

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Storm Dennis –
Flood Investigation Area RCT14

January 2022

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This report should be read in its entirety

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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 flooding that occurred within the regions of Glyn-taf, Rhydyfelin and Hawthorn adjacent to the River Taf (Flood Investigation Area RCT 14, 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 RCT 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 27 properties across Glyn-taf, Rhydyfelin and Hawthorn: including 23 residential properties and 4 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 at RCT14 in this incident was the overtopping of the main River Taf at several locations along the eastern and western embankments following persistent and heavy rainfall. River level gauge data from NRW’s Pontypridd monitoring station reveal that the River Taf was almost four times its typical level during Storm Dennis,

reaching a peak level of 5.32 metres; the highest river level recorded at the station since its opening in 1970.

On review of NRW's Flood Risk Assessment Wales Maps, the impacted properties within RCT14 are identified at high risk of flooding from the main river, however there are no formal flood defences currently in place.

The investigation also identified surface water accumulation on the highway to have contributed to the flooding that occurred within RCT14. The overtopping of the River Taf, the associated settling of fluvial deposits and the sheer intensity of rainfall during Storm Dennis resulted in the surface water drainage infrastructure throughout RCT14 becoming overwhelmed, leading to the accumulation of surface water and the internal flooding of additional properties. A manhole, associated to the Ilan Avenue culvert network, at Cardiff Road is also believed to have surcharged during the storm event, further exacerbating the issues faced.

NRW has been determined as the relevant Risk Management Authority responsible for managing the main river flooding that occurred during Storm Dennis. In response to the flooding at investigation area RCT14, NRW have;

- Carried out their own post event investigative analysis work to understand the mechanism of flooding from the River Taf at Glyn-taf, Rhydyfelin and Hawthorn;
- 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 the areas of improvement for future storm events, including the performance of NRW's Flood Warning Service and incident management response.

RCTCBC 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 ordinary watercourse and surface water flooding that occurred during Storm Dennis. In response to the flooding at investigation area RCT14, the LLFA has;

- Carried out survey, jetting and cleansing operations to an estimated 242 metres of culvert network within the investigation area;
- 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 in relation to their responsibilities as the Risk Management Authority for main river flooding; 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 at RCT14, 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

RCT14 – Flood Investigation Area RCT 14

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

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1. INTRODUCTION

1.1. PURPOSE OF INVESTIGATION

On the 15 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 and impact of the event, 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 RCT14, stretching from Glyn-taf to Hawthorn in the Lower Taf region.

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 \(rctcbc.gov.uk\)](https://www.rctcbc.gov.uk/flood-investigation-reports)

1.2. SITE LOCATION

The area investigated within this report stretches from the south of Glyn-taf to parts of Hawthorn below the A470. The area falls within the electoral wards of Treforest, Rhydyfelin and Hawthorn and is situated to the south-east of Pontypridd within the southern region of the county borough.

Glyn-taf, Rhydyfelin and Hawthorn are all located within the River Taf catchment and are predominantly situated to the east of the River Taf. As illustrated in Figure 1, the investigation area also includes a small amount of land to the west of the main river.

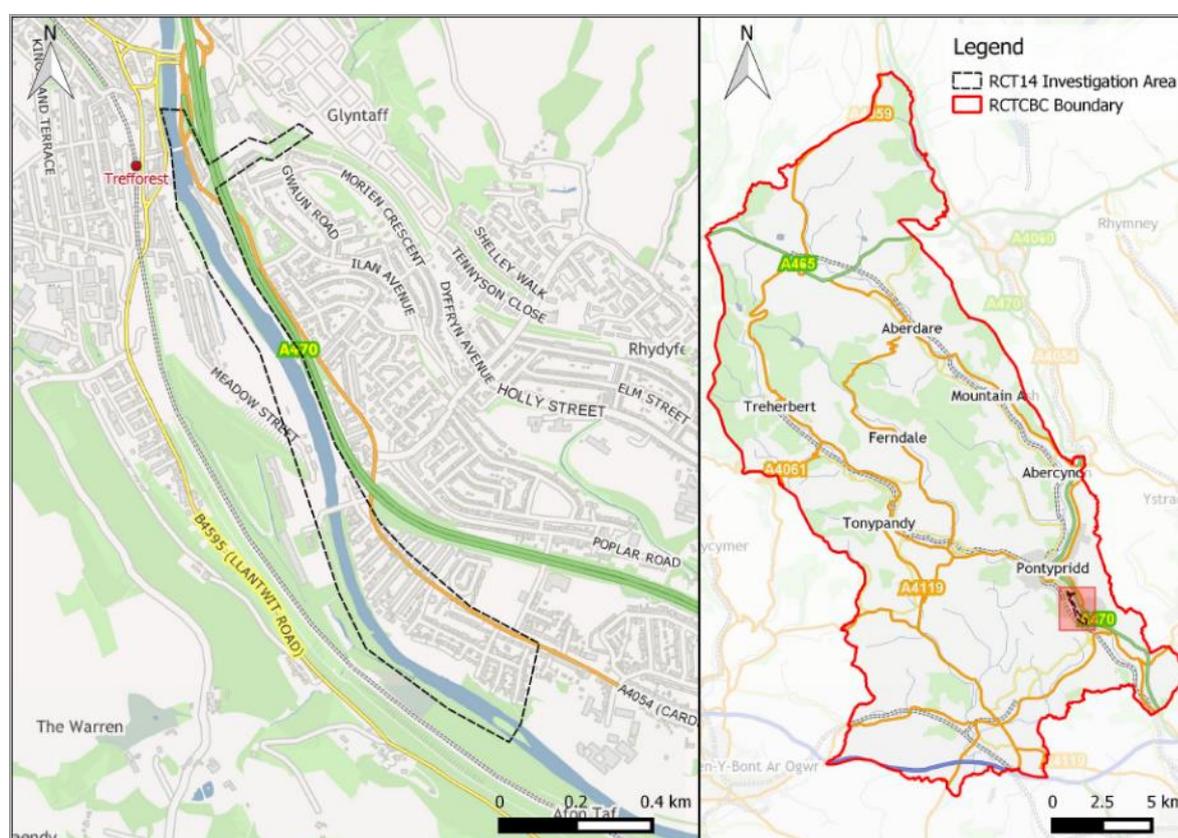


Figure 1: RCT Flood Investigation Area RCT14 Location Plan

RCT14 falls within the community areas of Glyntaf and Rhydyfelin. According to Welsh Government's CaRR, Glyn-taf and Rhydyfelin community areas are ranked 91st and 8th for surface water flood risk and 113th and 172nd for main river flooding in Wales, respectively.

NRW's Flood Risk Assessment Wales (FRAW) maps indicate 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.

RCT14 sits primarily on the eastern floodplains of the River Taf, with low to high fluvial flood risk sourced by the main river present across much of the investigation area. Flood risk from surface water and ordinary watercourse sources is also noted within parts of the investigation area, as illustrated in Figure 2. This is broadly associated with bank breaches of the unnamed watercourses which drain the north of the site, as outlined within RCT's FRMP³. 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.

