Merthyr Tydfil County Borough Council

Cyngor Bwrdeistref Sirol Merthyr Tudful

Flood and Water Management Act 2010

Section 19 Flood Investigation Report

Contents

Executive Summary

This report has been produced as part of the duties placed on Merthyr Tydfil County Borough Council (MTCBC) under Section 19 of the Flood and Water Management Act (2010). Section 19 of the Act states:

On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers necessary or appropriate, investigate…".

This Section 19 report provides a factual review of Storm Dennis, the storm event that occurred from 13 to 19 February 2020, reaching the UK on 15 February 2020. The report specifically focusses on the impact that Storm Dennis had on those areas found within the Merthyr Tydfil County area where more than twenty properties experienced internal flooding. Those areas have been identified as Troedyrhiw and Pentrebach.

The flooding that impacted MTCBC began on 15 February 2020 and was as a result of an extreme weather event. The Met Office issued a Red Warning for rain across parts of South Wales, predicting up to 150mm of rain falling in some parts of the South Wales Valleys. The Environment Agency issued more than 600 flood warnings and alerts, including several severe (threat to life) warnings. The record levels of rain caused several landslides in the local area.

The impact of the event in the MTCBC area was that 232 properties were flooded, comprising of mainly residential and some commercial properties. In addition, three main roads were flooded. These properties were in the following districts:

District of MTCBC	Number of Properties Flooded
Aberfan	15
Bedlinog	12
Castle Park	2
Cefn	4
Heolgerrig	6
Merthyr	1
Merthyr Tydfil	5
Merthyr Vale	9
Mountain Hare	1
Pant	2
Pentrebach	31 (and 1 carriageway)
Quakers Yard	9
Treharris	2
Troedyrhiw	129 (and 1 carriageway)
Misc.	4 (and 1 carriageway)
TOTAL	***232 and 3 carriageways***

Table 1: Breakdown of the number of properties that experienced internal flooding in MTCBC as a result of Storm Dennis.

As stated previously, the two geographical areas of focus for this report are Troedyrhiw and Pentrebach. A post event review has provided the following information:

- 129 properties in Troedyrhiw experienced internal flooding, after significantly high water levels in the River Taff meant that the Plymouth Feeder Channel could not discharge properly to it. The channel subsequently burst its banks.
- 31 properties in Pentrebach experienced internal flooding as a result of a blocked culvert.

Both incidents will have been exacerbated by the fact that Storm Ciara had hit the region the week before, and conditions had not yet returned to normal following that event.

MTCBC are aware that this flooding has caused great distress and hardship to many individuals and are working hard to alleviate these issues as quickly as possible. They are working with both individuals and communities to address any outstanding concerns they have; and to ensure they are better informed of their risk of future flooding, and how to reduce this risk going forward.

The Storm Dennis Recovery plan set out by MTCBC was quickly implemented and covers 47 repair and alleviation schemes across the borough. The recovery works not only include repairs to damaged infrastructure such as culverts, but also covers work to alleviate the impact of future extreme weather events. This will be achieved by works such as increasing the capacity of watercourses, and the installation of trash screens and flood monitors to various culverts.

It must be understood that MTCBC can never fully prevent flooding, but they do have a duty wherever appropriate and cost effective, to reduce the risk of a flood occurring. This Section 19 report details the facts of the event, together with the Council's response which satisfies its role and responsibilities as LLFA.

Flood Investigation Report

Date report of flooding received by LLFA	***15/02/2020***
Name and job title of person completing the investigation	***Huw Williams – Senior Land Drainage Engineer***
Date assessed as necessary/appropriate for investigation	***15/02/2020***
Date referred to relevant RMA	***22/02/2020***
Date Completed	***24/02/2021***
Date published on LLFA website	***14/06/2021***

1. Introduction

1.1 LLFA Investigation

February 15th - 16th saw an extreme weather event severely impact MTCBC. The impact of Storm Dennis reached many areas of the UK; however, this report focuses on the impact of two geographical areas within the Merthyr Tydfil County area, in the South Wales Valleys. The reason for the investigation being conducted in as a result of the duties of the LLFA in regard to Section 19 of the Flood and Water Management Act, 2010. The Act states:

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—

(a) Which risk management authorities have relevant flood risk management functions, and

(b) Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must—

(a) Publish the results of its investigation, and

(b) Notify any relevant risk management authorities.

1.2 Site Location

The County of Merthyr Tydfil is located in the wider county of Glamorgan, in the South Wales Valleys.

Many areas of Merthyr Tydfil experienced internal flooding as a result of Storm Dennis. The areas with the highest number of affected properties being Troedyrhiw, Pentrebach and Aberfan. As a review of this nature is triggered by MTCBC when more than 20 properties experience internal flooding, this report will focus on the flooding in the Troedyrhiw and Pentrebach areas. A full breakdown of the number of flooded properties in each district of MTCBC is shown overleaf.

District of MTCBC	Number of Properties Flooded
Aberfan	15
Bedlinog	12
Castle Park	2
Cefn	4
Heolgerrig	6
Merthyr	1
Merthyr Tydfil	5
Merthyr Vale	9
Mountain Hare	1
Pant	2
Pentrebach	31
Quakers Yard	9
Treharris	2
Troedyrhiw	129
Misc.	4
TOTAL	***232***

Table 2: Breakdown of the number of properties that experienced internal flooding in MTCBC as a result of Storm Dennis

Troedyrhiw and Pentrebach are two small villages within the Merthyr Tydfil County Borough Council area, which are situated east of the River Taff and the A470. Both villages are in close proximity of the Taff, and are at approximately the same ground level as the river, which will have contributed significantly to the level of flooding experienced.

