

Appendix F

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Storm Dennis –
Flood Investigation Area RCT01
(Hirwaun)

January 2022

ANDREW STONE

Head of Flood Risk Management and Strategic Projects
Strategic Projects, Sardis House, Sardis Road, Pontypridd, CF37 1DU

ROGER WATERS

Director
Frontline Services, Sardis House, Sardis Road, Pontypridd, CF37 1DU

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Prepared by	Catrin Evans BSc (Hons)			
Checked by	Owen Griffiths MSc, BSc (Hons)			
Approved by	Andrew Stone BSc (Hons), IEng, MICS, Assoc, MCIWM, AaPS			

This report should be read in its entirety

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

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CONTENTS

EXECUTIVE SUMMARY	1
ABBREVIATIONS & GLOSSARY	4
TABLES AND FIGURES	5
1. INTRODUCTION.....	7
1.1. Purpose of Investigation.....	7
1.2. Site Location	8
1.3. Drainage System.....	9
1.4. Investigation Evidence	10
1.5. Public Engagement	10
2. FLOODING HISTORY	12
2.1. Previous Flood Incidents	12
2.2. Flood Incident.....	13
2.3. Rainfall Analysis.....	19
3. POSSIBLE CAUSES	20
3.1. Culvert Conditions	20
3.2. Open Watercourse Conditions	23
3.3. Main River	26
3.3.1. Main River Levels and Flood Warnings	26
3.3.2. Main River Flood Risk.....	28
3.3.3. Main River Flood Defences.....	30
3.4. Highway Drainage Conditions	31
3.5. DCWW Apparatus Conditions	32
3.6. Surface Water	33
3.7. Access Structures	37
3.8. System at Capacity	38
3.9. Summary of Possible Causes	39
4. RISK MANAGEMENT AUTHORITY ACTIONS.....	40
4.1. Lead Local Flood Authority	44
4.2. Natural Resources Wales	47

4.3. Water Company	49
4.4. Highway Authority	50
USEFUL LINKS/CONTACTS	51

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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 an investigative report of the storm event that occurred on 15 and 16th February 2020 within Rhondda Cynon Taf County Borough Council area, focusing investigation on the flooding at Hirwaun in the Cynon valley (Flood Investigation Area RCT01, Figure 1).

This report was undertaken to identify the mechanism for 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 were planning to undertake actions related to those functions to manage the risk of flooding.

The flooding that affected RCT on 15 and 16th of February 2020, was a result of an extreme rainfall event, designated by the Met Office as ‘Storm Dennis’. The impact of the event at investigation area RCT01 resulted in internal flooding to 30 residential properties, one commercial property and extensive flooding to the highway. 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 cause of internal flooding at RCT01 in this incident was a result of water levels on the River Cynon exceeding river bank levels to the rear of Cae Felin Parc and passing through privately owned boundary walls, resulting in water flowing towards and into several properties. A review of NRW’s Flood Risk Assessment Wales Maps identifies the properties impacted at Cae Felin Parc at high risk of flooding from the main river, however there are no formal flood defences currently in place.

The investigation also noted surface water flooding as a primary source of flooding at RCT01 during Storm Dennis. The sheer volume of water falling on the catchment resulted in significant overland flows within the investigation area, with many roads acting as channels for the water. The volume of surface water, combined with main river flooding in areas, overwhelmed the existing surface water drainage infrastructure and resulted in flooding to several properties.

NRW has been determined as the relevant Risk Management Authority responsible for managing the river flooding that occurred during Storm Dennis. In response to the flooding at investigation area RCT01, NRW have;

- Carried out their own post event investigative analysis work to understand the mechanism of flooding from the River Cynon at Hirwaun;
- Commissioned a Cynon Flood Modelling Study for completion by March 2022. The outcomes of which will be utilised to undertake an initial economic assessment of the viability of potential flood risk management options.
- Developed a series of recommendations and a detailed action plan to address the areas of improvement required by NRW for future storm events, including the performance of NRW's Flood Warning Service and incident management response.

RCT as the Lead Local Flood Authority and Land Drainage 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 RCT01, the LLFA has;

- Carried out survey, jetting and cleansing operations to an estimated of culvert network length within the investigation area;
- Led on the development of a central Control Room, to compliment the Council's Contact Centre and CCTV Centre, 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
- Initiated an interim Property Flood Resistance project offering expandable flood gates to those properties deemed at high risk of flooding from local sources. Working in partnership with NRW, the LLFA have expanded the project to include properties at high risk of river flooding also.

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 RCT01, however, further measures have been proposed by all RMAs to improve preparedness and response to future flood events.

ABBREVIATIONS & GLOSSARY

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

RCT01 – Flood Investigation Area RCT 01

RMA – Risk Management Authority

SAB – Sustainable Drainage Approval Body

SFRA – Strategic Flood Risk Assessment

SuDs – Sustainable Drainage Systems

TABLES AND FIGURES

Table 1: Investigative evidence gathered in preparation of the Storm Dennis Section 19 report	10
Table 2: Summary of the source(s), pathway(s) and receptor(s) affected during Storm Dennis within investigation area RCT 01.....	13
Table 3: Flood Warnings issued by NRW for the River Cynon at Hirwaun during Storm Dennis	27
Table 4: Pre and post mining discharge rates for the Q100 + 30% climate change allowance event per sub-catchment	35
Table 5: Summary of culvert capacity assessment results for Culverts 1-3 (Figure 16) based on post mining conditions which indicate the current standard of protection of the structure in free-flowing conditions	38
Table 6: Summary of the source(s) and possible cause(s) of flooding in Hirwaun during Storm Dennis	39
Table 7: Risk Management Authority with relevant functions to manage the risk for different flood types.....	40
Table 8: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in RCT01 (as per Table 6)	41
Figure 1: Flood Investigation Area RCT01 Location Plan.....	8
Figure 2: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for rivers and ordinary watercourse and surface water flood risk at investigation area RCT01. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.	9
Figure 3: Observed flow paths at Cae Felin Parc and Swansea Road in Hirwaun during Storm Dennis	15
Figure 4: Landslip of the hillside above the railway line, Hirwaun on the 16 th February 2020 (image captured by resident)	16
Figure 5: Dropped kerb and highway gully at Meadow Lane, to the rear of the impacted properties at Beacons View (image captured by RCT's Flood Risk Management officers on 26/02/2020)	18
Figure 6: Swansea Road culverted watercourse network in investigation area RCT01	20
Figure 7: Obstruction identified approximately 6 meters downstream of the Swansea Road culvert inlet.....	21
Figure 8: Meadow Lane culverted watercourse network in investigation area RCT01.....	22
Figure 9: Rainfall Topographic Catchment area and named ordinary watercourses draining into the River Cynon at investigation area RCT01.....	23
Figure 10: Ordinary watercourses and culverted networks identified at Meadow Lane in the southwest of investigation area RCT01. The ordinary watercourses identified as possible causes of flooding during Storm Dennis are shown in red.....	24
Figure 11: Undefined and overgrown ordinary watercourse channel above Meadow Lane Culvert Inlet 2 (image captured by RCT's Flood Risk Management team following Storm Dennis).....	25

Figure 12: The River Cynon levels at Hirwaun station between the 14 th and 17 th February 2020 (Natural Resources Wales)	26
Figure 13: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for River sources at RCT01. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.	28
Figure 14: Damage to property caused by the River Cynon to the rear of Richmond Drive, Hirwaun on the 16 th February 2020 (image captured by resident).....	29
Figure 15: Natural Resources Wales' FRAW map for surface water and ordinary watercourse sources and indicative surface water flow paths within investigation area RCT01. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.....	33
Figure 16: Tower Colliery sub-catchments and associated culvert inlets	34
Figure 17: Surface water flooding to the A4061 Rhigos Road caused by surcharging culvert inlets associated to sub-catchment TIP 107A and TIP 107B (captured by RCT's Highways and Streetcare Depot on 16 th February 2020)	36

1. INTRODUCTION

1.1. PURPOSE OF INVESTIGATION

On the 15 and 16th February 2020 RCT was impacted by an extreme weather event which was designated by the Met Office as ‘Storm Dennis’. 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 RCT 01 which covers the village of Hirwaun in the Cynon valley.

The reason behind RCT’s investigation is in response to the duties of the local authority in regard to 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 covers the village of Hirwaun located within the River Cynon catchment in the north of Rhondda Cynon Taf, just north of Aberdare (Figure 1).