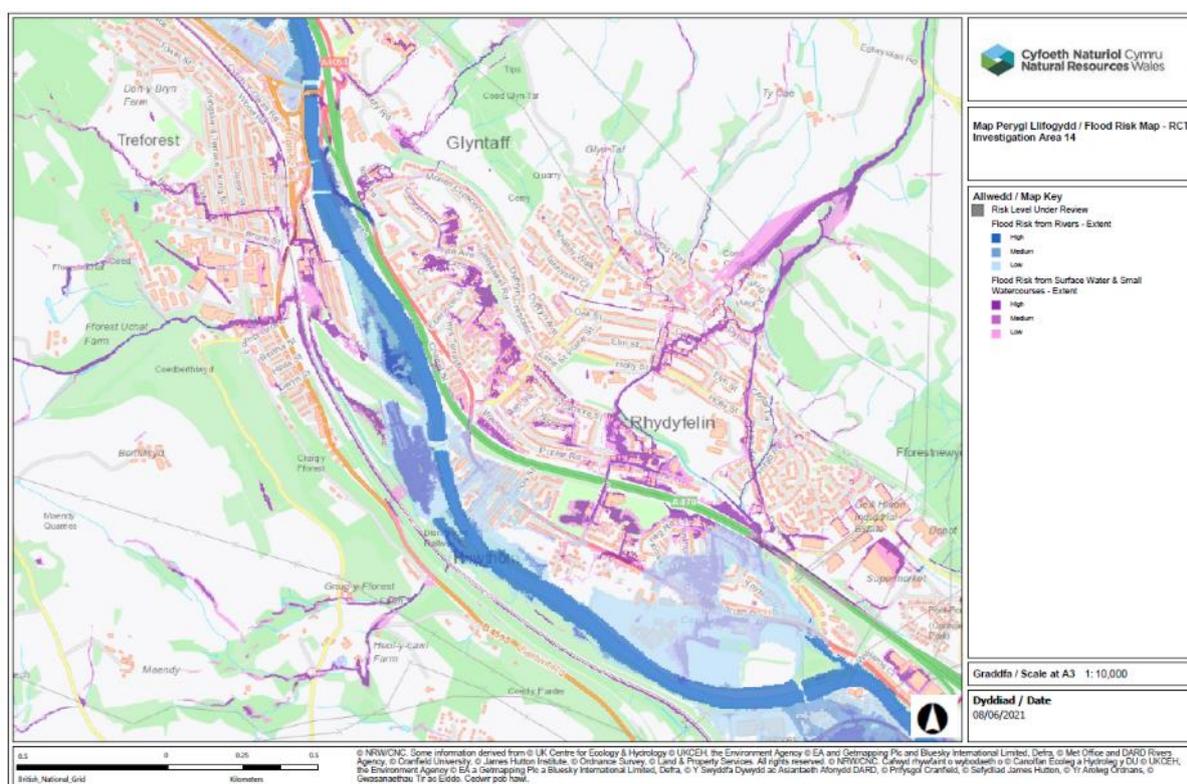


Figure 2: Natural Resources Wales' Flood Risk Assessment Water (FRAW) map for rivers and ordinary watercourse and surface water flood risk at investigation area RCT14. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

Aside from the culverted ordinary watercourse to the north of RCT14, there are no further known ordinary watercourses within the investigation area. Several named and unnamed ordinary watercourses drain the hillsides above Glyn-taf, Rhydyfelin and Hawthorn but flow outside the investigation area. These include the Nant Y Fforest, Nant Lonydd and Nant Corrwg.

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

1.3. DRAINAGE SYSTEM

The surface water drainage systems that serve investigation area RCT14 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.

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 RCT
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 have experienced internal flooding prior to February 2020.

Several reports of surface water flooding have been recorded across the investigation area, particularly along the A4054 Cardiff Road in the northernmost section of RCT14. Since 2010, flooding on Cardiff Road has resulted in the internal flooding of properties on at least two occasions, whereas reports of flooding at other locations within the investigation area have been exclusively external.

Residents affected by main river flooding during Storm Dennis state they had not experienced flooding from the River Taf prior, with all historic flood reports deriving from surface water flooding as a result of overwhelmed highway drainage and intense rainfall.

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 RCT’s Public Health, Protection and Community team during the days following the storm event. They identified 23 residential properties and 4 non-residential properties as internally flooded within the investigation area.

A summary of the source(s) and pathway(s) of flooding within RCT14 during Storm Dennis have been outlined in Table 2 and further described throughout this section.

Table 2: Summary of the source(s), pathway(s) and receptor(s) affected during Storm Dennis within investigation area RCT14

Source(s)	Pathway(s)	Receptor(s)
The primary source of flooding for this incident was the River Taf, adjacent to the investigation area, overtopping its banks.	There were numerous pathways related to the overtopping of the River Taf and the conveyance of fluvial flood water into adjacent streets and properties on both eastern and western riverbanks.	A total of 21 residential and 4 non-residential properties across Cardiff Road, Nant y Dall Avenue, De Barri Street and Old Tinworks Road were internally flooded by the overtopping of the main river.
Intense rainfall and subsequent surface water runoff, both locally and from the hillsides to the north-east of the investigation area, also contributed to the flooding that occurred.	The accumulation of surface water on Cardiff Road and adjacent streets resulted in the creation of pluvial flows throughout the investigation area.	2 residential properties, one on Owen Street and one on Alexon Way, were internally flooded by surface water. Pluvial flows are also likely to have contributed to the internal flooding of properties impacted by main river flooding across RCT14.

On review of Table 2, the primary source of the recorded flooding within the investigation area was the overtopping of the main river, the River Taf. The main river overtopped both its eastern and western banks at several locations throughout RCT14.

The impacts of the overtopping were exacerbated by intense rainfall and subsequent surface water flows throughout the investigation area, with surface water flows from the surrounding watershed and localised surface water accumulation both contributing sources.

Regarding the surrounding watershed, a rolling ball assessment (a Geographical Information System technique used to delineate a watershed using topographical data) was undertaken as part of Redstart's FIR to estimate the area of land that would be expected to drain from the hillsides surrounding investigation area RCT14 into the River Taf. Figure 3 illustrates the estimated topographic watershed determined using the rolling ball assessment, with two sub catchments identified within the area.

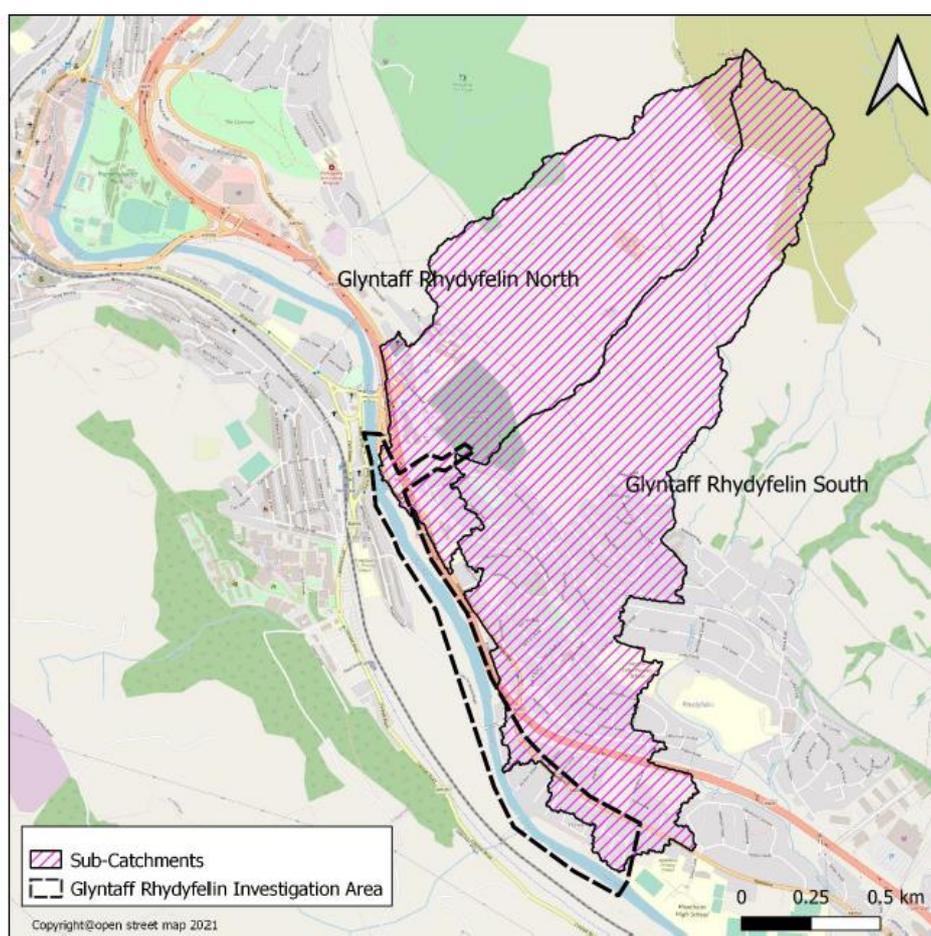


Figure 3: Flood Investigation Area RCT14 Sub-Catchments

For the purpose of this investigation, the flood incident at investigation area RCT14 will be described in three parts: the flood incident at ‘Glyn-taf Rhydyfelin North’ (sub-catchment 1), the flood incident at ‘Glyn-taf Rhydyfelin South’ (sub-catchment 2) and the flood incident on the western bank of the River Taf.

2.2.1. GLYN-TAF RHYDYFELIN NORTH

Glyn-taf Rhydyfelin North is an area of approximately 97 hectares that originates at the River Taf and extends northeastwards (Figure 3). All areas of the surrounding hillside that form the northern sub-catchment drain towards the main river.

The primary source of internal flooding within the sub-catchment was the overtopping of the River Taf during the early hours of Sunday 16th February. Figure 4 depicts the swollen River Taf flowing rapidly through Treforest prior to its overtopping.

The primary flow pathway was the conveyance of fluvial flood water over the main river’s eastern embankment and onto the A4054 (Cardiff Road) at multiple locations near the Castle Inn Bridge footbridge. Figure 5 illustrates the rapid onset of flooding from the River Taf at Cardiff Road once it had overtopped.