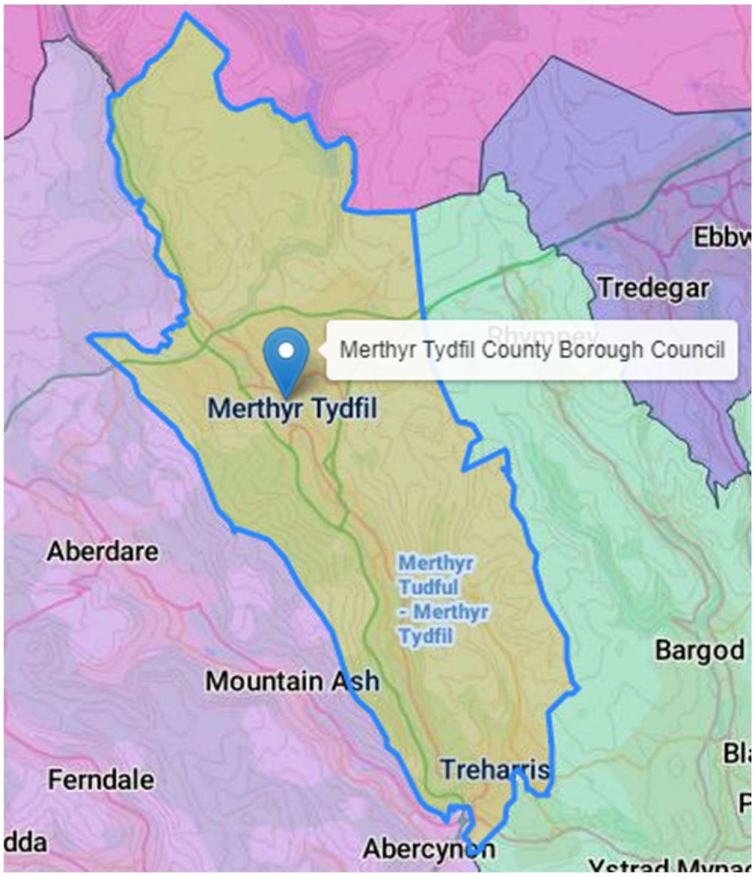

Image 1 – Google Map excerpt showing MTCBC

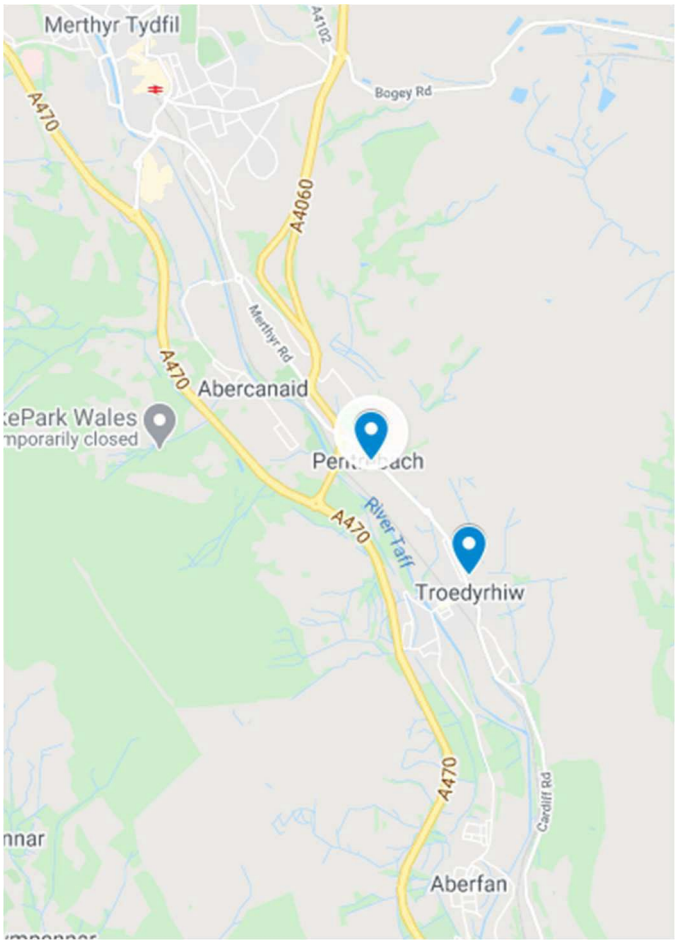

Image 2 – Google Map showing the location of Pentrebach and Troedyrhiw within MTCBC

Within the county boundaries of Merthyr Tydfil, the River Taff runs from north to south, almost through the centre of the county. The river enters the boundaries in the north west just north of the village of Vaynor, travelling south east to the town of Merthyr Tydfil, before running almost directly south past villages including Pentrebach and Troedyrhiw. The river leaves county boundaries just west of Treharris and continues south through Abercynon.

At Pentrebach, the village is surrounded by several open watercourses. The two most prevalent watercourses are one to the north of the village, and one to the south west, running almost parallel to the River Taff between the residential and industrial estate. The Nant-Yr-Odyn watercourse in the hillside above Pentrebach drains water from the hillside and local mines down towards Pentrebach. It is a culvert in this watercourse that became blocked, preventing the flow of water through it and eventually leading to the flooding at Pentrebach.

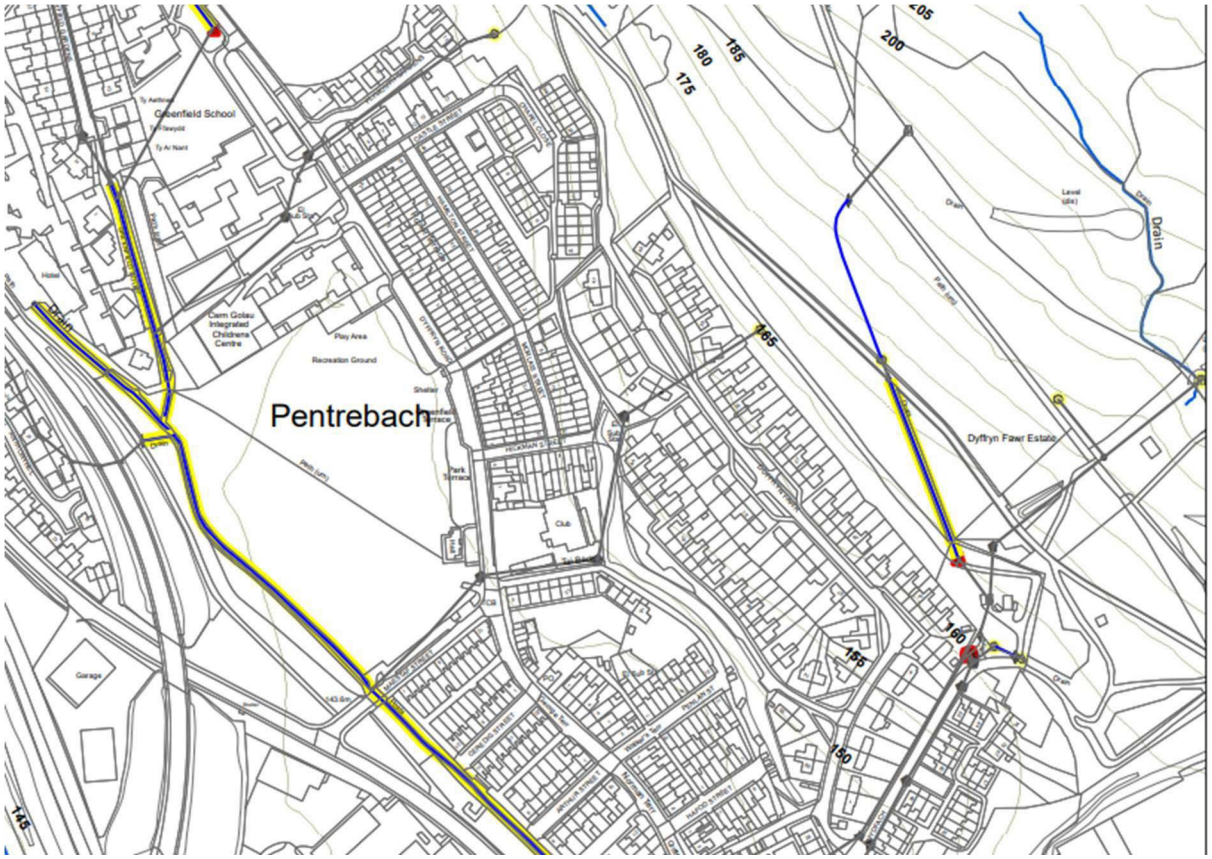

Image 3 – A map of Pentrebach and the surrounding watercourses

Troedyrhiw also has two significant watercourses around it, with one to the north east and another to the south west of the village. The watercourse to the south west is the Plymouth Feeder Channel, which feeds directly into the River Taff to the west of Troedyrhiw. It is this channel that became overwhelmed with the volume of water draining into it, that caused the flooding of the Troedyrhiw estate.

