

Investigation Report into Flooding- Storm Callum 12th - 14th October 2018



WORKING DRAFT

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1. Introduction

An investigation has been undertaken by Carmarthenshire County Council (CCC) as Lead Local Flood Authority (LLFA) in response to the flooding that occurred across Carmarthenshire on the 12-14th October 2018, as a result of Storm Callum. This report is a summary of the investigation and includes relevant information required to meet the statutory requirements placed on the Authority by Section 19 of The Flood and Water Management Act 2010.

The Flood Risk Regulations 2009 and the Flood and Water Management Act 2010 identify CCC as the LLFA in Carmarthenshire. This has placed a number of flood risk management duties and responsibilities on the Council. In particular, Section 19 of the Flood and Water Management Act 2010 places a duty upon CCC to undertake investigations into flood events to the extent that it considers necessary.

Flood and Water Management Act: Section 19 - Local authorities: investigations

(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.

Flood and Water Management Act (2010), S.19, c.29, London: HMSO

When considering if it is necessary or appropriate to investigate a flood event within its area, CCC will review the severity of the incident along with the number of properties affected and the frequency of such an occurrence.

CCC consider that the incident of Storm Callum is sufficiently severe and we have engaged with the relevant partners in the production of this report.

One of the requirements of Section 19 is that an investigation report must identify which Risk Management Authorities (RMA) have relevant flood risk management functions.

Through the investigation process, it was determined that the relevant RMA's for the flooding that occurred as a result of Storm Callum are:

- CCC as Lead Local Flood Authority (LLFA);
- CCC as the Highway Authority;
- Ceredigion County Council as a neighbouring LLFA;
- Ceredigion County Council as the Highway Authority;
- Natural Resources Wales (NRW) as the body responsible for managing flood risk from main rivers and the sea;
- Dwr Cymru Welsh Water (DCWW) as the company responsible for the management of foul water and some surface water management systems.
- Network Rail as a land owner with significant infrastructure in the flood risk areas.
- South Wales Trunk Road Agency as the body responsible for maintaining and managing the trunk Road network in South Wales.

In addition, it was found that a number of land owners and those with riparian responsibilities for watercourses are also relevant in this instance.

2. The focus of the report

Under section 19 of The Flood and Water Management Act 2010 Carmarthenshire County Council, as 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.

Where an Authority carries out an investigation under subsection (1) it must publish the results of its investigation, and notify any relevant risk management authorities.

Further guidance from Welsh Government has stipulated that reports should be produced for flooding incidents where twenty or more properties experience internal flooding. On that basis, Carmarthenshire County Council will undertake a full report on the flooding that affected the following communities.

- Johnstown (Carmarthen).
- Pensarn (Carmarthen).
- Llanybydder.
- Llandysul / Pont Tyweli.

Other areas of the County did experience flooding, but the numbers affected were below the stipulated threshold. These areas include the towns and communities in the Towy valley such as Abergwili and Nantgaredig, Ffairfach and Llandovery. Along the River Teifi, Cenarth and Llandysul were significantly affected with the smaller community's in-between also experiencing flooding. In the south of the county Ferryside saw significant flooding as did Burry Port and parts of Llanelli. The Gwendraeth valley was also significantly affected from Kidwelly to Gorslas.

There are also examples where two authorities are involved relating to incidents at County boundaries, and one of the authorities will take on the role of LLFA; this is the case in terms of Newcastle Emlyn, where the majority of internal flooding affected houses in Ceredigion, so Ceredigion County Council will take on the LLFA function. There is a reciprocal arrangement in place for investigations in Llanybydder where Carmarthenshire County Council has taken on the role of LLFA.

The report does not provide firm recommendations and conclusions in relation to the implementation of capital works that may be appropriate in terms of flood alleviation, but the report will set out a series of actions that will inform the debate about the feasibility and viability of future flood alleviation capital works where appropriate. Furthermore, the report does set out the need to map out and set out maintenance responsibilities and arrangements for drainage infrastructure assets in future.

WORKING DRAFT

3. Storm Callum

1.1 Forecasting and Prediction time line

Storm Callum began as an Atlantic depression moving eastwards on a powerful Jet Stream. As it tracked across the Atlantic Ocean it deepened to 938Mbs as it approached Ireland.

On Monday 8th October 2018 the UK Metrological Office (Met Office) produced a rainfall scenario map indicating the possibility of 50mm of rainfall in 12 hours in parts of west Wales.

At 11:20 on Tuesday 9th October 2018 the first official warnings with regards to Storm Callum was issued by the Met Office. This was a yellow warning for rain between 06:00 Friday and 23:59 Friday with a very low likelihood of medium impacts. At this time there was a potential for 60mm of rain on Friday 12th October on high and exposed areas.

At 11:04 on Wednesday 10th October the warning was updated with the likelihood increasing slightly. This was still a yellow warning for rain with 50-100mm of rain forecast for Friday 12th October 2018.

At 11:54 on Wednesday 10th October the yellow warning for rain was updated further to include Saturday 13th October 2018.

At 10:23 on Thursday 11th October the yellow warning for rain on Saturday 13th October was updated.

At 10:25 on Thursday 11th October an amber warning for rain was issued from 06:00 Friday 12th October through until 18:00 on Saturday 13th October. Rainfall totals of 40-80mm were widely forecast with 120-160mm forecast on higher ground. The amber warning indicated that there was a medium likelihood of medium impacts.

The weather warnings and Flood Guidance Statement can be viewed in **Appendix A.**

1.2 Rainfall data

The Met Office have reported that over a two day period (11th -12th October 2018) the heaviest and most persistent rain was focused on the Brecon Beacons

with 150-200mm of rain reported widely. The rainfall in the upland areas was 3-4 times as much as was experienced in coastal areas¹.

Figure 1 below shows the rainfall totals across Wales from 09:00 on Thursday 11th October to 09:00 on Saturday 13th October 2018.

Figure 1 Storm Callum Rainfall Totals 11th -13th October 2018

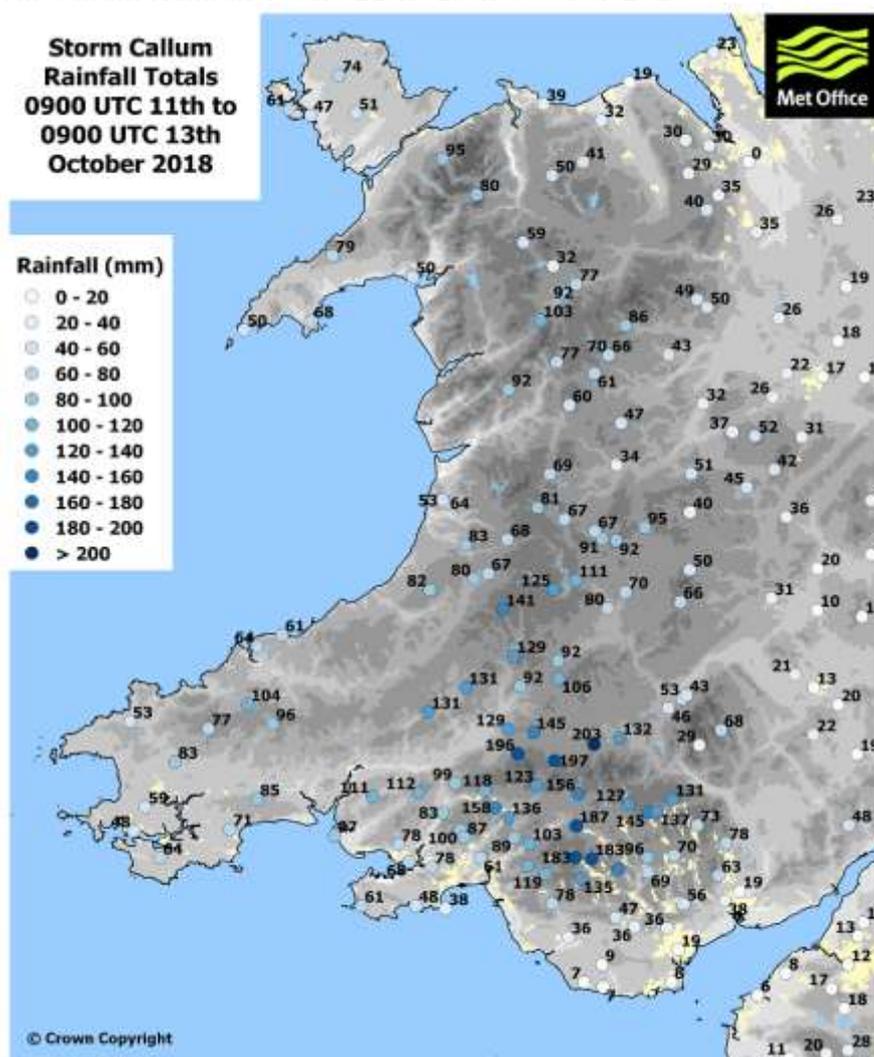
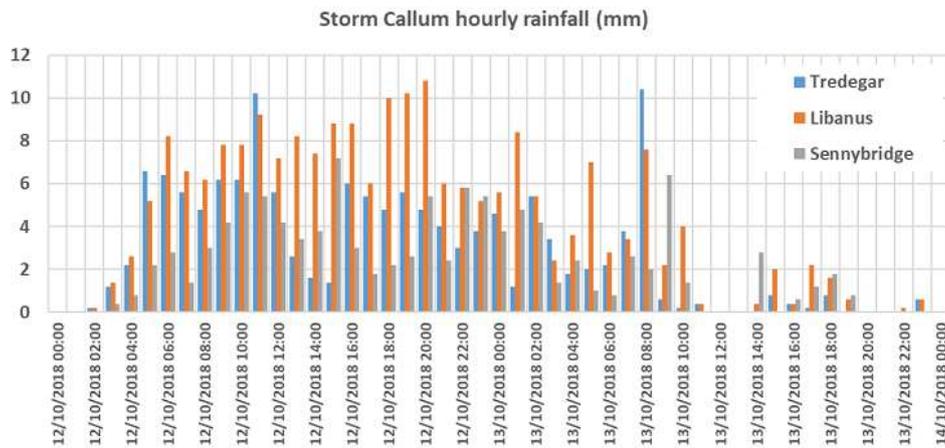


Figure 2 below highlights hourly rainfall in the Beacon Beacons. The Met Office has concluded that the extreme nature of the event was due to the duration of the event rather than the intensity.

The Met Office has concluded that, in terms of historical context, the 11th-12th October 2018 was one of the most notable and extreme rainfall / flood events across south Wales in the last 50 years.

¹ https://www.metoffice.gov.uk/climate/uk/interesting/october2018_wind

Figure 2 – Storm Callum Hourly Rainfall at Tredagar, Libanus and Sennybridge.



Natural Resources Wales have calculated that the annual probability for rainfall event associated with Storm Callum, in the upper catchment of the river Towy was between 1 in 100 and 1 in 330. NRW have also produced an isohyet map of south Wales that highlights the areas of highest rainfall over the 12th and the 13th October. This can be viewed in **Appendix B**.

1.3 The Wind

The Met Office have reported that the wind was 'notable but not exceptional' for the time of year. The highest gusts were recorded on Anglesey at 74mph. More locally the wind at Pembrey in Carmarthenshire reached 73mph.

4. Flood Investigation, Johnstown (Carmarthen)

The community of Johnstown is located to the south-west of Carmarthen Town. It is predominately a residential area but does have large business, education and recreational areas.

This investigation will focus specifically and predominantly on the residential area to the north of the A40 and the flooding that occurred as a result of Storm Callum. Map 1 below highlights the investigation area.

Figure 4 Johnstown (Carmarthen) Storm Callum flood investigation area



4.1 Headline Figures

From Friday 12th to Monday 15th October 2018 Carmarthenshire County Council recorded:

- 19 substantiated incidents of internal property flooding.
- The maximum depth of flood water of 900mm and that;
- Several roads, namely St Clears Road, Heol Salem and Heol Llansteffan, were closed or impassable.

1.2 Flood History

Natural Resources Wales have advised that there were significant flood events in 1979 and 1987.

Carmarthenshire County Council Flood Defence Team have no recorded incident of flooding in this area. (NB other agencies have historically taken the lead with regards to flooding in this area.)

The Highways Authority have confirmed that they have recorded incidents of highway flooding reported however these are predominately issues related to blocked highway gullies.

DCWW have advised that they hold records of flooding records on their definitive flooding list (DFL). In Johnstown two streets appear on the DFL - namely Llansteffan Road and Glantawelan.

1.3 Drainage Networks

1.3.1 Main Rivers

The Tawelan Brook is the primary watercourse in the area. Under the Flood and Water Management Act 2010, Natural Resources Wales (NRW) are responsible for flood and erosion risk management activities on main rivers. The Tawelan Brook is a main river.

The catchment of the Tawelan Brook is approximately 19.1km² and CCC Engineers have conservatively estimated that flows in the region of 16 cubic metres per second could be experienced in a 100 year annual probability rainfall event.

