RHONDDA CYNON TAF COUNTY BOROUGH COUNCIL

Flood and Water Management Act 2010

Storm Dennis February 2020 – Overview Report

July 2021

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EXECUTIVE SUMMARY

This report provides an overview of the storm event that occurred on the 15 and 16th of February 2020, including detailed rainfall, watercourse and river level analysis, a short summary of the impacts, primary flooding types and an overview of the roles and responsibilities of Risk Management Authorities in managing different sources of flooding. It does not identify any proposed specific causes, actions or works in relation to the storm event.

The flooding that affected RCT on 15 and 16th of February 2020, was a result of an extreme rainfall event. The storm was preceded by 6 weather warnings being issued by the Met Office ranging from; Yellow to Amber to Red warnings with rainfall predictions increasing closer to the 15th – 16th February. The Met Office designated the storm as 'Storm Dennis'.

The impact of Storm Dennis resulted in internal flooding to approximately 1498 properties and extensive flooding of infrastructure including rail and highway networks, town centers, business parks and leisure facilities. 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, Protection and Community Service, Natural Resources Wales and Dŵr Cymru Welsh Water.

Storm Dennis was indeed an unprecedented weather event which, according to NRW, was equivalent to a Q200 storm event. Record-breaking rainfall and river levels exceeded the design standard of all drainage infrastructure in RCT, resulting in the worst flooding in a generation to homes, businesses and infrastructure.

Detailed assessments of the flooding mechanisms and impacts caused during the storm event have been produced for individual areas across RCT. A total of twenty-eight areas have been investigated across the county borough, nineteen of which have met stipulated Welsh Government thresholds for the production of individual Section

19 Reports[1]. These reports will be made available to the public and will compliment this overview report of Storm Dennis.

[1] 40996 National Strategy for Flood and Coastal Erosion Risk Management in Wales (English) (gov.wales)

ABBREVIATIONS

DCWW – Welsh Water

FRMP – Flood Risk Management Plan

FWMA – Flood and Water Management Act 2010

LFRMS – Local Flood Risk Management Strategy

LLFA – Lead Local Flood Authority

NRW – Natural Resources Wales

RCT - Rhondda Cynon Taff CBC

RMA – Risk Management Authority

TABLES AND FIGURES

1. INTRODUCTION

1.1 BACKGROUND

On the 15 and 16th February 2020 Rhondda Cynon Taf County Borough Council (RCT) was impacted by an extreme weather event which was designated by the 'Met Office' as 'Storm Dennis'.

Storm Dennis was the 4th named storm of the 2019-2020 season and was the second of three consecutive storm events that made landfall in February 2020 i.e. Storm Ciara (8-9th February), Storm Dennis (15th-17th February) and Storm Jorje (28th February – 1st March), making February 2020 the wettest February on record in Wales and the UK.

The impacts of Storm Ciara were mainly felt towards the north of Wales, however, Ciara had left the ground saturated and rivers running high across RCT, exacerbating the impacts of Storm Dennis the following week. Weather impacts from Jorje were generally less severe than that from Storm Dennis, however flooding problems continued in the aftermath of these earlier storms and as a result of further rainfall on already saturated ground. It is important to note that the impacts of storm Jorje were not as easily discernible due to the wide-spread flooding caused by storm Dennis which left many properties empty during the latter event. Much of the flood damage following Dennis was still visible during Storm Jorje which restricted the post event inspections.

Communities within RCT were amongst the worst impacted by the storm with several hundred homes and businesses flooded. Rainfall in the catchment areas of RCT during the storm event was of such intensity that rivers and watercourses reacted extremely quickly, reaching record levels and flows. A major incident was declared by the South Wales Police following the serious disruption caused by the flooding.

Although every storm cannot be attributed to the effects of climate change, evidence suggests that extreme weather events, such as those of February 2020, will become more frequent in the future. Climate projections over UK land for the 21st century

suggest that winters will become warmer and wetter, summers will be drier, and we will experience an increase in the frequency and intensity of extreme weather events[2].

According to the UKCIP 2018, winters in the UK, for the most recent decade (2009-2018), have been on average 5% wetter than 1981-1900 and 12% wetter than 1961-1990. Summers in the UK have also been wetter, by 11% and 13% respectively, and the number of extreme rainfall events has also increased by 17% when comparing 2008-2017 with the 1961-1990 period[2].

Climate change is a well-established phenomenon which will bring significant challenges to communities, particurarly in relation to flood risk. As a society we must all learn to adapt to the changing climate, both in terms of preparedness for such extreme events and also in terms of responding to major instances of flooding.

1.2 Purpose of Report

The 15th and 16th February 2020 saw an extreme weather event impact RCT and resulted in widespread residential and commercial flooding across the authority. The purpose of this report is to provide an initial overview of the storm event, designated by the Met Office as 'Storm Dennis'.

This wider overview report of Storm Dennis provides a detailed analysis of rainfall during the event and the subsequent responses of local watercourses and Main Rivers flowing through the authority. It also includes a brief overview of the impacts experienced across RCT caused by a wide range of flood sources. This report will also set out how the authority intends to formalise the investigation process, as required under Section 19 of the FWMA, which has been underway since February 2020.

It is important to note that this overview report has been produced to compliment the specific flood investigations which will be published under Section 19 of the FWMA following this report.

[2] UKCIP18 Science Overview Report

2. STORM DENNIS

2.1 FORECASTING AND PREDICTION TIME-LINE

Storm Dennis was a European windstorm which became one of the most intense extratropical cyclones ever recorded. The cyclone emerged into the North Atlantic, where it redeveloped into Storm Dennis, officially named by the Met Office on 11 February, and subsequently underwent 'explosive intensification' on 13 February, reaching a near-record low pressure of 920 mb the following day, according to analyses from NOAA's Ocean Prediction Centre[3]. By Saturday 15th February, heavy rainfall and strong winds, driven by a powerful Atlantic jet stream, swept across the UK.

The analysis charts depicted within Figure 1 show Storm Dennis as the deepening area of low pressure to the north-west of the UK, driven by a powerful Atlantic jet stream. Twenty-four hours later Storm Dennis was still dominating the north Atlantic with rain-bearing fronts and strong winds sweeping across the UK[4].

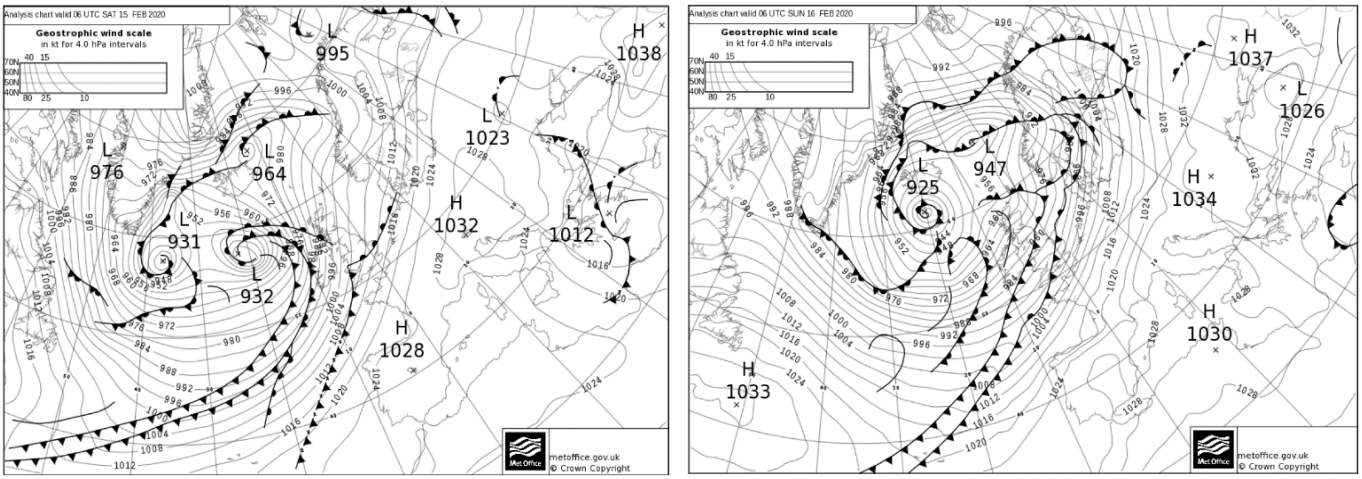

Figure 1: Met Office analysis chart at 06 UTC 15 February 2020 (left) and Met Office analysis chart at 06 UTC 16 February 2020 (right). Met Office.

[3] The Weather Channel - Bomb Cyclone Storm Dennis, One of the Most Intense North Atlantic Storms on Record, Triggers Massive Flooding in U.K. | The Weather Channel - Articles from The Weather Channel | weather.com
[4] Storm Dennis, Met Office - 2020_03_storm_dennis.pdf (metoffice.gov.uk)

The storm was tracked by the Met Office who issued approximately six weather warnings, four of which were issued prior to the storm making land fall and two during the event. The nature of the weather warnings identified an unpredictability to the storm track with a range of likelihoods and impacts leading up to the storm event.

Table 1: Summary table indicating the Met Office Warnings related to Storm Dennis

Warning Level	Event	Date of issue	Time	Likelihood	Impact	Range Rainfall (mm)	Range Wind Gusts (mph)
Yellow	Wind	11/02/2020	10:34	Medium	Low	N/A	50-60
Yellow	Rain	11/02/2020	11:36	Low	Medium	100-120	N/A
Yellow	Wind	12/02/2020	10:24	Medium	Low	N/A	50-60
Amber	Rain	13/02/2020	10:57	Medium	Medium	100-120	N/A
Amber	Rain	15/02/2020	11:07	Low	High	100-120	N/A
Red	Rain	16/02/2020	06:10	High	High	100-140	N/A

On Tuesday 11th February the Met Office issued their first weather warnings, in relation to Storm Dennis, for potentially hazardous winds and heavy rainfall to be expected over the weekend (15-16th).

A second yellow weather warning for wind was issued at 10:24 Wednesday 12th February for strong persistent winds between 50-60 mph to last until Monday 17th February.

On Thursday 13th February the storm deepened over the Atlantic increasing the likelihood of strong winds and heavy rainfall, triggering an Amber warning with a medium likelihood of medium impacts, which indicated a ‘potential risk to life’. During the storm event, a second amber weather warning was issued 11:07 Saturday 15th February, indicating severe impacts but remained at ‘Medium’ status due to the reduced likelihood. Prolonged heavy rain of 60-80mm was forecasted to fall widely, and up to 100-120mm expected in some places, between 12:00 Saturday 15th and 15:00 Sunday 16th February.

The overall flood risk warning was only upgraded to a 'Red' Weather warning for rain at 06:10, on Sunday 16th February which indicated a, 'danger to life', for parts of the South East Wales Valleys (Figure 2).

At the time the red warning was issued the storm had already flooded many communities within the authority. It was the first red warning issued specifically for rain since December 2015 and the first red weather warning of any kind issued for Rhondda Cynon Taf[5].

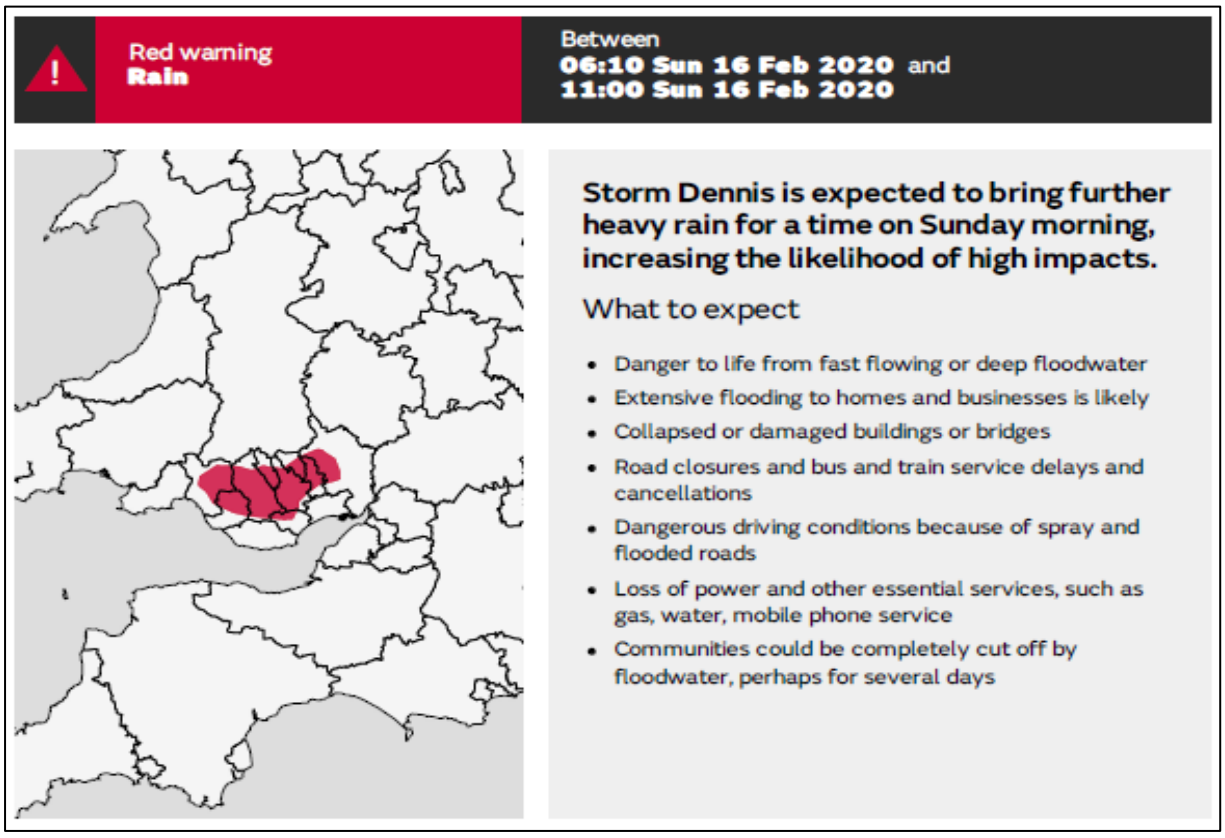

Figure 2: Weather warning issued by the Met Office's National Severe Weather Warning Service at 06:10 Sunday 16th February 2020. Met Office.