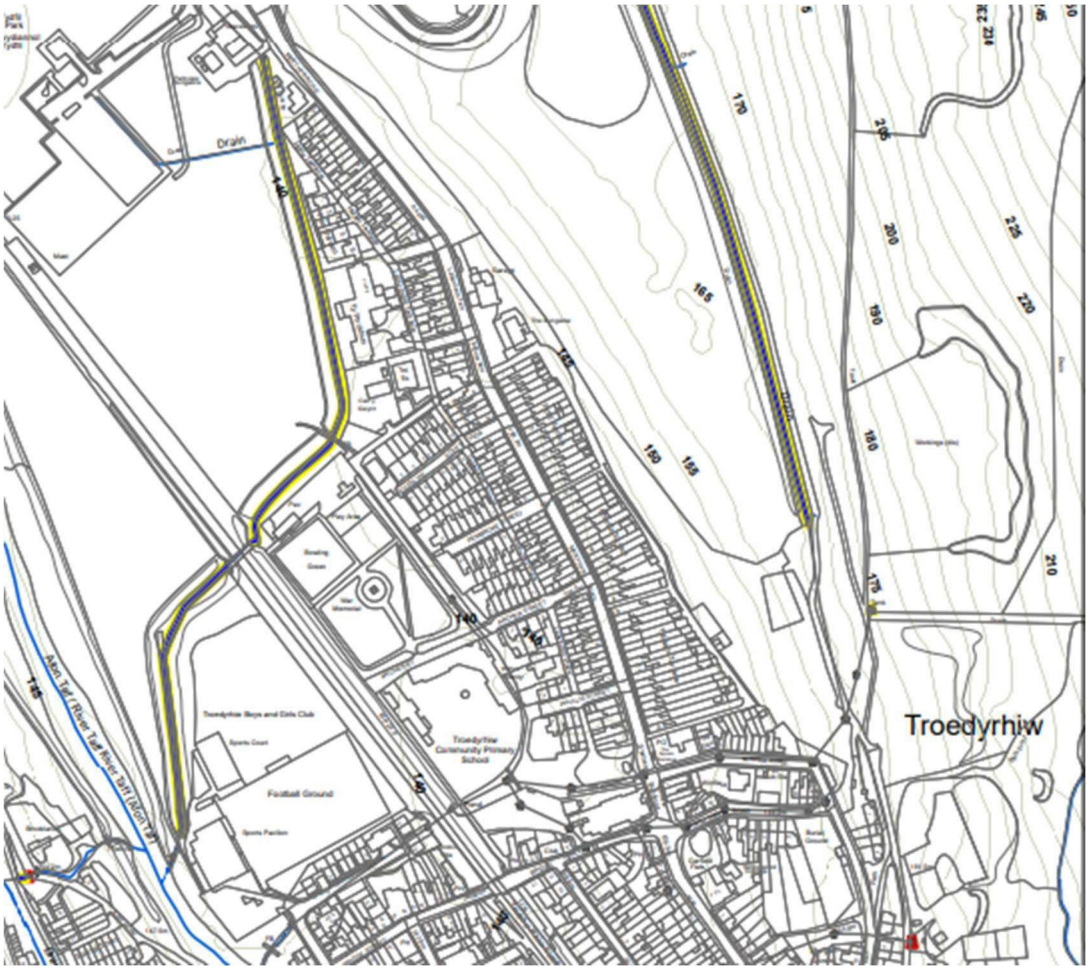

Image 4 – A map of Troedyrhiw and the surrounding watercourses

1.3 Drainage System

The majority of the local domestic and highway drainage systems were constructed by MTCBC and private housing developers; and were designed to a maximum capacity of a 1 in 30-year return period. The culverts affected are concrete structures that were previously undamaged; and are still within their design life period.

Although historically the design specifications may have been different, MTCBC currently design culverts to a maximum capacity of a 1 in 100-year return period (+30% to account for climate change). Surface water sewers adopted either by MTCBC or Dŵr Cymru Welsh Water (DCWW) have been designed in accordance with Sewers for Adoption – A Design and Construction Guide for Developers.

This document states that surface water sewers adopted will need to be designed using the Wallingford procedure.

As mentioned in more detail later in the report, Storm Dennis was found to be a 1 in 200 year event for the River Taff, far exceeding the design specifications used by MTCBC (and indeed most UK design teams). As such it would not have been surprising if the drainage system had become overrun during this event.

2. Flooding History

2.1 Previous Flood Incidents

It is thought that the last known major incidence of flooding in the area was during 1979 and 1980, when serious flooding occurred in Troedyrhiw, Pentrebach and Rhydycar. This flooding occurred, not as a result of the River Taff breaching its flood defences, but due to the inability of the local drainage systems to cope with storm water flow. Following these events, urgent repairs were carried out on the main Taff defences, after they were damaged during the storms. A report issued in 2009 noted that no other maintenance or improvements had been made to the defences since that time.

Empirical data is not available for the events that took place in 1979 and 1980, so a direct comparison with the events of 15th/16th February 2020 has not been possible. Records show, however, that during the flooding on 26th - 27th December 1979, 189 residential properties were flooded, in addition to several commercial properties. Two fatalities also occurred as a result of this event, when a culvert in Rhydycar collapsed. In comparison, the event in 2020 caused internal flooding to 160 properties across Troedyrhiw and Pentrebach, so the events were similar in their impact to the community.

It is worth noting that while this flood event took place in Troedyrhiw and Pentrebach, it was a different section of the river and culverts approximately half a mile away from the current locations that experienced the issue. It has therefore been surmised that the two are not connected in any way, and the previous flood incident will not need to be investigated in any further depth in relation to the flooding that took place in February 2020.

2.2 Flood Incident

A week prior to Storm Dennis reaching the UK, the area had been affected heavily by Storm Ciara. Prolonged and heavy rainfall during the weekend of 8 – 9 February 2020 left the ground saturated, leading to a lower ability to absorb and remove new rainwater. Higher than average water tables in the area (in part, due to Storm Ciara the week before) also meant that there was more water than usual entering the groundwater and local watercourses from old mine workings in the area (particularly in the Pentrebach area).

In addition, water levels in the River Taff were also higher than normal prior to Storm Dennis (again, in part due to Storm Ciara the week before). This subsequently reduced the ability of the surface water systems in place to discharge efficiently to the Taff.

A combination of all these factors meant that the Taff and associated watercourses and drainage systems were already working at an increased capacity compared to normal. As a result, when Storm Dennis reached the UK and MTCBC in particular, the heavy and intense rainfall in such a short period of time had a devastating impact.

Troedyrhiw

The flooding that occurred in Troedyrhiw on 15 and 16 February 2020 was as a result of an intense rainfall event that caused the overloading of open watercourses and culverts, when the River Taff became overwhelmed. In addition, large volumes of surface water not only caused a high level of surface water run-off, but also resulted in a landslide in the hillside above Troedyrhiw, causing flooding to the properties directly below. A post event survey, conducted by local council staff going door to door, identified 129 properties that had been internally flooded.

Pentrebach

In Pentrebach, the post event survey identified 31 properties that had been internally flooded. A culvert, impeded by debris and material run-off from a nearby hillside became blocked, preventing the flow of water through it. The debris was generated by scour, which was caused by normal run off and increased levels of ground water from tips and disused mine workings higher up in the catchment. The water that would normally have passed through the culvert was instead forced onto a nearby road, at which point it travelled down a steep slope along the road, flooding properties on a residential estate at the bottom of this slope.

2.3 Rainfall Analysis

With the peak of Storm Dennis reaching the UK on 15 and 16 February 2020, The Met Office issued a Red Warning (threat to life, immediate action should be taken to protect yourselves and others) for rainfall for parts of South Wales, and major and widespread flooding occurred. A peak rainfall event of 150mm/hour was recorded approximately between 3am and 4am on 16 February 2020. This peak period of rainfall ultimately caused watercourses to become overwhelmed. Rain radar images at 12 noon on 15 February 2020 and 00 midnight on 16 February 2020 show the heavy and persistent rainfall from Storm Dennis across the whole of the UK:

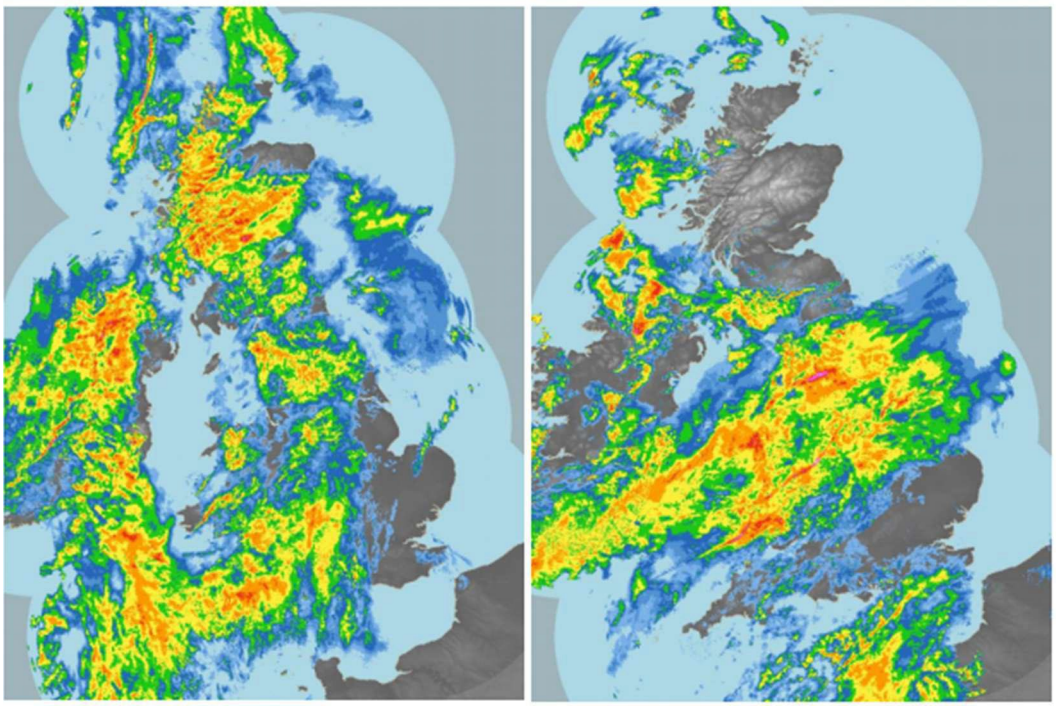

Image 5: Rainfall radar images of the UK 15-16 February 2020

Natural Resources Wales (NRW) report that during the period 15-16 February 2020, Wales saw 61 flood alerts, 89 flood warning and two severe flood warnings. This is the highest number of warnings for rivers ever recorded at any one time in Wales, highlighting the severity and impact that Storm Dennis had on the local watercourses.

Data collected by NRW shows that the Brecon Beacons and South Wales valleys were particularly hard hit, with River Taff catchments receiving more than 160mm of rainfall in some places – more than one months rainfall in a day. Other data collected by NRW also shows that on the morning of Sunday 16 February, the River Taff at nearby Pontypridd reached its highest level for over 40 years. The images below, from the Met Office, show the rainfall during Storm Dennis as actual volumes, and as a percentage of the 1981 – 2010 February average.

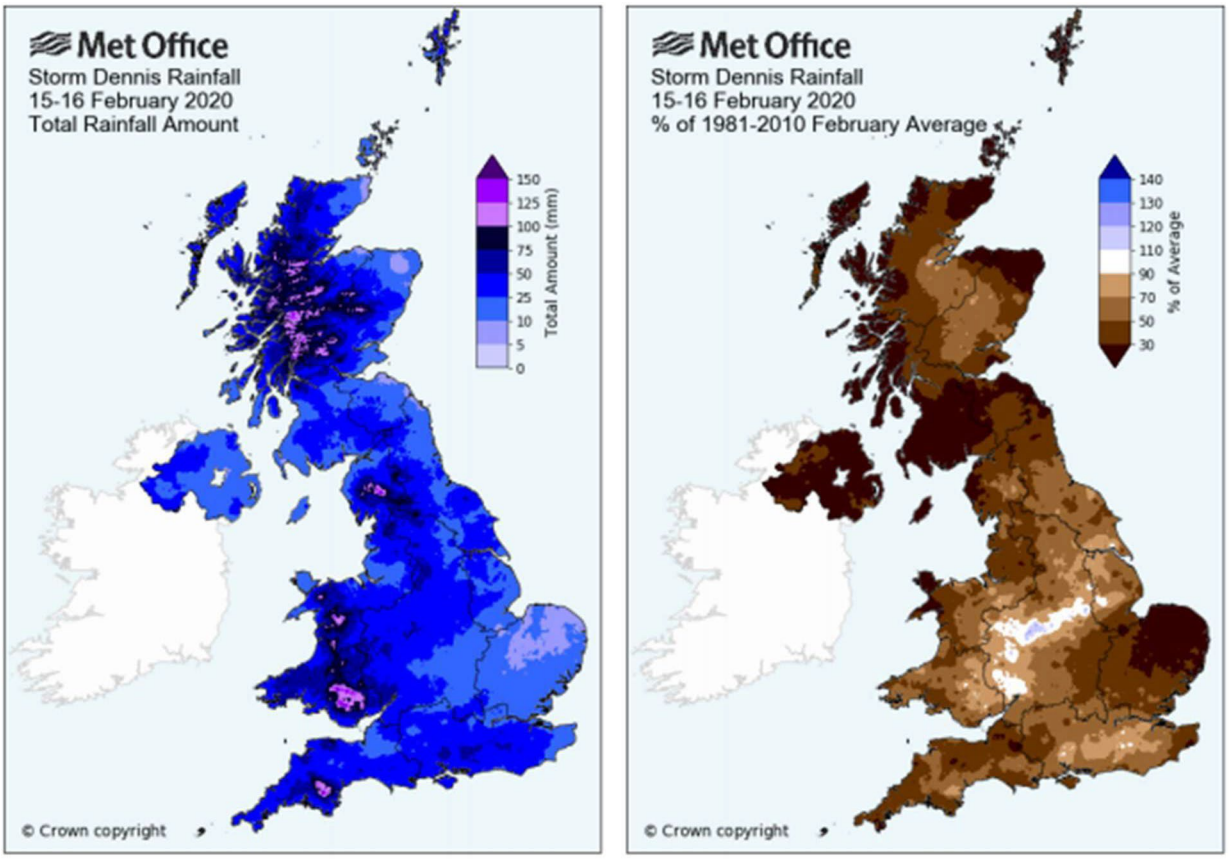

Image 6: Rainfall volumes seen during Storm Dennis.

As the above images, and data collected by both the Met Office and NRW show, the rainfall seen in the MTCBC area during Storm Dennis far exceeded anything experienced in similar short timeframes in recent times.

3. Possible Causes

3.1 Culvert Conditions

A blocked culvert was found to be the cause of the flooding event at Pentrebach, with debris and surface material from the land above entering the channel and being unable to travel further once it reached the culvert.

Currently, MTCBC operate a programmed maintenance schedule on watercourses and associated culverts, clearing any debris (such as a fallen tree or branches) or fly tipped material that is reported to the local authority by the public. In addition, MTCBC has flood monitoring stations on 14 of its culverts at highest risk. During storm events, MTCBC operate a cleansing schedule on those assets at highest risk, and where it is identified that attention needs to be focussed for that specific storm event.

Troedyrhiw

The Plymouth Feeder channel at Troedyrhiw flooded due to the river and subsequently the feeder channel becoming overwhelmed with the volume of water attempting to drain into it. While the cause was not a blocked culvert, it is important to ensure culverts are operating at optimum capacity so as not to impede the flow of water further. Increased levels of silt found at the base of the channel did cause some reduction of water flow, with a culvert owned by Transport for Wales (TfW) found to be working at 60% capacity. While the flooding at Troedyrhiw would still have occurred even if all culverts were operating at full capacity, the importance of keeping them maintained and running well cannot be overlooked.

Pentrebach

Investigation has found that a blocked culvert led to the flooding of 31 properties in the Pentrebach area.

A week prior to Storm Dennis, Storm Ciara had travelled across the UK, resulting in heavy rainfall in many areas including the South Wales valleys on 8 and 9 February 2020. As a result of the persistent, heavy rainfall in the Pentrebach area during Storm Ciara, surface water run-off from the hillside above the village caused a lot of material to enter the nearby watercourse. Pentrebach sits directly below an old mine/tip site. Excess rainwater at this site also caused increased levels of stone and silt run off, which not only entered the nearby watercourse, but resulted in an open channel appearing from the damage caused.

This build-up of additional material in the watercourse caused a culvert at the top of the Dyffryn Fawr Estate, adjacent to the Rhydfach carriageway, to become blocked. Water that should have entered the local sewer system via the culvert, instead spilled over onto the Rhydfach carriageway.

The location of this culvert is at the top of a steep section of carriageway, and as a result the water travelled down the road, gathering at the bottom of the slope and flooding 31 properties on the surrounding residential estate.