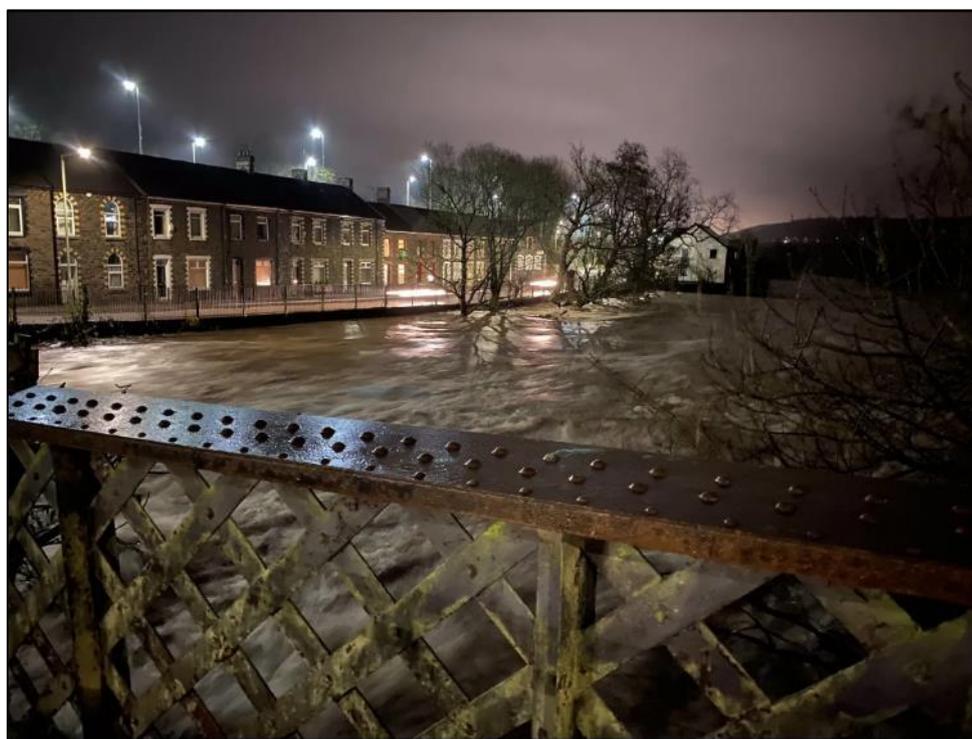


Figure 4: A downstream view of the River Taf at Castle Inn Bridge, Cardiff Road prior to its overtopping during Storm Dennis (Image: Storm Dennis, pontypriddtowncouncil.gov.uk)



Figure 5: Photo of the rapid onset of flooding from the River Taf at Cardiff Road during Storm Dennis
(Image: Wales Online)

Surface water flooding also occurred as a result of intense rainfall and subsequent pluvial flows. Whilst not as distinct in their impact, the pluvial flows are believed to have contributed to the internal flooding that occurred at Cardiff Road and resulted in external flooding throughout the wider catchment. The pathways of flooding within 'Glyn-taf Rhydyfelin North' sub-catchment have been depicted in Figure 6.

A total of 17 residential and 2 non-residential properties were internally flooded within Glyn-taf Rhydyfelin North during Storm Dennis. All flooded properties were located adjacent to the River Taf along Cardiff Road, highlighting the significant impact of the main river overtopping and the subsequent flooding that occurred in the area.

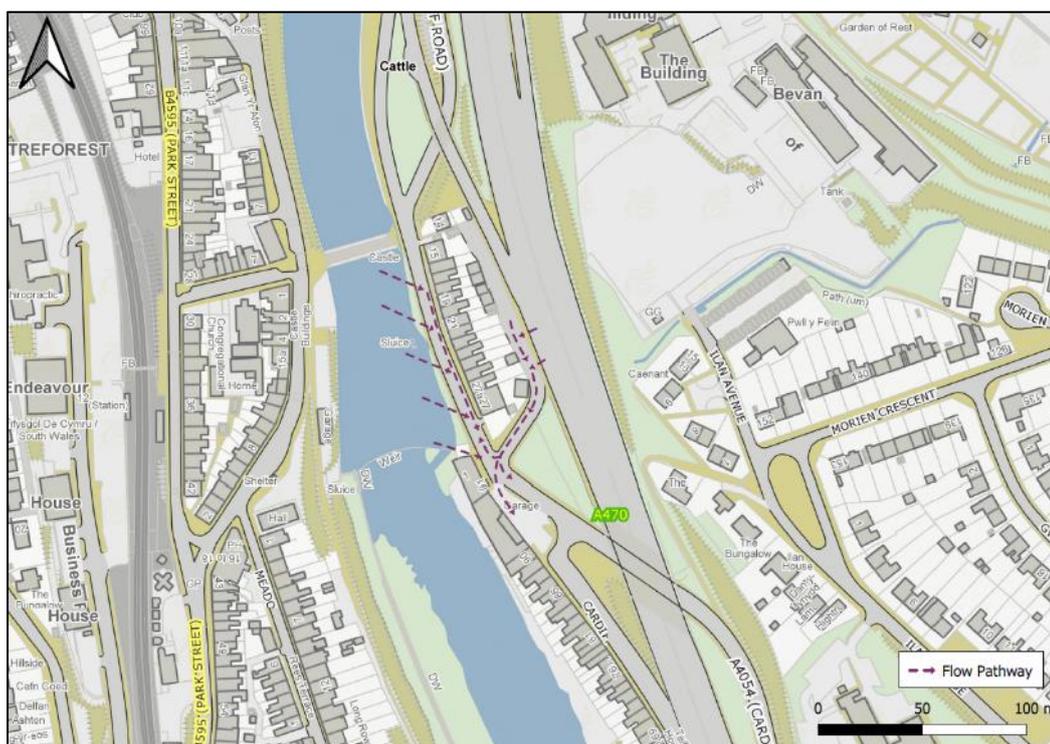


Figure 6: Flow Pathways that caused internal flooding within Glyn-taf Rhydyfelin North sub-catchment

2.2.2. GLYN-TAF RHYDYFELIN SOUTH

Glyn-taf Rhydyfelin South sub-catchment covers an area of approximately 140 hectares across the east and southeast of the study area and also includes areas of the surrounding hillside that drain towards the River Taf (Figure 3).

Alike Glyn-taf Rhydyfelin North, the primary source of flooding within the sub-catchment was the overtopping of the River Taf. The primary flow pathway saw flood water convey beyond the eastern riverbank onto De Barri Street and into the rear of properties on Nant Y Dall Avenue, with flood water reaching approximately 1.8 metres in some areas (Figure 7).

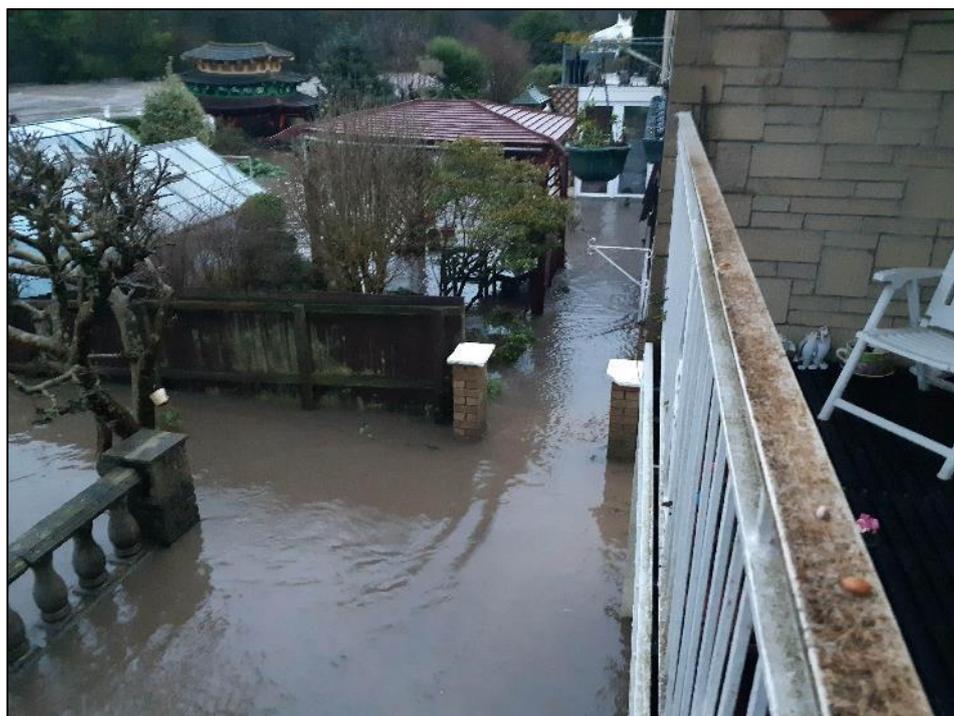


Figure 7: Image showing main river flooding to the south of Nant-y-Dall Avenue during Storm Dennis (image provided by resident)

Of the six properties within Glyn-taf Rhydyfelin South that were internally flooded, four were as a result of the River Taf overtopping its banks. The remaining two residential properties that reported internal flooding, one on Owen Street and one on Alexon Way, were flooded by surface water. The pathways of observed flooding within 'Glyn-taf Rhydyfelin South' sub-catchment have been depicted in Figure 8 below.