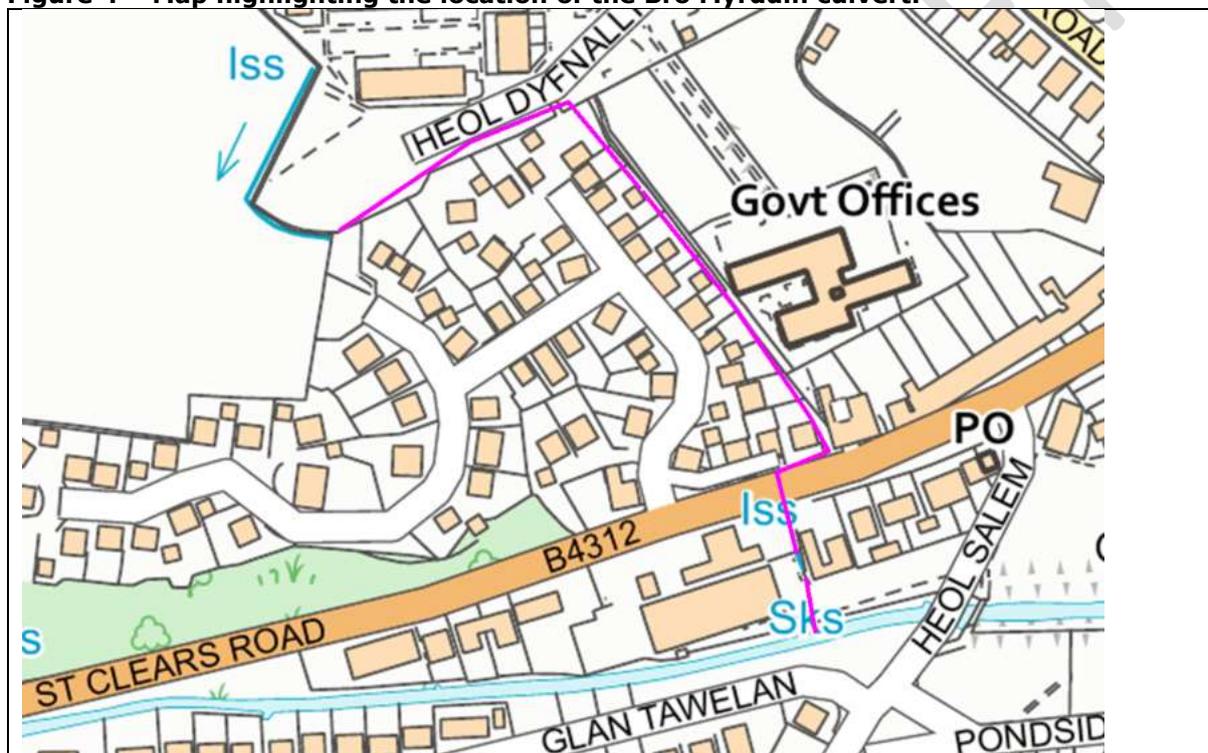
1.3.2 Ordinary watercourses

The Bro Myrddin ordinary watercourse drains along the western boundary of the Bro Myrddin estate. It is then culverted in the south western corner of the estate before it runs in a culvert, approximately 350 metres, before discharging into the Tawelan Brook downstream of the petrol station/garage in Old St. Clears Road. The catchment is approximately 4.3 hectares and peak flows are detailed below in Table 1.

Table 1 Estimated flood flows in the Bro Myrddin Catchment of Carmarthen.

QBar (mean annual maximum flow rate) (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
45	70	38	65

Figure 4 – Map highlighting the location of the Bro Myrddin culvert.



An evaluation of the drainage infrastructure, utilising a 2018 CCTV survey, has concluded that the system is of sufficient size to convey the above storm events.

1.3.3 Surface water drainage

The urbanised area in Johnstown is served by Dwr Cymru Welsh Water (DCWW) surface water and combined sewer systems. The only exception to this is Bro Myrddin estate (as detailed above).

DCWW have the drainage network mapped on their database (see **Appendix C**). However, no information exists on the maintenance regime, the standard of service or condition of these assets.

Action 1: DCWW to evaluate the standard of service and the condition of the surface water sewers servicing Johnstown.

1.3.4 The Highway Drainage System

The highway network is drained via highway gullies. The Highway Authority have the gullies mapped on their asset management system WDM; these are cleaned annually. There is no information available on where the gullies drain to or the standards and conditions of these carrier drains. It is assumed that this discharges into the DCWW surface water system.

Plate 1: Highway flooding on Heol Salem, Johnstown



Action 2: CCC Highways Authority to work with DCWW to evaluate the standard of service and the condition of the highway drainage in Johnstown.

1.4 Flood Risk Management Assets

1.4.1 Natural Resources Wales Flood Risk Management Assets

NRW have 49 flood risk assets in the Johnstown area. These include areas of high ground, embankments and walls that serve as flood defence structures.

The NRW hydraulic model (2017) indicates that both the Llansteffan Road Bridge, B4312 and the Heol Salem Bridge are surcharged during flood events and therefore will have an impact on flood risk. However, in the Storm Callum event, even though the soffits were surcharged, information collated by NRW Engineers highlighted that the defences on the upstream side of both bridges were not overtopped.

The Llansteffan Road Bridge has a soffit level of 6.21m AOD. The wrack marks level were 6.78m AOD and the flood defence crest level is 7.13m AOD. At the Heol Salem road bridge the soffit level is 6.71m AOD. The wrack mark levels were recorded at 6.85m AOD and the flood defence crest level is 7.13m AOD.

Plate 2: Flood waters at Heol Salem Bridge and Llansteffan Road Bridge.



1.6 The details of the flooding event

1.6.1 Flood Warnings

NRW have reported that the flood alert for the Lower Towy was issued at 13:56 on Friday 12th October 2018. The "Flood Alert" is issued in advance of any flooding and is the trigger for businesses and residents to be prepared as flooding is possible.

This was followed by the "Flood Warning" at 15:22 on Saturday 13th October 2018. This warning is the trigger for immediate action as flooding is expected (see **Appendix D**).

NRW utilise four flood codes to indicate the level of risk. Figure 6 below depicts the codes and their meanings.

Figure 6 Map of the NRW Johnstown Flood Warning Area

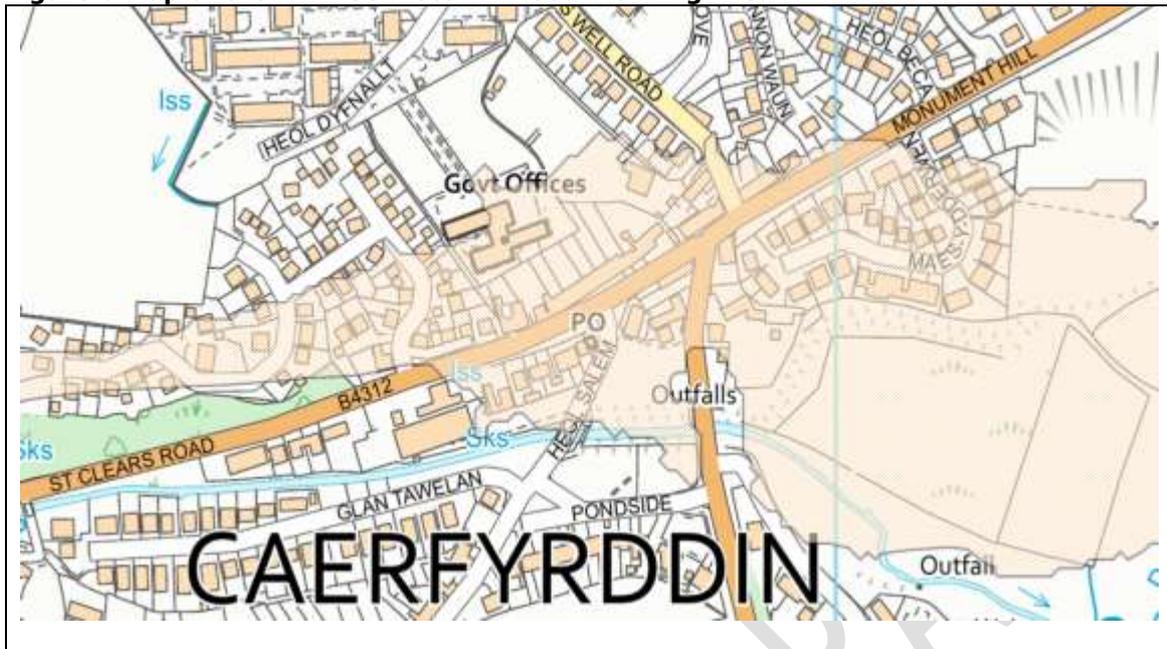


Figure 7 – NRW flood warning codes

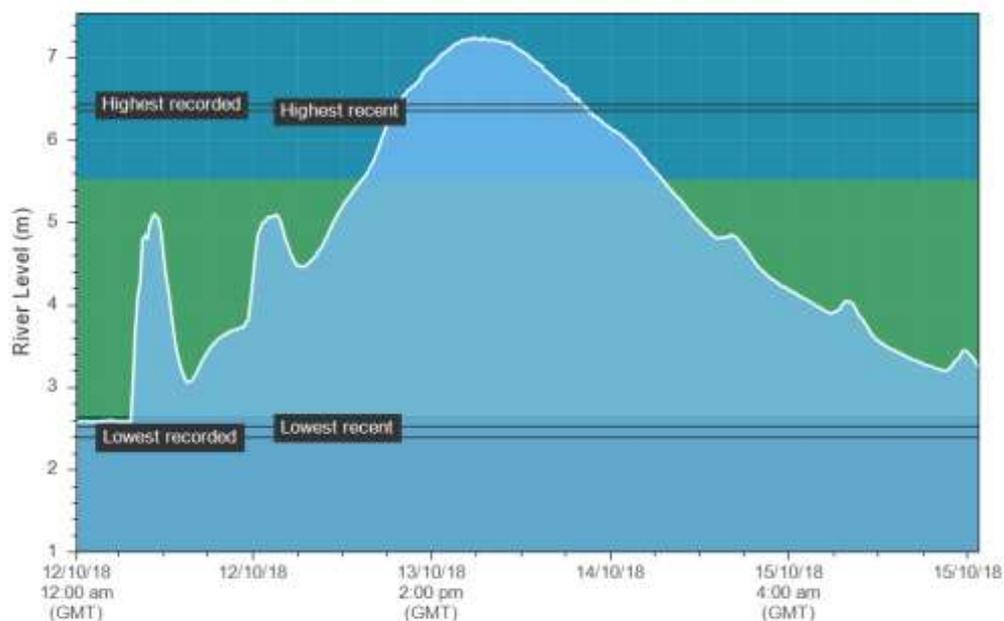
 FLOOD ALERT	<p>“Flooding is possible. Be prepared”</p> <p>The NRW issue Flood Alerts for targeted specific locations that are at risk of flooding.</p> <p>It will indicate that flooding is possible and that people should make some low impact preparations (e.g. move small valuable items upstairs, check travel plans) and remain vigilant</p>
 FLOOD WARNING	<p>“Flooding is expected. Immediate action required”.</p> <p>The NRW mainly target Flood Warnings at specific communities that are at risk from flooding. Some Flood Warnings may apply to stretches of coast and river.</p> <p>It will indicate that flooding is expected and that people should take more direct impact actions e.g. move belongings upstairs.</p>
 SEVERE FLOOD WARNING	<p>“Severe Flooding. Danger to life”.</p> <p>All customers who receive a Flood Warning will receive a Severe Flood Warning if conditions are met.</p> <p>It will be used in extreme circumstances to tell people that flooding is posing significant risk to life or significant disruption to communities which could also cause risk to life. Depending on the circumstances it would indicate that people should evacuate the area or take shelter within safe buildings.</p>
<p>Warning No Longer In Force</p>	<p>The NRW issues a message to tell people that the flood threat has passed and includes useful advice on what to do next.</p>

In the Johnstown flood warning area (as denoted by NRW - not this report) there are 134 properties eligible to receive warnings; just over 100 properties are fully registered (75%).

1.6.2 River Levels (Telemetry)

NRW have no telemetry on the Tawelan Brook. The nearest gauge is at Pothouse Wharf in Carmarthen. The flood water peaked at this location at a height of 7.25 metres on the 13th October at 18:15.

Figure 7: River Towy at Pothouse Wharf.



1.7 Investigation finding (Johnstown, Carmarthen)

1.7.1 Who was affected?

19 residential dwellings were flooded internally with many more businesses and dwellings affected externally. In addition, areas of the highway network were significantly affected, including St Clears Road and Llansteffan Road.

1.7.2 What happened?

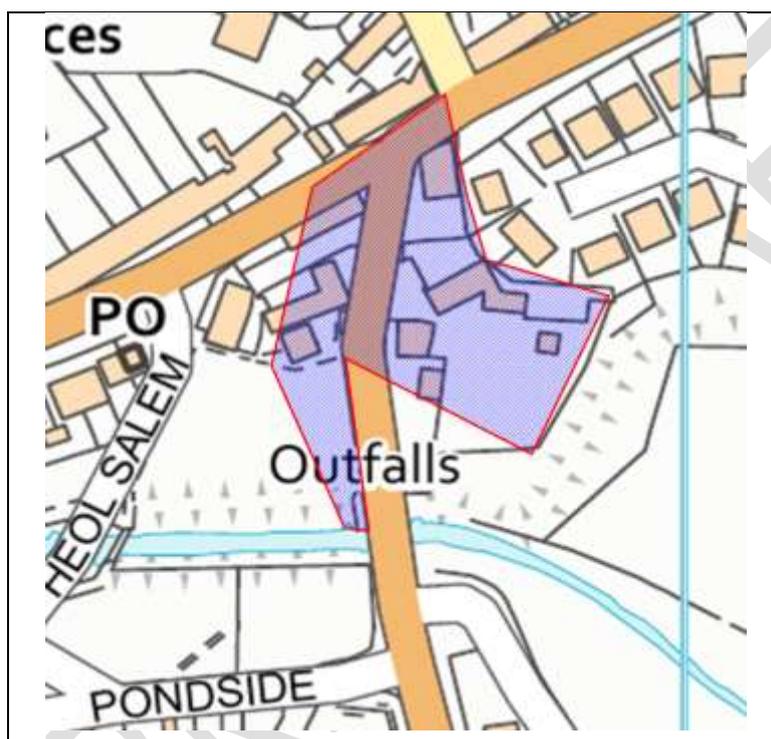
In addition to the extreme rainfall, investigations have identified that there were 4 areas of flooding that contributed to the overall flooding in the Johnstown area namely:

- The recreation ground/park and Llansteffan Road Bridge
- Heol Llansteffan Road
- St Clears Road
- Maes y Dderwen

Flooding at the Johnstown recreation ground / park and Llansteffan Road Bridge, Johnstown

Initial reports received stated that water escaped from the Tawelan Brook through the flood defence embankment. Once out of bank, water flowed through the recreation ground and northwards impacting on the highway, commercial and residential property.

Figure 9 – Map of the Johnstown recreation ground and Llansteffan Road Investigation area



It has also been reported that flooding in this area was from manholes in the highway which lifted under the force of the water inside. This flood water inundated the highway before spreading to affect local residential and commercial property.

Investigations have also concluded that contractors working on behalf of CCC removed a section of the NRW flood defence embankment while undertaking improvements to the adjacent walkway along Llansteffan Road. The actions were undertaken of the contractors own volition without the knowledge of CCC. This breach in the flood defence allowed flood flows to escape the Tawelan Brook. The breach was repaired by the contractor in liaison with CCC and NRW.

With regards to the surcharging manholes, investigations have highlighted that the primary asset in question is the DCWW surface water sewer (see maps in **Appendix C**). This is a 525mm diameter pipe that collects surface water from

Ash Grove, Ffynnon Waun, Heol Beca and property to the north and channels it to the Tawelan Brook.

Given the elevated water levels in the Tawelan Brook and the levels of the outfalls, free discharge would have been restricted. This would have resulted in water 'backing up' in the system until the force was great enough that it surcharged via the weakest point, be that a highway gully or a manhole.