The map below shows the flooded area (outlined in red) with the red arrow identifying the point at which the water breached the culvert and entered onto the Rhydfach carriageway.

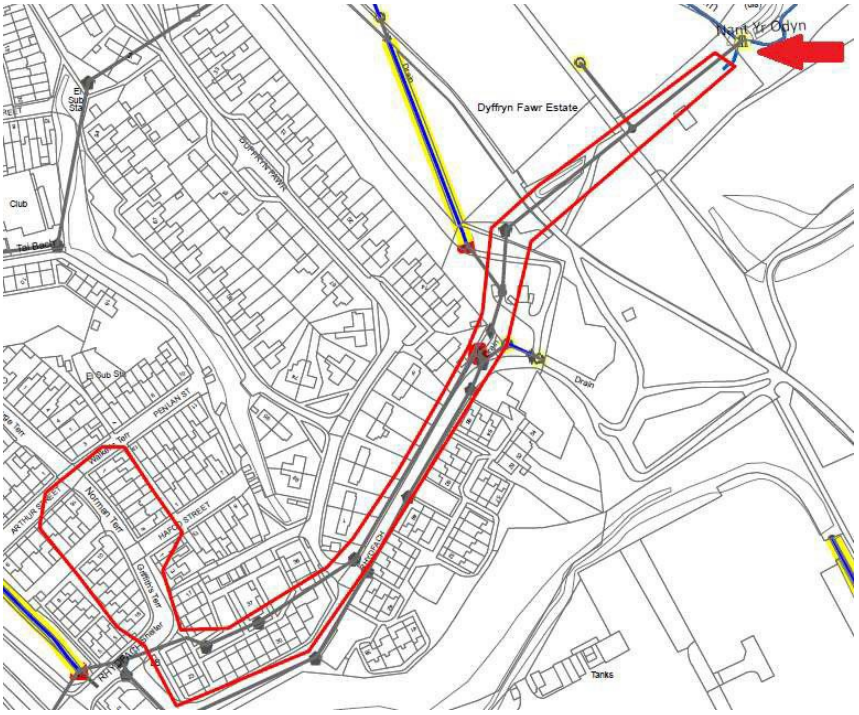

Image 7: Map showing the culvert that became blocked, and the area of Pentrebach subsequently flooded.

Image 8: Culvert no.4 at Pentrebach, cleared following the flooding incident.

Image 9: Uphill view of the damage caused by debris and loose material travelling down the hillside above Pentrebach, eventually entering the watercourse and blocking culvert no.4.

Image 10: Downhill view of the damage caused by debris and loose material at Pentrebach.

3.2 Open Watercourse Conditions

An over-loaded watercourse was found to be the cause of the flooding event at Troedyrhiw. Water levels in the River Taff were running high due to the increased rainfall from Storm Dennis, and Storm Ciara the previous week. This backed up into the Plymouth Feeder Channel, which could not cope with the volume of water.

While water levels were also higher in the open watercourses at Pentrebach, this was not found to have caused the flooding event there.

In order to ensure water can run freely along this watercourse before joining the nearby river, maintenance and upkeep of the channel is important. Currently, MTCBC operate ad-hoc maintenance on the watercourses, in terms of clearing any debris (such as a fallen tree or branches) or fly tipped material that is reported to the local authority by the public.

Troedyrhiw

The Plymouth Feeder Channel has been identified as the watercourse where a culvert overloaded, ultimately leading to the flooding of 129 properties on the nearby Troedyrhiw housing estate.

The map below identifies the channel in question (highlighted in yellow), as well as the area that was flooded by the watercourse (outlined in red). The arrow at the top left of the map shows the point of the channel at which the flooding occurred.

Image 11: Map showing the point at which the Plymouth Feeder Channel breached the embankment, and the area of Troedyrhiw subsequently flooded

A study was undertaken by Wallingford Hydrosolutions (WHS) on behalf of MTCBC, to better understand the reason for the flooding of the Plymouth Feeder Channel. The report, completed in June of 2020, sought to understand whether the flooding was a result of exceedance of the channel itself, or as a result of backlogging of the River Taff, which the channel feeds into.

WHS ran modelling across a total of six design events (2-yr, 5-yr, 10-yr, 20-yr, 50-yr and 100-yr) and determined:

- With water levels of the River Taff set to those observed during Storm Dennis, flooding of the Troedyrhiw estate occurred in all design events.
- With water levels set to normally observed levels, flooding of the Troedyrhiw estate did not occur until the 20-yr event.

This data confirms that while the volume of inflow to the Plymouth Feeder Channel contributed to the level of flooding seen, the water levels of the River Taff were a significant influence. A severe storm event, such as Storm Dennis, occurring in the catchment area of the River Taff is highly likely to lead to significant flooding of the Troedyrhiw estate, with the Plymouth Feeder Channel being particularly sensitive to water levels in the River Taff.

As a flood defence measure, a flood bund 2.5-3m in height had previously been built along the residential side of the water channel. There is a low point in this bund, situated at the same place the arrow is pointing on the map. It is at this low point that the watercourse breached the flood defences, flooding the nearby properties.

There are a number of highway drainage gully systems in the area connected to the Plymouth Feeder Channel. As a result of the feeder channel being overwhelmed and running at capacity, these drainage systems were unable to drain effectively.

Higher than normal levels of silt and other natural material were found at the bottom of the channel. This is, in part, as a result of the higher-than-average levels of surface water run-off into the channel, caused by the two storm events (Storm Ciara and Dennis) occurring in the week leading up to the flooding. A Network-Rail managed culvert was operating at reduced capacity as a result of the silt levels. As a result of the increased silt levels, this culvert was noted to be operating at 60% capacity. As mentioned above, MTCBC operate ad-hoc maintenance of the watercourses. It should be noted that while the introduction of a regular maintenance schedule would have helped by reducing the silt levels in the channel, this would not have prevented the channel over-loading and subsequent flooding that occurred.

Image 12: View of the Plymouth Feeder Channel with rising water levels during the day of 15 February 2020

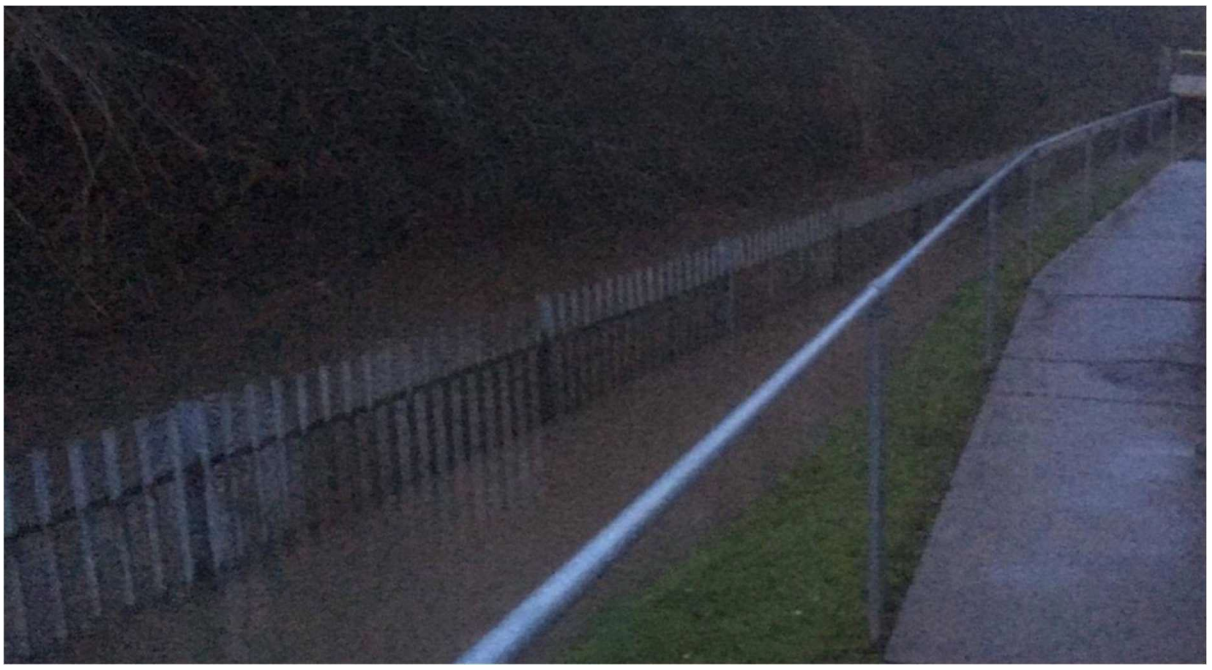

Image 13: Rising water levels at the Plymouth Feeder Channel, 15 February 2020

Image 14: Rising water levels at a railway culvert at the Plymouth Feeder Channel