On review of the range of warnings ahead of Storm Dennis, there is a clear trend that the storm event was shifting where changes in the likelihood and impact were fluctuating. Notably the latest pre event warning indicated a reduction in the likelihood of the impacts (a lack of warning time for the most severe and highest impact warning affected response times).

[5] Met Office 2020 - Storm Dennis triggers Red rain warning - Met Office

The most severe (red) warning was issued by the Met Office approximately 3-4 hours after the peak of rainfall hit the south of the borough, and 6-7 hours after peak rainfall was recorded in the upper parts of RCT. Main Rivers also reached their peaks prior to the red weather warning being issued as the River Rhondda and Cynon reached their recorded peak levels three hours prior, and the River Taff at Pontypridd reaching its peak at 04:45 (16 Feb), just over an hour prior to the warning being issued. By 06:10 (16 Feb) the worst of the rainfall and the majority of flooding was either in progress or had already occurred.

The weather warnings issued by the Met Office can be found in the online National Service Weather Warnings Archive.[6]

[6] Met Office National Severe Weather Warnings Archive - https://www.metoffice.gov.uk/research/library-and-archive/publications/national-severe-weather-warning-service

2.2 RAINFALL ANALYSIS

February 2020 has been the wettest February on record for Wales and the UK, and the fifth wettest winter (December, January, and February) on record (dated back to 1862) for the UK according to the Met Office[4]. In comparison with other parts of the UK, Wales was the worst affected by the winter storms, with a total of 288.4 mm of rainfall falling during February 2020.

The extremely wet February of 2020 was a result of a strong and southward displaced jet stream and positive North Atlantic Oscillation (NAO), both of which have been stronger than normal[7]. A positive NAO during winter is usually associated with wetter-than-normal conditions across the UK and northern Europe. Paired with a stronger jet stream directing the north Atlantic storm track towards northern Europe, a succession of low-pressure systems crossed the UK and resulted in persistent and heavy rainfall.

Three named storms crossed the UK during February: Storm Ciara (8-9th Feb), Dennis (15-17th Feb) and Jorje (28th Feb – 1st Mar). All three named storms (9 days) account for just over 44% of the total rainfall during February 2020[7]. Figure 3 illustrates the UK's daily areal-average rainfall totals for winter 2019/20, highlighting the exceptionally wet days of 8 and 15 February associated with Storm Ciara and Dennis. An average accumulation of 27mm across the UK on 15th February (Storm Dennis) was the second highest UK daily rainfall total in a Met Office series dating back to 1891[7].

[7] Met Office 2020 - Met Office: Why the UK saw record-breaking rainfall in February 2020 | Carbon Brief

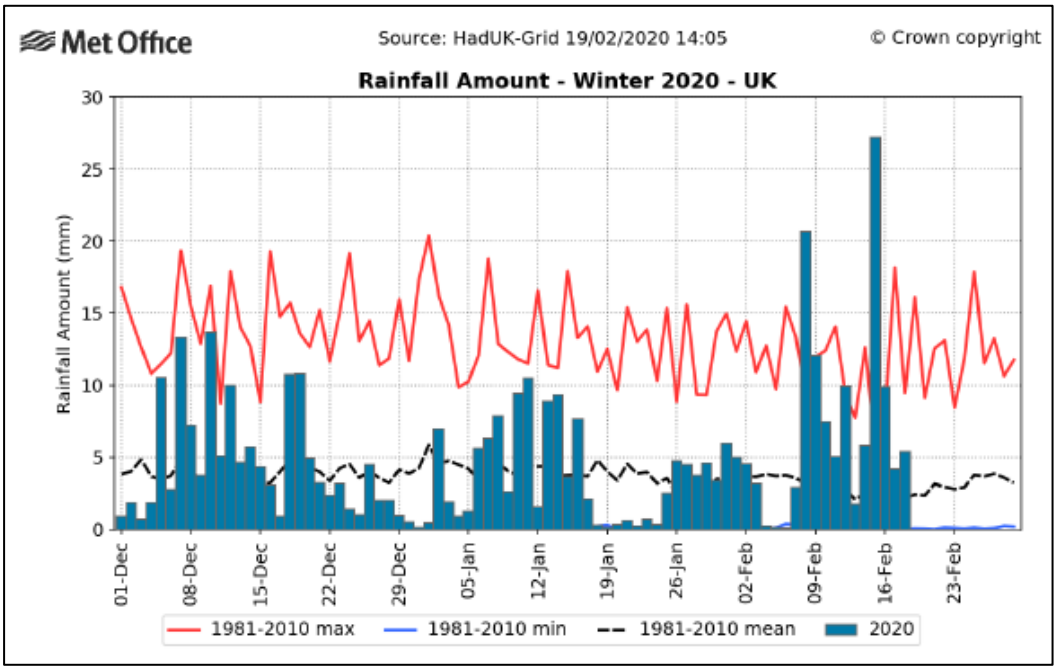

Figure 3: Daily rainfall totals averaged for the UK through winter 2019/20 (1 December 2019 – 18 February 2020). Met Office.

Figure 4 taken from the Met Office's Storm Dennis summary, illustrates the intensity and persistence of the rainfall that occurred during the 9-day period from 8th to 16th February, including both Storm Ciara and Dennis. Up to 150 to 250mm or more of rain fell across the south east Wales valleys with the highest amounts falling across higher ground. It is estimated that 120% of the February whole-month average fell widely across Rhondda Cynon Taf County with up to 180% in some localised areas[4] during the 9-day period. This intensity of rain falling on already saturated catchments, combined with the rapidly responding nature of the river catchments in Wales, led to some of the most unprecedented flooding in a generation.

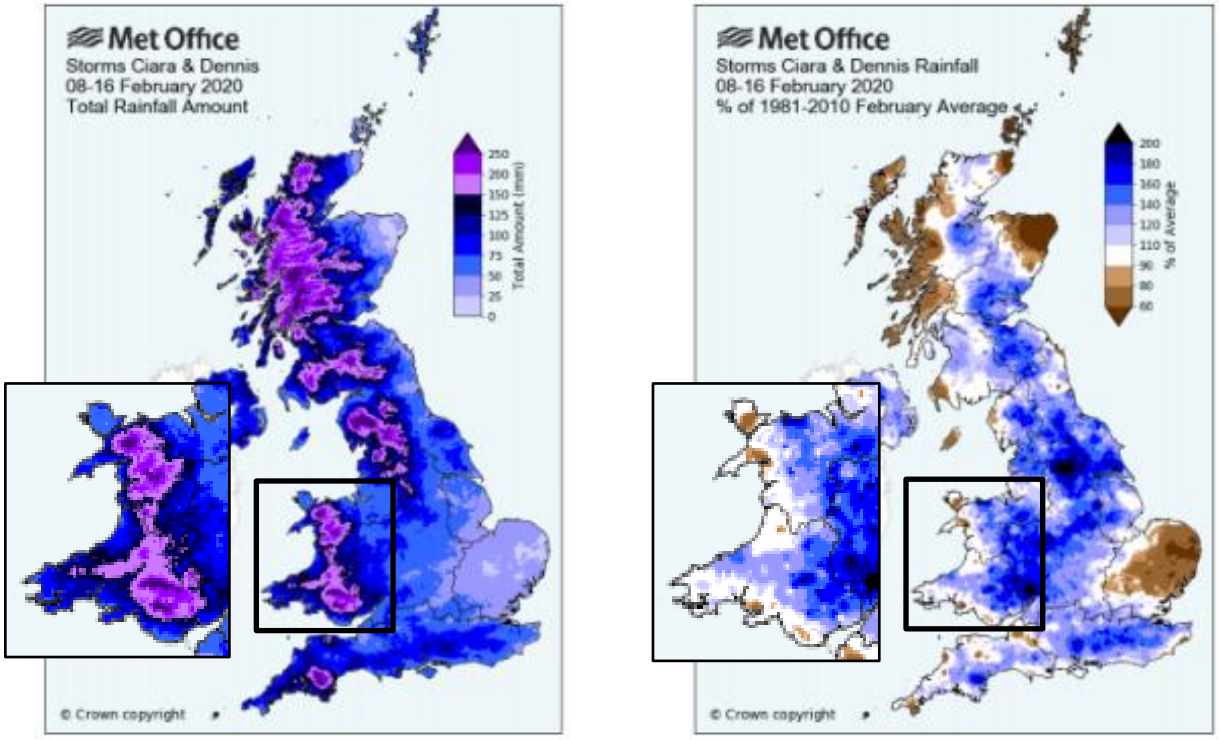

Figure 4: Total Rainfall amount (actuals) and % of 1981-2010 February average rainfall during 08-16th February 2020. Met Office.

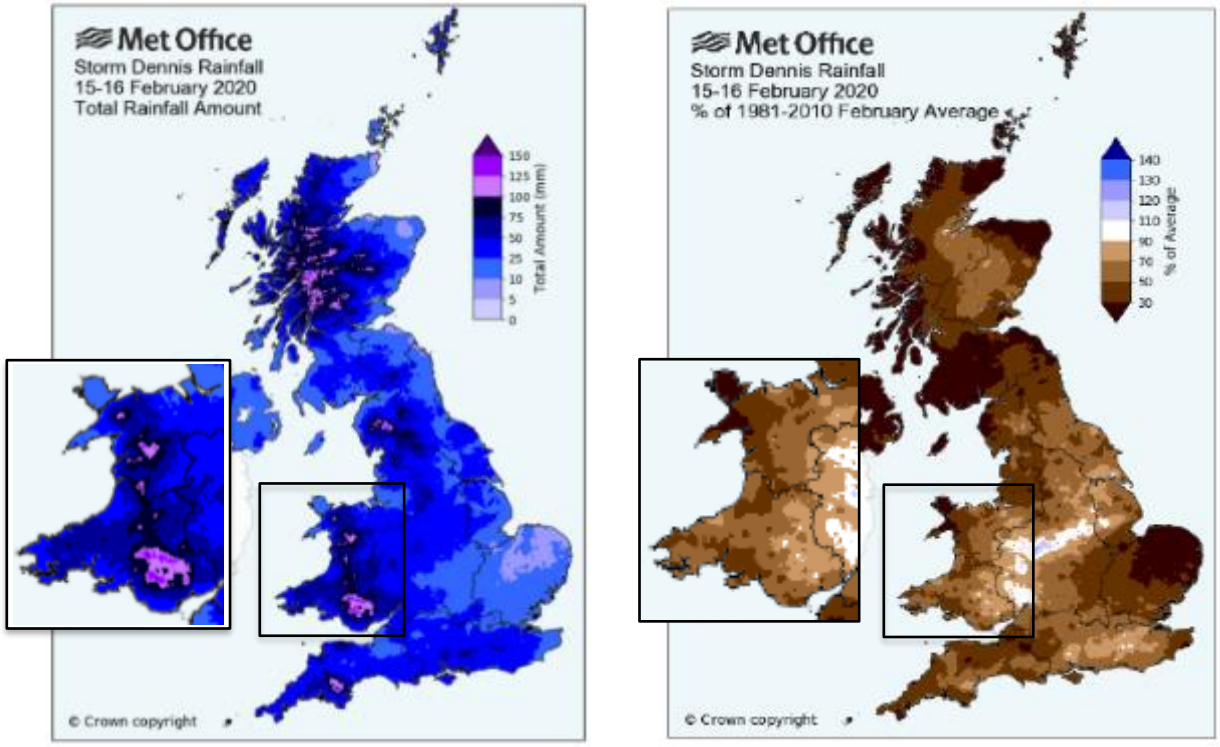

Figure 5: Total rainfall amounts (actuals) and % of 1981-2010 February average rainfall during Storm Dennis (15th-16th February). Met Office.

According to the Met Office 100 to 160mm of rain fell across the majority of RCT between the 15 and 16th February 2020 (Storm Dennis), with significant intensities recorded across the River Rhondda catchment (Figure 5).

Figure 6 below taken from NRW's review of the February 2020 flood events, illustrates the distribution of rainfall during Storm Dennis, highlighting the significant rainfall totals within a 48-hour period in areas of Wales and more specifically in the south east Wales valleys and RCT.