Owen Street is approximately 130 metres away from the River Taf and, whilst it is possible that fluvial flood water conveyed along the rear of De-Barri Street and into Owen Street, this is unlikely due to the lack of evidence and limited reports of flooding along the conveyance route. Surface water is believed to have accumulated on both Owen Street and Cardiff Road, resulting in the internal flooding of an end-of-terrace property on Owen Street.

The localised accumulation of surface water is believed to have been responsible for the internal flooding of a residential property on Alexon Way. Resident reports during the storm event suggest that the River Taf did overtop its banks south of Ymyl yr Afon (Figure 8); however, evidence suggests that fluvial flows did not convey a large enough distance to internally flood any nearby properties.



Figure 8: Flow pathways that caused flooding within Glyn-taf Rhydyfelin South

2.2.3. RIVER TAF WESTERN RIVERBANK

Within RCT14, a single property on the western bank of the River Taf was internally flooded during Storm Dennis. The non-residential property, located on Old Tin Works Road, is situated within 25 metres of the main river channel and is considered to have been impacted by the River Taf overtopping its western banks at this location.

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 are several unnamed watercourses which drain the upper catchment areas to the east of investigation area RCT14. These watercourses are culverted beneath Glyn-taf before discharging into the River Taf downstream. The most notable culverted watercourse in relation to our investigation is known as 'Ilan Avenue' culvert network which conveys water from the hillside above Glyn-taf Rhydyfelin North sub-catchment, beneath the A470, and discharges into the River Taf at Cardiff Road (illustrated in Figure 9).

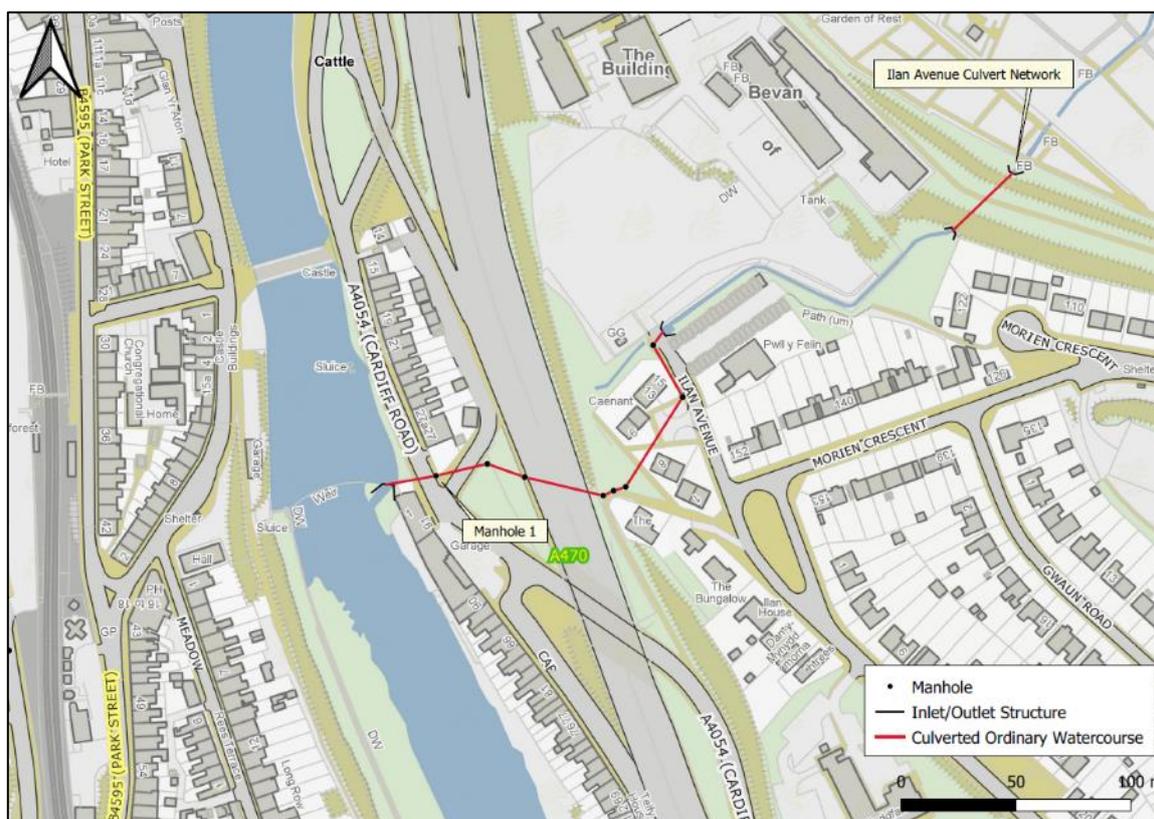


Figure 9: Ilan Avenue culverted ordinary watercourse location plan

Following Storm Dennis, a CCTV survey inspection of the culvert network was undertaken to ascertain both the operational condition of the network and its structural integrity. The survey identified some debris within the Ilan Avenue culvert network, with approximately two tonnes of material being removed from the system following the inspection. Little to no debris was identified at both culvert inlets following the storm event, indicating that the identified debris was already present in the network prior to

the storm event. Due to the lack of pre-storm survey data, it is not possible to conclusively determine whether this debris was present in the system prior to the storm event, if the material entered the system as a result of the exceptional weather conditions, or whether they are influenced by the outfall arrangement into the Main River.

Site inspections undertaken by RCT's Flood Risk Management team during Storm Jorge (February 28th to March 1st) identified a manhole adjacent to the affected properties on Cardiff Road (labelled 'Manhole 1' in Figure 9) surcharging. This resulted in repeat surface water flooding to the external extents of several properties at Cardiff Road.

The surcharging of 'Manhole 1' approximately two weeks after Storm Dennis has been attributed to the raised river levels within the River Taf which prevented water from outfalling from the culverted network and into the River Taf. Figure 10, taken during RCT's site inspection following the receding of flood water, shows 'Manhole 1' surcharging within the chamber.



Figure 10: Photo of 'Manhole 1' surcharging during Storm Jorge (captured by RCT's Flood Risk Management team on 28th February 2020)

Following the observations made at 'Manhole 1' during Storm Jorje, it is considered that the downstream culvert network may have contributed to surface water flooding on Cardiff Road during Storm Dennis; however, the overtopping of the River Taf has been determined as the primary cause of flooding to properties at Cardiff Road in the northern sub-catchment during Storm Dennis.

3.2. ORDINARY WATERCOURSE CONDITIONS

Whilst there are several unnamed watercourses within the upper catchment of the investigation area, many of these watercourses convey into the Nant Corrwg and Nant Lonydd before discharging into the River Taf (highlighted in Figure 11). These watercourses and their tributaries fall outside of the investigation area.

The unnamed ordinary watercourse associated to the 'Ilan Avenue' culvert network water (Figure 9) was inspected post event and found no evidence of recent scour to the channel.

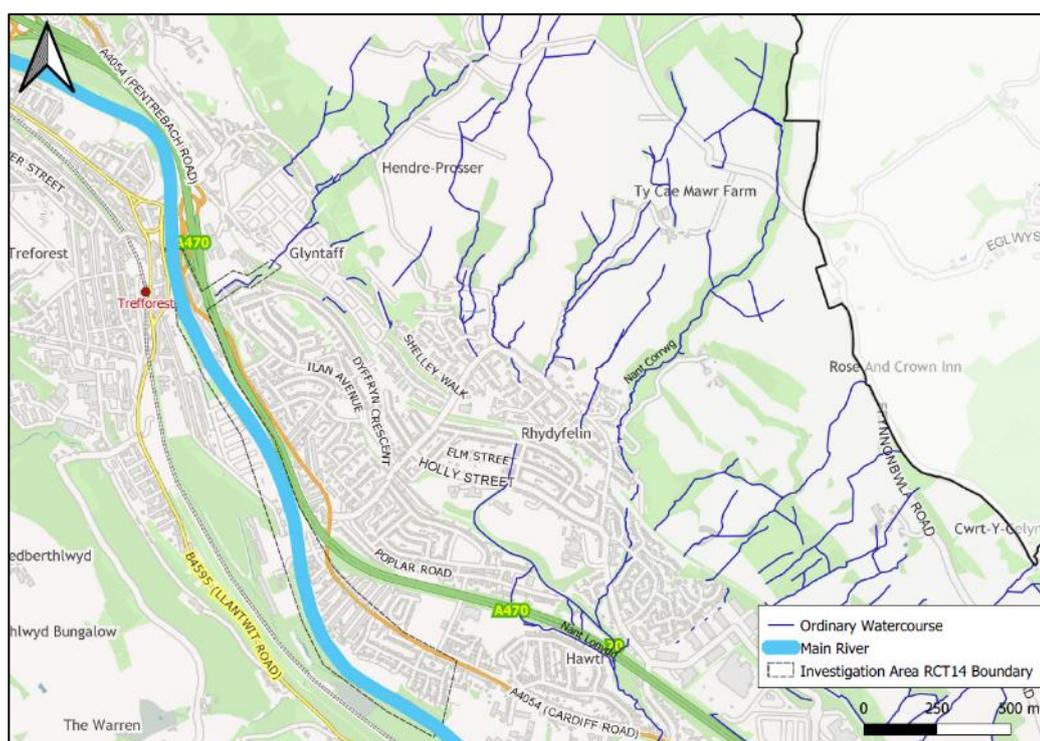


Figure 11: Map outlining main river and ordinary watercourse locations throughout RCT14 and the surrounding region.