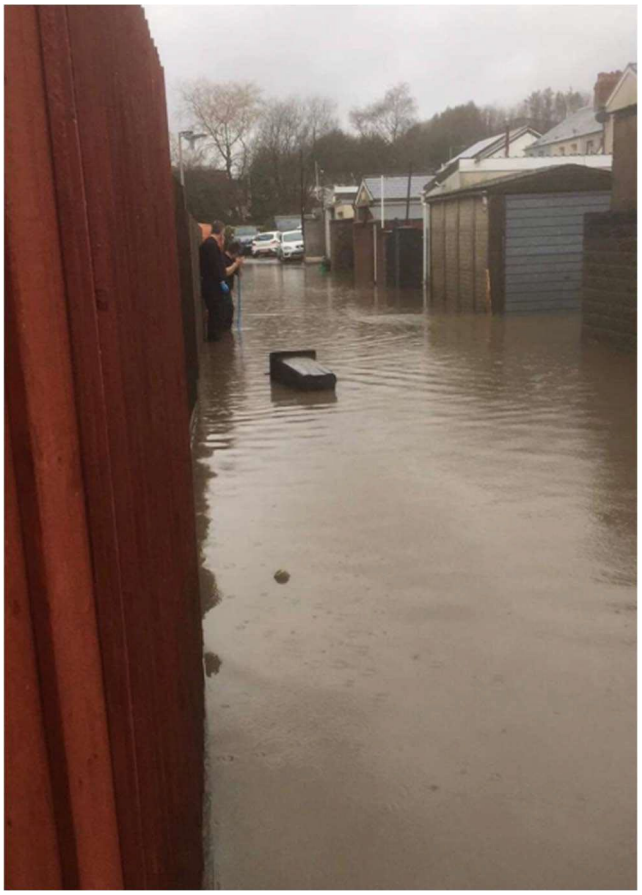

Image 15: Flood damage to properties on the Troedyrhiw estate following the overspill of the Plymouth Feeder Channel

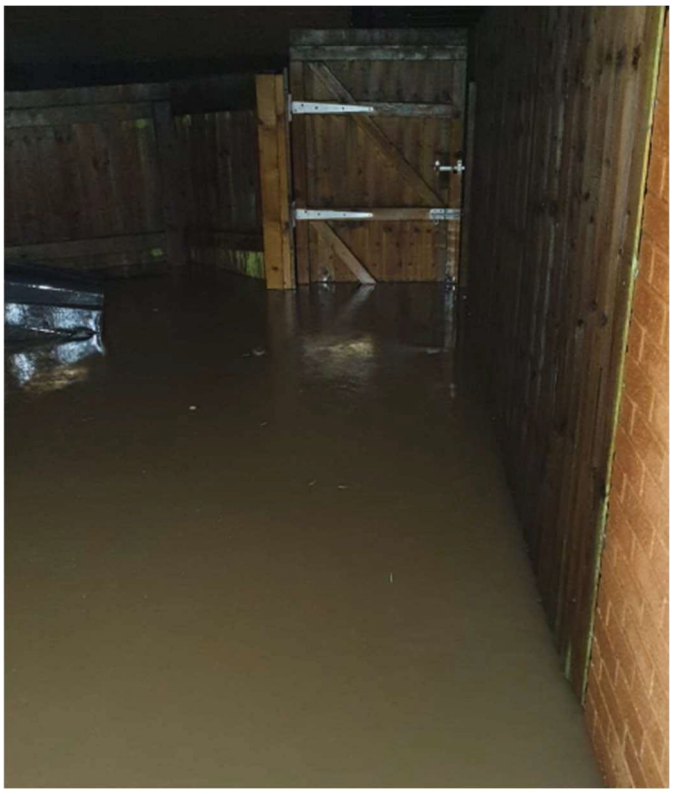

Image 16: Flood damage to properties on the Troedyrhiw estate following the overspill of the Plymouth Feeder Channel

Pentrebach

The channel leading to the blocked culvert in Pentrebach, while experiencing higher than normal water levels due to increased rainfall and surface water run-off, was not overloaded. The conditions of this watercourse do not need to be reviewed further as it was not the cause of the flooding event at this location.

3.3 Access Structures/Inspection Chambers

Investigation following the flooding event has confirmed that no relevant land drainage access structures or inspection chambers were compromised or affected during this event. The public sewer system, its performance and design were not the cause of the flooding events that occurred.

3.4 System at Capacity

Any remedial actions for this event should:

- Form part of MTCBC's Flood Strategy going forward.
- Be fully considered to ensure that they do not compromise existing risk mitigation measures, and that they do not increase the risk of flooding at another location.

- Consider that any severe storm event in the River Taff catchment area will lead to a heightened risk of flooding of the Plymouth Feeder Channel.

Rights and Responsibilities

4.1 Lead Local Flood Authority (LLFA)

Since the floods in the UK during the summer of 2007, the importance as flood risk management as part of the wider risk management approach has been elevated, through the evidence produced within the Pitt Review (published in 2008). Following the review, several recommendations were taken forward, one of them being the risk posed by climate change. The Review highlighted the need for the government to provide emphasis on the adaptation and mitigation techniques.

On a wider, international level, the Floods Directive (Directive 2007/60/EC of the European Parliament and of the European Council on the assessment and management of flood risks) was designed to provide a universal management strategy for flood risk. The directive was transposed into UK law in the form of the Flood Risk Regulations 2009. The regulations placed several requirements on local authorities identified as having a risk to flooding:

- Preliminary flood risk assessment maps and reports should be created by 22 December 2011 (based on which 'Flood Risk Areas' should be identified in accordance with Government guidance).
- Flood hazard maps and flood risk maps to be generated by 22 December 2013.
- Flood risk management plans should be in place by 22 December 2015.
- All assessments, maps, and plans to be subsequently reviewed and updated (where necessary) every 6 years.

Further to the development of the Flood Risk Regulations, the Flood and Water Management Act 2010 was produced to provide clarity regarding the powers and responsibilities of flood risk management authorities. The aims of both of these are to reduce the risk of future flooding through the use of a UK and European standard of flood risk. In Wales this is achieved by focussing on national strategies (put in place by the Welsh Government), river basin strategies (set by Natural Resources Wales) and local strategies (set by the LLFA).

The responsibility of MTCBC as the LLFA falls under Section 19 of the Flood and Water Management Act 2010. The LLFA is responsible for compiling the evidence as to what, when, why and how the event took place, to better understand the impacts. The LLFA should utilise the results to place responsibility for the incident onto the appropriate RMA, and it will be up to the RMA to progress with any flood risk alleviation schemes that are deemed sustainable and cost beneficial for the future impacts of climate change.

Each RMA has a duty under the Flood and Water Management Act 2010 to take flood risk measures, where appropriate. Under MTCBC's flood strategy, the LLFA has a duty to investigate and, where appropriate, seek to reduce the risk of flooding. Any measures that may impact ordinary watercourses and surface/groundwater flooding issues must be communicated to MTCBC and NRW before the RMA proceeds.

With climate change being a key principle in the management of future flood risk, the latest regulations focus on understanding a wider range of hazards (for example 1 in 100 and 1 in 1000-year return periods) and designing/planning appropriately based on the results of these events.