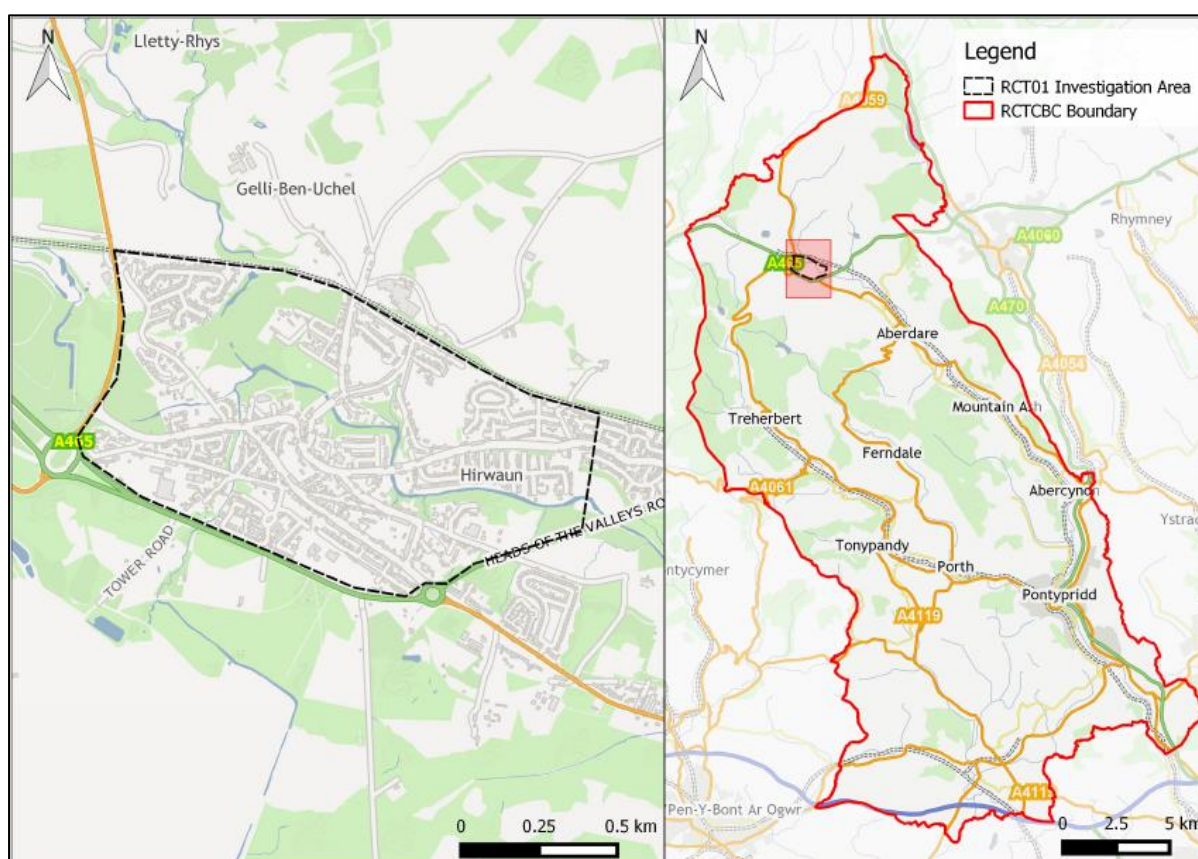


Figure 1: Flood Investigation Area RCT01 Location Plan

Hirwaun is predominantly a rural environment owing to the steep topography to the south of the investigation area. The investigation area itself is bounded to the south by the A4059 with residential development situated north of the primary road. The electoral ward of Rhigos bounds investigation area RCT01 to the north.

The River Cynon flows northwest to southeast through the centre of investigation area RCT01. The Nant y Bwlch watercourse drains the higher elevations in the south along with a number of minor unnamed watercourses which discharge into the River Cynon. Many of these watercourses are partially culverted beneath Hirwaun's residential development.

The highest risk posed to people and properties is broadly associated with the River Cynon across the length of the watercourse, with significant risk along sections of Cae Felin Parc and Llys Cynon. A risk of flooding is also noted in the north of the site, sourced from the River Cynon culvert inlet³. Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map also notes a low to high risk of surface water and ordinary watercourse flooding sources from various culvert inlets (Figure 2).

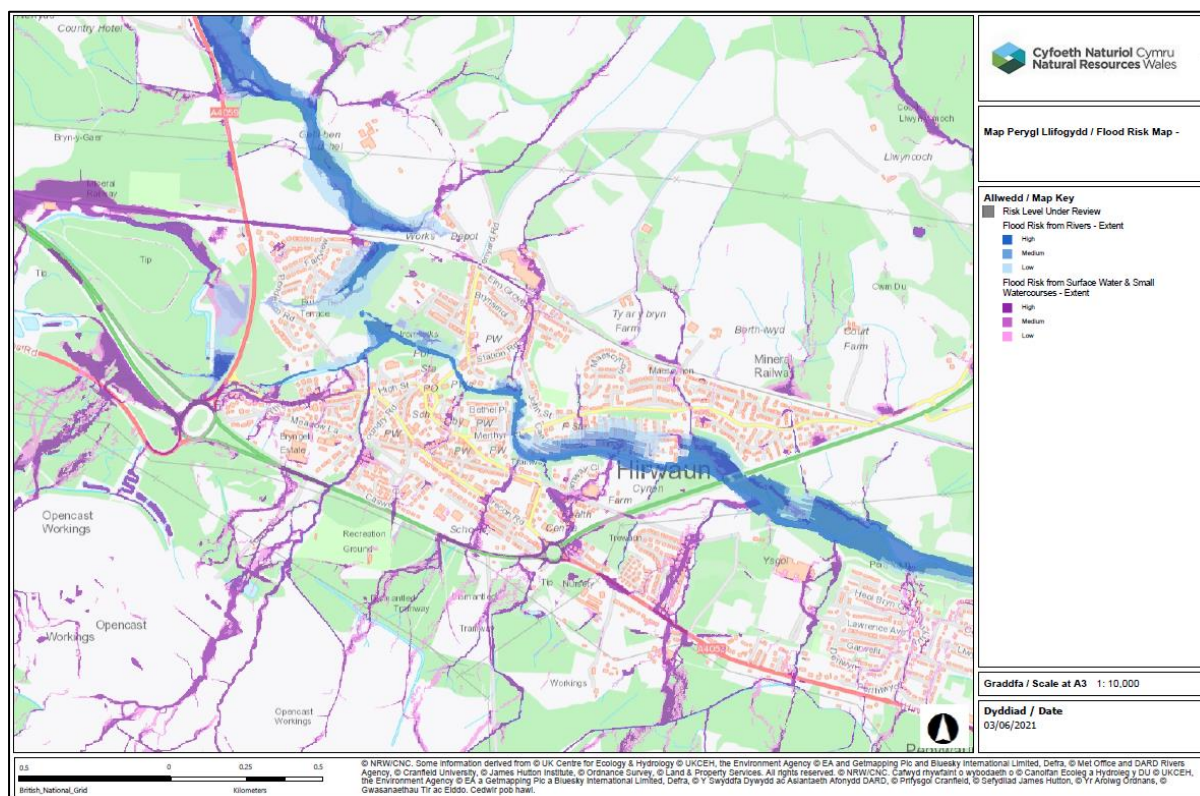


Figure 2: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for rivers and ordinary watercourse and surface water flood risk at investigation area RCT01. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

1.3. DRAINAGE SYSTEM

The surface water drainage system that serves investigation area RCT01 is that of the highway drainage network designed to manage the surface water within the highway and public surface water sewer and combined sewer networks operated by Dŵr Cymru Welsh Water.

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

1.4. INVESTIGATION EVIDENCE

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

Table 1: Investigative evidence gathered in preparation of the 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 February during storm Dennis, flood risk officers from the RCT Flood Risk Management department were deployed to areas across the borough to investigate reports of internal flooding by residents. Residents were engaged with by the Flood Risk Management team to determine the initial impacts caused by the flooding event and to investigate the potential source(s) and pathway(s) of flood water during the event. Due to the volume

of calls received by RCT's Out of Hour 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 was to engage with the 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

Residents affected by main river flooding state that they had not experienced flooding from the River Cynon in over 40 years prior to Storm Dennis. The last known main river flood event at Hirwaun occurred in December 1979. Residents added that they had observed significant erosion of the River Cynon bank to the rear of properties at Cae Felin Parc over the past twenty years.

Surface water flooding to the highway occurs frequently within the investigation area and surrounding areas during downpours, particularly along the A4061 Rhigos Road and the A465. These are often attributed to highway drainage infrastructure becoming hydraulically overwhelmed. Residents also stated that they have observed an increase in overland flows originating from the hillside above Hirwaun over the last few years. Notably, surface water and ordinary watercourse flooding originating from the Tower Colliery site has been a long-standing issue at Hirwaun.

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’ which 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.

The post event inspections undertaken on the days following the storm event by RCT’s Flood Risk Management Team and RCT’s Public Health, Protection and Community team identified 32 residential and 1 commercial property as internally flooded.

A summary of the source(s) and pathway(s) of flooding within investigation area RCT01 during Storm Dennis have been outlined in the 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 RCT 01

Source(s)	Pathway(s)	Receptor(s)
Water levels on the River Cynon exceeded river bank levels to the rear of properties along Cae Felin Parc	Floodwater, which overtopped the banks of the River Cynon, travelled through the rear of several properties along Cae Felin Parc and onto the highway before entering properties from the front and rear.	The floodwater contributed to the internal flooding of 20 properties at Cae Felin Parc including 1 commercial property. Several other properties along Cae Felin Parc and Llys Cynon were affected by external flooding due to water accumulation on the highway.
Intense rainfall led to significant surface water runoff along several streets	Surface water flowed down a number of highway networks including Swansea Road, Cae Felin Parc, Tramway, Tramway Close, Station Road, Garth Grove,	Surface water contributed to the internal flooding of 20 properties at Cae Felin Parc including one commercial property.