There is no evidence to suggest that the ordinary watercourses outlined in Figure 11 contributed to the flooding experienced in RCT14 during Storm Dennis.

3.3. MAIN RIVER

The designated main River Taf flows in a southeasterly direction through Glyn-taf, Rhydyfelin and Hawthorn (Figure 11). Areas on both the western and eastern embankments of the River Taf were impacted during Storm Dennis.

3.3.1. MAIN RIVER LEVELS AND FLOOD WARNINGS

The hydrograph in Figure 12 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 Pontypridd river level gauge, located approximately 750m north-west 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 metres in depth and continuing to rise at Pontypridd station. At approximately midnight on the 16th February the River Taf began to rise again, reaching a peak river level of 5.32 metres at 04:45 on the 16th of February; the highest level recorded for the River Taf at Pontypridd since 1970.

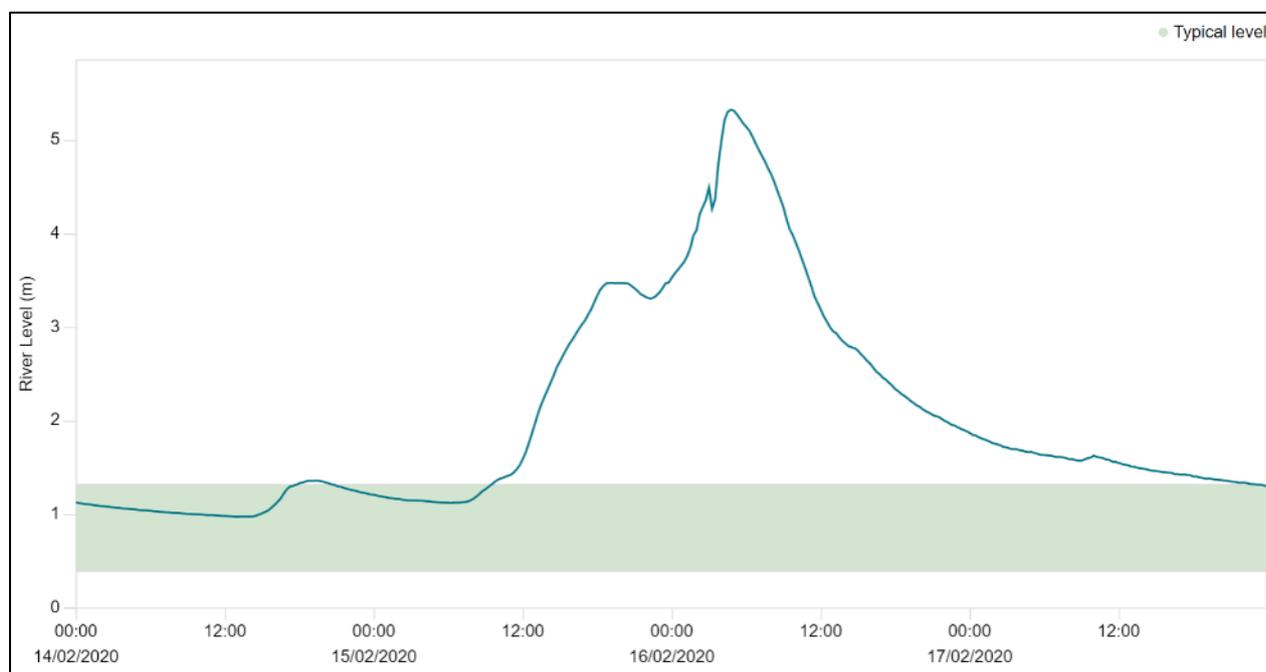


Figure 12: The River Taf levels at Pontypridd station between the 14th and 17th February 2020 (Natural Resources Wales)

The green bar displayed on the hydrograph shows the typical level of the River Taf at the Pontypridd station, ranging between 0.4 and 1.3 metres. 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 Pontypridd was almost four meters higher than its average level.

With significantly high river levels being recorded upstream in both the River Taf and the River Rhondda, it is accepted that the River Taf reached record-high levels beyond the confluence of the two rivers at Pontypridd. As a result, the river overtopped its banks downstream of the confluence, initially at Glyn-taf and then continued to overtop at several locations downstream, including adjacent to Cardiff Road on the eastern bank and adjacent to Old Tinworks Road on the western bank.

Investigation area RCT14 falls within two NRW Flood Warning Areas; the River Taf at Pontypridd and the River Taf at Hawthorn and Rhydyfelin. The Flood Warnings issued by NRW, and associated river levels at Pontypridd gauging station (i.e., nearest gauging station to RCT14), for the River Taf at investigation area RCT14 during Storm Dennis are shown in Table 3.

Table 3: Flood Warnings issued by NRW for the River Taf at RCT14 during Storm Dennis

Flood Warning Type	Location	Start Time	River Level (m) at Pontypridd
Flood Alert	River Taf	13:27 15/02/2020	2.178
Flood Warning	River Taf at Pontypridd	20:48 15/02/2020	3.443
Flood Warning	River Taf at Hawthorn and Rhydyfelin	04:00 16/02/2020	4.991
Severe Flood Warning	River Taf at Pontypridd	06:33 16/02/2020	5.039

NRW issued a 'Flood Warning' alert (indicating flooding is expected) for the River Taf at Pontypridd at 20:48 on the 15th February; at which point the main river was almost 3.5 metres in depth. A 'Flood Warning' alert was also issued for the River Taf at Hawthorn and Rhydyfelin at approximately 04:00 on the 16th of February; at which point the main river was 4.991 metres in depth (at Pontypridd gauging station); only 0.329 metres from the recorded peak level. By this time significant flooding had already commenced at several properties along the River Taf, with residents at Nant-Y-Dall Avenue observing flood water entering their properties from approximately 01:30 onwards.

A 'Severe Flood Warning' alert (indicating Community-wide flooding and possible risk to life) for the River Taf at Pontypridd was also issued by NRW at 06:33 on the 16th February; at which point the River Taf was 5.039 metres in height.

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 (RCT14), this is in reference to both the 'Flood Warning' alert at Hawthorn and Rhydyfelin and the 'Severe Flood Warning' alert issued at Pontypridd.

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 Review⁴.

3.3.2. MAIN RIVER FLOOD RISK

As outlined in Section 2, the overtopping of the River Taf resulted in the internal flooding of several properties in close proximity to the watercourse, with properties up to 60 metres inland reporting internal flooding directly as a result of the overtopping.

Figure 13 is an excerpt from NRW's Flood Risk Assessment Wales (FRAW) mapping exercise which depicts the main river flood extents for the 'Defended' scenario, i.e., with the presence of flood defence infrastructure. 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 flooding that occurred within RCT14 during Storm Dennis is largely consistent with the modelled outputs of NRW's FRAW map (Figure 13), with the majority of investigation area RCT14 identified at high and medium risk of fluvial flooding.

A high risk of flooding means that an area has a chance of flooding of greater than 1 in 30 (3.3%) each year; meanwhile, a medium risk of flooding signifies a yearly chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%).