Despite the volume of evidence available to support climate change, there are still large numbers of people who question the validity of this information, and how much of an impact any climate change will have on future life in the UK. The work of UKCIP09 projects that climate change will bring hotter and drier summers, warmer and wetter winters, and more frequent extreme weather events.

The development of a mitigation strategy for climate change is a long-term process which must begin with an understanding of the likelihood and impact of climate change occurring. Flood Risk Management Plans will aim to develop these mitigation strategies, with the consideration of both short- and long-term plans. The Flood Risk Management Plans put in place by the LLFA will never fully remove the risk of flooding, nor will engineering design solutions. Rather, a resilience to flooding will need to be developed and incorporated into designs and Flood Management Plans. The LLFA should work closely with RMA's, and local communities to ensure a holistic and sustainable approach which includes the impact of the predicted future change in climate.

In relation to this specific event, MTCBC as the LLFA does not only have a responsibility to complete a Section 19 report on the incident. MTCBC also had a responsibility to ensure, when the flood occurred, that appropriate action was taken as swiftly as possible, to minimise the impact to people and properties as much as possible. A debriefing questionnaire completed by an on-call engineer who responded to the event, highlighted some issues that led to a delayed response in some instances, including:

- Access to 4x4 vehicles limited, delaying attendance to those areas more difficult to reach due to flood water such as Troedyrhiw.
- Depleted sandbag stock resulting in these defences not being readily available to all who needed them.
- Insufficient numbers of staff on call for the size of the storm event, meaning resources were stretched, resulting in slower response times.

It is important to note that the scale of the impact of Storm Dennis, and the large area within County Borough that it covered was unexpected, even with prior warning of the storm event. In addition to this, the impacts of Storm Ciara the previous week were still being felt (accounting for some issues such as the depleted sandbag stock). However, remedial action should be taken going forward, to ensure problems like this are mitigated as much as possible for future flooding events.

4.2 Natural Resources Wales (NRW)

Natural Resources Wales (NRW) has an operational responsibility for flooding from main rivers, the sea, and coastal erosion, and an oversight responsibility in relation to all flood and coastal erosion risk management in Wales.

While the flood damage being reviewed was not caused directly by the flooding of a main river, a report carried out by WHS concluded that the cause of the flooding at Troedyrhiw was fluvial; and that a severe storm event in the River Taff catchment was highly likely to lead to significant flooding of the Troedyrhiw estate. During the event, the levels of the River Taff rose substantially (Storm Dennis resulted in an approximately 1 in 200-year event for the River Taff).

NRW were heavily involved in the creation of MTCBC's Flood Risk Management Plan (2015), with representatives attending the Flood Risk Management Working Group and the South East Wales Flood Risk Management Group.

4.3 Water/Sewerage Company

Dŵr Cymru Welsh Water (DCWW) is the responsible water company that provides both potable and wastewater services to the whole of MTCBC. It is a Risk Management Authority (RMA) and as such the company is responsible for the control and movement of fresh and foul water systems. DCWW also have responsibility for the disused Glamorganshire canal which runs from Merthyr Tydfil to Abercynon. Although it is not a working canal, the canal still conveys surface water in parts and has areas prone to flooding. During storm Dennis, a number of flooding incidents occurred due to over topping of the Glamorganshire canal. It is likely that over topping occurred due to capacity issues within the canal and a poor current maintenance regime. MTCBC have approached DCWW with view to taking responsibility for its maintenance but DCWW have confirmed they wish to retain maintenance responsibilities.

A number of properties were flooded due to overtopping of the Glamorganshire canal including an 10,000m2 industrial unit in Abercanaid, 16 properties in Aberfan and 2 properties in Troedyrhiw.

4.4 Network Rail

Network Rail has an operational responsibility for flooding from land ownership. As part of this responsibility, they have a duty to undertake regular maintenance of any and all assets on their land that pose a risk to flooding. During this event, no flooded watercourses or culverts were identified as being on Network Rail land; and as such no specific responsibility for Network Rail has been identified outside of the usual expectations.

4.5 Highway Authority

The Highways Agency and MTCBC Highways department have the lead responsibility for providing and managing highway drainage and roadside ditches under the Highways Act 1980. They should work alongside other RMA's to ensure their flood management activities are well coordinated.

As the flooding incidents that occurred were not as a result of any issues with highway drainage or roadside ditches, the highways authorities do not have any specific responsibilities in relation to this incident.

4.6 Riparian Landowners

Riparian Landowners are legally responsible under common law for the maintenance of the land generally up to the centreline of any watercourse adjacent to their property. This includes the maintenance of the bed, banks and any boundary features e.g. vegetated strips such as hedging, with routine clearance of debris and/or blockages. This does not mean that the owner must remove all debris from the watercourse, but it does require the owner to maintain as far as it does not pose a

risk or nuisance to a neighbour. Any works to modify the watercourse by the landowner must first be passed through the relevant RMA, LLFA or NRW.

4.7 Residents and Property Owners

Residents and property owners are responsible for the protection of their own properties against flooding. The drainage systems used for highways have not been designed for the defence of properties, but for the proper function of highways. Residents have the right to defend their property as long as they do not subsequently increase the risk of flooding to other properties. The watercourses and culverts throughout MTCBC are overseen by MTCBC and so are governed by the rules for Riparian Landowners, set out in section 4.6.

MTCBC carries out maintenance on an ad-hoc basis to reduce the risk of flooding, but this will not entirely remove the risk. Residents therefore need to be aware of and prepared for the potential for surface water flooding. There are several companies that can aid them in being prepared, by offering property level protection (PLP). This support can vary from carrying out initial surveys to determine the risks, to providing equipment that is designed to prevent flood water entering the property. The level of support offered can be tailored to what is desired and can be afforded by the residents/property owners.

4. Permissive Powers of Risk Management Authorities

Risk Management Authorities have direct permissive powers under the Flood and Water Management Act 2010, as well as the Land Drainage Act 1991. The LLFA can utilise such powers as section 14A General Powers: Flood risk management work, taken from the Land Drainage Act, and amended through the Flood and Water Management Act 2010, Schedule 2.

The use of this section can have a varied approach, from public awareness campaigns in order to increase knowledge, to engineering works designed to mitigate the impact of flooding. The approaches taken will follow MTCBC's local flood risk management aim, that we will 'endeavour to reduce Flood Risk in all of the areas identified as being subject to significant flood risk". They will also follow the four objectives of the Welsh Governments National Flood and Coastal Erosion Risk Management Strategy:

- Reducing the consequences for individuals, communities, businesses and the environment from flooding and coastal erosion
- Raising awareness of and engaging people in the response to flood and coastal erosion risk
- Providing an effective and sustained response to flood and coastal erosion events

- Prioritising investment in the most at-risk communities

5. Flood Alleviation Schemes

As a result of Storm Dennis, a total of 47 flood relief schemes have been identified across the Merthyr Tydfil borough. Due to the scale of the works, a three-year completion plan has been put in place, split into three phases. Phase 1 is already underway, with Phase 2 due to start in early 2021, and phase 3 in 2022. The Covid-19 Pandemic has caused some delays to the plans; however, work is underway, and officers are working hard to complete the work as quickly as possible, without compromising on safety and quality. The recovery works not only include repairs to damaged infrastructure such as culverts, but also covers work to alleviate the impact of future extreme weather events. This will be achieved by works such as increasing the capacity of watercourses, and the installation of trash screens and flood monitors to various culverts.

More details of the planned works can be found in the 'Storm Dennis Recovery Booklet (v10), produced by MTCBC in order to provide information to residents and property owners. In an effort to educate local residents and property owners on their responsibilities, and how they can act to protect their properties going forward, the booklet also contains information on how to prepare for another flood. It also provides details on how to access affordable insurance for their property.

While MTCBC, as the local authority, are doing everything they can to minimise future flood risk, this work cannot be achieved without the co-operation of other RMA's and asset owners. These also have a responsibility to do as much as they can to help ensure minimised risk of flooding, and minimised damage as a result of flooding, in the future.