	<p>Fairview, Penmark Row, Meadow Lane and Rhigos Road.</p> <p>Flow pathways within the investigation area followed local topography towards the lower elevations</p>	<p>Surface water runoff also resulted in internal flooding to 8 residential properties, including one at Tramway, two at Tramway Close, 2 properties at Station Road, 1 at Fairview, 2 at Penmark Row and a further property at Beacons View</p> <p>Several properties were also impacted externally by surface water accumulation along the highway network which was unable to drain away.</p>
<p>Overland flow originating from the hillside below the A465</p>	<p>Surface water runoff flowed overland down the hillside below the A465 and onwards towards properties at Rhigos Road and Meadow Lane.</p>	<p>Internal flooding to 1 residential property on Rhigos Road from the front.</p> <p>A 1 further residential property at Rhigos Road was externally affected.</p>

On review of Table 2, the primary source of the recorded flooding observed at RCT01 in this incident originated from the main River Cynon when river levels exceeded riverbank levels to the rear of properties at Cae Felin Parc. The River Cynon flows northwest to southeast through the centre of Hirwaun, just south of Cae Felin Parc.

Several calls were reported by residents at Cae Felin Parc on Sunday 16th February to report that the River Cynon had “breached” its banks and floodwater was entering several properties. According to residents, water entered the rear of multiple properties before continuing its flow path onto the highway and travelling in an easterly direction towards Llys Cynon before reaching elevated ground. On its flow path several properties were internal flooding through the front of the properties as a result of the overland flows.

Twenty properties along Cae Felin Parc, situated on the northern bank of the River Cynon, were confirmed as internally flooded by RCT officers. Water was reported to have reached flood depths over 1 metre within some properties. It was noted during

on-site investigations that there was some compartmentalisation of flooding to properties at Cae Felin Road due to some properties' rear garden boundary walls causing some avoidance of internal flooding.

It was also reported by residents that a secondary source of flooding, identified as surface water runoff travelling along the roads above Cae Felin Parc, also contributed to the flooding of properties at Cae Felin Parc during Storm Dennis. Surface water was unable to drain via the highway and private surface water drainage network because the networks were overwhelmed by the intense rainfall.

The associated flow paths observed during Storm Dennis at Cae Felin Parc and Swansea Road are illustrated in Figure 3.



Figure 3: Observed flow paths at Cae Felin Parc and Swansea Road in Hirwaun during Storm Dennis

Reports of a suspected surcharged culvert inlet located at Swansea Road (labelled 'Swansea Road Culvert Inlet' in Figure 3) were also received by some residents, however following further engagement with RCT's Highways and Streetcare Depot and the Hirwaun Fire Station, it was confirmed that the inlet did not surcharge during Storm Dennis.

Additionally, there was a landslide reported upstream of the investigation area, to the rear of the railway track, with no properties reported as being affected by flooding. Further downstream, to the east of Devonshire Drive, eroded material sourced by the landslide was identified at the River Cynon culvert inlet, causing flooding onto the Village Green however no properties were affected at this location. Evidence of the landslide is provided in Figure 4.



Figure 4: Landslip of the hillside above the railway line, Hirwaun on the 16th February 2020 (image captured by resident)

Isolated incidences of surface water flooding to properties was also identified as a significant source of flooding within investigation area RCT01. On the southern bank of the River Cynon, two residential properties at Tramway Close and one property at Tramway were confirmed as internally flooded. The source of flooding was identified as surface water runoff originating from the hillside to the rear of the affected property at Tramway which was channeled towards the property by local topography. Surface water continued its path towards lower ground at Tramway Close, resulting in internal flooding to two properties situated at lower elevations than the road.

Two properties at Station Road were confirmed by RCT's Public Health team to have been internally flooded. The evidence suggests that surface water flowing down the steep road entered the basement of one property as it's situated at a lower elevation than the road itself. Overland flow from land to the rear of Station Road is also considered to have entered the rear of one property due to the influence of local topography channeling surface water to this location.

Surface water runoff flowing down the steep roads to the northwest of investigation area RCT01 was also identified as a source of internal flooding to one property at Fairview. The area to the rear of the affected property is at a low point causing surface water to accumulate here before flowing onwards to reach the rear of the property. Surface water runoff is also reported to have flowed along Fairview and Penderyn Road causing external flooding to the fronts of some properties.

Two residential properties located at Penmark Row were internally flooded during the event. The properties were initially investigated by DCWW following reports of sewer flooding from residents, however DCWW confirmed no restrictions or defects had been identified within their network at this location. The affected properties are located at a low point in the road where surface water would naturally accumulate. The evidence indicates that the surface water drainage network became overwhelmed during the storm event and caused water to pond and enter both properties from the front.

To the southwest of investigation area RCT01, two properties were reportedly flooded internally, and a further two suffering external flooding, at Rhigos Road and Beacons View during the storm event. According to the affected residents, water originated from the hillside to the rear of the affected properties and conveyed towards the front of the properties. The area of hillside immediately to the rear of the affected properties is located below the A465 trunk road and is identified under private landownership.

A highway gully fronting one of the properties was reportedly overwhelmed by the volume of surface water, resulting in water ingress from the front. Ponding surface water on Meadow Lane is believed to have overtopped the dropped kerbs behind Beacons View and enter properties from the rear. Figure 5 shows the lowered section of pavement at Meadow Lane which allowed surface water to overtop and enter the impacted properties from the rear.



Figure 5: Dropped kerb and highway gully at Meadow Lane, to the rear of the impacted properties at Beacons View (image captured by RCT's Flood Risk Management officers on 26/02/2020)

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

It was suggested by residents that the 'Swansea Road Culvert Inlet' (Figure 3) surcharged during the storm event and caused additional flows towards Cae Felin Parc, however it has since been confirmed that the culvert was not identified as a source of flooding. Despite this, following Storm Dennis, CCTV survey inspections of the culvert network was undertaken to ascertain both the operational condition of the network, and its structural integrity along sections of the network.

The culvert network drains the hillside above investigation area RCT01 which is culverted beneath Hirwaun's residential development and ultimately outfalls into the River Cynon at Cae Felin Parc (illustrated in Figure 6). The culvert network is also identified as falling under mixed public and private ownership.

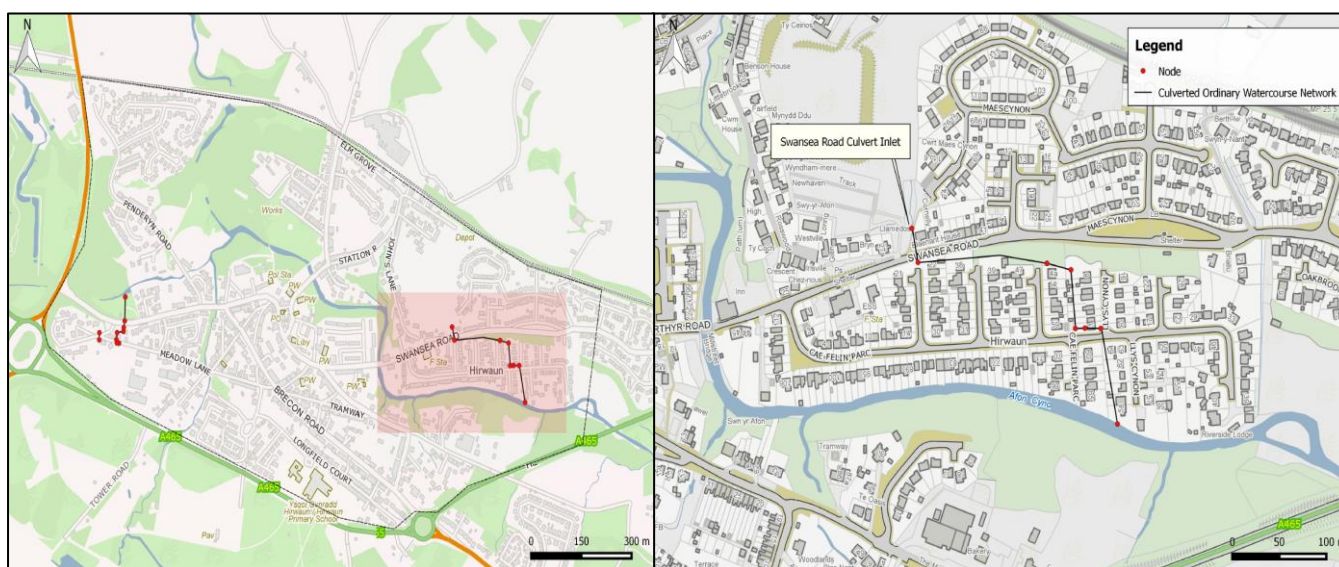


Figure 6: Swansea Road culverted watercourse network in investigation area RCT01

It should be noted that all surveys reported in this section were undertaken post flood event. It's not possible to say what debris identified in the survey was mobilised and deposited as a result of the storm event and what had been deposited by previous events. As such, the following should be considered to be reflective of the asset condition at the end of the storm event and may not necessarily be reflective of the condition of the assets prior to the onset of the storm event.