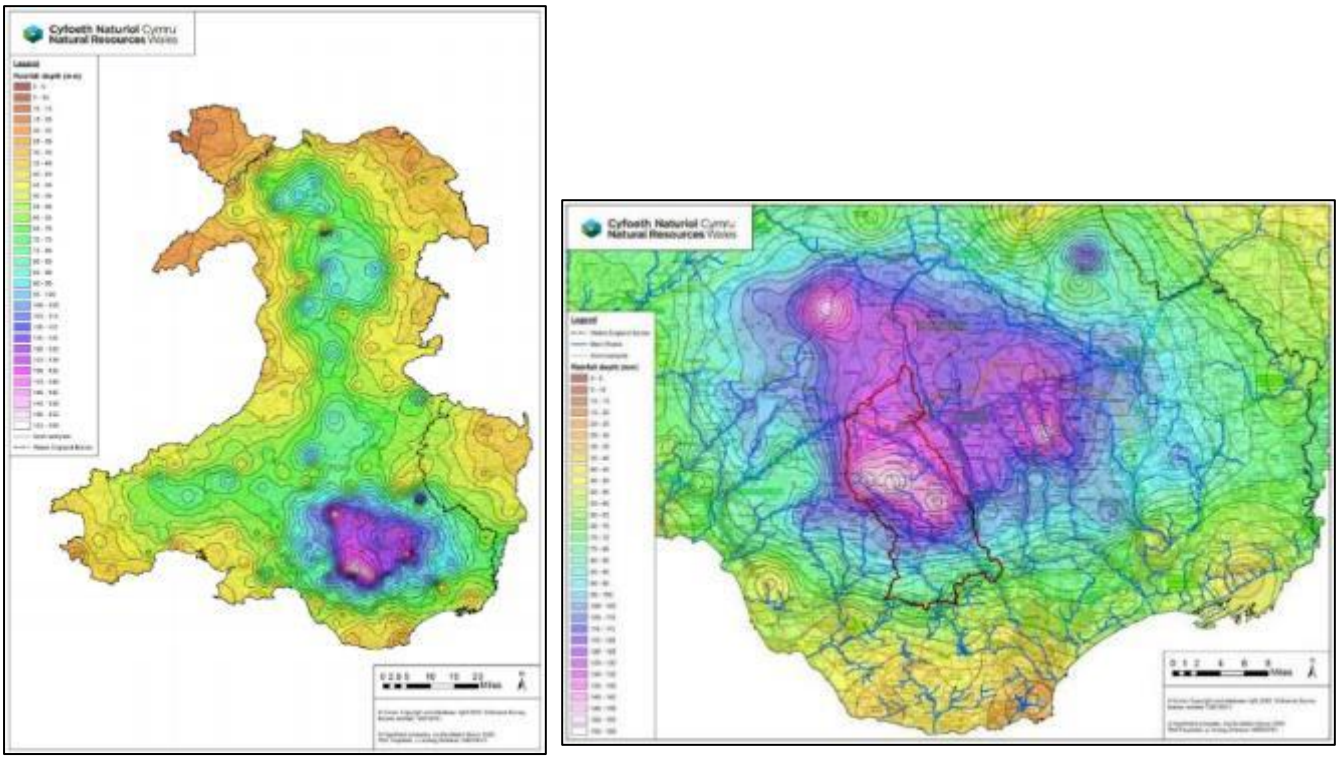

Figure 6: Rainfall Isohyet Map showing rainfall over a 48h period during Storm Dennis in Wales (left) and South Wales (right). Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

The greatest rainfall totals fell across the northern parts of RCT, and more specifically to the north west region of the borough. According to data collected from NRW's rain gauges, during Storm Dennis the tops of the Rhondda Fawr catchment received 132.4mm of rainfall in 24 hours, the equivalent of 62% of an entire month's rainfall in

a single day, whilst the tops of the Cynon valley catchment received 119.8mm in 24 hours, the equivalent of 75% of an entire month's rainfall in a single day[8].

Rainfall during the event was also recorded at four weather stations maintained by RCT. An additional four monitoring stations owned and maintained by NRW have also been included in this review to account for rainfall amounts in the upper Cynon and the Rhondda valley catchments.

Geographically the RCT stations are situated to the south and south east of the borough within the urban catchments of Cwmaman, Cilfynydd, Rhydyfelin and Coedely. NRW's Tyn y Waun station is located to the north west of the borough in the Rhondda Fawr valley while the Maerdy station lies within the Rhondda Fach valley. The Hirwaun station is located to the north east in the upper Cynon valley and the Nant yr Ysfa is situated at St Gwynno Forest above the town of Ynysybwl. All four of NRW's rain gauges are situated on higher ground compared with RCT's monitoring stations which reflect the higher rainfall totals and intensities captured within Table 2 for NRW stations.

[8] Based on the Long-Term Average (LTA) for February as provided by the Met Office, using the period 1981-2010

Table 2: Rainfall totals and peak hourly intensities recorded at four RCT monitoring station and four NRW stations during Storm Dennis (15-16th February 2020). Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

Monitoring Station	Total Rainfall (mm)	Total Rainfall (mm) (15/02/20)	Peak Hourly Intensity (mm/hour) (15/02/20)	Total Rainfall (mm) (16/02/20)	Peak Hourly Intensity (mm/hour) (16/02/20)
RCT Cwmaman	94.0	54.4	6.6	39.6	7.4
RCT Cilfynydd	88.6	49	8.4	39.6	10.2
RCT Rhydyfelin	53.4	25.2	5.2	28.2	8.8
RCT Coedely	58.8	25.4	4.4	33.4	11.2
NRW Hirwaun	129.2	85.2	13.4	44	9.6
NRW Tyn y Waun	150.2	91.4	12.0	58.8	10.6
NRW Maerdy	157	93.2	12.0	63.8	14.8
NRW Nant yr Ysfa	145.4	85.6	10.4	59.8	14

Table 2 details the summary of the rainfall recorded for both the 15th and 16th of February (Storm Dennis), including daily totals and peak hourly intensities. Rainfall amounts and the associated impacts of Storm Dennis varies across different areas of the borough. Table 2 identifies a moderate increase in rainfall the further north the stations are located, with greater rainfall totals in the northern extent of the borough occurring over the two days i.e. 129.2 mm of rain falling over a 2-day period at Hirwaun compared with 53.4 mm further south in Rhydyfelin.

NRW's Tyn y Waun and Maerdy stations confirm prolonged and exceptional amounts of rainfall occurred further west within the upper Rhondda catchments, especially during Saturday 15th February through till the early hours of Sunday 16th February. Evidence captured by RCT and NRW rain gauges is reflected within NRW's Figure 6b which illustrates that greater rainfall totals were experienced in the northern parts of RCT, and particurarly in the Rhondda valleys.

Rainfall intensities were high across the whole of the borough but localised and sporadic ‘rain bombs’ were widespread, especially to the north west of RCT extending to the south east of the borough during the storm event.

Figures 7 and 8 below depicts the rainfall intensities recorded at RCT and NRW’s rain gauges situated across different areas of the borough during the 15 and 16th of February. It aims to provide a holistic overview of rainfall patterns across RCT to account for localised differences in rainfall conditions.

Hourly rainfall intensities peaked initially towards the northern extent of the borough at Hirwaun and Tyn y Waun stations during Saturday (15th February) night at approximately 22:30-23:30 GMT, whilst short bursts of intense rainfall were recorded further south during the early hours of Sunday morning (16th February) between 02:30-03:30 GMT, reaching peaks of 11.2 mm/hour at Coedely and 10.2 mm/hour at Cilfynydd.

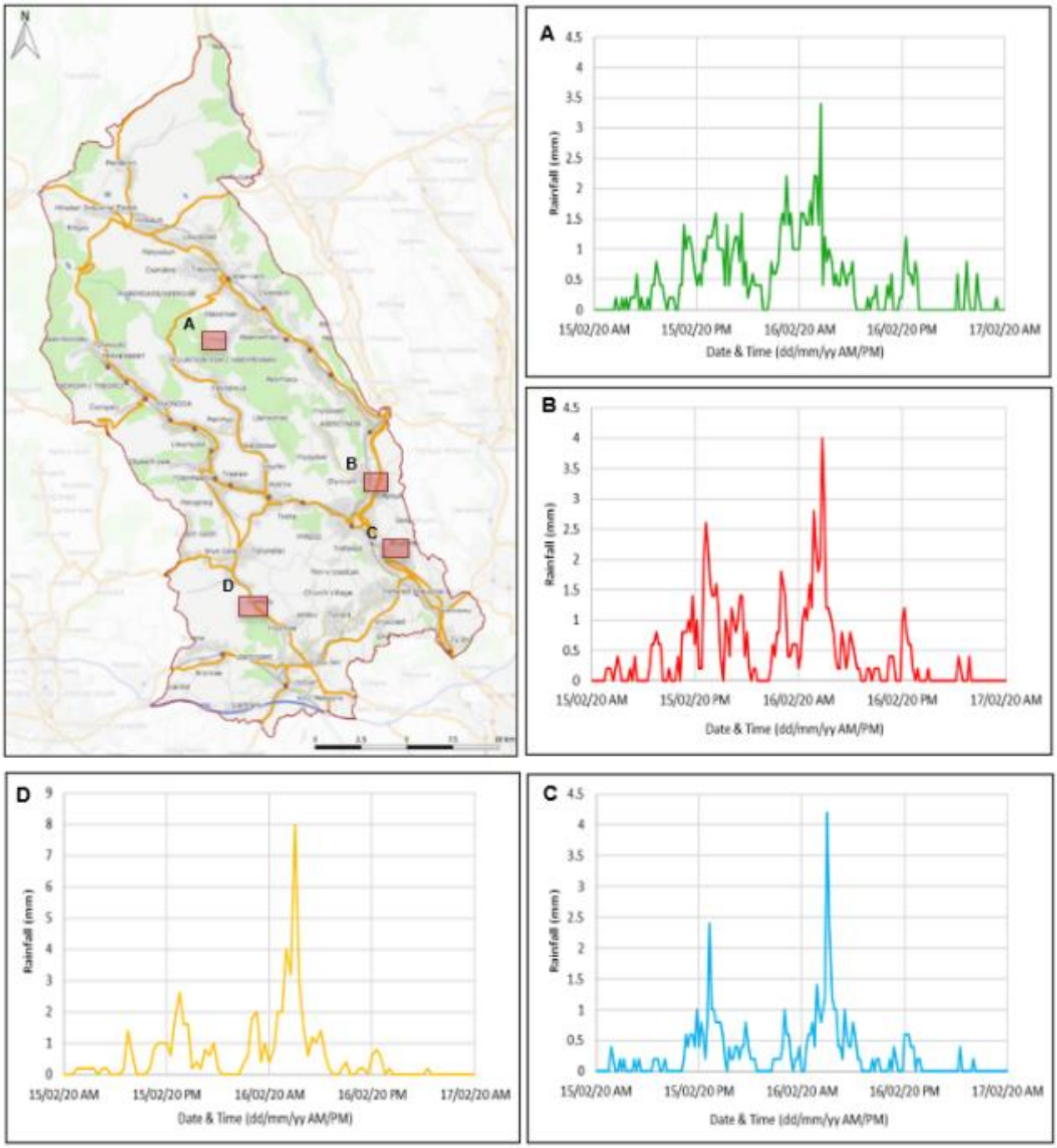

Figure 7: Rainfall (mm) readings at RCT's four rainfall gauge monitoring stations during Storm Dennis (15th – 16th February 2020); Cwmaman (A), Cilfynydd (B), Rhydyfelin (C), Coedely (D)