⁴ [February 2020 Floods in Wales: Flood Incident Management Review \(cyfoethnaturiol.cymru\)](https://www.cyfoethnaturiol.cymru/February-2020-Floods-in-Wales-Flood-Incident-Management-Review)

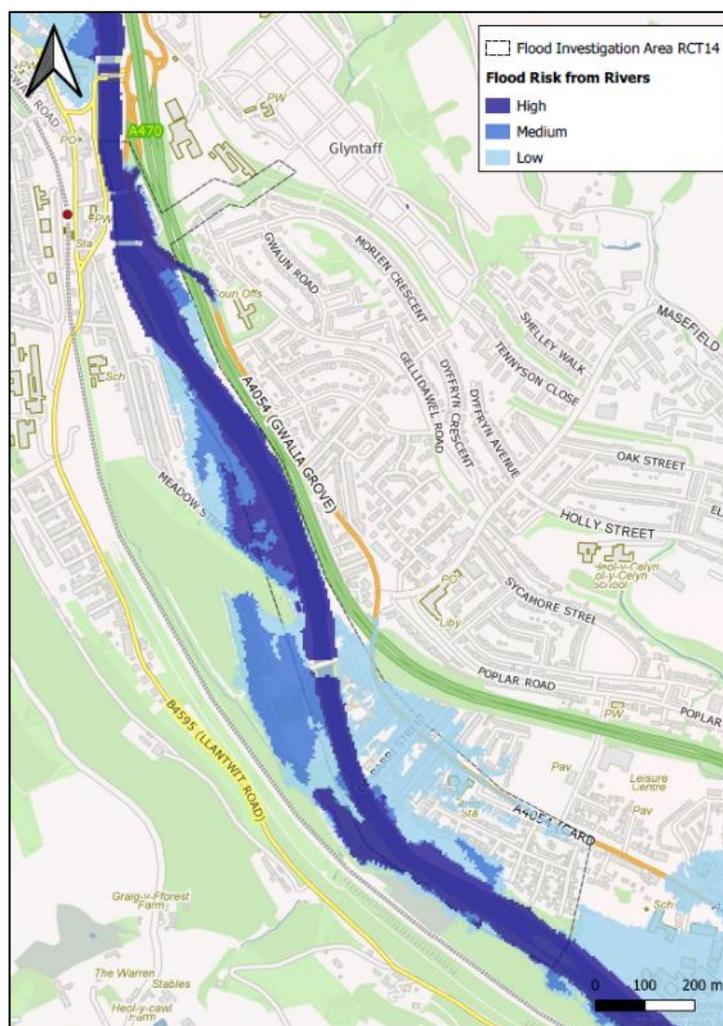


Figure 13: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for River sources. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

Based on NRW's Flood Hazard maps, flooding to a depth greater than 0.9 metres is predicted along parts of Cardiff Road in the northern sub-catchment (Figure 14), as well as areas south of Nant-y-Dall Avenue in the southern catchment during a medium risk event (Figure 15). Flooding of this depth and greater was observed at these locations during Storm Dennis.

Figure 15 does not identify Alexon Way as an area of main river flood risk, further supporting the notion that fluvial flows did not reach the impacted property. Surface water flooding has been determined as the likely cause of internal flooding at this location.

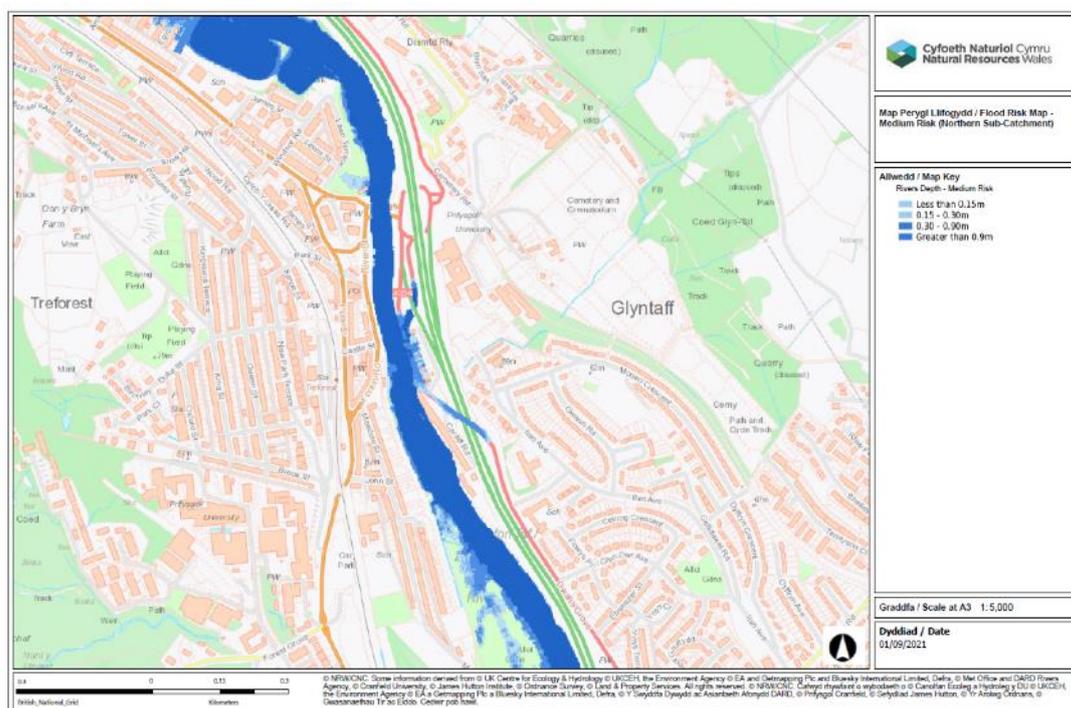


Figure 14: NRW's National Flood Hazard derived map for Medium Risk River Flood Depth in RCT14 Northern Sub-Catchment. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved

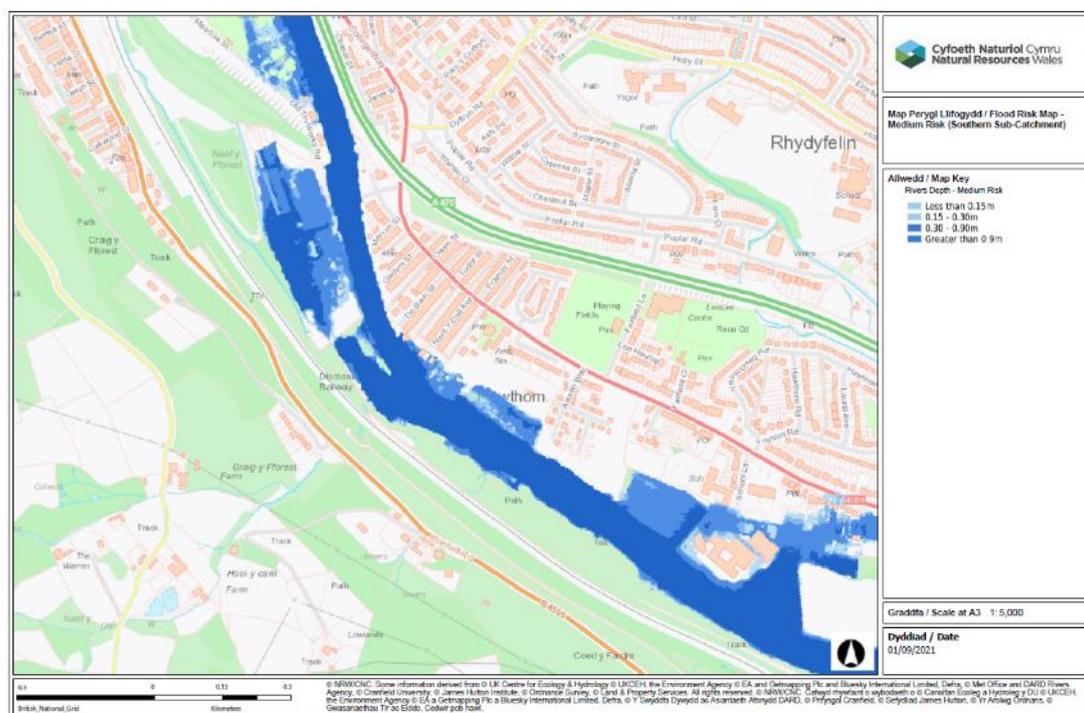


Figure 15: NRW's National Flood Hazard map for Medium Risk River Flood Depth in RCT14 Southern Sub-Catchment. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

3.3.3. MAIN RIVER FLOOD DEFENCES

There are no formally designated flood defences along the River Taf at investigation area RCT14, i.e., there are no flood defences operated or maintained by NRW. The closest flood defence, demarcated on Figure 16 by a bold red line, is immediately downstream of Alexon Way at the southern extent of the investigation area boundary.

Figure 16 illustrates the reduction in flood risk that derives from the presence of a flood defence structure, with the defended area of Hawthorn identified at low risk of main river flooding in comparison to areas of Glyn-taf and Rhydyfelin upstream that are identified at high and medium risk of fluvial flooding.