The condition of the Swansea Road culvert network was surveyed to be in poor condition, with multiple sections graded as 4-5 due to settled debris, fractures and

cracks reducing the culvert's cross-sectional area. Approximately 6 meters downstream of the culvert inlet the CCTV survey was abandoned due to a large obstruction identified in the network (Figure 7).



Figure 7: Obstruction identified approximately 6 meters downstream of the Swansea Road culvert inlet

Although the network was identified in poor condition, flooding was not observed from the inlet or anywhere along the network.

An additional two culvert networks at Meadow Lane (labelled 'Meadow Lane Culvert Inlet 1 and 2' in Figure 8) were also surveyed and assessed as a potential contributing source of flooding to properties at Rhigos Road and Beacons View. Both culvert inlets fall under the ownership and responsibility of private landowners.

The Meadow Lane culvert networks and inlets under review are illustrated in Figure 8. Both culvert networks were surveyed to be in poor condition, with silt accumulation and obstacles reducing the networks' cross-sectional area. Despite its poor condition, 'Meadow Lane culvert inlet 1 and 2' was not identified as a source of flooding during Storm Dennis. Residents affected by flooding in this area confirmed that no flooding was observed from either inlet.

Flooding is therefore considered to have been as a result of overland runoff flowing from the area of hillside behind the affected properties at Rhigos Road. The area of hillside is discussed in Sections 3.2 and 3.6.

In response to the settled debris identified within the culvert networks, several jetting and cleansing operations were undertaken by a Council appointed contractor to clear the debris from within the culvert networks. An estimated 205 tonnes of material was removed from the Swansea Road and Meadow Lane culvert networks during cleansing exercises.



Figure 8: Meadow Lane culverted watercourse network in investigation area RCT01

3.2. OPEN WATERCOURSE CONDITIONS

There are several named and unnamed ordinary watercourses which flow through investigation area RCT01. Notable watercourses include the Nant y Cnapiau and Nant y Bwlch which both drain the catchment area to the south and southwest of Hirwaun before discharging into the River Cynon (Figure 9).

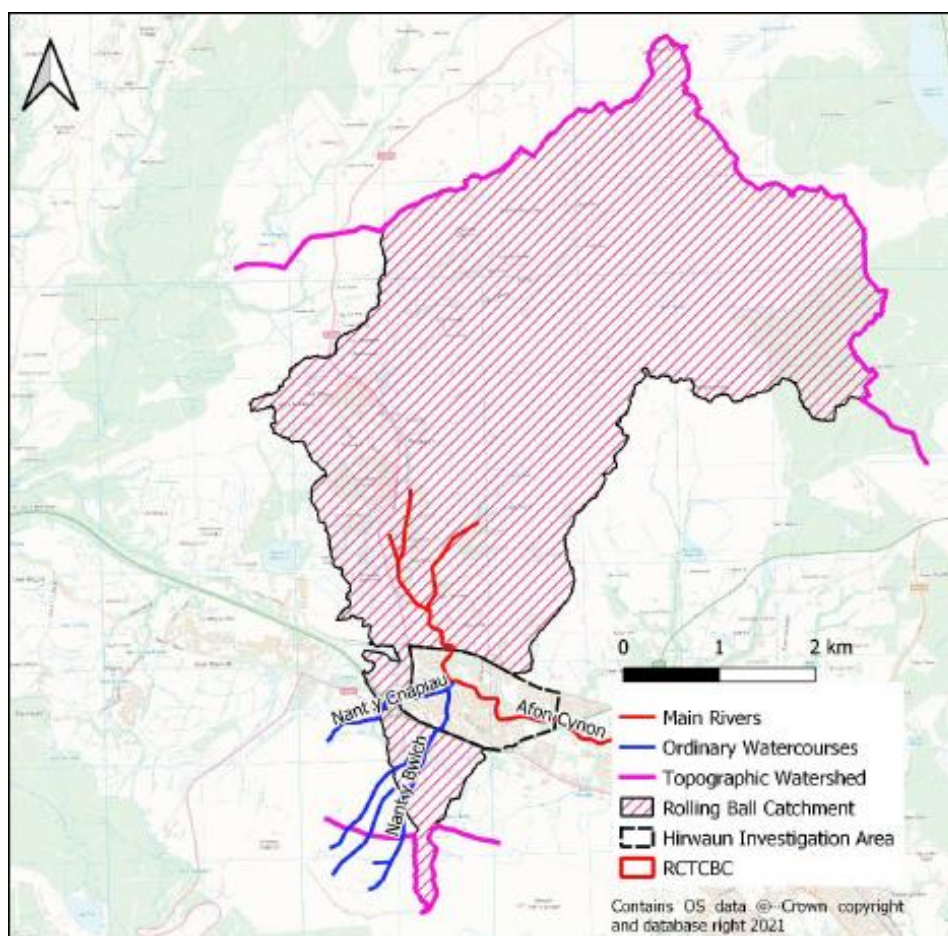


Figure 9: Rainfall Topographic Catchment area and named ordinary watercourses draining into the River Cynon at investigation area RCT01

The unnamed watercourses flowing down the hillside below the A465 (highlighted red in Figure 10), before discharging into the Nant y Cnapiau, were investigated by RCT Flood Risk Management officers as potential sources of flooding to properties at Rhigos Road and Beacons View following reports that water originated from the hillside.

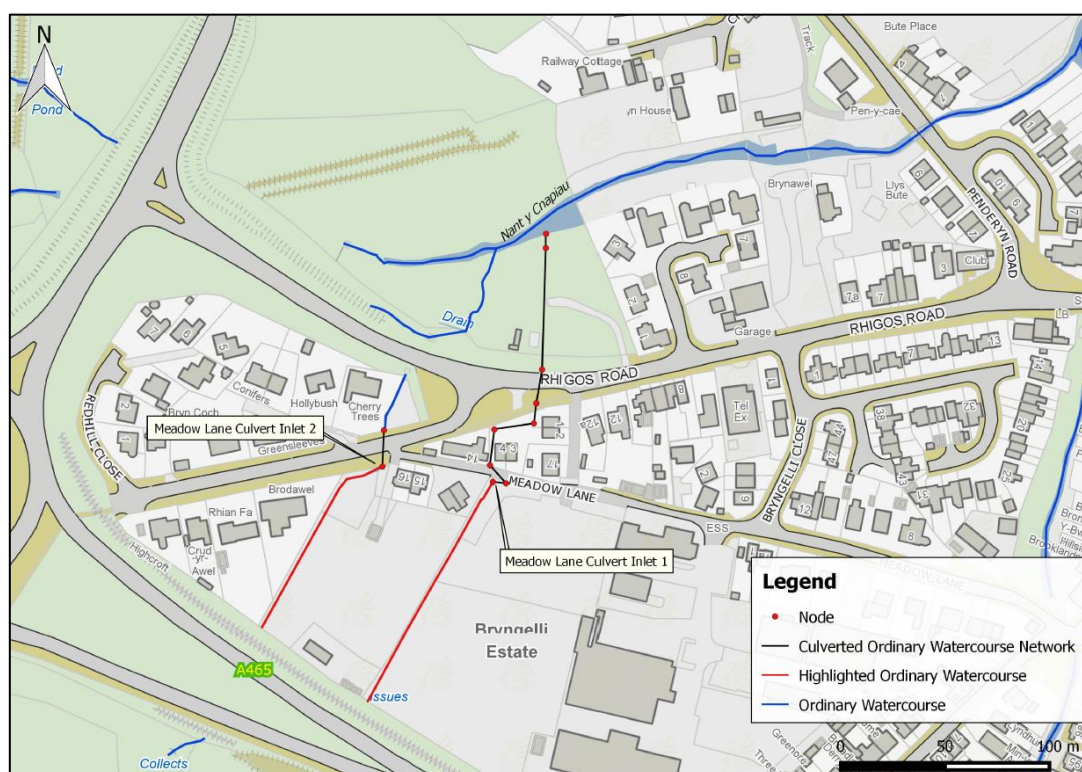


Figure 10: Ordinary watercourses and culverted networks identified at Meadow Lane in the southwest of investigation area RCT01. The ordinary watercourses identified as possible causes of flooding during Storm Dennis are shown in red.

The hillside and associated watercourses were inspected to assess their condition for any evidence of scour or land movement of the hillside which would indicate potential overland flows had occurred. The assessment found no significant erosion of the channels, however both watercourses were mostly undefined and overgrown with dense vegetation which impacted the on-site assessment (Figure 11).

LIDAR data reveals that the watercourse and hillside which drains into 'Meadow Lane Culvert Inlet 2' is relatively flat in the upper section, directly below the A465, which would allow water to pond in this area before flowing overland. There is also a hedge line adjacent to the watercourse which is considered to have aided in the diversion of surface water directly towards the impacted properties. The area of hillside is identified under private landownership.