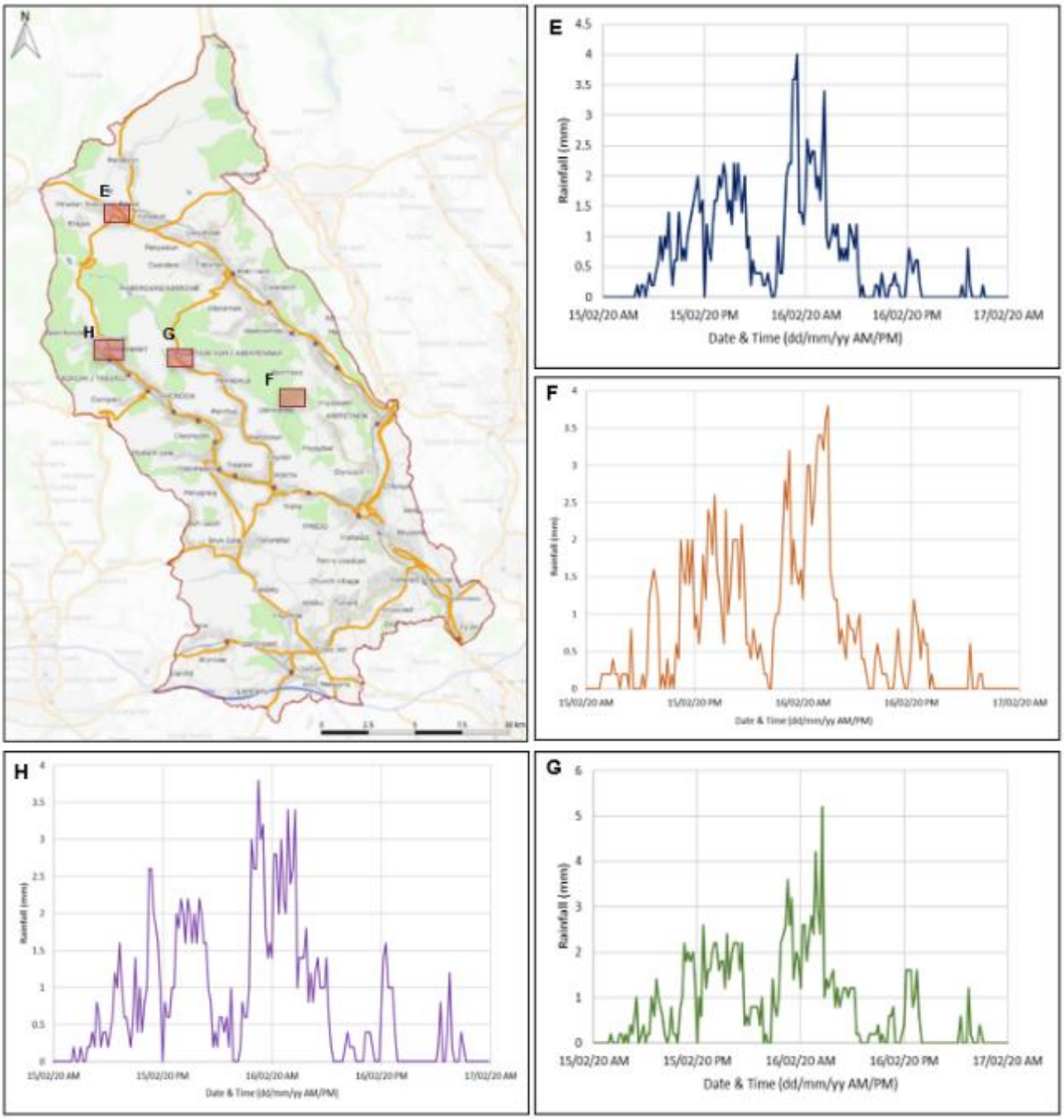

Figure 8: Rainfall (mm) readings at NRW's four rainfall gauge monitoring stations during Storm Dennis (15th – 16th February 2020); Hirwaun (E), Nant yr Ysfa (F), Maerdy (G), Tyn y Waun (H). Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

2.3 ORDINARY WATERCOURSE RESPONSE

The catchments of the South East Wales Valleys within RCT; the Rhondda, Cynon, Taff and Ely, are all characterised by steep sides, which are susceptible to intense rainfall and associated flash flooding. The combination of topographic, geological and geographical factors causes the catchments within RCT to have an almost immediate response to rainfall with events often subsiding in hours, rather than days (FRMP, 2015).

The character of the landscape reflects the rapid rise and subsequent fall in watercourse levels in response to rainfall. This is illustrated well within the four hydrographs in Figure 10 which show the levels within three ordinary watercourses situated at Cwmaman, Cilfynydd and Rhydyfelin, and two water basins situated within the upper catchment of Cwmaman and at Coedely; all of which are monitored by RCT. The three watercourses rose rapidly over a short amount of time, with a lag time of approximately 15 to 30-minutes after peak rainfall. This exceptionally short lag time between peak rainfall and peak discharge overwhelmed many watercourses during the storm event.

The Nant Aman Fach, situated in the Cynon valley catchment within the town of Cwmaman reached its peak level of 1.5094 meters at 02:45 on the 16th February, 15-minutes after peak rainfall was recorded at 02:30 (3.4 mm/00:15). The Nant Aman Fawr is similarly located within the town of Cwmaman and is served by a Flood Attenuation Basin which is supported by a monitoring station maintained by RCT (Figure 9). During the event the attenuation basin peak water level was 1.38m at 03:00am on the 16th February, 30 minutes after peak rainfall was recorded at 02:30.

Notably the attenuation basin was active for approximately 12 hours during the storm event. At its peak the basin attenuated 2000m^3 of flood water. The volume of flood water being attenuated during the event shows the volume of water generated by the intense rainfall over a short duration.

Figure 9: Cwmaman Attenuation Basin located in the Cynon valley catchment

The Nant Cae Dudwg watercourse, situated further south at Cilfynydd, reached its peak level of 2.3779 meters at 02:45 16th February 15-minutes after peak rainfall was recorded.

Rhydyfelin, further south again, is drained by a number of ordinary watercourses. The monitoring station is located near the culvert inlet downstream. A significant response in watercourse levels was recorded at Rhydyfelin, increasing from 0.28541 to 0.75855 meters in 15-minutes. Peak rainfall was 4.2 mm at 03:00 16th February which caused watercourse levels to peak at 0.75855 30-minutes later at 03:30.

To the south east of the borough, RCT have a monitoring station situated at Coedely pond. The rainfall gauge recorded a short burst of intense rainfall of 8 mm between 02:30 and 03:00 (16th February). Levels within the pond reached a peak of 1.2117 meters at 06:00 16th February, 3 hours after the peak rainfall. The readings recorded at Coedely pond provide a useful display of the slower response to rainfall within a large body of water compared with the rapid rise and fall of levels within an ordinary watercourse.

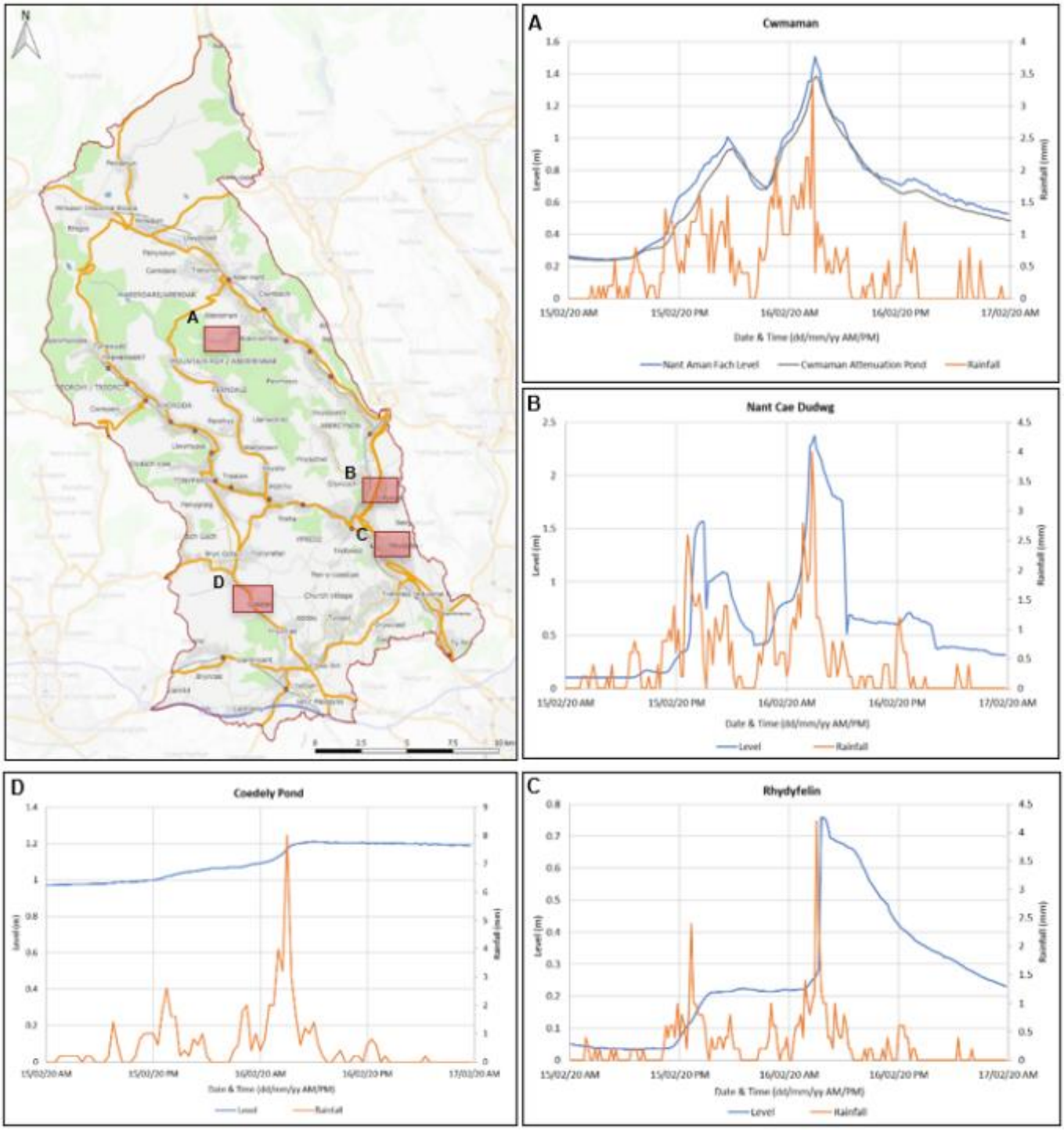

Figure 10: Watercourse/body level (m) and rainfall amounts (mm) at RCT's four weather monitoring stations during storm Dennis (15th – 16th February 2020); A. Nant Aman Fach and Cwmaman Attenuation Basin (Cwmaman), B. Nant Cae Dudwg (Cilfynydd), C. Unnamed watercourse (Rhydyfelin) and D. Coedely Pond

Within a 14-hour period, levels within the Nant Gwawr which flows west to east through the town of Aberaman, rose extremely suddenly during Saturday (15 Feb) night and remained high untill suddenly falling by Sunday (16 Feb) morning, leaving behind deposited debris mobilised during the peak flows. The images captured by RCT's monitoring station demonstrate the watercourses' rapid response to rainfall which was replicated across the borough at a number of ordinary watercourses (Figure 11).

Figure 11: Images of the Nant Gwawr inlet captured at RCT's monitoring station (15/02/20 20:34 (top left), 16/02/20 03:30 (top right), 16/02/20 08:27 (bottom left), 16/02/20 10:27 (bottom right))

2.4 MAIN RIVER RESPONSE

This section of the report will provide an overview of the Main River response within RCT however, for a detailed analysis refer to NRW's February 2020 Floods in Wales: Flood Event Data Summary[9] report which provides a summary of the Main River level and flow responses across Wales during Storm Dennis.

Storm Dennis incurred the most river level warnings than at any one time in Wales. During the peak of Storm Dennis (15-16th February), 61 Flood Alerts, 89 Flood Warnings and two Severe Flood Warnings were in force across Wales. 3 Flood Alerts and 12 Flood Warnings including one Severe Flood Warning were in force across RCT during the 15th – 16th February. Figure 12 below illustrates the extent of the flood warnings that were issued by NRW across RCT during Storm Dennis.

Figure 12: Flood Warnings in place across RCT during storm Dennis (15th – 16th February 2020). Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

[9] February 2020 Floods in Wales: Flood Event Data Summary, Oct 2020 - https://cdn.cyfoethnaturiol.cymru/media/692376/february-2020-floods-in-wales-flood-event-data-summary-high-resolution-eng.pdf

Rivers in the South Wales area are relatively steep and flow through narrow valleys that are underlain by impermeable geology. Consequently, runoff from headwaters and ordinary watercourses rapidly reach the Main Rivers and levels respond quickly following intense rainfall.

The steep sided catchments of RCT's valleys paired with already saturated ground following previous rainfall during Storm Ciara meant that river levels rose suddenly and in a matter of hours during Storm Dennis. Almost a quarter (22%) of NRW's 231 river level gauges in Wales recorded their highest ever levels during the peak of Storm Dennis. Data from NRW's River Monitoring stations show that river levels reached record levels at all stations across Rhondda Cynon Taf.

Provisional data from NRW's river level gauges shows that on Sunday morning (16th February) the River Taff at Pontypridd reached its highest level for over 40 years of 5.2 meters (16ft) – 78 cm higher than the level in the 1979 floods. At the peak of the flood in Pontypridd, NRW estimate that 805 m^3/s of water was flowing down the River Taff, warranting a severe flood warning to be issued for the Taff at Pontypridd, and a further four flood warnings further downstream. Between 22:15 (15 Feb) and its peak in Pontypridd at 04:45 (16 Feb), the River Taff nearly doubled in flow in just 6.5 hours and increased in height by 2m.[10]

The Cynon typically runs through the town of Aberdare at a level of approximately 0.5 meters. At its peak during storm Dennis (03:00 16th Feb), levels reached 2.13 meters (7ft), breaking a record set in 1998. Four flood warning alerts were issued by NRW at locations along the River Cynon.

The Rhondda river was three times its usual level at Tynewydd monitoring station situated in the upper Rhondda, peaking at 1.62 meters at 02:45 16th February. Three flood warning alerts were issued by NRW at locations along the Rhondda River.