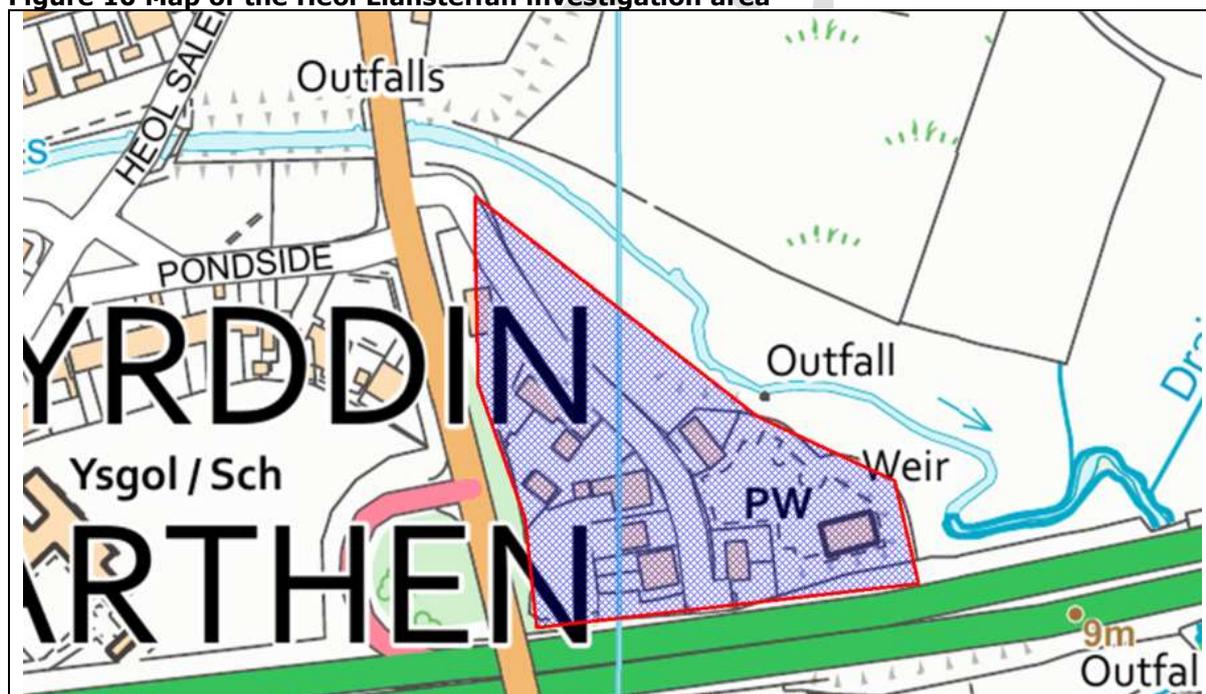
Action 3: Repair flood bank – COMPLETE.

Action 4: Investigate why flood bank was removed - COMPLETE.

Flooding at Heol Llansteffan Road, Johnstown

Surface water initially pooled on the highway and then spread to neighbouring residential property as the rain continued. The water appeared not to drain away. There were also unsubstantiated reports that there was ground water flooding.

Figure 10 Map of the Heol Llansteffan investigation area



Investigations have revealed that there is a DCWW foul system and two highway surface water systems serving Heol Llansteffan. The highway surface water systems discharge into the Tawelan Brook approximately 40 metres to the east. There is a DCWW overflow on the upstream end of the sewer (see Figure 11 below).

Given the elevated water levels in the Tawelan Brook and the levels of the outfalls, free discharge would have been restricted. This would have resulted in water 'backing up' in the system as the continued rainfall could not drain away.

The CCTV survey has also revealed that only one of the highway drainage systems has a non-return valve.

NRW have also highlighted that water could have overtopped a low point in the defences between Bronant and the Kingdom Hall. They are working with the landowners to put a structure in place to continue the level of flood protection afforded by nearby flood banks.

Figure 11: Map of the highway drainage at Llansteffan Road, Johnstown



Action 6: Clarify drainage asset owners and management responsibilities (Heol Llansteffan, Johnstown) COMPLETE

Action 7: Investigate the presence and functionality of the non-return valves in the highways drainage systems (Heol Llansteffan, Johnstown) COMPLETE

Action 8: Jet/clean the drainage system and action repairs accordingly (Heol Llansteffan, Johnstown)

Action 9: Implement a highways flooding management plan (Heol Llansteffan, Johnstown)

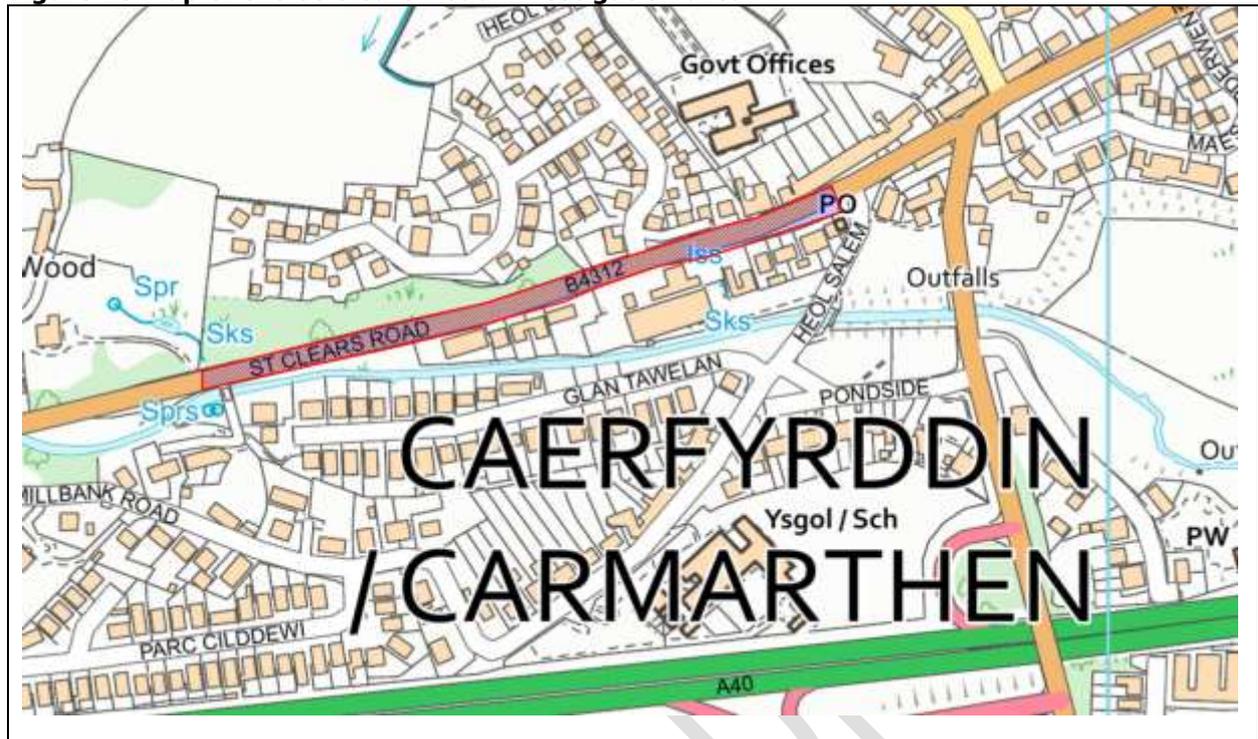
Action 10: Investigate the standard of service of the flood defence embankment (Heol Llansteffan, Johnstown)

Flooding at St Clears Road, Johnstown

Surface water initially pooled on the highway and then spread to neighbouring residential property as the rain continued. The water appeared not to drain away. There were unsubstantiated reports that water surcharged through the highway gullies.

It has also been reported that ground water flooding was evident in this area. Some properties had no surface inundation but water rose up through the floor. Comments were also made that flooding was very random with some properties along St Clears Road escaping internal flooding.

Figure 13 Map of the St Clears Road investigation area.



Investigations have concluded that there are two DCWW surface water systems in this area of St Clears Road (Figure 13). One drains Parc Starling and the second is an overflow that drains runs under the eastern end of St Clears Road. Unfortunately there are also gaps in knowledge pertaining to the highway drainage system.

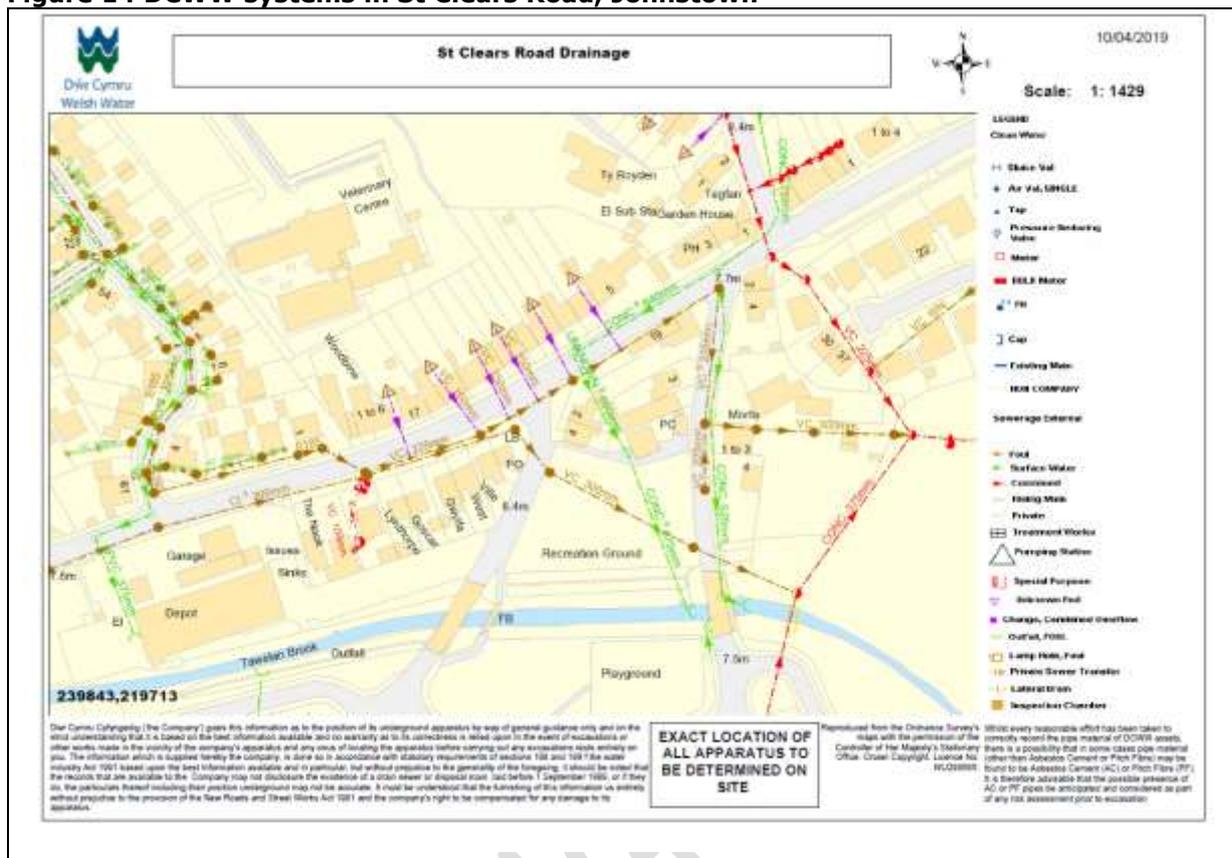
Given the elevated water levels in the Tawelan Brook and the levels of the outfalls, this report has concluded that free discharge would have been restricted. This would have resulted in water 'backing up' in the system as the continued rainfall would not be able to drain away. This would have eventually filled the DCWW systems and any highway systems and the water would have then surcharged onto the highway.

Action 11: Highways Authority to undertake CCTV investigations to clarify the layout of the drainage in St Clears Road, Johnstown.

Action 12: DCWW and the Highways Authority to evaluate the standard of service that is afforded by the drainage system in St Clears Road, Johnstown.

Action 13: DCWW and the Highways Authority to evaluate management options for exceedance in St Clears Road, Johnstown.

Figure 14 DCWW systems in St Clears Road, Johnstown



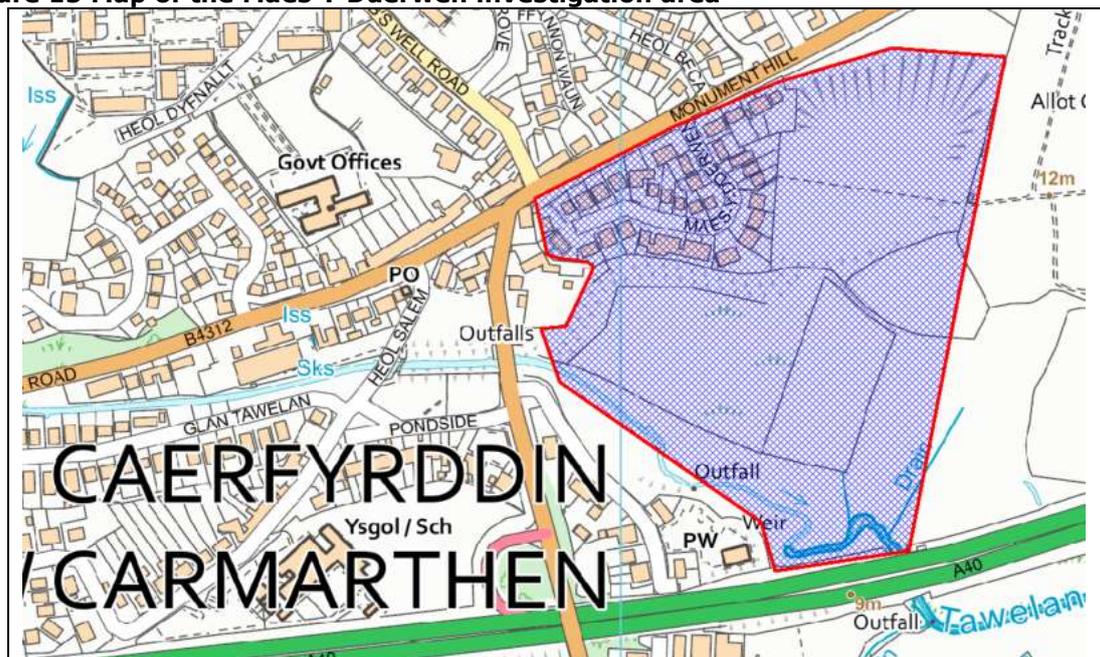
Flooding at Maes Y Dderwen, Johnstown

Flood water inundated the flood plain and overtopped the flood defence embankment to the south of Maes Y Dderwen before flooding residential properties behind. There were also unsubstantiated reports of ground water flooding.