Figure 11: Undefined and overgrown ordinary watercourse channel above Meadow Lane Culvert Inlet 2 (image captured by RCT's Flood Risk Management team following Storm Dennis)

The intensity of rain falling on the already saturated catchment of Hirwaun during Storm Dennis is considered to have overwhelmed the unnamed watercourse below the A465 causing water to spill out of bank and flow overland towards the properties below.

Further engagement with residents in the area described the water coming from the hillside as “muddy water” and went on to suggest that the water was originating from the former Tower Colliery coal mining site. Based on historical flood incidences and Flood Risk Management investigations (described in Section 3.5) relating to Tower Colliery, there is evidence to suggest that water may have originated from the former colliery site and exacerbated flooding issues to the properties affected at Rhigos Road.

There is no other evidence to suggest that ordinary watercourse conditions within the rest of investigation area RCT01 contributed to the flooding of properties during Storm Dennis.

3.3. MAIN RIVER

The designated main River Cynon flows through the centre of investigation area RCT01 (Figure 1). The river was identified as a primary source of flooding to several properties within the investigation area.

3.3.1. MAIN RIVER LEVELS AND FLOOD WARNINGS

The hydrograph in Figure 12 illustrates the rapid rise in levels of the River Cynon in response to rainfall between the 14 – 17th February 2020, captured at NRW's Hirwaun monitoring station which is situated near Cae Felin Parc.

NRW issued a 'Flood Alert' (indicating possible flooding) for the entirety of the River Cynon at 12:51 on the 15th February, during that time the River Cynon at Hirwaun had reached almost a metre in depth. The River Cynon continued to rise during the early hours of Sunday 16th February morning before reaching a peak level of 1.333 metres at 02:15 on 16th February 2020; the highest level recorded for the Cynon at Hirwaun.

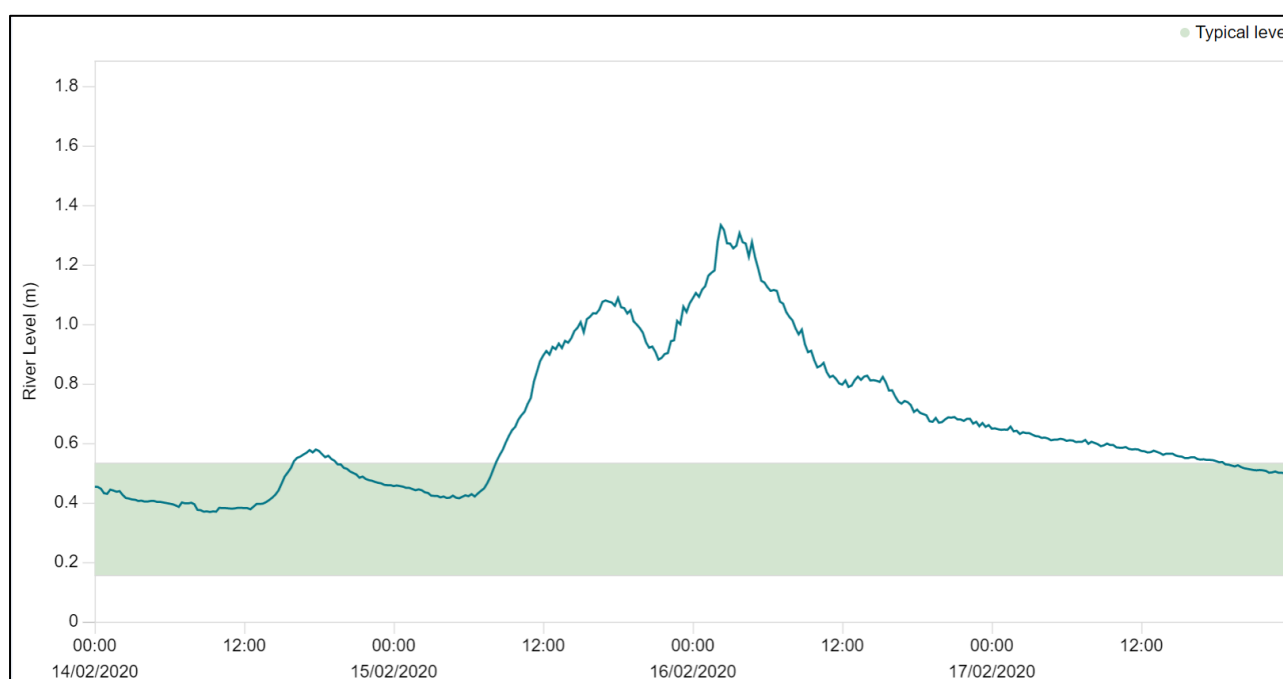


Figure 12: The River Cynon levels at Hirwaun station between the 14th and 17th February 2020 (Natural Resources Wales)

The green bar displayed on the hydrograph shows the typical level of the River Cynon at Hirwaun station, ranging between 0.15 and 0.55 metres. At its peak, the River Cynon at Hirwaun was almost a meter higher than its average level, stressing the

extreme and unprecedented levels that RCT's rivers rose to during the storm's peak intensity. As a result of the significant rise in river levels following heavy and persistent rainfall, the River Cynon overtopped its banks to the rear of Cae Felin Parc, leading to property flooding.

River levels in the Cynon at Hirwaun subsided relatively quickly following the peak, returning to its typical levels the following day on the 17th February 2020.

Investigation area RCT01 falls within NRW's Hirwaun Flood Warning Area. The Flood Warnings issued by NRW, and associated river levels, for the River Cynon at Hirwaun during Storm Dennis are shown in Table 3.

Table 3: Flood Warnings issued by NRW for the River Cynon at Hirwaun during Storm Dennis

Flood Warning Type	Location	Start Time	River Level (m) at Hirwaun
Flood Alert	River Cynon	12:51 15/02/2020	0.924
Flood Warning	River Cynon at Hirwaun	02:45 16/02/2020	1.272

A 'Flood Warning' alert (indicating flooding is expected) for the River Cynon at Hirwaun was issued by NRW at 02:45 on 16th February; 30 minutes after the River Cynon reached its peak level at 02:15. By this time however, main river flooding to properties at Cae Felin Parc had already commenced.

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 (RCT01), this is in reference to the 'Flood Warning' alert at Hirwaun.

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.

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

3.3.2. MAIN RIVER FLOOD RISK

The main river flooding that occurred within investigation area RCT01 during Storm Dennis is largely consistent with the modelled outputs of NRW's Flood Risk Assessment Wales (FRAW) mapping.

Properties impacted by flooding at Cae Felin Parc are identified at high risk of fluvial flooding, as depicted within Figure 13, which is an extract from NRW's FRAW mapping exercise and 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).

A high risk of flooding means that an area has a chance of flooding of greater than 1 in 30 (3.3%) each year; a medium risk of flooding signifies a yearly chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%); meanwhile a low risk of flooding means that an area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%) each year.

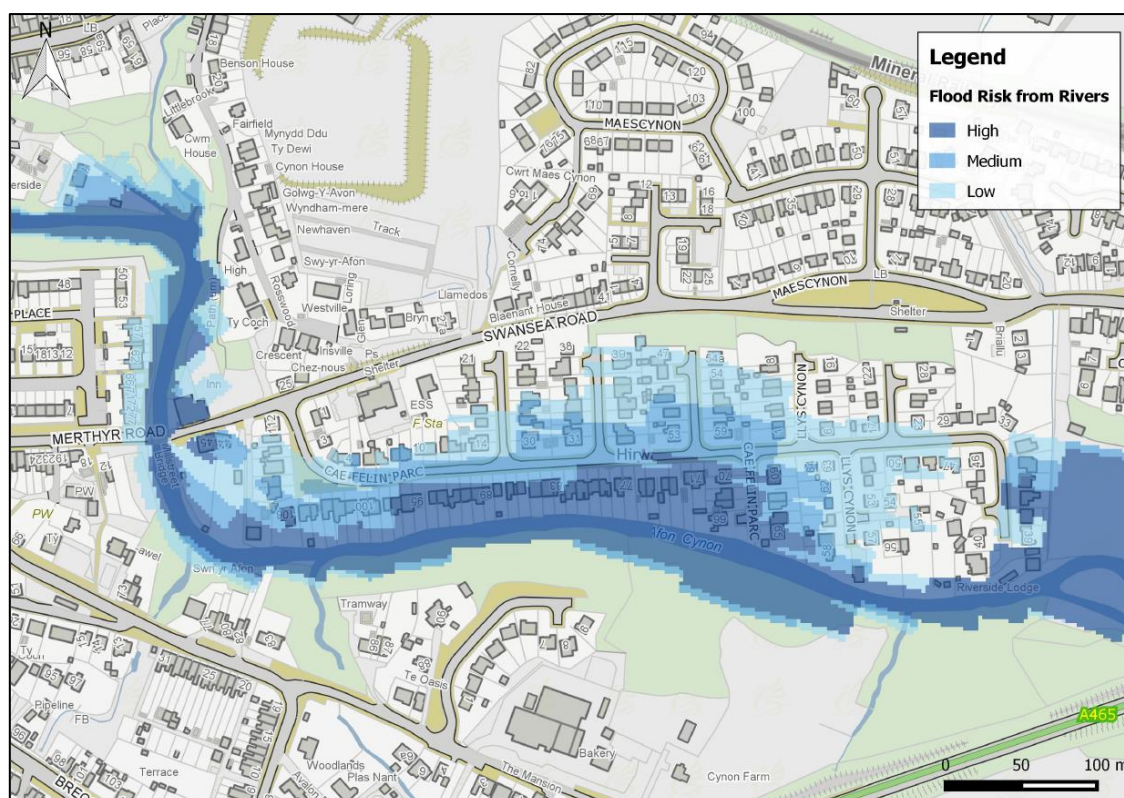


Figure 13: Natural Resources Wales' Flood Risk Assessment Wales (FRAW) map for River sources at RCT01. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

Those properties directly adjacent to the River Cynon suffered the most severe impacts, with reported flood depths up to 1 metre in height observed at those properties falling in the high flood risk zone.

