded Property Insurance Scheme - https://www.floodre.co.uk/

Natural Resources Wales – Check Flood Warnings - https://naturalresources.wales/flooding/check-flood-warnings/?lang=en

Natural Resources Wales - Long Term Flood Risk - https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en

Rhondda Cynon Taf CBC - Local Flood Risk Management Plan - https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/Floodriskregulations2009.aspx

Rhondda Cynon Taf CBC - Local Flood Risk Management Strategy - https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/LocalFloodRiskManagementStrategy.aspx

Rhondda Cynon Taf CBC – Sustainable Drainage – https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/SustainableDrainage/SustainableDrainage.aspx

Welsh Government - National Strategy for Flood and Coastal Erosion Risk Management - https://gov.wales/sites/default/files/publications/2019-03/national-strategy-for-flood-and-coastal-erosion-risk-management-in-wales.pdf

Welsh Water – How to Contact Us – https://www.welshwater.com/en/Contact-Us.aspx