Initial investigations have suggested that the Maes Y Dderwen area of Johnstown was predominately affected by fluvial flooding. NRW have confirmed that the flood bank to the south of Maes Y Dderwen (on the left bank of the Tawelan Brook flood plain) was approximately 100mm lower over a 5-metre reach. However, this report has also concluded that there were a number of factors working together to adversely affect flood risk in the area.

Surface water flowing downhill from the land to the north, could become trapped on the landward side of the embankment. Ground water flooding was reported throughout Johnstown. This was due to the weight and volume of water in the Tawelan Brook forcing water through the local geology and out of the ground neighbouring the watercourse.

Figure 15 Map of the Maes Y Dderwen investigation area



Action 14 NRW to evaluate the need to raise the flood bank at Maes Y Dderwen, Johnstown, Carmarthen;

Action 15: NRW and CCC to evaluate surface water management options on the landward side of the defence.

1.8 Summary of actions from the Johnstown Investigation.

Action 1: DCWW to evaluate the standard of service and the condition of the surface water sewers servicing Johnstown.

Action 2: CCC Highways Authority to work with DCWW to evaluate the standard of service and the condition of the highway drainage in Johnstown.

Action 3: Repair flood bank at Johnstown – COMPLETE.

Action 4: Investigate why flood bank was removed - COMPLETE.

Action 5: Undertake a CCTV of the drainage system (Heol Llansteffan, Johnstown) COMPLETE

Action 6: Clarify drainage asset owners and management responsibilities (Heol Llansteffan, Johnstown) COMPLETE

Action 7: Investigate the presence and functionality of the non-return valves in the highways drainage systems (Heol Llansteffan, Johnstown) COMPLETE

Action 8: Jet the drainage and action repairs accordingly (Heol Llansteffan, Johnstown).

Action 9: implement a highways flooding management plan (Heol Llansteffan, Johnstown).

Action 10: Investigate the standard of service of the flood defence embankment (Heol Llansteffan, Johnstown).

Action 11: Highways Authority to undertake CCTV investigations to clarify the layout of the drainage in St Clears Road, Johnstown.

Action 12: DCWW and the Highways Authority to evaluate the standard of service that is afforded by the drainage system in St Clears Road, Johnstown.

Action 13: DCWW and the Highways Authority to evaluate management options for exceedance in St Clears Road, Johnstown.

Action 14: NRW to evaluate the need to raise the flood bank at Maes Y Dderwen, Johnstown, Carmarthen.

Action 15: NRW and CCC to evaluate surface water management options on the landward side of the defence at Maes Y Dderwen, Johnstown, Carmarthen.

Table 2: Recommended Actions to be taken forward by the relevant RMAs or property / landowners, from the S19 Johnstown Investigation into the Storm Callum Flooding.

Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Term	Target Date
DCWW	Richard Davies	1	DCWW to evaluate the standard of service and the condition of the surface water sewers servicing Johnstown.	CCTV survey of the network identifying defects accordingly. Utilise the information gathered on pipe sizes, along with catchment and rainfall information to calculate the standard of service.	Medium	Oct 2019
Highway Authority	Ian Thomas	2	CCC Highways Authority to work with DCWW to evaluate the standard of service and the condition of the highway drainage in Johnstown (Generic).	Ian Thomas (CCC) and Richard Davies (DCWW) to look at asset records and CCTV surveys and document the condition of their assets. From the culvert survey information the standard of service can be calculated and recorded.	Medium	Oct 2019
CCC		3	Repair the flood bank at Johnstown Recreation Park.		Short	COMPLETE

CCC & NRW		4	Investigate why the flood bank was removed.		Short	COMPLETE
CCC (FD&CP)		5	Undertake CCTV of the drainage system in Llansteffan Road.		Short	COMPLETE
CCC (FD&CP)		6	Clarify drainage asset owners and responsibilities (Llansteffan Road).		Short	COMPLETE
Highways Authority	Ian Thomas	7	Investigate the presence and functionality of the non-return valves in the highways drainage systems (Heol Llansteffan, Johnstown).	Undertake a review of the CCTV survey or implement a monitoring programme to test the functionality of the NRVs.	Short	COMPLETE
Highways Authority	Ian Thomas	8	Jet the drainage and action repairs accordingly (Heol Llansteffan, Johnstown).	Utilise framework contractor to undertake the works.	Medium	Oct 2019
Highways Authority	Ian Thomas	9	Implement a highways flooding management plan (Heol Llansteffan, Johnstown).	Work with NRW, FD&CP and CCC Emergency Planning to agree triggers and actions to manage risk	Medium	Oct 2019
NRW	Aneurin Cox	10	Investigate the standard of service of the flood defence embankment (Heol Llansteffan, Johnstown).	Undertake an assessment of the flood banks and deliver works to ensure the standard of service can be achieved.	Short	COMPLETE

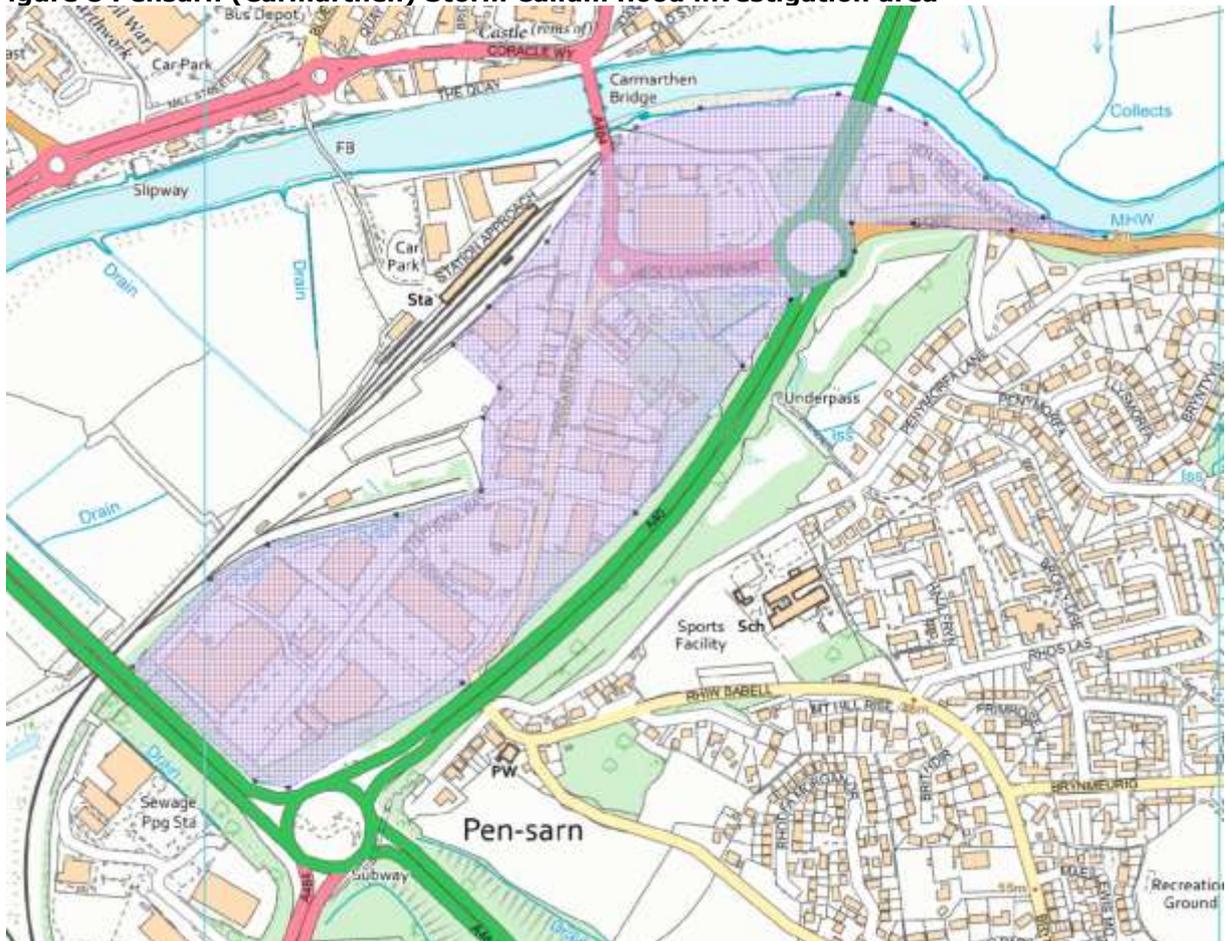
Highways Authority	Ian Thomas	11	Highways Authority to undertake investigations to clarify the layout of the drainage in St Clears Road, Johnstown.	Undertake a CCTV survey of the highway network to identify its location, size and condition.	Medium	Oct 2019
DCWW & Highways Authority	Richard Davies DCWW Ian Thomas CCC	12	DCWW and the Highways Authority to evaluate the standard of service that is afforded by the drainage system in St Clears Road, Johnstown.	Utilise the CCTV information gathered on pipe sizes, along with catchment and rainfall information to calculate the standard of service.	Medium	Oct 2019
DCWW & Highways Authority	Richard Davies DCWW Ian Thomas CCC	13	DCWW and the Highways Authority to evaluate management options for exceedance in St Clears Road, Johnstown.	Formulate a flood risk management plan to manage highway flooding.	Medium	Oct 2019
NRW	Aneurin Cox	14	NRW to evaluate the need to raise the flood bank at Maes Y Dderwen, Johnstown, Carmarthen.	Undertake an assessment of the flood banks and deliver works to ensure the standard of service can be achieved.	Medium	Nov 2019
CCC & NRW	Ben Kathrens Aneurin Cox	15	Evaluate surface water management options on the landward side of the defence at Maes Y Dderwen, Johnstown, Carmarthen.	CCC will calculate the volume of water that can potentially accumulate behind the defence and, if necessary NRW will suggest preferred methods to remove that water through their flood bund.	Medium	Oct 2019

5. Flood Investigation, Pensarn Carmarthen

The community of Pensarn is located to the south of Carmarthen Town. It is predominately a retail / business area but does have 9 residential dwellings.

This investigation will focus specifically on Pensarn Road, Old Llangunnor Road and Stephens Way Retail Park. Figure 8 below highlights the investigation area.

Figure 8 Pensarn (Carmarthen) Storm Callum flood investigation area



5.1 Headline Figures

During the Storm Callum weekend, Friday October 12th to Monday October 15th, Carmarthenshire County Council recorded:

- 9 substantiated incidents of internal property flooding.
- 14 substantiated incidents of internal business flooding.
- A maximum depth of flood water of 2.25 metres.
- The local highway network namely Pensarn Road, Old Llangunnor Road and Stephens Way was closed / impassable.

1.2 Flood History

Pensarn has a history of significant flooding events stretching back to 1929. Prior to the 1960's we have been informed that school busses passing through Pensarn were scheduled around the tide as the highway flooded twice daily. In the late 1950s / early 1960s a low wall was constructed to manage flood risk. This was overtopped in 1964 flood event and failed during flooding in 1965.

The flood wall was rebuild but in 1979 at Old Llangunnor Road it was overtopped in a flood event which was assessed as a 1 in 50 annual probability event at the time. In 1981 the wall was overtopped again. That flood event was assessed as a 1 in 20 annual probability. In 1984 the Old Llangunnor Road flood wall was raised a further 250mm and the railway bridge across the Tywi was removed. However, in October 1987 Pensarn was flooded again when the flood defence wall overtopped. This event was assessed as a 1 in 100 annual probability event.

Carmarthenshire County Council Flood Defence Team have no additional flood events recorded in this area.

The Highways Authority have confirmed that there have been incidents of highway flooding in Pensarn but these are associated with blocked highway gullies.

DCWW have stated that they have records of minor flooding in the Pensarn area when there is a failure at the pumping station.

1.3 Drainage Networks

1.3.1 Main rivers

The River Towy is the primary watercourse in the area.

Under the Flood and Water Management Act 2010, Natural Resources Wales (NRW) are responsible for flood risk management activities on main rivers. The River Towy is a Main River and the largest and longest watercourse in Carmarthenshire.

The Towy Pill, a small watercourse that traverses the river Towy flood plain, is located north-west of the network rail main line. This is also a main river that receives water discharging from Stephens Way in Pensarn.

1.3.2 Ordinary Watercourses

There are no ordinary watercourses in this area.

1.3.3 Surface water drainage systems / sewers

There are a number of surface water drainage systems serving the area namely at;

- Stephens Way Retail Park.
- Stephens Way.
- Pensarn Road.
- Old Llanynnor Road West.
- Old Llangunnor Road East (North of the A40).
- Sticle.

Stephens Way Retail Park surface water sewer

The Stephens Way Retail Park is drained by a private surface water sewer. This captures surface water from the commercial buildings and car parks before discharging into the River Towy (see Figure 9). The catchment for this system is approximately 3.3 hectares and CCC Flood Defence Engineers have calculated the following storm flows.

Table 3 Storm water flows in Stephens Way Retail Park, Pensarn, Carmarthen.

QBar mean annual maximum flow rate (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
33	54	29	49

In light of the information above and the results of a 2018 CCTV drainage survey, this report has concluded that the drainage system has sufficient capacity to manage all of the above storm events.

Figure 9: Plan of the Stephens Way Retail Park storm water sewer.



Stephens Way surface water sewer

The northern leg of the Stephens Way surface water system serves the adopted highway section of Stephens Way and the businesses at the north end of Stephens Way including the Royal Mail depot (Figure 10). This is also a private surface water sewer. This system flows across Network Rail land in a north westerly direction before discharging into the Towy Pill.