Elsewhere within the investigation area, and in addition to the flood damage at Cae Felin Parc, the River Cynon also impacted the rear of properties further upstream at Richmond Drive, to the north of investigation area RCT01, causing significant erosion of the banks in some locations. Figure 14 depicts an image of property damage caused by significant erosion of the riverbanks.

Residents reported significant deposition of large stones and debris mobilised by extreme flows within the River Cynon during the storm event. It is likely that the landslide that occurred above the railway track (Figure 4) supplied additional eroded material into the watercourse, however this is not considered to have contributed to the flooding at Cae Felin Parc.

Flood risk from main rivers is noted across the length of the River Cynon that flows through RCT01, however Cae Felin Parc is identified as an area of significant risk in terms of impact to people and properties. No incidences of internal flooding sourced by the River Cynon were reported at RCT01, other than at Cae Felin Parc.



Figure 14: Damage to property caused by the River Cynon to the rear of Richmond Drive, Hirwaun on the 16th February 2020 (image captured by resident)

3.3.3. MAIN RIVER FLOOD DEFENCES

The properties impacted by the River Cynon at Cae Felin Parc are currently 'Undefended', i.e., there are no formally designated flood defence infrastructure under the operation and maintenance of NRW in place along the River Cynon at Hirwaun. It was noted by residents within the public engagement exercise that a lack of formal flood defences and the poor condition of the riverbanks in some locations was exacerbating flooding issues at Cae Felin Parc.

There are no formally designated flood defence assets at Cae Felin Parc. River levels on the River Cynon exceeded the river bank levels and resulted in water ingress through privately owned assets, i.e., rear boundary walls of properties. Due to variations in the height and structural condition of the properties' rear boundary walls, some properties backing on to the River Cynon at Cae Felin Parc were more affected in comparison to others.

Based on evidence provided by the FRAW map and the lack of formal flood defences, properties at Cae Felin Parc are identified at high risk of flooding from the main river (Figure 13).

3.4. HIGHWAY DRAINAGE CONDITIONS

Surface water runoff along the highway was reported by residents at various locations within the investigation area, however there is no evidence to suggest that the condition of the highway drainage within RCT01 significantly contributed to the flooding of properties. The highway drainage infrastructure was overwhelmed by intense rainfall and subsequent surface water flows which led to the accumulation of standing water entering properties at Fairview, Penmark Row, Rhigos Road, Beacons View, Tramway Close and Station Road.

Several residents reported surface water accumulation on the highway at Cae Felin Parc during the storm event. The surface water drainage network at this location was surveyed by a Council appointed contractor following the flood event which identified the network as heavily silted. Widespread deposits of mud, silt and debris are assumed to have entered the highway drainage system at Cae Felin Parc following the overtopping of the River Cynon, leading to a reduction in the hydraulic capacity of the network.

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 RCT01 was exceeded as a result of 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. DCWW APPARATUS CONDITIONS

There is no evidence from this investigation that DCWW apparatus contributed to the Storm Dennis event within investigation area RCT01.

DCWW reported no issues within RCT01 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

Surface water flooding was identified as a predominant source of flooding within investigation area RCT01, causing internal flooding to at least 10 confirmed properties across Hirwaun and contributing to the flooding of a further twenty properties at Cae Felin Parc.

The pathways for surface water runoff during the storm event was observed primarily along the highway network, but also as overland flows originating from areas of hillside within the investigation area. It should be noted that the exact flow routes have not been confirmed due to limited anecdotal evidence, however, NRW's national surface water and ordinary watercourse flood maps provide a reasonable indication of the pathways that would have occurred during the storm event. These indicative surface water flow paths are illustrated in Figure 15 and correlate well with NRW's surface water flood map.

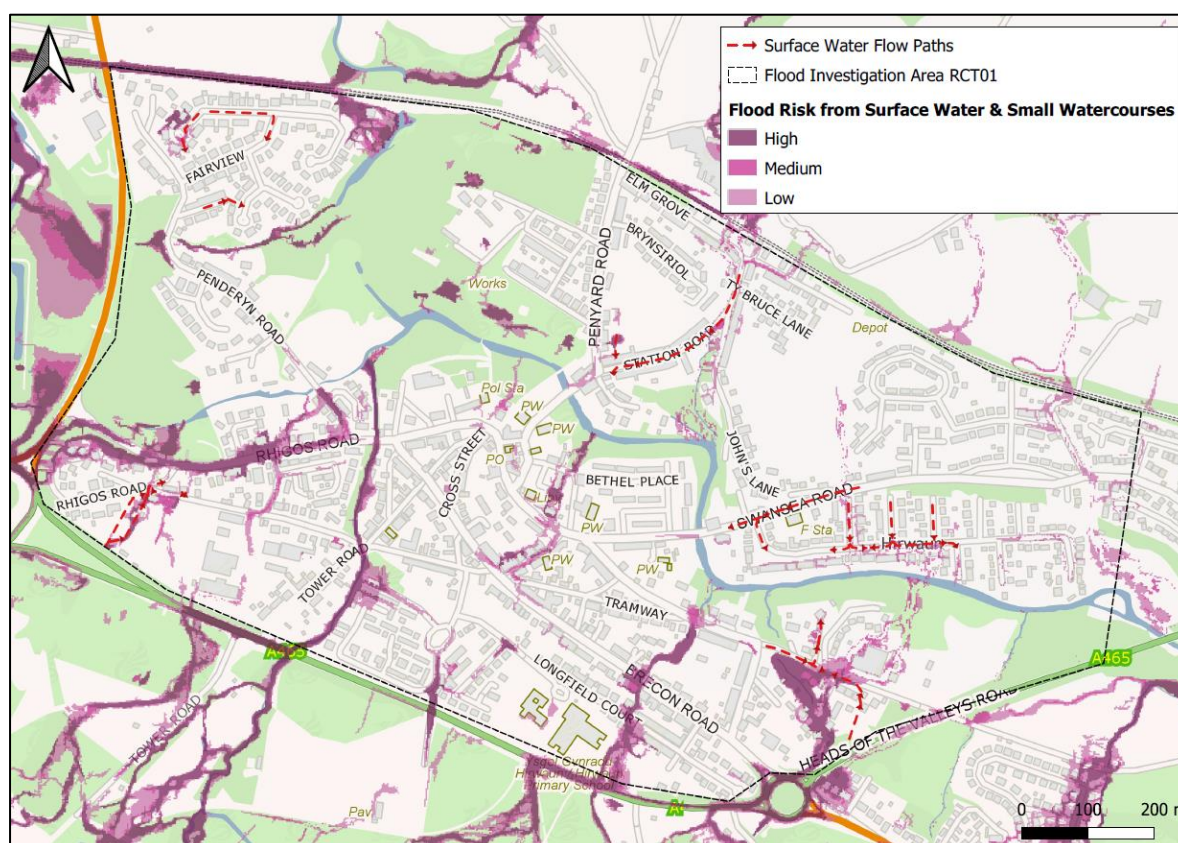


Figure 15: Natural Resources Wales' FRAW map for surface water and ordinary watercourse sources and indicative surface water flow paths within investigation area RCT01. Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.

Runoff was channeled via several roads, towards properties at Cae Felin Parc, Tramway, Penmark Row, Fairview and Station Road. The gradient of the roads, elevation of properties relative to the road, and the extent of impermeable surfaces surrounding the affected streets is considered to have; increased surface water flows along the highway and attributed to the pooling of water outside properties. In most cases, the surface water flooding at RCT01 was primarily caused by intense rainfall falling on already saturated catchments following Storm Ciara on 7-8th February 2020.

Based on residents' accounts captured during the public engagement exercise (described in Section 3.2.), excess water is observed to be conveying towards the investigation area from the Tower Colliery site, situated to the south west of the investigation area, above the A465 trunk road. This excess water is considered to have contributed to the overland runoff that was observed by residents flowing down the hillside below the A465 and towards two properties at Rhigos Road.

Land reclamation and restoration works have been ongoing at Tower Colliery since its closure in 2008. These works include the re-profiling of the former colliery site back to its pre-mining conditions, which involves the reduction of discharge rates from the site to post-mining conditions, as accepted by the Local Planning Authority. The sub-catchment areas associated to the Tower Colliery planning application are illustrated in Figure 16.