[10] Natural Resources Wales Flood Event Data Summary - February 2020 Floods in Wales: Flood Event Data Summary (cyfoethnaturiol.cymru)

Figure 13 reflects the rapid response of the three Main Rivers flowing through RCT during the early hours of Sunday 16th February. NRW's hydrographs reflect a similar situation to that of the ordinary watercourse response; a rapid rise in water level, short lag time followed by a fast recedence in river levels. The volume and force of water associated with the water depths depicted below make them particularly dangerous.

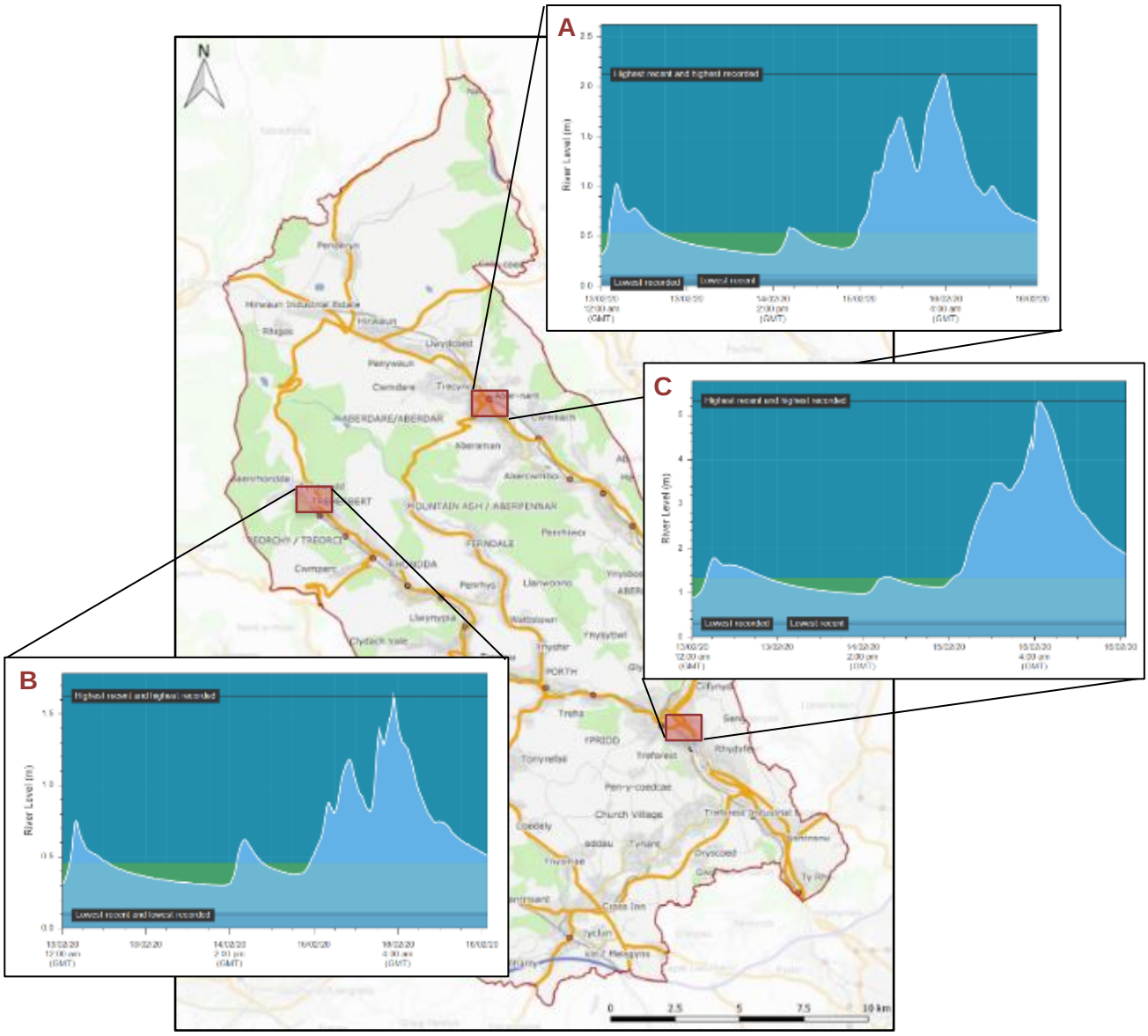

Figure 13: River Levels at the Cynon at Aberdare (A), Rhondda at Tynewydd (B) and the Taf at Pontypridd (C) between the 13th – 17th February 2020 (NRW's River Level Monitoring Stations). Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

According to NRW, it is estimated that the lower Taff experienced the equivalent of a 1:200 flood (0.5% chance in any one year of an event of this scale occurring) event storm. It is clear from the evidence provided throughout this overview report that Storm Dennis was indeed an unprecedented event. Exceptional levels of rain caused record-breaking river levels across RCT and widespread flooding to several communities.

NRW have since highlighted within their review of the February 2020 storms that significant issues relating to the accuracy and timeliness of some flood warnings occurred during February 2020. Whilst a record 243 Flood Alerts, 181 Flood Warnings and 6 Severe Flood Warnings were issued in February 2020, 12 flood warnings were not issued when they should have been, and 6 were issued late, including warnings along the River Taff.

On the River Taff, five river gauge thresholds to consider issuing Severe Flood Warnings were exceeded, but these warnings did not get issued. The River Taff at Nantgarw (issued at 05:19 16th Feb) was issued later than they should have been as anecdotal evidence indicate properties in Nantgarw began flooding before the flood warning had been issued. In addition, the Severe Flood Warning at Pontypridd was issued relatively late compared to the timing of reports of significant flooding.

For details relating to each individual flood warning issued by NRW within RCT, refer to Table 1 within Appendix A.

2.5 WIND DATA

Winds were comparable to storm Ciara, gusting at over 58 mph across the UK and over 69 mph (60Kt) around exposed coastlines. Gusts across Rhondda Cynon Taf were slightly above average, reaching speeds of up to 66 mph on lower ground and 84mph on higher ground during the early morning of Sunday 16th February (Table 3 and 4). In terms of wind speeds, this was notable although not exceptional for this time of year. However, one feature of storm Dennis was the persistence of the strong winds across the UK for several days (Met Office).

Table 3: 24-hour Wind Summary for RCT on 15th February 2020 (MetDesk)

RCT Above 200m	**15/02/20 00:00 – 06:00**	**15/02/20 06:00 – 12:00**	**15/02/20 12:00 – 18:00**	**15/02/20 18:00 – 00:00**
Direction	S	S	SW	SW
Speed (mph)	7-22	15-30	21-37	21-39
Gust (mph)	31-44	45-65	58-79	63-82
RCT Below 200m	**15/02/20 00:00 – 06:00**	**15/02/20 06:00 – 12:00**	**15/02/20 12:00 – 18:00**	**15/02/20 18:00 – 00:00**
Direction	S	S	SW	SW
Speed (mph)	4-17	13-22	19-28	19-30
Gust (mph)	27-34	43-49	51-60	57-66

Table 4: 24-hour Wind Summary for RCT on 16th February 2020 (MetDesk)

RCT Above 200m	**16/02/20 00:00 – 06:00**	**16/02/20 06:00 – 12:00**	**16/02/20 12:00 – 18:00**	**16/02/20 18:00 – 00:00**
Direction	SW	SW	W	W
Speed (mph)	20-39	20-38	20-34	23-25
Gust (mph)	62-82	66-84	54-57	55-76
RCT Below 200m	**16/02/20 00:00 – 06:00**	**16/02/20 06:00 – 12:00**	**16/02/20 12:00 – 18:00**	**16/02/20 18:00 – 00:00**
Direction	SW	SW	W	W
Speed (mph)	20-30	20-30	20-27	23-28
Gust (mph)	57-66	65-66	54-56	55-58

RCT received 12 out of hour calls reporting fallen trees during Storm Dennis (15-16th February). The location of these incidences was widespread and impacted not only key transport networks across the borough but also influenced the mobilisation of

debris which may have contributed to blockages to assets. It is important to note that the time of year that storm Dennis occurred in meant that leaf mass would have already fallen, suggesting that blockages to gullies, culvert inlets and trash screen were most likely caused by larger pieces of debris mobilised from the steep valley hillsides.

3. IMPACTS

Storm Dennis saw an exceptional amount of rain fall in a short amount of time, which caused rapid increase in river and watercourse levels and led to severe flooding to communities across RCT. Very few communities within RCT escaped the impacts of Storm Dennis.

It was noted that RCT recorded approximately 1496 reports of flooding and 19 reports of landslides within the borough during Storm Dennis and the days following the event (15th – 29th February).

Provisional data following the investigations undertaken by RCT's Flood Risk Management team and Public Health department, estimate that approximately 1091 residential properties and 407 commercial premises were internally flooded during Storm Dennis. The number of properties that suffered external flooding is expected to be much higher.

The primary causes of flooding to properties across RCT was due to pluvial sources (surface water and ordinary watercourses). Approximately 806 receptors were internally flooded due to pluvial flood sources, of which 704 were residential properties. Fluvial flooding from the Main Rivers was also a dominant flood source during Storm Dennis, causing approximately 692 receptors to flood internally, of which 305 were commercial premises.

The map below shows the extent of the flooding during Storm Dennis per electoral ward within RCT (Figure 14). Notably, the impacts of flooding were widespread, with Pentre, Pontypridd, Taffs Well and Hawthorn worst affected. Areas to the southeast of the borough were least affected during Storm Dennis.

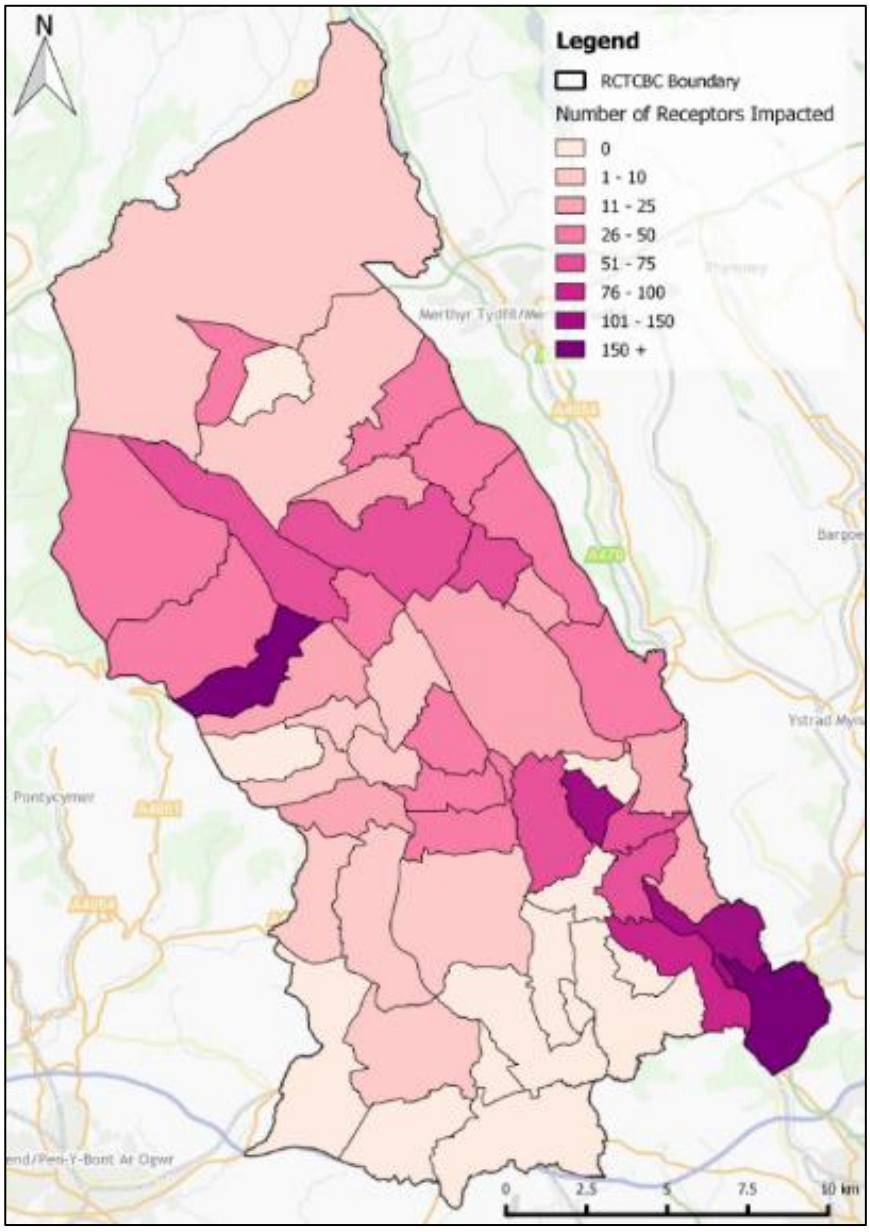

Figure 14: Number of Receptors flooded per electoral ward within RCT during Storm Dennis (15 – 16th February 2020)

3.1 IMPACTS - TYPES OF FLOODING

This section identifies the key sources of flooding and describe the mechanisms of each type of flooding that occurred during Storm Dennis. It is not intended to cover every incidence of flooding across the county borough, but to provide an overview of the primary flood sources. An overview of the flooding impacts to infrastructure and assets during Storm Dennis has also been described within section 3.2.