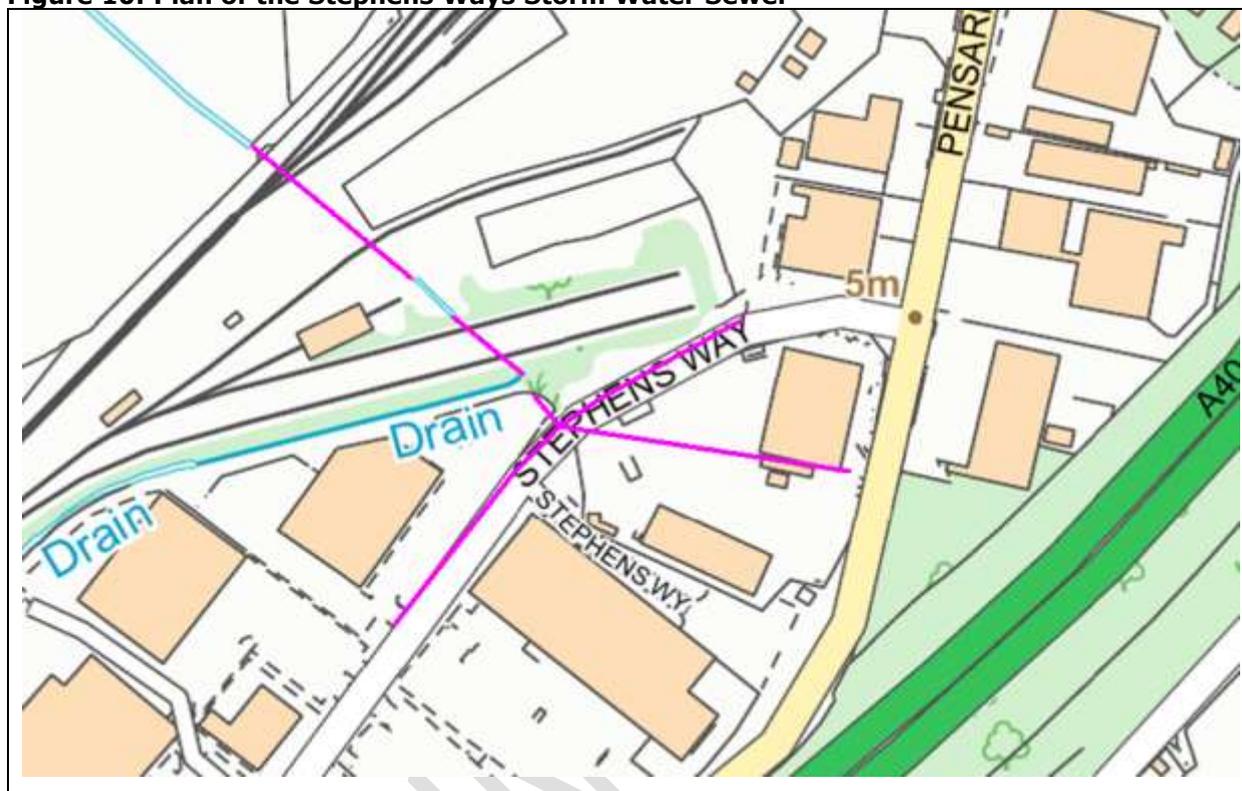
The catchment for this system is 3.7 hectares and as such CCC Flood Defence Engineers have calculated the following storm flows.

Table 4: Storm water flows in Stephens Way, Pensarn, Carmarthen.

QBar (mean annual maximum flow rate) (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
37	60	33	55

In light of the information above and the results of a 2018 CCTV drainage survey, this report has concluded that the drainage system has sufficient capacity to manage all of the above storm events.

Figure 10: Plan of the Stephens Ways Storm Water Sewer



Pensarn Road surface water sewer

From south to north along Pensarn Road runs a large surface water sewer. This is also a private surface water sewer. It collects surface water from Pensarn Road and the roofs and yards of neighbouring commercial premises.

The catchment for this system is approximately 4 hectares and as such CCC Flood Defence Engineers have calculated the following storm flows.

Table 5: Storm Water Flows in Pensarn Road, Carmarthen

QBar (mean annual maximum flow rate) (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
38	62	34	57

In light of the information above and the results of a 2018 CCTV drainage survey, this report has concluded that the drainage system has sufficient capacity to manage all of the above storm events.

Sticle surface water sewer

At the south side of Carmarthen Bridge there is a confluence between the above mentioned Pensarn surface water sewer and the Sticle surface water sewer. The Sticle system drains the land to the east and is a private surface water sewer. A review of the DCWW maps has highlighted that surface water from the above Llangunnor estate discharges into this system. However DCWW are checking the accuracy of the maps in this area.

Action 16: DCWW to check the accuracy of the surface water maps in the Llangunnor area of Carmarthen and update accordingly.

It was originally thought that the A40 also discharged into this system via the attenuation ponds and lagoons. However information from the South Wales Trunk Road Agency (SWTRA) has highlighted that this is not the case.

The catchment for this system has been calculated at approximately 10 hectares and as such CCC Flood Defence Engineers have calculated the following storm flows. These calculations have not taken into consideration any attenuation provided by the A40 ponds and lagoons, and are hence regarded as a worst case scenario.

Table 6: Storm Water Flows in Sticle, Pensarn, Carmarthen

QBar (mean annual maximum flow rate) (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
97	158	86	145

In light of the information above and the results of a CCTV drainage survey, this report has concluded that the drainage system has sufficient capacity to manage the storm flows from all of the above events.

Action 17: Investigate the effects of the attenuation lagoons and basins on flows entering the Sticle surface water sewer.

Old Llangunnor Road West surface water sewer.

The western leg of Old Llangunnor Road, beneath and alongside Carmarthen Bridge, to the west, is served by an independent surface water sewer. This system is fed from roofs and yards of the adjacent businesses and runs under Network Rail land before discharging into the River Towy beyond the NRW flood wall.

The catchment for this system is only approximately 5500m² and as such CCC Flood Defence Engineers have calculated the following storm flows.

Table 7: Storm Water flows at Old Llangunnor Road West, Pensarn, Carmarthen.

QBar (mean annual maximum flow rate) (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
5	8	4.5	7

Figure 11 Old Llangunnor Road Surface Water System



In light of the information above and the results of a CCTV drainage survey, this report has concluded that the drainage system has sufficient capacity to manage all of the above storm events.

Old Llangunnor Road Central

There is no information currently available on the surface water systems servicing the area between No.3 Old Llangunnor Road and the A40. A site walkover has identified the highway drainage gullies and two outfalls into the River Towy. CCTV surveys will be required to develop a further understanding.

Action 18: Undertake a CCTV survey of Old Llangunnor Road and the Currys PC World car park to ascertain its network, structural and service conditional and its future maintenance liability.

Old Llangunnor Road East

As with Old Llangunnor Road Central, there is currently no information available with regards to this system. NRW have stated that there is a single outfall to the River Towy servicing this area.

Action 19: Undertake a CCTV survey of Old Llangunnor Road (east of the A40) to ascertain its network, structural and service conditional and its future maintenance liability.

1.3.4 The Highway Drainage System

The adopted highway network in the area is serviced by highway gullies. The Highway Authority has limited details of the drainage system that serves this network. The recent CCTV surveys have provided some information and as such this report has concluded that the highway gullies along Pensarn Road and Stephen Way probably discharge into the private surface water sewers. As stated above, the Old Llangunnor Road area will need further investigation to determine if there are separate surface water and highways drainage systems.

1.3.5 South Wales Trunk Road Agency (SWTRA) Drainage

Both the A40 and A48 have drainage systems that discharge towards the Pensarn Area. It was initially thought that that the A40 discharged west into an attenuation pond system at Sticle; SWTRA have stated that this is not correct.

To the south west, the A48 east bound carriageway discharges to the Stephens Way Retail Park sewer.

Action 20: Collate information on the drainage systems that serve the A40 and A48 - COMPLETE

1.3.6 DCWW system

The details of the DCWW infrastructure servicing Pensarn are shown in **Appendix E**. Old Llangunnor Road, the northern leg of Pensarn Road and southern Terrace are serviced by a combined sewer system. The remainder of the Pensarn area has only foul drainage.

Action 21: DCWW to confirm that there are no DCWW assets in Stephens Way - COMPLETE

1.4 Flood Risk Management Assets

1.4.1 Natural Resources Wales Flood Risk Management Assets

NRW have 50 assets on the Pensarn area of which 16 are flood risk management assets categorised as 'defences'. These include areas of high ground, embankments, demountable defences and walls.

NRW and their predecessor organisations have a history of flood risk management in the Pensarn area dating back to the 1970s.

In 1970 a 400-metre long wall was built along Old Llangunnor Road in Pensarn the crest height of which was approximately 7.0 metres AOD. In 1979 that wall overtopped in a flood event which was assessed as a 1 in 50 probability. In 1981 the wall overtopped again in a flood event that was assessed as a 1 in 20 probability.

Figure 12 NRW flood risk management assets in Pensarn (Carmarthen) WEST



In 1984 Old Llangunnor Road wall was raised a further 250mm. New Defences were installed at Bridge Wharf, Old Station Road and along the Railway line. The railway bridge across the Towy was also removed. However in October 1987 Pensarn was flooded again when the defences were overtopped. This event was assessed as a greater than 1 in 100 probability event.

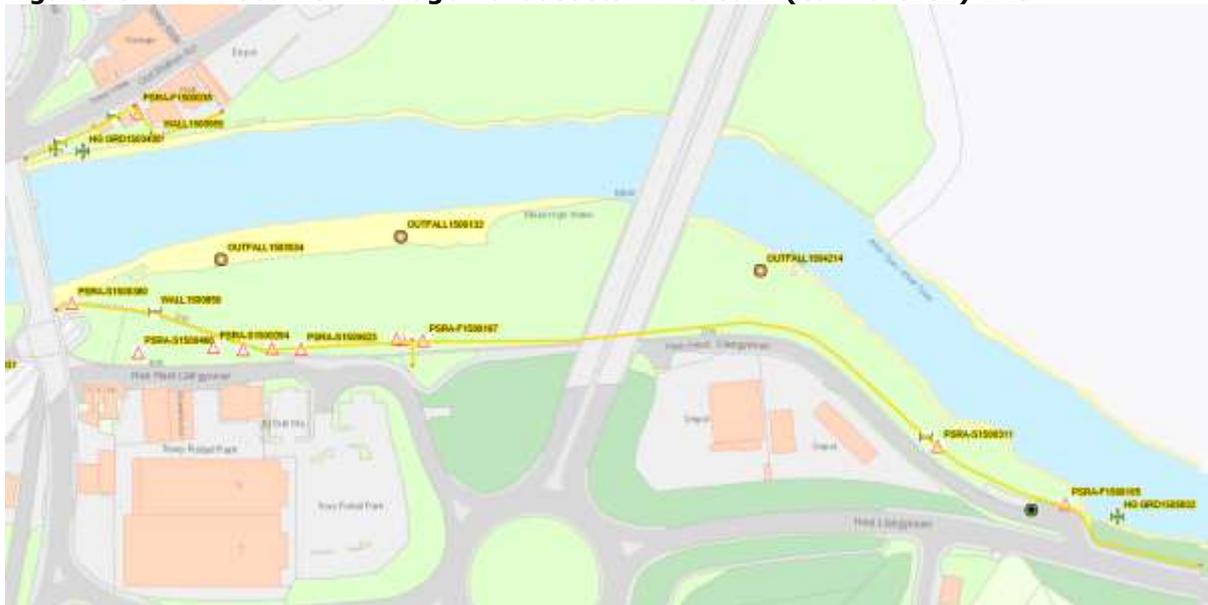
In 1989 a flood modelling exercise was undertaken by HR Wallingford.

In 1991 the first recommendations from the modelling exercise were undertaken (Carmarthen FAS Phase 1 – “Waterway Improvements”). These included re-aligning the River Towy for smoother flow entry under Bascule Railway Bridge.

In 1996 Carmarthen FAS Phase 2 was undertaken. The Old Llangunnor Road Wall was raised by approximately 500mm and other defences constructed in 1984 were raised accordingly.

In 2003 Carmarthen FAS Phase 3 (Stage 3) was undertaken. The western section of Old Llangunnor Road wall was raised by 300mm. The eastern section, upstream of the A40, was left at the 1996 level due to insufficient cost benefit analysis. The probability of a flood event overtopping the wall in any single year was calculated as 1 in 66 at the time.

Figure 13 NRW flood risk management assets in Pensarn (Carmarthen) EAST



1.4.2 CCC Flood Risk Management Assets

Within the flood investigation area there is only a single CCC Flood Risk management asset, namely a pump, beneath Carmarthen Bridge.

This pump was originally constructed by Environment Agency Wales in 2003. The pump facilitates the discharge of water from the Sticle and Pensarn Road surface water sewer into the River Towy just upstream of Carmarthen Bridge.

The pump is housed in a chamber off Old Llangunnor Road. The pump will operate when water levels reach 3.665mAOD. The invert of the outfall is 5.7mAOD.

CCC Flood Defence Engineers have calculated the catchment area draining to the pump as approximately 14 hectares. As detailed above, the pump manages surface water from a combination of the Sticle and Pensarn Road surface water systems. CCC Flood Defence Engineers have calculated the combined flows as detailed below in Table 8. These flows assume all the flood water will reach the pump and do not factor in any attenuation at Sticle.

Table 8 Storm flows with the potential of reaching the pump at Old Llangunnor Road.

QBar (mean annual maximum flow rate) (litres/Second)	Q100 Flood flow rate with an annual probability of 1 in 100 (litres/Second)	Q1 Flood flow rate with an annual probability of 1 (litres/Second)	Q30 Flood flow rate with an annual probability of 1 in 30 (litres/Second)
135	220	120	202

This report has concluded that the pump cannot be accurately evaluated without a robust understanding of all the storm flows it is likely to have to manage. As such the following actions have been recommend to ensure a robust assessment can be undertaken in the near future.

Action 22: Develop a better understanding of the outputs from the Sticle lagoon system;

Action 23: Re-evaluate the effectiveness of the pump at Old Llangunnor Road.

1.5 Other Assets

1.5.1 Carmarthenshire County Council Bridges and Structure

CCC Highway Structures Team manage a single structure in the investigation area namely structure W4122_1 Carmarthen Town Bridge.

NRW have confirmed that this bridge causes an afflux in severe flooding events and therefore impacts on the flood risk in the area.

1.5.2 South Wales Trunk Road Agency

The South Wales Trunk Road Agency (SWTRA) manage the A40 road bridge. NRW have not commented on the flood risk pertaining to this structure.

1.5.3 DCWW

DCWW operate a pumping station in Pensarn that is located to the rear of ATS. This is a critical asset which drains the foul flows from all of the Pensarn area.

1.6 The details of the flooding event

1.6.1 Flood Warnings

NRW have reported that the flood alert for the Lower Towy was issued at 13:56 on Friday 12th October 2018. This "Flood Alert" is issued in advance of any flooding and is the trigger for businesses and residents to be prepared as flooding is possible.