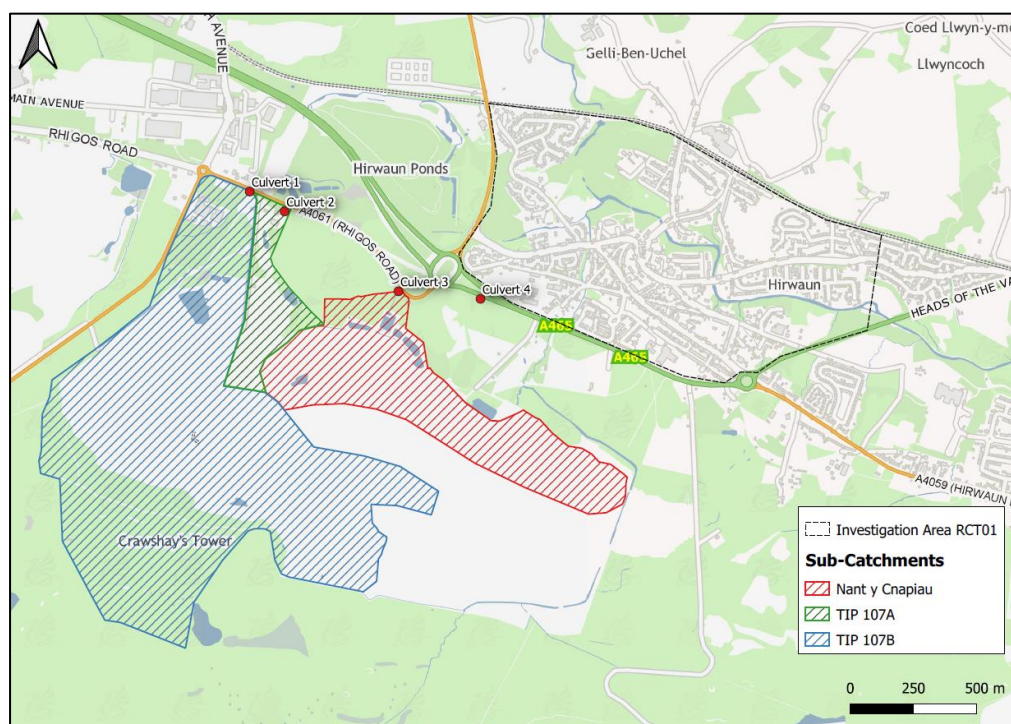


Figure 16: Tower Colliery sub-catchments and associated culvert inlets

An assessment of the pre and post mining discharge rates for the development site has been investigated by RCT's Flood Risk Management team. The results of the assessment for each sub-catchment are depicted within Table 4.

Table 4: Pre and post mining discharge rates for the Q100 + 30% climate change allowance event per sub-catchment

Sub-Catchment	Pre-Mining Discharge Rates (l/s)	Post Mining Discharge Rates (l/s)	Variance (l/s)
Nant y Cnapiau	3363.21	2370.29	-992.92
TIP 107A	1187	766	-421
TIP 107B	4950	4691	-259

The assessment has determined that the post-mining discharge rates will reduce the flow of water discharging from the Tower Colliery site by 29% for the Nant y Cnapiau catchment, 36% for TIP 107A and 5% for TIP 107B.

At the time of the storm event however, the catchment areas were known to have not been arranged and re-profiled as post mining conditions stipulate. This means that the surface water and ordinary watercourse flows conveying down the sub-catchments towards 'Culverts 1, 2 & 3' (illustrated in Figure 16) were being exacerbated due to the arrangements of the catchment on site.

As a result of which flooding was reported along Rhigos Road by residents. A site inspection undertaken by RCT officers several hours after the peak of the storm event identified 'Culvert 1 & 2', to be flooding the highway (Figure 17). The cause of which was attributed to the volume of water identified at the culvert inlets rather than any debris accumulation. Based on available evidence, it is assumed that 'Culvert 3' was also surcharging due to excess flows travelling down the Nant y Cnapiau sub-catchment during the storm event.

The area immediately downstream of the Nant y Cnapiau inlet (Culvert 3) is served by an existing land drainage channel which acts as a dedicated overflow channel to 'Culvert 3', i.e., the land drainage channel conveys flows both east and west at the A4061 Rhigos Road. The routing of excess water to the west of 'Culvert 3' conveys towards 'Culvert 4' where the routing to the east enters into a highway culvert that crosses Rhigos Road and outfalls into the unnamed ordinary watercourse channel. The indicative exceedance flow paths to the west and east of 'Culvert 3' are illustrated in Figure 18. The routing of water east towards 'Culvert 4' however, is considered to have exacerbated the flow of water at this location, contributing to the overland flows towards properties at Rhigos Road.



Figure 17: Surface water flooding to the A4061 Rhigos Road caused by surcharging culvert inlets associated to sub-catchment TIP 107A and TIP 107B (captured by RCT's Highways and Streetcare Depot on 16th February 2020)

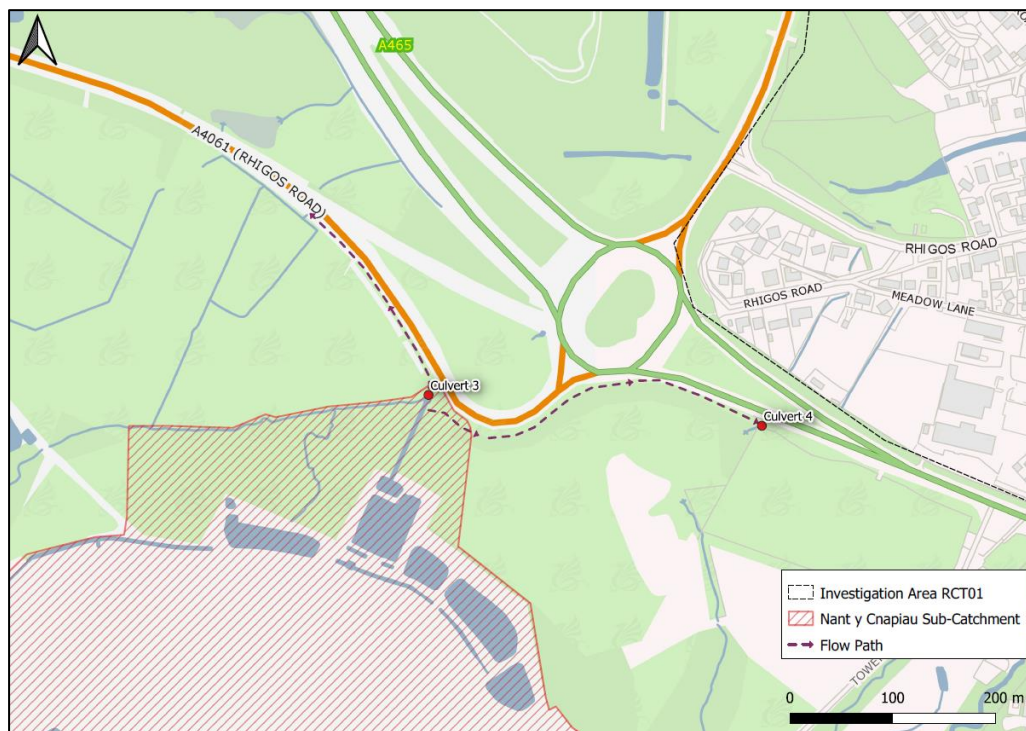


Figure 18: Exceedance flow paths to the east and west of Culvert 3

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

The capacity of the culverted ordinary watercourse structures associated to the discharge of water from the Tower Colliery site (introduced in Section 3.6), which falls outside of RCT01, has been described below.

Culvert capacity assessments of the existing infrastructure (illustrated in Figure 16) based on post-mining discharge rates was undertaken as part of the Flood Risk Managements' team investigations. The results of which are summarised in Table 5.

Table 5: Summary of culvert capacity assessment results for Culverts 1-3 (Figure 16) based on post mining conditions which indicate the current standard of protection of the structure in free-flowing conditions

Culvert Inlet	Associated Catchment	Standard of Protection (SOP) – Free Flowing
Culvert 1	Nant Y Cnapiau	Q2
Culvert 2	Tip 107A	Q30
Culvert 3	Tip 107B	Q30

Based on the results of the culvert capacity assessment, the SOP of the existing infrastructure is below current design standards, as defined by CIRIA C786⁵, and cannot accommodate the discharge of water from both pre and post mining conditions. This is considered to have exacerbated the flooding at Culvert 4.

Design and construction work to upgrade the SOP of culvert structures 'Culvert 1, 2 & 3' to 1 in 100 annual probability flood event (Q100) are in development by both the Highway Authority and the Welsh Government, respectively.

Based on the available evidence presented in the above sections, it is concluded that exceedance flows from the Tower Colliery site are considered to have contributed to the surface water flooding that impacted two properties at Rhigos Road during the storm event.

On review of the available evidence gathered as part of this investigation, the culverted ordinary watercourse structures identified within investigation area RCT01 have not been identified as sources of flooding during Storm Dennis and their hydraulic capacities have not been assessed.