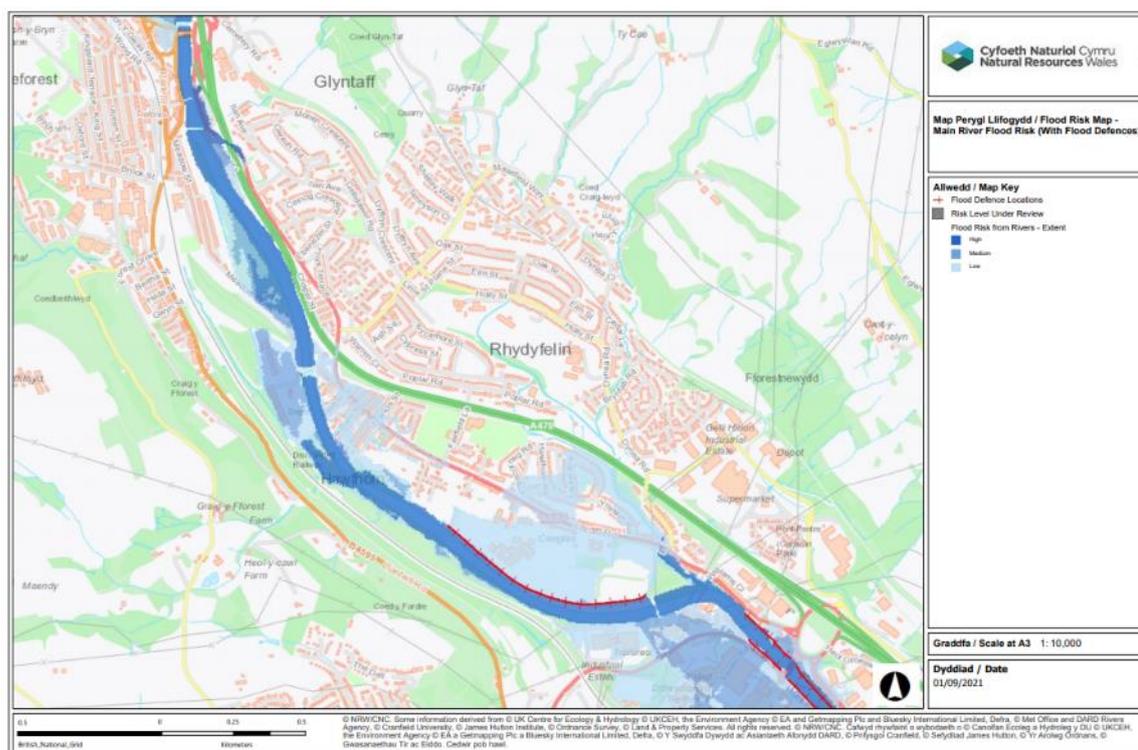


Figure 16: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for River sources, including flood defence locations at investigation area RCT14. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

The current indicative design standard of protection (SOP) 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 Q100⁵.

⁵ [National Strategy for Flood and Coastal Erosion Risk Management in Wales \(English\) \(gov.wales\)](https://www.gov.wales/national-strategy-for-flood-and-coastal-erosion-risk-management-in-wales)

Despite there being no formal flood defences at RCT14, Storm Dennis has been estimated as a 1 in 200 (Q200) flood event according to NRW, therefore the unprecedented rise in river levels within the Taf during the storm event would have resulted in the overtopping of assets up to Q100 SOP.

NRW's 'Flood Incidence Response Review'⁴ does in fact outline 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

Several streets, including Cardiff Road, Nant-y-Dall Avenue and De Barri Street, were observed to be flooding as a result of the overtopping of the River Taf during Storm Dennis. These fluvial flows deposited mud, silt and debris across the investigation area which are assumed to have entered the highway drainage system, leading to blockages and a reduction in the hydraulic capacity of the surface water network. Accompanied by intense rainfall and significant surface water conveyance, it is considered that the highway drainage infrastructure in the affected regions of RCT14 became overwhelmed during the storm event.

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 RCT14 was exceeded as a result of a both 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 during Storm Dennis.

3.5. DŴR CYMRU WELSH WATER APPARATUS

There is no evidence from this investigation that DCWW apparatus contributed to the flooding that occurred during Storm Dennis within investigation area RCT14.

DCWW reported no issues within RCT14 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

Whilst surface water is believed to have been the primary cause of internal flooding at two properties within RCT14, surface water is considered to have contributed to and exacerbated the main river flooding observed across the investigation area.

The pathways for surface water runoff during the storm event were observed primarily along the highway network within RCT14. The exact flow routes have not been confirmed due to lack of anecdotal evidence, however, NRW's national surface water and ordinary watercourse flood maps (Figure 17) provide a reasonable indication of the pathways and areas most at risk of flooding from local sources.

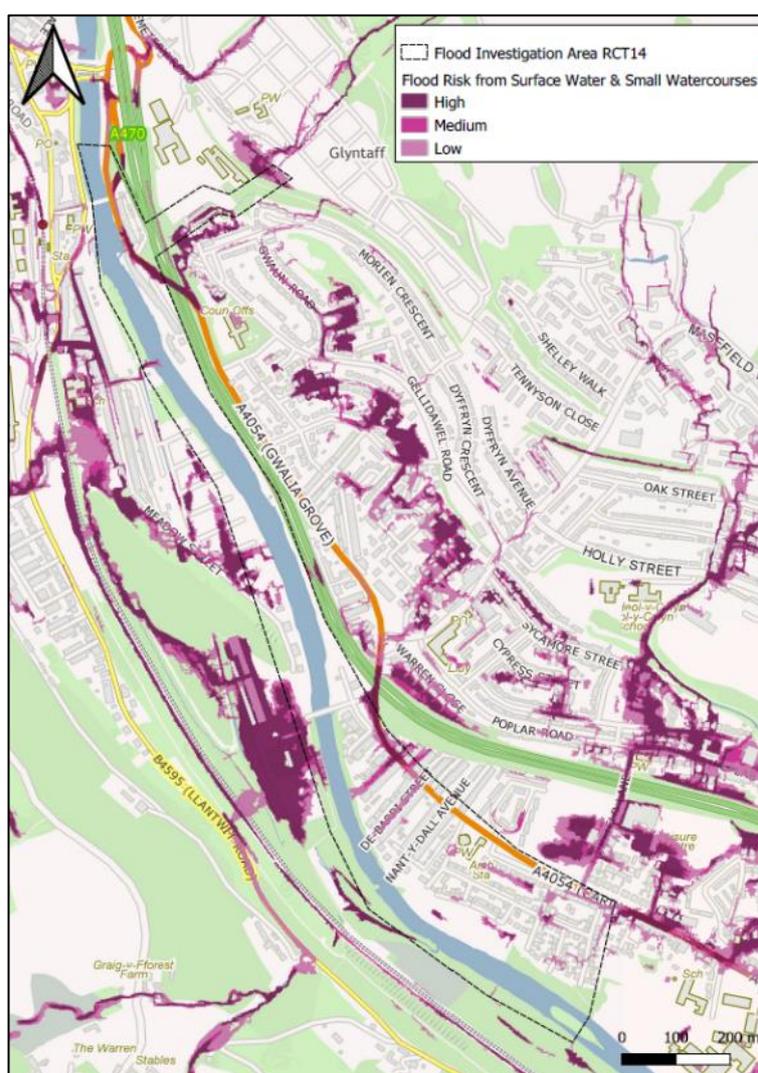


Figure 17: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for Surface Water and Ordinary Watercourse flood sources. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

With the exception of Owen Street, which is denoted as an area of medium surface water flood risk in Figure 17, the majority of high and medium surface water flood risk areas which experienced internal flooding were also flooded by the overtopping of the River Taf. This further reinforces the notion that surface water was a secondary influence on the flooding that occurred in RCT14, with areas that were solely impacted by surface water, such as Gwilym Street, primarily experiencing external flooding rather than internal flooding.

3.7. ACCESS STRUCTURES

No access structures were identified during the asset investigations within the area, as such 'access structures' have not been considered within this report.

3.8. SYSTEM AT CAPACITY

Whilst the overtopping of the River Taf has been determined as the primary cause of flooding to the majority of properties within RCT14, the capacity of the ‘Ilan Avenue’ culvert network (illustrated in Figure 18) has also been assessed to ascertain its current standard of protection following the observed surcharging of a manhole at Cardiff Road following Storm Dennis (Figure 10).