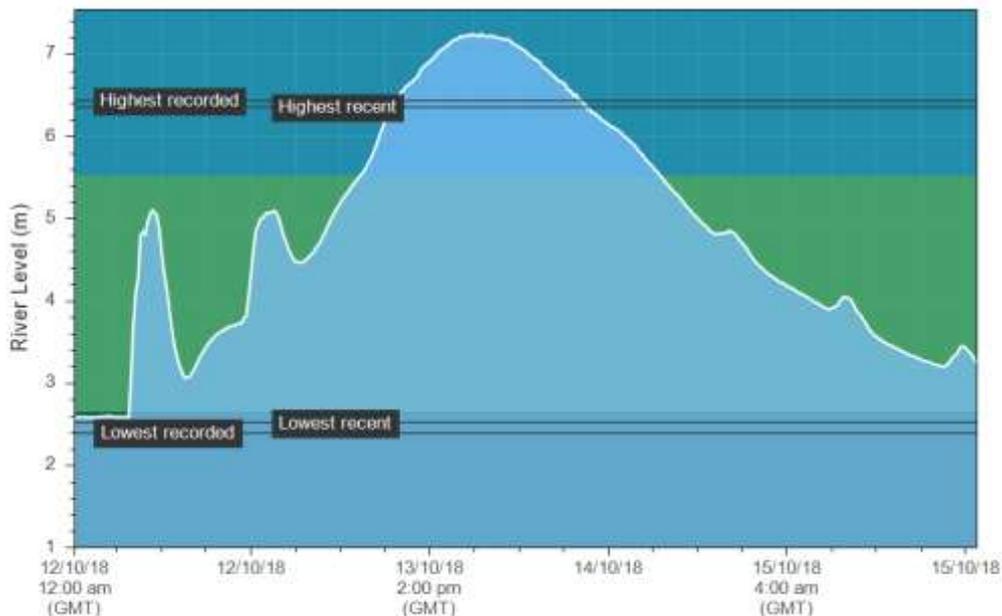
This was followed by the "Flood Warning" at 15:13 on Saturday 13th October 2018 (**Appendix F**). This warning is the trigger for immediate action as flooding is expected.

In the Pensarn flood warning area (as denoted by NRW - not this report) there are 131 properties eligible to receive warnings; 116 properties are registered for flood warnings, which is 88.5%.

1.6.2 River Levels (Telemetry)

NRW have stated that the flood water peaked at a height of 7.25metres on the 13th October at 18:15.

Figure 14 River Towy at Pothouse Wharf



1.6.3 Information gathered from site

CCC Flood Defence Engineers were on site at 1500 on Saturday 13th October 2018. They recorded the extent of the flooding in Pensarn at this time. Their observations are recorded below on Plate 4.

Plate 4 Photographs of the Flooding along Pensarn Road on Saturday 13th October 2018 at 1515.



1.7 Pensarn Investigation findings and Conclusions

9 residential dwellings and 14 businesses were flooded internally. Many more businesses and dwellings were affected by flood waters but only externally. In addition, areas of the highway network were significantly affected, including Old Llangunnor Road, Stephens Way and Pensarn Road.

1.7.1 What happened

This report has concluded that there were four areas of flooding in Pensarn namely:

- Old Llangunnor Road East (north of A40).
- Pensarn Road and Old Llangunnor Road.
- Southern Terrace.
- Stephens Way.

Old Llangunnor Road East (The area east of the A40)

At this location, water escaped from the River Towy through the flood wall and eventually over the top of the flood defence wall. It has also been reported that water was forced up through the ground.

NRW have calculated that the flood event on the River Towy had a return period of 50 years. As such, Storm Callum was the biggest flood event since 1987.

As highlighted above, the flood defence wall was not upgraded in 2003 and remains at the 1996 level. Therefore water levels overtopped this section of the defence as it was lower than the neighbouring downstream defences.

NRW have employed a Panel Engineer to undertake an assessment of the wall and make recommendations to resolve the issues. NRW have no plans to increase the height of the wall at this time.

Action 24: NRW to arrange for a structural inspection of the flood defence wall at Old Llangunnor Road to be undertaken COMPLETE.

Plate 5 Photographs of the flood defences at Old Llangunnor Road on the afternoon of 18th October 2018.



Pensarn Road and Old Llangunnor Road

Surface water initially pooled on the highways, then spread to neighbouring residential and commercial properties. Water did not come over the flood defence wall. There have been unsubstantiated reports of ground water flooding.

As previously stated, this investigation has revealed that there are information gaps pertaining to the drainage network in Old Llangunnor Road. However, the CCTV surveys that have been undertaken in this area have concluded that while the culvert is of sufficient size to manage the necessary storm water flows, there are sections of the sewer that are in need of maintenance (see Plate 3 below).

Plate 6: A partially blocked surface water sewer off Old Llangunnor Road, Pensarn.



Action 25: Network Rail to investigate and repair the section of blocked culvert at Old Llangunnor Road, West.

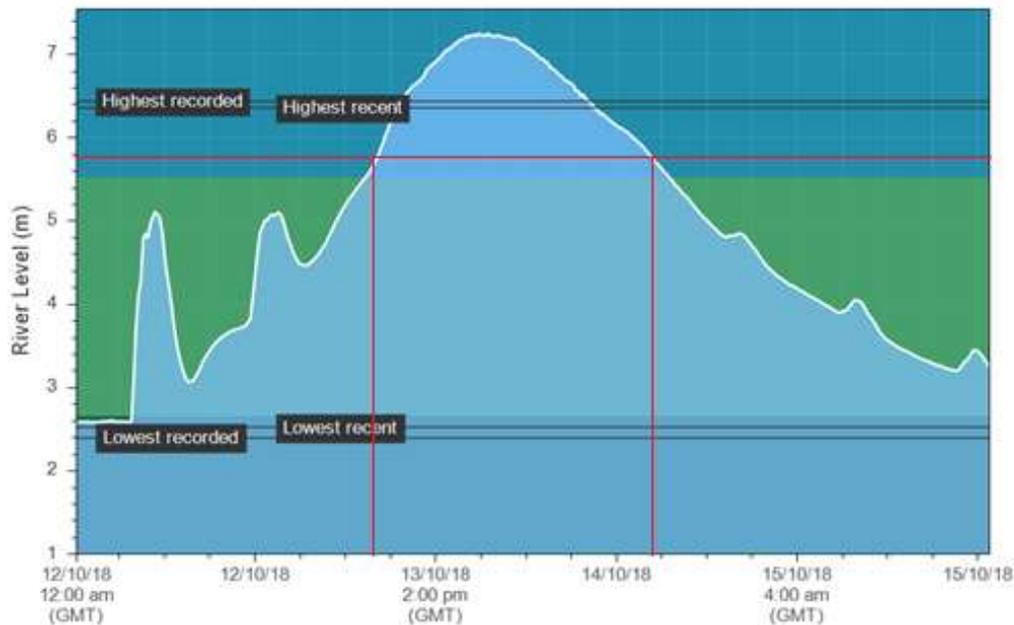
A CCTV survey of the Pensarn Road surface water sewer has highlighted some structural issues but nothing that is adversely affecting capacity. CCC Flood Defence and Coastal Protection Team will continue to monitor this as part of their routine duties.

As detailed above, there is a pumped discharge to the River Towy from the Pensarn surface water sewer. The outfall is set at a level of 5.7m AOD which is 2 metres higher than the invert of the drainage network on the landward side of the flood defence wall. The pump is designed to negate the 'tide locking effect' of an elevated River Towy by raising the water up thus allowing free discharge even in time of flood. However, when flood levels in the River Towy exceed 5.8 metres AOD, this report has concluded that the pump's discharge rate would have been adversely affected.

A review of the NRW telemetry data highlights that for approximately 24 hours, during the peak of the flood, water levels in the River Towy would have been greater than 5.8m AOD (Figure 15).

This report has therefore concluded that water flowing into the surface water sewer would have been discharged at a lesser rate as the River Towy rose. The volumes of surface water entering the system then exceeded the discharge rate which resulted in the surface water backing up in the sewer. When capacity in the sewer was reached, water surcharged through manholes and highway gullies.

Figure 15 Graph highlighting the period of time that the River Tawe would have limited the functionality of the pump



Action 26: Evaluate the capacity of the storm water sewers in Pensarn Road - COMPLETE

Action 27: Evaluate inputs from the Llangunnor Estate – COMPLETE

Action 28: Liaise with SWTRA on the discharges from the A40 and the level of attenuation provided by the lagoon and ponds at Sticle - COMPLETE

Action 29: Bid for financial assistance to evaluate the flood mechanisms at Pensarn and comprise a list of potential mitigation and management measures- COMPLETE

Action 30: Formulate a short to medium term flood management plan to manage exceedance at Pensarn.

Southern Terrace

Water infiltrated into the basements of properties. There was flooding of the adjacent highway (Pensarn Road).

The investigation has not come up with a single specific direct causation of why the basements of the properties flooded. They have not been structurally assessed as a part of this report. However, given the volume of water in the

area and observations and reports of ground water flooding at Old Llanygnor Road, this report has concluded that groundwater simply migrated into the basements.

An evaluation of the Sticle surface water sewer concluded that it was a private storm water sewer and that there was sufficient capacity to manage storm flows. However, a CCTV surveys has revealed structural defects that require repair.

Plate 7 Photograph of the defects in the Sticle Surface Water Sewer



Action 31: Identify the owners of the Sticle Storm water Sewer - COMPLETE

Action 32: Ensure the necessary repairs are undertaken to the Sticle Storm Water sewer

Stephens Way and Stephens Way Retail Park

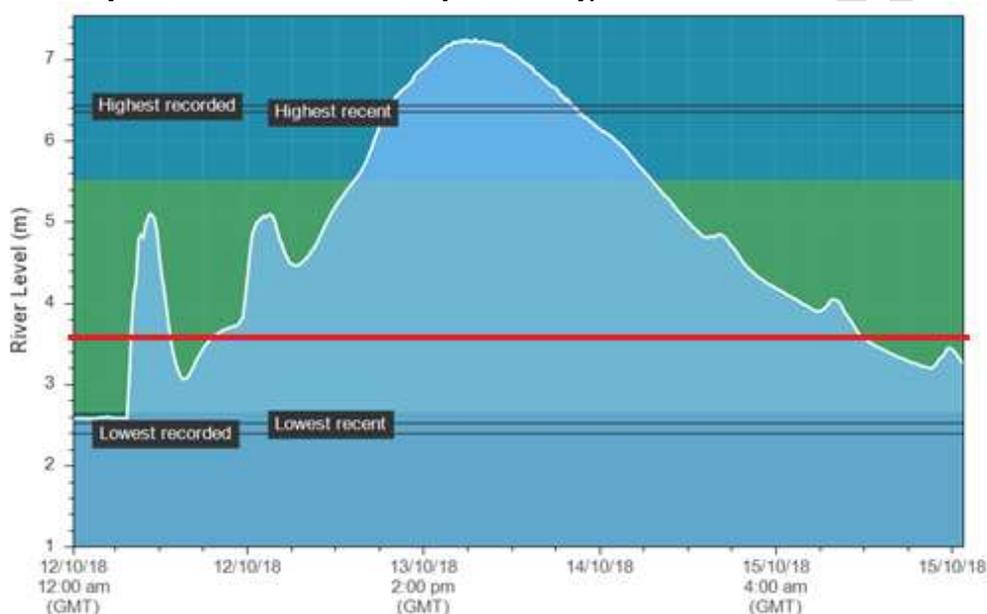
Surface water initially pooled on the highway and car park and then spread to neighbouring commercial properties.

CCTV investigation has revealed that the area is serviced by two private storm water sewers. Both systems have been identified as having service and structural defects that need addressing. As detailed above, there is sufficient capacity in the system to manage the storm flows however, given the extent of the defects, this report concludes that they were a contributing factor, adversely affecting conveyance and capacity.

The other contributing factor, and the primary factor for exceedance and flooding, is tide locking. This investigation has concluded that as the water level of the Towy rose above that of the outfall, the ability of the sewer to discharge

was adversely affected. The invert levels of the outfalls are not on record but based on the levels of other outfalls in the area, it is concluded that they would have been impacted over a period of days (see Figure 16). The volumes of surface water entering the system would have exceeded the discharge rate which subsequently resulted in the surface water backing up in the sewer. When capacity in the sewer was reached, water surcharged through manholes and highway gullies.

Figure 16: Graph highlighting the period of time that the River Towy would have limited the functionality of storm outfalls at Stephens Way, Pensarn.



Action 33: Inform the storm water sewer benefactors in Stephen Way of their obligations with regards to the drainage system and advise them to make the repairs identified.

1.8 Local residents also had the following questions:

Q. I am convinced that my property would not have flooded had the council brought out the extra 2 portable pumps as they have done for the last 17 years?

A. CCC Flood Defence Engineers and NRW officers cannot agree with this statement. The permanent fixed pump was constructed in 2003 after the 1997 floods. In the 16 years post construction there has been no deployment of additional mobile/portable pumps by either agency.

Q. Why was the reservoir opened at Llyn Brianne?

A. No water was released from Llyn Brienne. The reply from DCWW can be viewed in **Appendix G**

1.9 Summary of Actions from the Pensarn Investigation.

Action 16: DCWW to check the accuracy of the surface water maps in the Llangynnor area of Carmarthen and update accordingly.

Action 17: Investigate the effects of the attenuation lagoons and basins on flows entering the Sticle surface water sewer.

Action 18: Undertake a CCTV survey of Old Llangunnor Road and the Currys PC World car park to ascertain its network, and structural and service condition, and its future maintenance liability.

Action 19: Undertake a CCTV survey of Old Llangunnor Road (north of the A40) to ascertain its network, and structural and service condition, and its future maintenance liability.

Action 20: Collate information on the drainage systems that serve the A40 and A48 - COMPLETE

Action 21: DCWW to confirm that there are no DCWW assets in Stephens Way - COMPLETE

Action 22: Develop a better understanding of the outputs from the Sticle lagoon system.

Action 23: Re-evaluate the effectiveness of the pump.

Action 24: NRW to arrange for a structural inspection of the flood defence wall to be undertaken.

Action 25: Network Rail to investigate and repair the section of blocked culvert at Old Llangunnor Road, West.

Action 26: Evaluate culvert capacity – COMPLETE

Action 27: Evaluate inputs from the Llangunnor Estate – COMPLETE

Action 28: Liaise with SWTRA on the discharges from the A40 and the level of attenuation provided by the lagoon and ponds at Sticle - COMPLETE

Action 29: Bid for financial assistance to evaluate the flood mechanisms at Pensarn and comprise a list of potential mitigation and management measures-
COMPLETE

Action 30: Formulate a short to medium term flood management plan to manage exceedance.