⁵ CIRIA C786 Culvert, screen and outfall manual (2019)

3.9. SUMMARY OF POSSIBLE CAUSES

The above sections have identified and described the possible causes of flooding within investigation area RCT01 during Storm Dennis which occurred on the 15 and 16th February 2020. A summary of the identified sources and possible causes of flooding (issue) has been outlined below in Table 6.

Table 6: Summary of the source(s) and possible cause(s) of flooding in Hirwaun during Storm Dennis

Ref No	Asset (Source)	Issue	Asset Owner	Type of Flooding
1	River Cynon	Levels on the River Cynon exceeded river bank levels to the rear of properties at Cae Felin Parc causing internal flooding to at least 20 properties and extensive flooding to the highway. Flood water passed through/over several privately owned assets (boundary walls) before entering properties.	Various Private Landowners	Main River
2	Overland flow from the hillside to the rear of Rhigos Road	Significant flows entering the unnamed ordinary watercourse that flows down the hillside behind Rhigos Road are considered to have caused the ordinary watercourse channel to overtop, resulting in overland flows towards the rear of properties at Rhigos Road.	Private Landowner	Ordinary Watercourse and Surface Water
3	Surface water runoff and accumulation across several streets within RCT01	Surface water runoff was channeled down the steep roads within the investigation area towards several properties situated at localised low points. This resulted in internal flooding to 10 residential properties and external flooding to several more.	Rhondda Cynon Taf Highway Authority	Surface Water

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 7. 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 and Responsibilities'⁶, and RCT's 'FRM – Storm Dennis - Overview Report'².

Table 7: Risk Management Authority with relevant functions to manage the risk for different flood types

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

Risk Management Authorities have direct flood risk management functions under the Flood and Water Management Act 2010, as well as the Water Resources Act 1991, Land Drainage Act 1991 and the Highways Act 1980. Through analysis of the flooding that impacted RCT01, 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;

⁶ [National Strategy for Flood and Coastal Erosion Risk Management in Wales \(English\) \(gov.wales\)](https://gov.wales/national-strategy-for-flood-and-coastal-erosion-risk-management-in-wales)

“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 RCT01 as a result of Storm Dennis has been previously identified and summarised within Table 6. The Risk Management Authorities responsible for managing that flooding have been listed within Table 8 below, along with a series of recommendations presented by the LLFA.

Table 8: Recommendations provided by the LLFA to be considered by the relevant Risk Management Authority identified in response to the source(s) of flooding in RCT01 (as per Table 6)

Ref No	Asset (Source)	Asset Owner	Type of Flooding	Relevant Risk Management Authority	Recommendations
1	River Cynon	Various Private Landowners	Main River	Natural Resources Wales	R1A NRW to “complete detailed investigative analysis work to understand the mechanisms of flooding in areas known to have flooding from main rivers”, including the River Cynon at Hirwaun. 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 Cynon at Hirwaun, 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	Overland flow from the hillside to the rear of Rhigos Road	Private Landowner	Ordinary Watercourse and Surface Water	Lead Local Flood Authority and Land Drainage Authority	R2A	The LLFA and LDA to identify asset ownership and responsibility.
					R2B	The LLFA and LDA to investigate and assess the ordinary watercourse conditions and surface water drainage

						arrangements on the area of hillside.
					R2C	The LLFA to work with the Local Planning Authority to ensure the post mining arrangements and discharge flows are regulated.
3	Surface water runoff and accumulation across several streets within RCT01	Rhondda Cynon Taf Highway Authority	Surface Water	Highway Authority and Lead Local Flood Authority	R3A	The LLFA and the Highway Authority to evaluate surface water management options to alleviate flooding from the highway at several locations across the investigation area.

4.1. LEAD LOCAL FLOOD AUTHORITY

In review of Ref 2 – 3 in Table 8, 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 RCT01 during Storm Dennis.

The LLFA exercised the following functions in response to the flooding at investigation area RCT01;

- 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.
- An estimated 861 meters of ordinary watercourse culvert network length within investigation area RCT01 has been surveyed following the storm event to ascertain both the operational condition and structural integrity along sections of the network. **(R2B)**
- An estimated 207 tonnes of material and debris was removed from the culverted watercourse network within investigation area RCT01 during jetting and cleansing operations.
- The LLFA and LDA have undertaken clearance works to the culvert inlet structures which fall under the responsibility of the Authority.
- The LLFA have expanded their asset inspection and maintenance schedule to include culvert inlets within the investigation area in its response to extreme weather event planning.
- The LLFA commissioned a consultant (Redstart) to investigate the standard of protection of the existing culvert networks in RCT01 to determine their hydraulic capacity following the identification of several structural and operational defects within sections of the network.

- The LLFA has exercised its powers, under Section 13 of the FWMA, to request information and co-operation from NRW in relation to their responsibilities as a RMA in response to Storm Dennis.
- The LLFA has set up a central Control Room, to compliment the Council's Contact Centre and CCTV Centre which is based at the Council's offices, to provide a comprehensive and informed response to the residents of RCT as appropriate during storm events.
- The LLFA have initiated an interim Property Flood Resistance project offering expandable flood gates to those properties deemed at high risk of flooding from local sources.
- 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 propose to exercise the following functions in response to the flooding at investigation area RCT01;

- Following the surveying of culvert networks in RCT01, the LLFA propose to input and update all relevant asset data.
- 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.
- The LLFA propose to install remote telemetry monitoring devices at key culvert structures to enable operators to ensure the drainage systems in investigation area RCT01 are operating effectively.
- In response to the grade 4 and 5 structural defects identified within the Swansea Road culvert network, the LLFA and LDA have applied for Welsh Government funding to utilise their permissive power under Section 64 of the Land Drainage Act 1991 to undertake rehabilitation works to the culverted ordinary watercourse network.
- 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 Upper

Cynon 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 SFRAs also aim to encourage whole catchment measures, including working with natural processes, to alleviate flood risk in those areas of highest risk. **(R2B, R3A)**

4.2. NATURAL RESOURCES WALES

In review of Ref 1 in Table 8, NRW has been identified as the relevant Risk Management Authority in relation to the main river flooding from the River Cynon during Storm Dennis.

NRW has exercised the following functions in response to the flooding at investigation area RCT01;

- 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 Cynon at Hirwaun to ensure it was clear of blockages.
- During the post flood event recovery, NRW were in attendance at Cae Felin Parc to aid the Council in the removal of debris from the highway drainage network and DCWW infrastructure.
- Utilising post event data and information, NRW have reviewed the Resultant Thresholds for the River Cynon at Hirwaun 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, according to NRW, improve how live flood warning and water level data is shared before and during flood events. **(R1C)**
- NRW arranged a community meeting with residents to discuss flood plans and flood warning service. **(R1C)**
- NRW have commissioned a Cynon Flood Modelling Study which is programmed for completion by the end of March 2022. **(R1A)**
- Following the flooding events of February 2020, NRW published a review of its incident response to Storm Ciara and Dennis in October 2020⁷. 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.

⁷ [Natural Resources Wales / Our response to Storm Ciara and Storm Dennis](#)

-
- 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 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 RCT01;

- Following the completion of NRW's Cynon Flood Modelling Study, NRW propose to undertake an initial economic assessment of the viability of potential flood risk management options. Greatest consideration should be given to areas at high risk of flooding from rivers on a prioritised basis, such as Cae Felin Parc. **(R1A, R1B)**
- Following the completion of NRW's Cynon Flood Modelling Study, 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

DCWW were not identified as a relevant authority in relation to flooding at investigation area RCT01 during Storm Dennis. Despite this, calls were received by DCWW in relation to the flooding at Hirwaun.

DCWW have exercised the following functions in response to the flooding at investigation area RCT01;

- DCWW carried out their own investigations in response to incidents of flooding that were reported by residents directly to DCWW.
- DCWW contacted residents affected by flooding to offer support and advice to assist in the recovery following Storm Dennis.

DCWW do not propose to undertake any further functions in relation to the event at investigation area RCT01.

4.4. HIGHWAY AUTHORITY

During the investigation into the flooding at investigation area RCT01 during Storm Dennis, the Highway was identified as flooding from a combination of sources, notably as a result of surface water runoff, ordinary watercourse flows and flooding from the River Cynon.

Ref 3 of Table 8 identified the Highway Authority as a relevant Risk Management Authority in relation to the surface water flooding that occurred along the highway across RCT01.

RCT as the Highway Authority have exercised the following functions in response to the flooding at investigation area RCT01;

- 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 flood water to ensure the safety of the highway post event.
- The Highway Authority have undertaken clearance works to the culvert inlet structures which fall under the responsibility of the Highway Authority.

RCT as the Highway Authority propose to undertake the following functions in relation to the event at investigation area RCT01;

- 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.
- Upgrade works to 'Culvert 1' and 'Culvert 2', associated to the Tower Colliery sub-catchments (illustrated in Figure 16), to increase the SOP to Q100, are currently on the Highway Authority's development programme for construction in 2022/23. **(R3A)**

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>