3.1.1 PLUVIAL FLOODING - ORDINARY WATERCOURSE

An ordinary watercourse is defined as a watercourse that does not form part of a Main River. This includes streams, drains, culverts, dikes, ditches and passages through which water flows. Ordinary watercourse flooding is the most common cause of flooding within RCTCBC and occurs when the capacity of a local drainage channel is exceeded and/or culvert inlets and trash screens are blocked with debris (FRMP, 2015)[11].

Storm Dennis was an exceptional and unprecedented storm event which led to large parts of both the Cynon and Rhondda Valleys being affected by ordinary watercourse flooding as a result of culvert networks becoming over capacitated resulting in hydraulic overload/surcharging, as well as large stonewash and debris being transported downstream causing damage and blockages to culvert inlets and debris screens (Figures 15 and 16). It is estimated that 65% of all residential flooding during Storm Dennis was primarily caused by pluvial sources (ordinary watercourse and surface water).

Areas worst affected by ordinary watercourse flooding were widespread and mainly affected residential properties. These areas include Treherbert, Treorchy, Pentre, Mountain Ash, Abercwmboi and Ferndale, among others.

[11] RCT's Flood Risk Management Plan 2015 - https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/RelatedDocuments/FloodRiskManagementPlanFinal.pdf

Figure 15: Pentre Road culvert inlet pre (left) & post Storm Dennis (right) showing evidence of significant blockage to the inlet

Figure 16: Section of open watercourse, upstream of the Nant-y-Ffrwd culvert inlet near Granville Terrace, Mountain Ash immediately after Storm Dennis (right) and three months post storm event (left)

Evidence of scour in the upper catchments of RCT (illustrated in Figure 17) indicate the power of the flows within the watercourses which mobilised and transported large amounts of debris and stonewash downstream towards culvert inlets and carrier lines during the storm event.

Figure 17: Upper catchment of the Nant Cae Dudwg watercourse, Cilfynydd (left) and the Nant y Ffrwd watercourse, Mountain Ash (right) showing evidence of bank scour and deposition of debris in and adjacent to the channel

Storm Dennis has highlighted the role of morphological processes as a significant contributor to flood risk in many areas in RCT. The degree of morphological instability and potential sediment supply varies from catchment to catchment, however both historical and present-day anthropogenic landscape changes at the catchment scale have been identified as key influences on ordinary watercourse behaviours and local flood risk.

3.1.2 FLUVIAL FLOODING - MAIN RIVER

Fluvial flooding (flooding from the main river) can be caused by river levels '*overtopping'* their banks and/or '*breaching'* of the defence structures. 'Main Rivers' are usually larger streams and rivers and include certain structures that control or regulate the flow of water in, into or out of a main river. In Wales, main rivers are legally designated by Natural Resources Wales (NRW) and under the Flood and Water Management Act 2010, NRW are responsible for flood risk management activities on Main Rivers[19].

Following Storm Dennis, NRW, acting as the risk management authority responsible for managing the risk of flooding on Main Rivers, have published several reports which analyse and critically review NRW's response to the events.

The River Taff, Cynon and Rhondda (Fawr and Fach) are the primary Main Rivers running through Rhondda Cynon Taf. All three primary Main Rivers overtopped their banks at various locations across the borough, with the most notable flooding impacts occurring along the River Taff which is fed by both the Cynon and Rhondda rivers and caused flooding to multiple receptors situated within the urban and industrial floodplains of the Taff. Areas worst affected include Pontypridd, Nantgarw, Treforest Industrial Estate and Taffs Well and the affected receptors primarily being commercial units. The aerial photographs captured below by South Wales National Police Air Service (Figure 18) show the dramatic inundation of Pontypridd Town Centre and Treforest Industrial Estate by the River Taff on Sunday morning (16th February 2020).

Figure 18: Main River flooding from the Afon Taf at Pontypridd (left) and Treforest Industrial Estate (right). South Wales National Police Air Service.

NRW own and maintain approximately 13.29 km of flood defences within RCT. That's equivalent to 7.7% of the total length of Main Rivers that flow through RCT. NRW have acknowledged within their review of the February 2020 floods that their defences did overtop in a number of locations, however defences did not structurally fail or become breached[10].

Some privately owned defences and highway retaining walls were also overtopped and some were breached and damaged during the storm event.

3.1.3 Pluvial Flooding - Surface Water & Groundwater

Pluvial flooding includes both ordinary watercourse and surface water flooding. Surface runoff occurs when rainwater which is on the surface of the ground and has not yet entered a watercourse, drainage system or public sewer (FRMP, 2015). As a result of RCT's catchment geomorphology, climate and concentrated urban development, surface water flooding is common and particularly prominent following a prolonged period of rainfall when the catchment is saturated, or after an intense storm and drainage systems become overwhelmed.

Flooding from groundwater occurs as a result of water rising from the underlying aquifer or from water flowing through normal springs. This tends to occur after sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth[12].

Historic mining activities within RCT have disrupted the 'natural' groundwater regime within the coal measures and it is likely that the interconnection between many of the collieries has resulted in cross catchment 'groundwater flow' in certain parts of RCT. Although the carboniferous limestone is recognised as a major aquifer, and the coal measures and Triassic strata are minor aquifers with local importance, the contribution of groundwater to even low flows is modest[12].

Although the risk posed by groundwater flooding is generally low, the already-saturated catchments caused by previous rainfall during Storm Ciara likely contributed to surface water flooding during Storm Dennis.

Surface water flooding was experienced across the majority of RCT and was exacerbated in some locations by the impacts from ordinary watercourse and sewer network flooding. Notable areas of surface water flooding include Glenboi within the town of Mountain Ash (Figure 19) as well as large parts of Trehafod (Figure 20).

[12] RCT's Preliminary Flood Risk Assessment 2011

Figure 19: Surface water flooding at Glenboi, Abercwmboi captured by RCT's FRM team during Storm Dennis (16th February)

Figure 20: Surface water flooding at Trehafod Road (left) and the A4058 above Trehafod captured during Storm Dennis (16th February) (source: Facebook)

3.1.4 SEWER NETWORK

Sewer flooding is often caused by excess surface water entering the drainage network and exceeding the capacity of the sewer. When this happens, sewage can overflow from manholes and gullies and cause flooding to land and properties.

Dŵr Cymru Welsh Water have primary responsibility for flooding from water and sewerage systems (foul, surface-water and/or combined). Many areas have separate sewer systems to take foul water and rainwater (surface-water), but most sewers are combined, meaning that they are designed to simultaneously collect surface runoff and sewage water in a shared system.

Flooding arises from combined sewers when excess rainwater entering the system exceeds the capacity of the sewer. Due to the exceptional and unprecedented amounts of rainfall during Storm Dennis, the sewer network in many parts of the borough become overwhelmed. Notable areas of flooding from the sewer network include parts of Aberdare and Cwmbach.

3.1.5 PUMPING STATIONS

Pumping stations are built when the existing drainage system in an area is lower than the public sewer to which it has to connect. Water (foul, surface water and sewage) is then 'lifted' and pumped through a discharge pipe to the main sewer.

Within RCT there are multiple pumping stations with various ownerships including Council owned and privately owned, but the majority of surface water and sewer pumping stations are owned and maintained by Dŵr Cymru Welsh Water.

Pumping stations are designed to cope with very high flows in flood situations, however some pumping stations and their supporting drainage infrastructure across RCT became overwhelmed by the sheer amount of water that entered the drainage systems, including stations at Abercynon, Cwmbach and Glenboi.

3.2 IMPACTS – ASSETS & INFRASTRUCTURE

Current design standards for flood risk assets are outlined in Table 5 below;

Table 5: Current design standards for flood risk assets

Asset Type	Design Standard	Guidance Document
Highway Drainage	Q30 (1 in 30 year)	Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems[13]
Sewers	Q30 (1 in 30 year)	Sewers for Adoption 7th Edition[14]
Ordinary Watercourse	Q100 (1 in 100 year) plus climate change allowance	Culvert, screen and outfall manual CIRIA C786[15]
Main River	Q100 (1 in 100 year) plus climate change allowance	Flood and Coastal Erosion Risk Management Business Case Guidance[16]

It should be of note that the design standards are applicable to infrastructure constructed in modern time. Significant extents of the assets & infrastructure within RCT were constructed during the age of industrialisation and urbanisation in the late 19th and early 20th century indicating that a growing number of assets are expected to reach or exceed their design life within the next 30 years[17].

[13] statutory-national-standards-for-sustainable-drainage-systems.pdf (gov.wales)
[14] WRC., 2012. Sewers for Adoption: 7th edition
[15] CIRIA Culvert, Screen and Outfall Manual (C786)
[16] https://gov.wales/sites/default/files/publications/2019-06/flood-and-coastal-erosion-risk-management-fcerm-business-case-guidance_0.pdf
[17] Welsh Water 2050 Consultation Document - Final version.pdf

Storm Dennis exceeded all current design standards, resulting in unprecedented damage to assets and infrastructure across the county borough, including several bridges, culverts, sewers, retaining walls and highway infrastructure.

It is estimated that Storm Dennis caused approximately £70 million of damages to civil infrastructure alone (excluding tips), and it is estimated that the overall spend on the Highway Structures and landslips will be in excess of £91 million.

The below sections are intended to provide a short overview of the damages caused to infrastructure.

3.2.1 Structural Infrastructure

Extensive damages to infrastructure across RCT including bridges, culverts and retaining walls occurred during Storm Dennis. Many of the damages caused by the storm was as a result of Main River flows carrying large debris at high velocity along the watercourses and subsequently breaching its banks at several locations, causing significant damage to several highway and privately owned retaining walls. Figures 21 show sections of damaged river retaining walls at Blaenrhondda and evidence of severe scouring to the riverbanks of the River Taff caused by the storm event.

Figure 21: Damages to Berw Road retaining wall at Pontypridd (left) and Blaen y Cwm Road river wall at Blaenrhondda (left)

Record breaking river levels and velocities caused whole trees to uproot from the banks and other woody debris to be transported along the watercourses resulting in damages to approximately 72 bridges and footpaths across the county borough. Evidence of accumulated material at the Nant Clydach Bridge at Ynysybwl and Feeder Pipe footbridge at Abercynon are illustrated below (Figure 22).

Figure 22: Damages to Nant Clydach Bridge at Ynysybwl (left) and Feeder Pipe footbridge at Abercynon (right)

Damages to infrastructure also occurred as a result of ordinary watercourse and surface water flooding, mainly through the mobilisation of large debris from the upper catchments which resulted in blockages to culvert inlet structures and trash screens further downstream (illustrated in Section 3.1.1).

3.2.2 HIGHWAY INFRASTRUCTURE

Flooding to the highway network across RCT was widespread. Highway drainage infrastructure in several locations became overwhelmed by the sheer volume of surface water entering the drainage network, resulting in surface water ponding which led to many of the borough's primary transport corridors becoming impassible, including the A465 at Hirwaun and the A4095 at Mountain Ash (Figure 23).

Figure 23: Images captured by Local Authority officers of the A465 Underpass at Hirwaun Industrial Estate (left) and the A4059 (New Road) at Mountain Ash on 16th February 2020

Damages to highway infrastructure was also commonplace. Debris and stonewash mobilised from the upper catchments above residential settlements and carried downstream via watercourses resulted in blockages to the highway drainage network which not only caused significant damages but also exacerbated the flooding to the highway. Figure 24 depicts evidence of silt and stonewash deposited onto the highway below Heath Terrace, Ynyshir following the storm event.

Figure 24: Image captured by Council Highways and Streetcare Depot officers at Heath Terrace, Ynyshir on 17th February 2020

4. Roles and Responsibilities of Risk Management Authorities

The term 'Risk Management Authorities' refers to the organisation(s) that have legislative powers concerning flood risk management. A Welsh Risk Management Authority is defined in Section 6 of the Flood and Water Management Act 2010 as Natural Resources Wales; a Lead Local Flood Authority (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.

RCT work in partnership with those organisations to investigate and manage flood risk. Whilst RCT as the LLFA has a duty to investigate flood incidents in its area, it may be the responsibility of another RMA, or a land/property owner, to take actions to resolve an issue.

Table 6: Risk Management Authorities responsible for different flood types

Source of Flooding	LLFA	NRW	Water Company	Highway Authority	SWTRA
River		✓			
Sea		✓			
Surface Water	✓			✓ (on or coming from the Highway)	✓ (on or coming from the Highway)
Ordinary Watercourse	✓				
Groundwater	✓				
Sewer flooding			✓		
Reservoirs		✓			

Table 6 summarises which RMAs are primarily responsible for managing flood risk dependent on the source of flooding. The roles and responsibilities of each individual RMA has been further described within the sections below.

4.1 Lead Local Flood Authority

Within the Flood and Water Management Act 2010, Rhondda Cynon Taf County Borough Council has been established as the Lead Local Flood Risk Authority (LLFA) for its administrative area.

As defined in the Flood and Water Management Act 2010, RCT is responsible for 'Managing' what is termed, its 'local flood risk'. This includes the risk of flooding from ordinary watercourses, surface runoff and groundwater.

Local Authorities have always had certain responsibilities in relation to ordinary watercourses, and in practice most Local Authorities took the lead in dealing with surface water flooding incidents prior to the changes contained within the Flood and Water Management 2010.