Action 31: Identify the owners / benefactors of the Sticle Storm water Sewer -
COMPLETE.

Action 32: Ensure the necessary repairs are undertaken.

Action 33: Inform the drainage system benefactors of their obligations with regards to the drainage system and advise them to make the repairs identified.

Table 9 Recommended actions to be taken forward by the relevant RMAs or property / landowners, from the S19 Pensarn Investigation in the Storm Callum Flooding.

Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
DCWW	Richard Davies	16	DCWW to check the accuracy of the surface water maps in the Llangunnor area of Carmarthen and update accordingly.	Internal review of the data.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	17	Investigate the effects of the attenuation lagoons and basins on flows entering the Sticle surface water sewer.	Utilise WG grant money to evaluate flooding in Pensarn including the effects of the lagoons.	Long	April 2020
CCC FD&CP	Ben Kathrens	18	Undertake a CCTV survey of Old Llangunnor Road and the Currys PC World car park to ascertain its network, and structural and service condition, and its future maintenance liability.	Enlist CCTV contractor.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	19	Undertake a CCTV survey of Old Llangunnor Road (north of the A40) to ascertain its network, and structural and service condition, and its future maintenance liability.	Enlist CCTV contractor.	Medium	Oct 2019

CCC FD&CP	Ben Kathrens	20	Collate information on the drainage systems that serve the A40 and A48.	Liaison with SWTRA and evaluation of the Highway Authority WDM database.	Short	COMPLETE
DCWW	Richard Davies	21	DCWW to confirm that there are no DCWW assets in Stephens Way.		Short	COMPLETE
CCC FD&CP	Ben Kathrens	22	Develop a better understanding of the outputs from the Sticle lagoon system.	Utilise WG grant money to evaluate flooding in Pensarn including the effects of the lagoons.	Long	April 2020
CCC FD&CP	Ben Kathrens	23	Re-evaluate the effectiveness of the pump.	Utilise WG grant money to evaluate flooding in Pensarn, including the effectiveness of the pump.	Long	April 2020
NRW	Aneurin Cox	24	NRW to arrange for a structural inspection of the flood defence wall to be undertaken.	NRW to enlist the services of a Panel Engineer to evaluate the flood walls at Pensarn.	Medium	COMPLETE
Network Rail	Robert Knapman	25	Network Rail to investigate and repair the section of blocked culvert at Old Llangunnor Road, West.		Short	July 2019
CCC FD&CP	Ben Kathrens	26	Evaluate culvert capacity in Pensarn Road.	Use CCTV survey data and FSR or FSR rainfall data.	Short	COMPLETE
CCC FD&CP	Ben Kathrens	27	Evaluate inputs from the Llangunnor Estate.	Evaluate DCWW network and CCTV surveys.	Short	COMPLETE

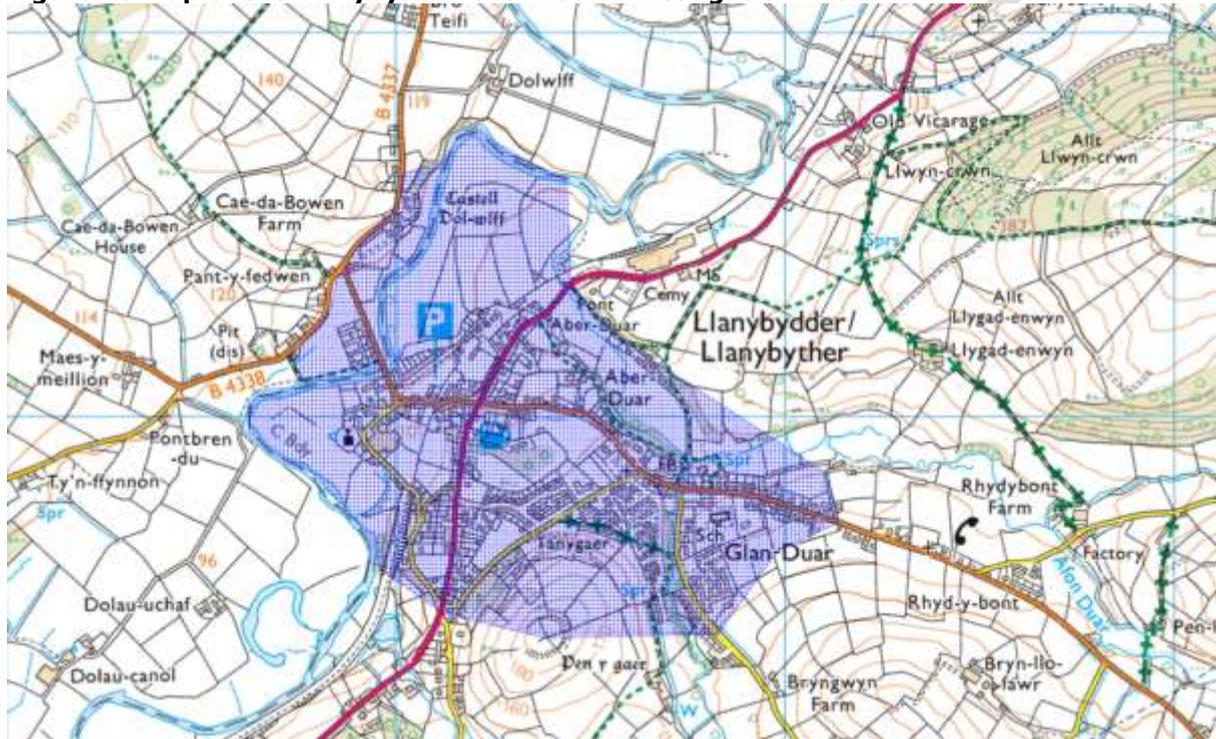
CCC FD&CP	Ben Kathrens	28	Liaise with SWTRA on the discharges from the A40 and the level of attenuation provided by the lagoon and ponds at Sticle.	Liaise with SWTRA.	Short	COMPLETE
CCC FD&CP	Ben Kathrens	29	Bid for financial assistance to evaluate the flood mechanisms at Pensarn and comprise a list of potential mitigation and management measures- COMPLETE	Submit an application to Welsh Government for funding under the capital work flood risk management pipeline programme.		COMPLETE
CCC Civil Contingency officer	Richard Elms	30	Formulate a short to medium term flood management plan to manage exceedance.	NRW and CCC Civil Contingency officers to formulate a plan.	Long	Feb 2020
CCC FD&CP	Ben Kathrens	31	Identify the owners / benefactors of the Sticle Storm water Sewer.	Undertake land registry searches and evaluate inputs into the system.	Short	June 2019
CCC FD&CP	Ben Kathrens	32	Ensure the necessary repairs are undertaken to the Sticle storm Water Sewer.	Write to the benefactors requesting a financial contribution and if unsuccessful evaluate issuing a notice under the Land Drainage Act 1991.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	33	Inform the drainage system benefactors of their obligations with regards to the drainage system and advise them to make the repairs identified at Stephens Way.	Write to the benefactors requesting a financial contribution and if unsuccessful evaluate issuing a notice under the Land Drainage Act 1991.	Medium	Oct 2019

6. Flood Investigation, Llanybydder

The town of Llanybydder is located in the north of the county approximately 7km south-west of Lampeter.

This investigation will focus on the flooding in the area highlighted below in Figure 18. For the purpose of the report there are two distinct areas of flooding - namely Station Terrace and Heol Y Dderi.

Figure 18 Map of the Llanybydder S19 Flood Investigation Area



1.1 Headline Figures

Over the above mentioned period Carmarthenshire County Council recorded:

- 32 substantiated incidents of internal property flooding.
- 4 substantiated incidents of internal flooding at commercial properties.
- The B4337 and Llanybydder Bridge were closed.
- NRW has stated that Storm Callum is the biggest flood event on record in the Teifi catchment, 35% greater than the 1987 floods.
- The event had a return period of 300-400 years (0.25-0.33% Annual Event Probability).
- Rainfall totals indicate a return period of up to 460 years.

1.2 Flood History

Natural Resources Wales have stated that there were significant flooding events in March 1981 and October 1987.

Carmarthenshire County Council Flood Defence Team have no recorded incident of flooding in this area.

The Highways Authority have confirmed that they have recorded incidents of highway flooding previously, however these were predominately issues related to blocked highway gullies.

DCWW have stated that there has been historical flooding on Station Road and Highmead Terrace. Both areas have seen capital investment which has resolved the issues.

1.3 Drainage Networks

1.3.1 Main Rivers

The River Teifi is the primary watercourse in the area. Under the Flood and Water Management Act 2010, Natural Resources Wales (NRW) are responsible for flood risk management activities on main rivers. The River Teifi is a main river.

1.3.2 Ordinary Watercourses

There are two ordinary watercourses of significance in the investigation area namely;

- The Afon Duar
- Nant Einon

The Afon Duar

To the north east of Llanybydder is the Afon Duar. This watercourse marks the northern extent of the town.

The catchment of this watercourse is 14.64km². Analysis of the flood flows has been undertaken and is shown in Table 9. The area at risk of fluvial flooding is highlighted on the Welsh Government Development Advice Map (DAM) below in Figure 19.

Table 9 Flood Flows on the Afon Duar at Llanybydder

1 in 100 annual probability Peak flow (metres cubed / second)	Annual probability Peak flow (metres cubed / second)	1 in 30 annual probability Peak flow (metres cubed / second)
21.81	8.62	17.31

Figure 19 Welsh Government Development Advice Flood Map for the Afon Duar, Llanybydder.



The Nant Einon

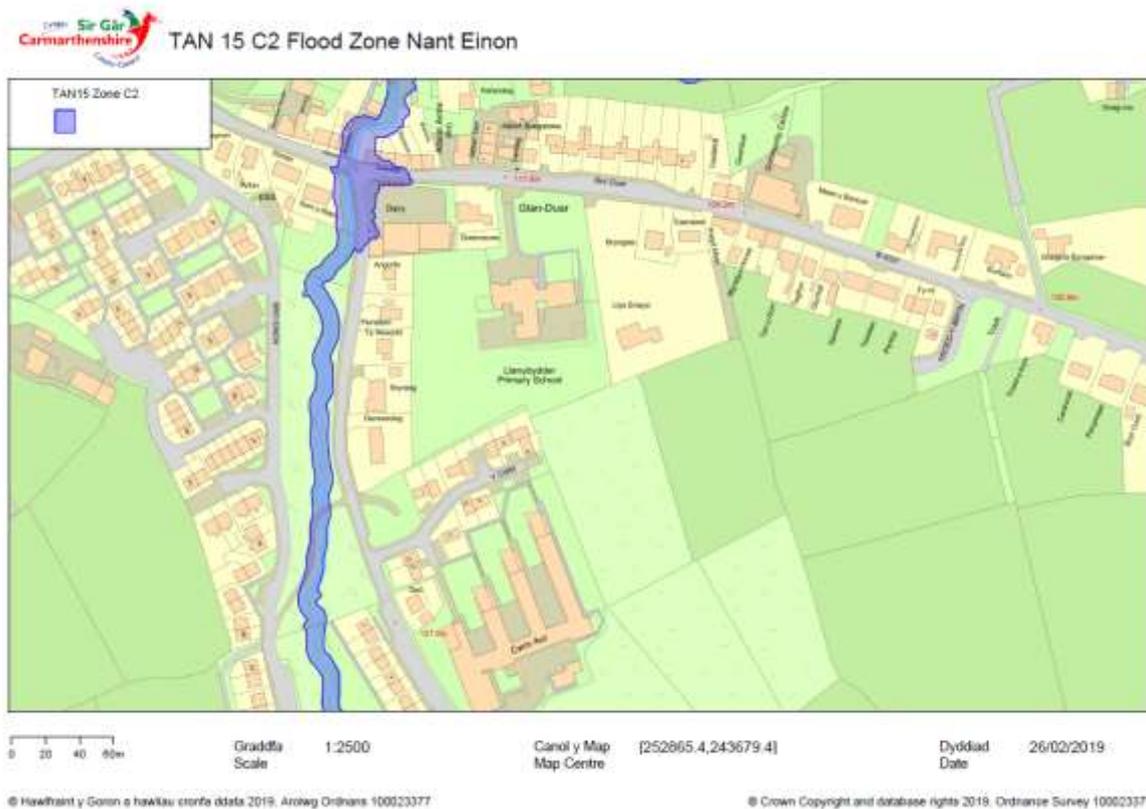
The Nant Einon flows south to north through the western district of the town. It passes beneath the B4337 (Plate-9) before meeting the Duar.

The catchment of this watercourse is 1.76km². Analysis of the catchment has given the flow data in Table 10. The area at risk of fluvial flooding is highlighted on the Welsh Government Development Advice Map (DAM) displayed on Figure 20.

Table 10 Catchment Analysis of the Nant Einon at Llanybydder

1 in 100 annual probability Peak flow (metres cubed / second)	Annual probability Peak flow (metres cubed / second)	1 in 30 annual probability Peak flow (metres cubed / second)
3.5	1.27	2.75

Figure 20 Welsh Government Development Advice Flood Map for the Nant Einon, Llanybydder.



1.3.3 Surface water drainage

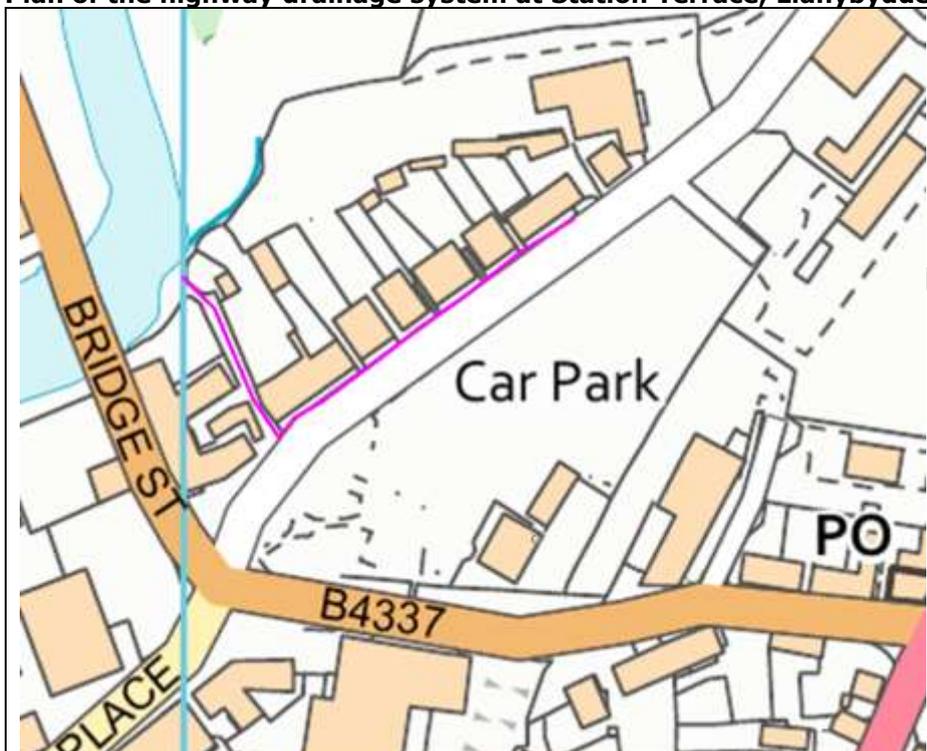
There are no known surface water systems in the area other than those detailed below, which are owned and operated by DCWW and the Highways Authority.