Troedyrhiw

In Troedyrhiw, the following works are either planned or are already underway in order to repair damage caused by Storm Dennis and alleviate the effect of future storm events:

Area	Works
Chapel Street	Drainage and reinstatement work to a landslide together with improvements to nearby watercourses
Park Place	Re-profiling of Glamorganshire canal to rear of Park Place
Cwmdu Road	Drainage and reinstatement of work to a landslide
Nant Cwmdu	Creation of headwall to culverted section under Nant y Coed. Installation of 70m of palisade fencing to prevent fly tipping. Installation of

	sacrificial trash screen in section of watercourse under A470
Nant y Coed	Drainage and reinstatement work to a landslide
Fernhill Close	Replace 200m of undersized culvert along Chapel Road. Re-profiling and lining of existing channel to the rear of Fernhill Close
Plymouth Feeder, Troedyrhiw	Dredging of feeder to remove silt. Installation of 2.5m high flood defence to the Transport for Wales culvert. Installation of new footbridge to southern section at the higher level, to remove an identified pinch point.. Installation of flood monitoring devices at both ends of the feeder channel. Installation of non-return valve.
Plymouth Feeder, Troedyrhiw	Flood modelling to determine cause of flooding and type of flood defence required to protect Troedyrhiw (completed)

Table 3: Details of the flood relief work planned/being carried out in Troedyrhiw

Pentrebach

In Pentrebach, the following works are either planned or are already underway in order to repair damage caused by Storm Dennis and alleviate the effect of future storm events:

Area	Works
Nant yr Odyn (mountainside adjacent to Duffryn Fawr)	Culvert inlet improvement works and installation of sacrificial trash screen upstream of the inlet
Dyffryn, Pentrebach	Culvert inlet improvement works and installation of sacrificial trash screen upstream of the inlet. Installation of flood monitoring station at culvert inlet.
Plymouth Feeder, Pentrebach	Improvement works to 100m section of Plymouth Feeder at Maestaff Street. Installation of flood monitoring station at Maestaff Street bridge.

Table 4: Details of the flood relief work planned/being carried out in Pentrebach

6. Conclusion

The flooding that took place on 15 February 2020 was as a result of an extreme weather event that impacted much of the UK. Heavy and prolonged rainfall resulted in a much higher than normal volume of surface water run-off into local watercourses, which subsequently could not cope. One week prior, Storm Ciara had made its way across the UK, the aftereffects of which were still present by the time Storm Dennis arrived. In the MTCBC area in particular, groundwater levels and river levels remained high following Storm Ciara. In addition, the flow of water in some areas was impeded by debris that had made its way into the watercourses and culverts in the aftermath of Storm Ciara.

In Troedyrhiw, 129 properties experienced internal flooding, when the Plymouth Feeder Channel could no longer contain the volume of water flowing through it. Investigation has found that water levels of the River Taff were significantly higher than normal, with Storm Dennis being recorded as a 1 in 200-year event for the river catchment. This resulted in water in feeder channels, and the Plymouth Feeder Channel at Troedyrhiw specifically, becoming backlogged and unable to cope with the demand. It has been noted that future severe storm events in the River Taff catchment are highly likely to cause repeat flooding of the Plymouth Feeder Channel at Troedyrhiw. A number of prevention/alleviation measures are being put in place at the feeder channel to reduce the potential of future flooding events. As well as the installation of additional flood defences and a higher foot bridge, a non-return valve is also being installed, as well as flood monitoring devices at either end of the channel.

In Pentrebach, 31 properties were flooded when a blocked culvert caused the flow of water through a watercourse to become impeded. Water that should have entered a watercourse at the top of Rhydfach via the culvert, instead spilled over onto the Rhydfach carriageway. The location of this culvert is at the top of a steep section of carriageway, and as a result the water travelled down the road, gathering at the bottom of the slope and flooding properties on the surrounding residential estate.

As the LLFA, MTCBC were swift to act in identifying what work was needed in order to repair damage created by Storm Dennis, and what work could be carried out to mitigate the risk of further flooding events in the local area. These extensive works are currently underway, with the aim of being completed in 2022, assuming no further delays due to Covid-19 or other unavoidable scenarios. The use of community engagement and awareness programmes will be essential in developing the resilience of the local communities. The aim of this communication will be to increase public knowledge on why the flooding occurred, and what residents can do to protect themselves and their properties in the future. MTCBC has already provided some information on this matter in the form of the ‘Storm Dennis Recovery Booklet (v10)’, with more information and help available to residents on the council website.

7. Recommendations

The following recommendations are made as a result of this report:

- Flood repair and alleviation work to be completed as soon as possible, as per the repair schemes laid out by MTCBC.
- A review of the resources available (such as 4x4 vehicles, gully suckers and sandbags) should be completed. Stocks of essential materials (such as sandbags) should be increased where necessary, and stored in a location that is quickly accessible to those staff who respond to any future flooding events.
- Public awareness program to inform residents that it is their responsibility to defend their own properties, provided their actions do not pose an increased risk of flooding to other properties. Where possible, provide examples of or signpost towards information regarding property level protection schemes (PLPS) such as flood gates, walls, driveway orientation etc.
- Riparian owners informed of their duties to maintain the watercourse which is generally up to the centreline of watercourse adjacent to their property.
- TfW to ensure regular monitoring of it's flood defence assets to ensure they are working at optimum capacity. The highest risk assets should be identified and a maintenance plan implemented to suit.
- DCWW to continue the monitoring and, where/if necessary, upgrade or repair work to the local waste water sewage system to ensure it meets current design criteria wherever possible, and is fit for purpose. If an issue is identified whereby the system will not cope with future flooding events, this matter should be resolved as soon as possible to limit potential damage. DCWW should as soon as practicable, implement a robust maintenance regime for the Glamorganshire canal to reduce flood risk to neighbouring properties.
- NRW, as the body responsible for the flooding of main rivers, should review whether it is possible to do anything to alleviate the pressure on the River Taff during future extreme weather events. While significant work to the Taff may not be possible, all options should be explored.
- A review of the current watercourse/culvert maintenance policy in place with MTCBC, to determine whether more regular maintenance of such features would be beneficial and cost effective.
- The encouragement of SuDS designs and green environments within communities for any future developments, to maximise natural drainage solutions wherever possible.

Useful Links/Contacts

- Emergency Advice from MTCBC
  https://www.merthyr.gov.uk/resident/crime-safety-and-emergencies/emergency-planning/

- Flooding advice from MTCBC
  https://www.merthyr.gov.uk/resident/parking-roads-and-travel/flooding-and-drainage/flood-alerts-advice-and-insurance/

- Severe weather updates from MTCBC
  https://www.merthyr.gov.uk/news-and-events/latest-news/severe-weather-updates/

- Storm Dennis Help and Advice from MTCBC
  https://www.merthyr.gov.uk/resident/crime-safety-and-emergencies/emergency-planning/storm-dennis-help-and-assistance/

- National Flood Risk Management Strategy
  https://gov.wales/national-strategy-flood-and-coastal-erosion-risk-management-wales

- Local Flood Risk Management Plan
  https://www.merthyr.gov.uk/resident/parking-roads-and-travel/flooding-and-drainage/flood-risk-management/

Abbreviations

DCWW	-	Dŵr Cymru Welsh Water
DEFRA	-	Department for Environment, Food and Rural Affairs
FRMP	-	Flood Risk Management Plans
IDD	-	Internal Drainage Districts
LFRMS	-	Local Flood Risk Management Strategy
LLFA	-	Lead Local Flood Authority
MTCBC	-	Merthyr Tydfil County Borough Council
NRW	-	Natural Resources Wales
RMA	-	Risk Management Authority
SuDS	-	Sustainable Urban Drainage System
TfW	-	Transport for Wales
UKCIP	-	United Kingdom Climate Impact Programme
WHS	-	Wallingford Hydrosolutions