The Flood and Water Management Act 2010 places a number of statutory duties on Local Authorities in their role as LLFAs including:

1 - A duty to develop, maintain, apply and monitor a strategy for local flood risk management in its area[18]
2 – A duty to comply with the National Strategy[19]
3 – A duty to co-operate with other authorities, including sharing data
4 – **A duty to investigate all flooding within its area, insofar as a LLFA consider it necessary or appropriate**
5 - A duty to maintain a register of structures and features likely to affect flood risk;
6 - A duty to contribute to sustainable development; and
7 - Consenting powers on ordinary watercourses.

[18] RCT Local Flood Risk Management Strategy - https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/LocalFloodRiskManagementStrategy.aspx
[19] WG National Strategy for Flood and Coastal Erosion Risk Management - 40996 National Strategy for Flood and Coastal Erosion Risk Management in Wales (English) (gov.wales)

The role of RCTCBC as the LLFA to investigate the Storm Dennis flood event falls under Section 19 of the Flood and Water Management Act 2010.

Under the Flood Risk Regulations 2009 the LLFA also have duties to contribute to the production of Flood Risk Management Plans[20].

In addition to these, each LLFA has a number of what are called permissive powers under the FWMA. These are powers that allow them to do something, but do not compel them to and include:

1 - Powers to request information in connection with the authority's flood and coastal erosion risk management functions;
2 - Powers to designate certain structures or features that affect flood or coastal erosion risk;
3 - The expansion of powers to undertake works to include broader risk management actions; and
4 - The ability to cause flooding or coastal erosion under certain conditions.

Rhondda Cynon Taf County Borough Council also manage flood risk via the permissive powers bestowed upon all Lead Local Flood Authorities under the Land Drainage Act 1991, which allow them to regulate ordinary watercourses (outside of internal drainage districts) to maintain proper flow by;

- Issuing consents for altering, removing or replacing certain structures or features on ordinary watercourse; and

- Enforcing obligations to maintain flow in a watercourse and repair watercourses, bridges and other structures in a watercourse.

These powers are for the purpose of preventing flooding or remedying or mitigating any damage caused by flooding. Enforcement powers under the Act assist the Council in carrying out its duties under the Flood and Water Management Act 2010 and the Land Drainage Act 1991 to help with their land drainage and flood risk management functions across RCT through better regulation of activities on, near or adjacent to an ordinary watercourse, which may increase the risk of flooding. The responsibility for

[20] RCT Flood Risk Management Plan - Flood Risk Management Plan (Final) (rctcbc.gov.uk)

maintenance of watercourses ultimately rests with the landowner. Riparian landowners' rights and responsibilities are discussed in Section 5.3.

LLFA's in Wales also take on the role of the SuDS Adopting and Approving Body (SAB) in relation to sustainable drainage systems as of the 7th January 2019. In this role they have a duty to ensure surface water drainage for new developments with drainage implications is built and functions in accordance with mandatory National Standards for Sustainable Drainage Systems (SuDS) prior to construction work taking place[21].

[21] https://gov.wales/sites/default/files/publications/2019-06/statutory-national-standards-for-sustainable-drainage-systems.pdf

4.2 NATURAL RESOURCES WALES

Under the Flood and Water Management Act 2010, Natural Resources Wales is responsible for managing the risks of flooding from main rivers and the sea, and for regulating the safety of reservoirs. In addition, NRW also have operational responsibilities in relation to coastal erosion and a wider oversight role for all flood and coastal erosion risk management in Wales.

The oversight role is integral to the delivery of national policy on flooding and coastal erosion risk management and has been taken forward to ensure that Natural Resources Wales has the remit to support the Welsh Government across the full range of flood and coastal erosion risks affecting Wales.

As part of their oversight role, Natural Resources Wales will lead on the provision of technical advice and support to other Risk Management Authorities. They will also lead on national initiatives such as Flood Awareness Wales, the national raising awareness program, and be the single point of contact for enquiries and information on flood risk, via their Flood Line warning service[22].

The Flood and Water Management Act 2010 places a number of statutory duties on Natural Resources Wales including:

a) Co-operating with other authorities, including sharing data;
b) Reporting to the Minister on flood and coastal erosion risk in Wales including the application of the National Strategy; and
c) The establishment of Regional Flood and Coastal Committees.

In addition to their statutory duties, Natural Resources Wales has a number of permissive powers. These are powers that allow them to do something, but do not compel them to and include:

a. Powers to request information
b. The ability to raise levies for local flood risk management works, via the Regional Flood and Coastal Committees
c. Powers to designate certain structures or features that affect flood or coastal erosion risk

[22] NRW Flood line Warning - https://naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/?lang=en

d. The expansion of powers to undertake works to include broader risk management actions; and
e. The ability to cause flooding or coastal erosion under certain conditions.

This new allocation of responsibilities is also consistent with Natural Resources Wales' role; in relation to the Flood Risk Regulations 2009, which allocates specific responsibility for conducting assessments in relation to mapping and planning the risks of flooding from main rivers, the sea and reservoirs to Natural Resources Wales, as well as providing guidance to Local Authorities on these matters for flooding from other sources.

Under the Regulations, Natural Resources Wales also takes on an assessment and coordination role at a national level, ensuring the correct information is passed back to the European Commission.

4.3 WATER COMPANY

Dŵr Cymru Welsh Water (DCWW) is the regional water and sewerage treatment company serving Rhondda Cynon Taf CBC. Water and sewerage companies are responsible not only for the provision of water, but also for making appropriate arrangements for the drainage of foul water, the treatment of waste, surface water sewers and combined sewers. They have primary responsibility for floods from water and sewerage systems, which can include sewer flooding, burst pipes or water mains or floods caused by system failures.

No changes have been made to the operational arrangements for water and sewerage companies in respect of flood risk.

Water companies, when exercising their flood or coastal erosion risk management functions in relation to an area within Wales, must have regard to the relevant Local Strategies and any associated guidance.

The Flood and Water Management Act 2010 places a number of statutory duties on Water and Sewerage Companies including:

1 - A duty to act consistently with the National Strategy;

2 - A duty to have regard to the content of the relevant Local Strategy; and

3 - Co-operation with other Authorities, including sharing data.

Water and sewerage companies often hold valuable information, which could greatly aid the understanding of flood risks faced by communities across Wales.

4.4 Highway Authority

Highway authorities have the lead responsibility for providing and managing highway drainage and roadside ditches under the Highways Act 1980. The owners of land adjoining a highway also have a common-law duty to maintain ditches to prevent them causing a nuisance to road users.

Rhondda Cynon Taf County Borough Council, as the highway authority, is the relevant RMA with responsibility for ensuring the roads and highways within its area is clear of obstructions and to manage and maintain the surface water drainage infrastructure to an appropriate design standard to drain surface water from the highway. As part of their duty, they are responsible for carrying out routine and reactive works to these systems to ensure they are working to maximum capacity.

Highway drainage is not designed to manage overland flows from private areas, parks or open space. In these instances, the capacity of the highway drainage may become exceeded by a combination of highway and private surface water, resulting in surface water flooding.

4.5 South Wales Trunk Road Agency (SWTRA)

The Welsh Government has a responsibility for managing flood risk on motorways and major trunk road drainage under the Highways Act, section 100. The Trunk Road Agency must ensure that road projects do not increase flood risk and road discharges do not pollute receiving waterbodies.

5. Role of Other Authorities & Asset Owners

Whilst not designated flood risk management authorities, stakeholders such as infrastructure providers, riparian landowners and residents have responsibilities to maintain their assets for the purposes of managing flood risk.

5.1 Network Rail & Transport for Wales

Whilst legislation does not impose an official role on Network Rail/Transport for Wales, they have an operational responsibility for flooding as a land and asset owner and are required to undertake regular maintenance of all drainage infrastructure and assets that pose a risk to flooding.

5.2 Riparian Landowners

If you own land or property located adjacent to or abutting a waterway (watercourse, stream, ditch) then in legal terms you are a Riparian Owner and have certain common law rights and responsibilities.

Riparian Landowners are legally responsible under common law for the maintenance of the land generally up to the centerline of any watercourse adjacent to their property[23]. This includes the maintenance of the bed, banks and any boundary features e.g. vegetated strips such as hedging, with routine clearance of debris and/or blockages.

This does not mean that the owner must remove all debris from the watercourse, but it does require the owner to maintain as far as it does not pose a risk or 'nuisance' to a neighbour. Any works to modify the watercourse by the landowner must first be passed through the relevant Risk Management Authority, Lead Local Flood Authority (LLFA) or Natural Resources Wales (NRW).

[23] Natural Resources Wales – Riverside Property Owners - https://naturalresources.wales/flooding/managing-flood-risk/riverside-property-owners-know-your-rights-and-responsibilities/?lang=en

Under common law, Riparian Owners have rights and responsibilities relating to any watercourse that passes through or adjacent to the boundaries of their land. The means that the landowner must:

- Pass on flow without obstruction, pollution or diversion affecting the rights of others;
- Accept natural flood flows through their land, even if caused by inadequate capacity downstream, as there is no common law duty to improve a watercourse;
- Maintain the bed and banks of the watercourse (including trees and shrubs growing on the banks) and clear any debris, natural or otherwise;
- Not cause any obstruction to the free passage of fish;
- Keep the bed and banks clear from any matter that could cause an obstruction either on their land, or by being washed away by high flow to obstruct a structure downstream;
- Take responsibility for protecting their property from seepage through natural or constructed banks, and;
- Keep clear any structure that they own such as culvert, trash screen, weirs and mill gates.

Under the FWMA 2010, a landowner needs consent from the Land Drainage Authority if they want to construct a culvert or flood relief control structure on any ordinary watercourse.

5.3 Residents, Property & Business Owners

Residents, property and business owners are responsible for the protection of their own properties against flooding as well as maintaining private surface water drainage infrastructure such as guttering and soakaways. Residents have the right to defend their property as long as they do not subsequently increase the risk of flooding to other properties.

Residents are advised to review their personal flood resilience to ensure that they are as prepared as possible for any future flooding events. For more information on property flood products and services to help reduce the risk of flooding to homes and/or businesses, see The Blue Pages webpage[24].

[24] Blue Pages, Flood Directory - http://bluepages.org.uk/

6. SECTION 19 INVESTIGATION & REPORTING

The Section 19 report is a statutory requirement of the Flood and Water Management Act 2010, which primarily focuses on the statutory responsibilities and duties of flood risk management authorities in response to a flood event.

The purpose of the investigation is to determine which Risk Management Authorities (RMA's) have relevant flood risk management functions and which functions have been exercised in response to a flood. Specifically, Section 19 of the Flood and Water Management Act 2010 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 publish the results of its investigation, and notify any relevant risk management authority"[25]

Current Welsh Government guidance outlined within the National Strategy for Flood and Coastal Erosion Risk Management[1] stipulates that Section 19 reports should be produced for flooding incidents where twenty or more properties experience internal flooding following a storm event.

Due to the widespread and extensive flooding impacts of Storm Dennis across Rhondda Cynon Taf, hot-spot areas which experienced internal flooding have been clustered into twenty-eight Flood Investigation Areas (FIA) (Figure 25). These FIAs are also listed in Table 7. Individual Flood Investigation Reports (FIR) will be produced for each FIA identifying the causes and mechanisms of flooding within each area, nineteen of which will be progressed into Section 19 reporting following the thresholds set out by the Welsh Government. Those Flood Investigation Areas that require a

[25] Flood and Water Management Act 2010 – Section 19 - https://www.legislation.gov.uk/ukpga/2010/29/section/19

Section 19 Report have been highlighted within Table 7, along with links to the relevant reports published on the Council's website.