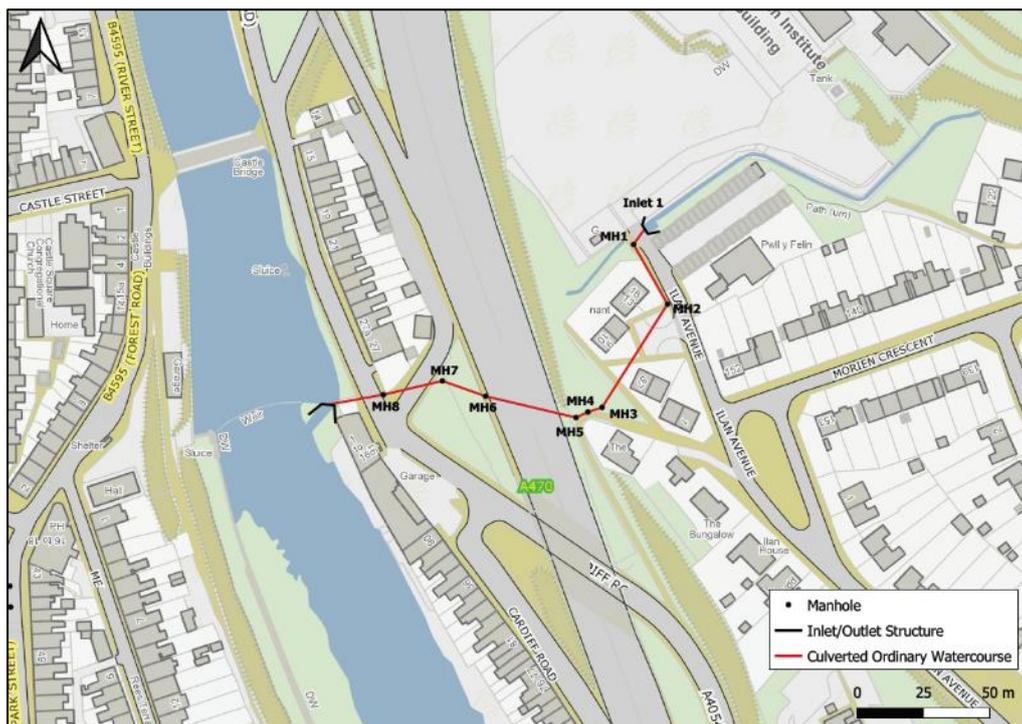


Figure 18: Ilan Avenue culverted ordinary watercourse network with annotated Manhole labels

The results of the culvert capacity assessment are summarised in Table 4.

Table 4: Summary of the culvert capacity assessment results which indicate the current standard of protection of the Ilan Avenue culvert network in free flowing and blockage conditions

Culvert Network	Standard of Protection (SOP) – Free Flowing	Standard of Protection (SOP) – Blockage Condition
Ilan Avenue Upstream (Inlet 1 – MH3)	Q200 (0.5% AEP)	Q2 (50% AEP)
Ilan Avenue Downstream (MH4 – MH8)	Q30 (3.3% AEP)	Q2 (50% AEP)

The assessment infers that the upstream section of the network, at the culvert inlet adjacent to Ilan Avenue, has adequate hydraulic capacity to accommodate storm events up to Q200 in free-flowing conditions. This is significantly reduced to Q2 in blockage conditions however, no blockage to the upstream inlets was observed during Storm Dennis.

The capacity of the Ilan Avenue downstream network (which conveys flows beneath the A470 and Cardiff Road) was assessed as having a SOP below current design standards for new culverts as defined by CIRIA C789. This is further reduced to Q2 in blockage conditions.

The results suggest that the downstream network likely became overwhelmed during Storm Dennis due to the reduction in hydraulic capacity within the downstream culvert network, and high river levels in the River Taf further restricting the downstream networks' hydraulic capacity to discharge the flow of water. These findings support the post event observations which identified 'Manhole 1' as surcharging during Storm Jorje due to hydraulic overload.

3.9. SUMMARY OF POSSIBLE CAUSES

The above sections have identified and described the possible causes of flooding within RCT investigation area 14 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 5.

Table 5: Summary of source(s) and possible cause(s) of flooding in RCT14 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 conveying into several properties.	Mixed Ownership	Main River
2	Surface water drainage network across RCT14	Intense rainfall across RCT combined with the overtopping of the River Taf severely overwhelmed highway drainage infrastructure, resulting in the accumulation of surface water on many streets throughout the investigation area.	Rhondda Cynon Taf CBC Highway Authority	Surface Water
3	Ilan Avenue Culvert Network – Manhole 1	A manhole near Cardiff Road associated with Ilan Avenue culvert network was witnessed surcharging in the weeks following the storm event. This manhole is also considered to have surcharged during Storm Dennis, exacerbating the internal flooding experienced at nearby properties.	Rhondda Cynon Taf CBC Highway Authority	Surface Water & Ordinary Watercourse

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 6. 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 6: 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, the Water Resources Act 1991 and the Highways Act 1980. Through analysis of the flooding that impacted investigation area RCT14, 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 investigation area RCT14 during Storm Dennis have been previously identified and summarised within Table 5. The Risk Management Authorities responsible for managing that flooding have been listed in Table 7 below, along with a series of recommendations put forward by the LLFA.

Table 7: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in investigation area RCT14 (as per Table 5)

Ref No	Asset (Source)	Asset Owner	Type of Flooding	Relevant Risk Management Authority	Recommendations
1	River Taf	Mixed Ownership	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 Glyn-taf, Rhydyfelin and Hawthorn. Aligns with recommendation ‘Action FD2’ within NRW’s Flood Incident Management Review.
					R1B NRW to work with landowners to assess and review the risk of flooding from the River Taf at RCT14, an area deemed at high risk of fluvial flooding,

						to identify the viability of risk management options.
					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	Surface water drainage network across RCT14	Rhondda Cynon Taf CBC Highway Authority	Surface Water	Highway Authority and Lead Local Flood Authority	R2A	The Highways Authority to jet and cleanse the highway drainage network and action repairs accordingly.
					R2B	The LLFA to develop a Strategic Outline Business Case to identify suitable management methods to reduce the risk of flooding from local sources (ordinary watercourse, surface water, groundwater).
3	Ilan Avenue culvert network - Manhole 1	Rhondda Cynon Taf CBC Highway Authority	Ordinary Watercourse and Surface Water	Land Drainage Authority and Lead Local Flood Authority	R3A	The LLFA and LDA to identify drainage asset ownership and responsibility.
					R3B	The LLFA and LDA to investigate the standard of protection and the condition of the culvert structure and network as a whole.
					R3C	The LLFA to jet and cleanse the ordinary watercourse culvert network.

					R3D	The LLFA to develop a Strategic Outline Business Case (SOC) to identify suitable management methods to reduce the risk of flooding from local sources (ordinary watercourse, surface water, groundwater).
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4.1. LEAD LOCAL FLOOD AUTHORITY

In review of Ref 2 and Ref 3 of Table 7, 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 RCT14 during Storm Dennis.

The LLFA exercised the following functions in response to the flooding at investigation area RCT14:

- 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 and LDA have exercised their permissive powers under Section 64 of the Land Drainage Act 1991 to investigate the culvert structures and network conditions and its impact on the flooding within the investigation area. **(R3B)**
- An estimated 242 metres of ordinary watercourse culvert network length within investigation area RCT14 has been surveyed following the storm event to ascertain both the operational condition and structural integrity along sections of the network. **(R3B)**
- An estimated 2 tonnes of debris was removed from the culverted watercourse network within investigation area RCT14 during cleansing operations. **(R3C)**
- The LLFA and LDA have undertaken clearance works to the Ilan Avenue culvert inlet structures which fall under the responsibility of the Authority. **(R3C)**
- The LLFA commissioned Redstart to investigate the standard of protection of the Ilan Avenue culvert network in RCT14 to determine its hydraulic capacity following the identification of operational defects within sections of the network. **(R3B)**
- The LLFA has exercised its powers, under Section 13 of the FWMA, to request information and co-operation from NRW and South Wales Trunk Road Agency (SWTRA) 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 RCT14:

- Following the surveying of the Ilan Avenue culvert network in RCT14, the LLFA propose to input and update all relevant asset data. **(R3A)**
- The LLFA propose to develop a SOC to better understand the risk of flooding within RCT14 using a whole catchment approach to provide recommendations for suitable management mechanisms to reduce the wider risk of flooding to people and properties from local sources (Ordinary Watercourse, Surface Water and Groundwater). **(R2B, R3D)**
- 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. **(R3A)**
- 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. **(R2B, R3D)**
- 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 in Table 7, 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 has exercised the following functions in response to the flooding at investigation area RCT14:

- 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 Glyn-
taf, Rhydyfelin and Hawthorn to ensure it was clear of blockages.
- NRW specifically outline within their 'Flood incident Management Review'⁴ 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 Pontypridd 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 2020⁶. 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 Flood Warning Service Review carried out by NRW in 2018. Several of the

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

recommendations directly link to the recommendations set out by NRW within their Flood Incident Management Review **(R1C)**.

NRW propose to exercise the following functions in response to the flooding at investigation area RCT14:

- 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. 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)**

4.3. WATER COMPANY

Dŵr Cymru Welsh Water were not identified as a relevant authority in relation to the flooding at investigation area RCT14 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 RCT14 during Storm Dennis, the Highway was identified as flooding from a combination of sources, notably as a result of surface water runoff and main river flooding from the River Taf.

Ref 2 of Table 7 identifies the Highway Authority as a relevant Risk Management Authority in relation to the surface water flooding that occurred along the highway across RCT14.

RCT as the Highway Authority have exercised the following functions in response to the flooding within investigation area RCT14:

- 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 and associated silty material, to ensure the safety of the highway post event. **(R2A)**

RCT as the Highway Authority propose to undertake the following function in relation to the storm event at RCT14:

- 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>