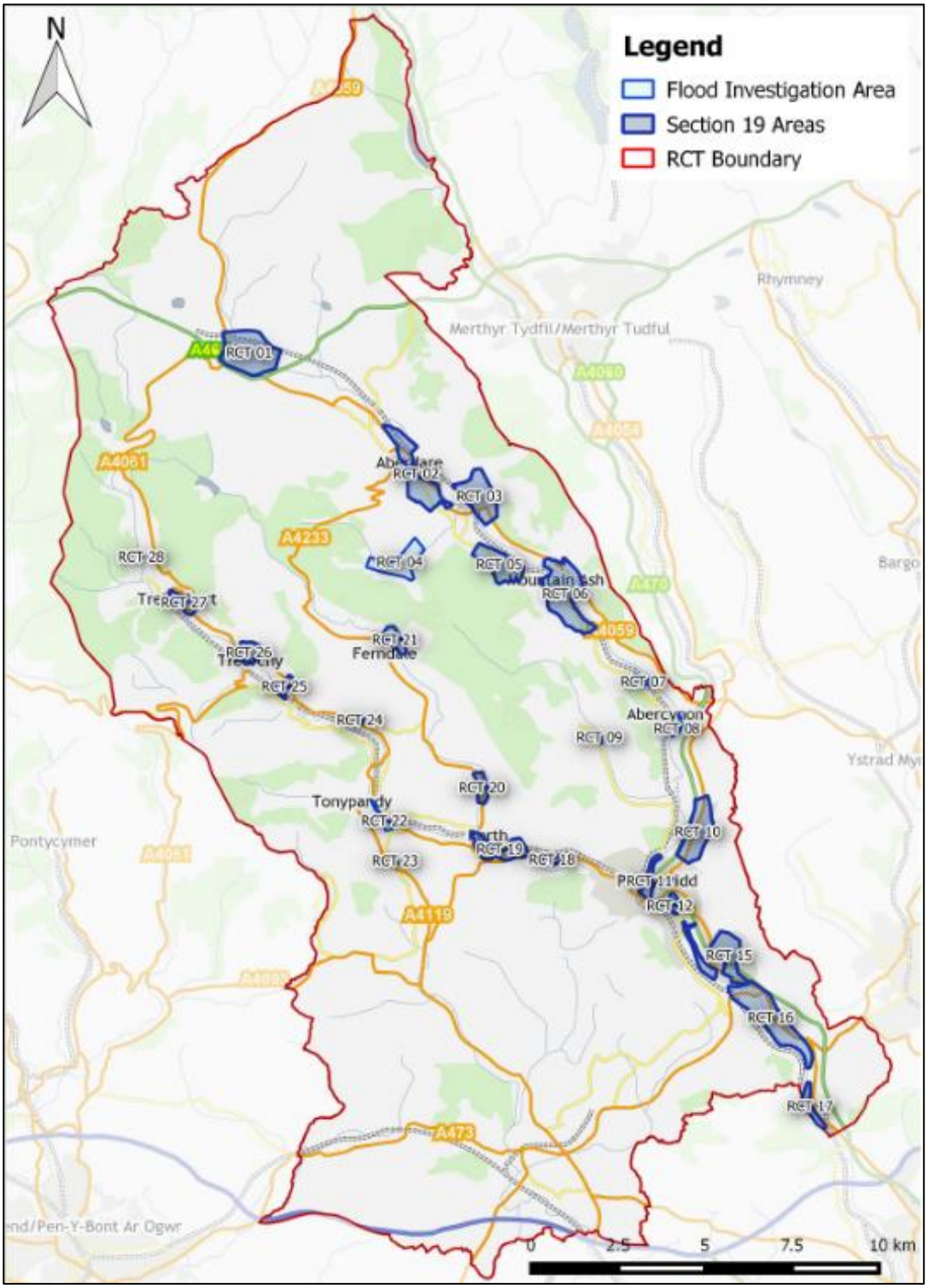

Figure 25: Flood Investigation Areas and Section 19 Areas in RCT

Table 7: List of all twenty-eight Flood Investigation Areas, the number of receptors affected, a determination of whether a Section 19 Report is required and links to those reports

Flood Investigation Area Reference	Location	Total Number of Receptors Affected	Section 19 Report	Link to Section 19 Report
RCT01	Hirwaun	35	Yes	FRM – S19 - 001
RCT02	Aberdare	50	Yes	FRM – S19 – 002
RCT03	Cwmbach	34	Yes	FRM – S19 – 003
RCT04	Cwmaman	11	No	N/A
RCT05	Abercwmboi Fernhill	74	Yes	FRM – S19 – 005
RCT06	Mountain Ash	68	Yes	FRM – S19 – 006
RCT07	Ynysboeth	15	No	N/A
RCT08	Abercynon	14	No	N/A
RCT09	Ynysybwl	19	No	N/A
RCT10	Cilfynydd	25	Yes	FRM – S19 – 010
RCT11	Pontypridd	158	Yes	FRM – S19 – 011
RCT12	Treforest	50	Yes	FRM – S19 – 012
RCT13	Pentrebach	10	No	N/A
RCT14	Hawthorn	27	Yes	FRM – S19 – 014
RCT15	Rhydyfelin	33	Yes	FRM – S19 - 015
RCT16	Nantgarw	306	Yes	FRM – S19 – 016
RCT17	Taffs Well	36	Yes	FRM – S19 – 017
RCT18	Trehafod	68	Yes	FRM – S19 – 018
RCT19	Porth	61	Yes	FRM – S19 – 019
RCT20	Ynyshir	26	Yes	FRM – S19 – 020
RCT21	Ferndale	26	Yes	FRM – S19 – 021
RCT22	Tonypandy	7	No	N/A
RCT23	Penygraig	10	No	N/A
RCT24	Ystrad	14	No	N/A
RCT25	Pentre	169	Yes	FRM – S19 – 025
RCT26	Treorchy	44	Yes	FRM – S19 – 026
RCT27	Treherbert	23	Yes	FRM – S19 - 027
RCT28	Blaenrhondda	9	No	N/A

A brief summary of the flooding mechanisms and impacts which occurred during Storm Dennis within those Flood Investigation Areas that fall below the threshold stipulating the production of a Section 19 report, have been provided within Table 8.

Table 8: Summary of the flooding mechanisms observed during Storm Dennis within the Flood Investigation Areas that do not stipulate a Section 19 report

Flood Investigation Area Reference	Number of Receptors Affected	Summary of Flood Mechanisms
RCT04	11	Investigation area RCT04 is located within the town of Cwmaman situated within the River Aman catchment in the Cynon valley. The primary source of flooding at Cwmaman was identified as the overtopping of several unnamed ordinary watercourses, possibly exacerbated by poor culvert conditions downstream but primarily caused by extreme rainfall flowing down the hillsides, leading to flooding to several properties situated at Brynhyfryd, Glanaman Road, Kingsbury Place and Treneol. A section of the Nant Aman watercourse (designated by NRW as a Main River) was also observed to have overtopped its bank at a low point causing internal flooding to a property at Llanwonno Road.
RCT07	15	Investigation area RCT07 lies within the community area of Ynysboeth located in the River Cynon catchment on the western bank of the river. The source of flooding at Ynysboeth originated primarily from the Nant-y-Fedw ordinary watercourse which overtopped at a culverted section of the watercourse due to an observed blockage and caused internal flooding to properties adjacent to the inlet at Abercynon Road, and further downstream at Nant-y-Fedw. Additional sources of flooding were recorded from surcharging highway drainage infrastructure and surface water runoff from the hillside towards the B4275 Abercynon Road.

RCT08	14	Investigation area RCT08 is situated within the town of Abercynon located in the River Cynon catchment and bounded to the south and east by the River Taf catchment. The source of flooding at Abercynon originated from two surcharging culvert inlets, one at the northern end of River Row causing properties to flood, and the second culvert above Wood Road which resulted in surface water runoff travelling towards low points and causing internal residential flooding. Highway drainage infrastructure became overwhelmed during the storm event and the mobilisation of debris carried by the flowing water caused partial blockages, resulting in the reduced capacity of the surface water drainage systems. The River Cynon is also known to have overtopped its banks upstream of River Row, contributing to the flooding of these properties.
RCT09	19	Investigation area RCT09 is located within the town of Ynysybwl in the River Cynon catchment, to the west of Abercynon. The source of flooding at Ynysybwl originated from the Main River, the Nant Clydach, which overtopped its defence embankments adjacent to Clydach Terrace and resulted in internal flooding to several properties.
RCT13	10	Investigation area RCT13 is located within the electoral ward of Trallwng. The area is bounded to the north by the A4054 Pentrebach Road and to the south by the River Taf and the A470. An unnamed ordinary watercourse overtopped its banks adjacent to Nightingales Bush, causing internal flooding to residential properties after becoming overwhelmed during the storm event.

		Surface water runoff along Pentrebach Road was also identified as a contributing source of flooding to properties.
RCT22	7	Investigation area RCT22 is located within the town of Tonypandy in the Rhondda River catchment. The source of flooding at Tonypandy in this incident originated from extreme rainfall running from the hillsides to the southeast and southwest of the town draining to lower ground and causing surface water flooding to several commercial properties along Foundry Road and Talycelyn Road. Highway drainage infrastructure at Foundry Road was observed to have become blocked during the storm event, further contributing to the observed surface water flooding.
RCT23	10	Investigation area RCT23 is situated within the village of Williamstown in the Rhondda valley. The source of flooding in this incident originated from the overtopping of the Nant Ffrwdamas ordinary watercourse which flows to the rear of Brook Street. The watercourse became overwhelmed during the storm event and breached its lower embankments allowing water to flow onto Brook Street, causing blockages to highway drainage infrastructure and resulting in internal flooding to several properties.
RCT24	14	Investigation area RCT24 is located within the community area of Ystrad in the Rhondda River catchment. The primary source of flooding at Ystrad originated from the surcharging of a culvert inlet and manholes located to the rear of Danygraig and near the Nant Gelligaled ordinary watercourse to the west of Danygraig. The culvert network was identified as heavily silted, resulting in the reduced capacity of the drainage infrastructure which ultimately caused surcharg.

		Water flowed downhill towards the rear of the impacted properties along Penrhys Road.
RCT28	9	Investigation area RCT28 is located within the town of Blaenrhondda, to the northwest of Treherbert, at the head of the Rhondda Fawr valley. The primary source of flooding at Blaenrhondda was identified as originating from an unnamed ordinary watercourse to the rear of the impacted properties on Brook Street. The watercourse became overwhelmed during the storm event by both the volume of water and the mobilisation of debris from the mountainside which caused the culvert inlet and trash screens to block, resulting in the overtopping of the watercourse from its concrete channel.

Approximately a further 78 properties, in addition to those outlined in Table 7 and 8, have been confirmed as experiencing internal flooding during Storm Dennis. Those additional properties fall outside the boundaries of the twenty-eight FIAs. For that reason, neither Flood Investigation Reports nor Section 19 Reports have been produced for those properties, however, the Authority's Flood Risk Management Team have undertaken initial investigations and will continue to manage the flood risk associated to each location on a prioritised basis.

As part of producing the Section 19 Reports, RCTCBC as the LLFA will seek to collaborate with the local community and those affected to draw upon detailed local knowledge. The primary outcome for each flood investigation report is to gain a better, more comprehensive understanding of local flood risk across RCT, especially in relation to ordinary watercourse and surface water flood risk. Ultimately the production of Section 19 investigation reports will support future targeted investment in reducing flood risk, allow the development of recommendations for proposed solutions and will

feed into the development of RCT's revised Local Flood Risk Management Strategy, due to be published within the next two years.

CONCLUSION

This overview report has been produced to provide a factual account of the events that occurred during Storm Dennis (15-16th February 2020) and is not meant as a detailed investigation into the individual flooding mechanisms that impacted so many.

February 2020 was the wettest February on record in Wales. Significant rainfall totals were reached over the entire month, but particularly during Storm Dennis which occurred on the 15 and 16th February 2020.

Rivers and watercourses across RCT reached record-breaking levels, resulting in severe impacts which exceeded all design standards for drainage assets and infrastructure in RCT. No action could have prevented the unprecedented rainfall and river levels that occurred during Storm Dennis, resulting in the worst flooding in a generation for many communities.

While the figures suggest that the flooding events experienced in February 2020 were exceptional, climate science suggest that they might not be quite so exceptional in the years to come. It is evident that storms are becoming more frequent and severe across Wales and the UK. The need to enhance community resilience, build preparedness and improve our ability to adapt to the challenges facing society now and in the future is paramount.

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

APPENDIX A: NRW RIVER WARNINGS & ALERTS

Table 1: River Warnings and Alerts issued by NRW for Rhondda Cynon Taf County Borough Council area between the 15-17th February 2020

Message Type	Location	Start Time	End Time
Flood Alert	River Cynon	12:51:38 15/02/2020	07:31:08 17/02/2020
Flood Alert	River Taff	13:27:38 15/02/2020	09:15:17 21/02/2020
Flood Alert	Rhondda River	14:43:04 15/02/2020	07:25:17 17/02/2020
Flood Warning Rapid Response	River Cynon at Mountain Ash	19:45:09 15/02/2020	14:21:00 16/02/2020
Flood Warning Rapid Response	River Cynon at Abercynon	19:49:37 15/02/2020	14:23:06 16/02/2020
Flood Warning	River Taff at Pontypridd	20:48:22 15/02/2020	22:08:33 16/02/2020
Flood Warning	River Taff at Taffs Well and Industrial Areas of Gwaelod y Garth	20:52:24 15/02/2020	22:13:37 16/02/2020
Flood Warning	River Taff at Upper Boat	02:10:17 16/02/2020	14:32:03 16/02/2020
Flood Warning Rapid Response	River Cynon at Hirwaun	02:45:58 16/02/2020	14:18:59 16/02/2020
Flood Warning Rapid Response	River Rhondda at Porth	02:49:11 16/02/2020	14:35:17 16/02/2020
Flood Warning Rapid Response	River Cynon at Aberdare	02:58:21 16/02/2020	14:13:35 16/02/2020
Flood Warning Rapid Response	Rhondda Fawr at Pentre	03:03:06 16/02/2020	14:15:53 16/02/2020
Flood Warning	River Taff at Hawthorn and Rhydyfelin	04:00:53 16/02/2020	15:13:59 16/02/2020
Flood Warning	River Rhondda at Trehafod	05:07:43 16/02/2020	15:44:48 16/02/2020
Flood Warning	River Taff at Nantgarw	05:19:05 16/02/2020	22:15:55 16/02/2020
Severe Flood Warning	River Taff at Pontypridd	06:33:35 16/02/2020	22:08:33 16/02/2020

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