1.3.4 The Highway Drainage System

The highway network in Llanybydder is drained via highway gullies. There are no plans available for the highway drainage in and around Heol Y Dderi. However, after a site visit, CCC Flood Defence Engineers have concluded that the

gullies drain to the adjacent Nant Einon. No information exists on the standard of service or condition of these assets.

Figure 28 Plan of the highway drainage system at Station Terrace, Llanbydder



At Highmead Terrace, site visits have ascertained that the highway discharges to the adjacent flood plain. At Station Terrace, the Highways Authority have stated that there is an independent highway drainage system. Gullies drain the carriageway and the footway. The drainage system runs southwest down Station Terrace before turning north, alongside No.1 Station Terrace and to the River Teifi. The standard of service and condition of this system is not known.

Action 34 Undertake a CCTV survey of the highways drainage at Station Terrace, to ascertain the condition and standard of service.

1.3.5 DCWW

Llanbydder is part combined and part foul-only system. There are no public surface water systems in Llanbydder.

Action 35 Ascertain the details of the surface water drainage around Heol Y Dderi.

1.4 Flood Risk Management Assets

1.4.1 Natural Resources Wales Flood Risk Management Assets

NRW have no flood risk management assets in this area.

1.4.2 CCC Flood Risk Management Assets

CCC have no flood risk management assets in this area.

1.4.3 Carmarthenshire & Ceredigion County Council Bridges and Structures

The Teifi Bridge (Ref B4337_7) is a stone, four arch structure which spans between Carmarthenshire and Ceredigion (Plate 8). NRW have not commented on the bridge's effect on flood risk. They have however stated that there is a flood model available that can be utilised to extract that information.

Plate 8 River Teifi Bridge at Llanybydder.



The culvert beneath the B4337 at Heol Dderi (Ref B4337_6) is a twin, rectangular culvert with a varying diameter (Plate 9).

This report has concluded that this structure has an adverse effect on flood risk due to its size and alignment. There is insufficient capacity for the culvert to convey the necessary extreme storm flows and its alignment and design prohibits water flowing efficiently through the structure.

This investigation has also concluded that the DCWW pipe across the front of the culvert poses a substantial blockage risk.

Action 36: Investigate relocation of the sewer pipe to reduce the risk of blockage.

Plate 9 Photograph of the Nant Einon upstream of the B4337 highway culvert.



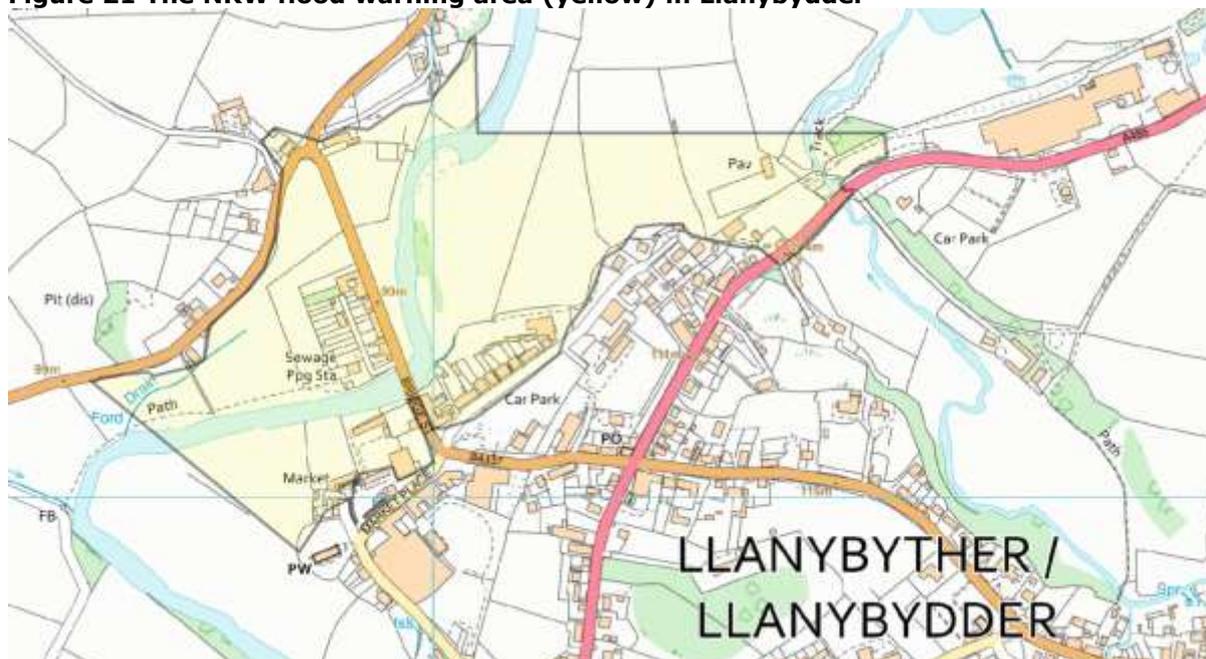
1.5 The details of the flooding event

1.5.1 Flood Warnings

NRW have reported that the "Flood Warning" for Llanybydder was issued at 13:05 on Saturday 13th October (**Appendix H**). This warning is the trigger for immediate action as flooding is expected.

In the Llanybydder flood warning area (as denoted by NRW - not this report, see Figure 21), there are 36 properties fully registered out of the 91 properties at risk, which is 39.56%. However, an additional 25 properties are signed up as 'Extended Direct Warnings' (see explanation below), which means that 61 or 67% of properties could be receiving the flood warnings for Llanybydder.

Figure 21 The NRW flood warning area (yellow) in Llanybydder



Extended Direct Warnings –

These are properties within the geospatial area for which the flood warning is targeted, who have not signed up formally for the flood warning service, but whose details (landline and mobile) have been captured in an agreement with phone operators, and “added” to the list of flood warning recipients in the area for which the warning is issued. We cannot trace these as address and mobile number details cannot be shared with us. We see a report of which phones have been sent the message but not enough to locate the address.

1.6 River Levels (Telemetry)

NRW have stated that there is no data available for this location.

Action 37: NRW to look into upgrading their telemetry monitoring network in the Llanybydder area.

1.7 Llanybydder Investigation finding

1.7.1 Who was affected

32 residential dwellings and 4 business was flooded internally. Many more businesses and dwellings were affected by flood waters but only externally. In

addition, areas of the highway network were significantly affected including Highmead Terrace, Station Terrace, the B4337 and Heol Y Dderi.

1.7.2 What happened

This report has concluded that there were two areas of flooding in Llanybydder that had different causes namely;

- Highmead Terrace, Station Terrace and areas adjacent to the Afon Teifi and;
- Heol Y Dderi and the B4337.

Highmead Terrace & Station Terrace

Water levels in the River Teifi rose to record levels as a result of the exceptional rainfall. The water level kept on rising until it flooded Highmead Terrace and Station Terrace. Residents reported water coming in through the front and back of their properties and up through the floor.

Using data gathered from Glanteifi gauging station, located downstream of Llanybydder between Llechryd and Cenarth, NRW have been able to calculate that this event had a return period of 300-400 years (0.25-0.33% Annual Event Probability) and rainfall totals indicate a return period of up to 460 years. NRW has stated that Storm Callum is the biggest flood event on record, being 0.6metres or 200m³/second (35% greater) than the previous highest recorded flood event in 1987.

This report therefore concludes that it was the sheer volume of rain, falling over a prolonged period, that resulted in the extreme flooding observed.

However, during the investigation, a number of alleged aggravating factors were highlighted. The primary issue was regarding the Highmead Terrace causeway (the highway B4337) that runs from Llanybydder Bridge into Ceredigion. It is alleged that this highway embankment, running across the floodplain, acts as a dam and elevates flood levels upstream. It was also alleged that after the 1987 floods, Dyfed County Council or the National Rivers Authority had a capital scheme planned to reduce the flood risk to Llanybydder.

This investigation has found no evidence of this flood defence scheme. Records in all three organisations - namely Ceredigion CC, Carmarthenshire CC and NRW - have been checked and nothing has been found. In addition, retired officers from these organisations have been contacted and they do not recall there ever being such a plan.

With regards to the impact of the causeway on flood risk, this report has concluded that a more detailed assessment will need to be commissioned. NRW has stated that they have a flood model that can be utilised, however actions to mitigate flooding at any location cannot be undertaken to the detriment of others. In addition an NRW Flood Risk Activity Permit would be required for any works undertaken on the causeway.

Action 38: Carmarthenshire and Ceredigion CC will commission a study to evaluate the effect of the causeway on flood risk and the legality and consequences of its removal or modification. NRW can lead and facilitate the production / interrogation of flood flow models to illustrate which scenario would achieve the best outcome.

A second potential aggravating factor is that works undertaken by DCWW in the Teifi flood plain, adjacent to Highmead Terrace, have modified the flood plain and adversely affected flood risk.

DCWW have confirmed that a scheme was carried out in 2014 to resolve flooding in the area. This involved the construction of storage tanks on land north of Highmead Terrace. There was no intention to increase surface levels and the construction of the apparatus should not have had any effect on topography or ground water.

Action 39: DCWW to investigate whether all spoil from the construction works was disposed of offsite and not spread on the floodplain.

Action 40: Carmarthenshire and Ceredigion Civil Contingency officers to meet with Llanybydder Community Council and help them formulate a flood management plan.

Flooding at Heol Y Dderi.

Surface water initially pooled on the highway. This spread to neighbouring residential properties. The Nant Einon eventually broke its banks and flooded the highway and neighbouring residential properties.

Evidence gathered as part of the investigation suggests that there were a number of key factors combining to cause the flooding observed. These include high rivers fuelled by the heavy rainfall, impediment of flood flows under the B4337, other blockages and finally the tide locking of highway drainage.

This report has already detailed the extreme rainfall that was experienced in Carmarthenshire over 11th to 13th October 2018. As such river levels were high and there was wide spread fluvial flooding.

Modern mitigation of fluvial flooding incorporates green infrastructure wherever possible, as an alternative to the grey, hard engineering that has been previously preferred. This includes attenuation of surface water in urban areas, and upland catchment management to try to reduce high river levels and manage flood flows. Consequently this report would make the following recommendations:

Action 41: Investigate opportunities for upland catchment management.

Action 42: Investigate the urban surface water system and opportunities for retro-fitting sustainable drainage features to manage surface water and flood risk.

With regards to the highway culvert beneath the B4337, CCC Flood Defence Engineers have concluded that its current standard of service is approximately the 1 in 40 annual event probability (AEP). To bring this structure up to current standard on the 1 in 100 AEP plus climate change (30%), a box culvert of between 3.5m² and 4m² (depending on alignment and gradient) would be needed. As such, any scheme would need to consider the flood risk downstream and the feasibility of placing such a large structure in the road, given existing apparatus/services.

Action 43: Undertake a feasibility exercise to identify the constraints that will impact on the upgrading of the B4337 highway culvert.

The investigation has identified a number of issues with the highways drainage. As highlighted above, the highway drainage network and its condition is not currently mapped, but this report has come up with a number of actions to assist in the management of flood risk. This includes diverting the highway drainage to discharge downstream of the highway culvert and therefore remove the risk of tide locking. There are currently no flaps on the outfalls and water could potentially travel from the watercourse and back out of the highway gullies during flood events. Plate 10 below highlights this issue.

Plate 10 Photographs of un-flapped highway drainage outfalls along the Nant Einon.



Action 44: Add flaps to the outfalls of the highway drainage.

Action 45: Investigate the feasibility of diverting the highway drainage to discharge on the downstream end of the B4337 culvert.

Finally, the investigation has identified that debris along the Nant Einon and Afon Duar during the storm event has contributed to the blockage risk and therefore increased the flood risk. The river banks along sections of these watercourses are also in a poor state of repair and there are large erosion pockets evident. There have also been complaints that cattle management gates along the watercourses that prevent livestock from damaging river banks and spawning beds were the cause of blockages.

This report has concluded that the management of the bed and banks of these watercourses, in addition to any fencing and gates that traverse them are the responsibility of the riparian land owners. Help and advice can be sought from NRW or the relevant local authority but each riparian land owner must take some responsibility in the management of the flood risk at or below their land.

Action 46: Identify the land owners and inform them of their riparian duties to maintain the river banks and keep them clear of debris.

1.8 Local residents' questions

A list of questions pertaining to the flooding event was submitted by Llanybydder Community Council on behalf of the residents during the flood investigation. These questions and their formal replies are attached in **Appendix I**.

It has also been agreed that Carmarthenshire and Ceredigion County Council Civil Contingency officers will work with the Llanybydder Community Council to develop a flood management plan for the area (Action 40).

1.9 Summary of Actions from the Llanybydder Investigation.

Action 34: Undertake a CCTV survey of the highways drainage at Station Terrace, to ascertain the condition and standard of service.

Action 35: Ascertain the details of the surface water drainage around Heol Y Dderi.

Action 36: Investigate relocating the sewer pipe to reduce risk of blockage.

Action 37: NRW to look into upgrading their telemetry monitoring network in the Llanybydder area.

Action 38: Carmarthenshire and Ceredigion CC will commission a study to evaluate the effect of the causeway on flood risk and the legality and consequences of its removal or modification. NRW can lead and facilitate the production of flood flow models to illustrate which scenario would achieve the best outcome.

Action 39: DCWW to investigate whether all spoil from the construction works was disposed of offsite and not spread on the floodplain.

Action 40: Carmarthenshire and Ceredigion Civil Contingency officers to meet with Llanybydder Community Council and help them formulate a flood management plan.

Action 41: Investigate opportunities for upland catchment management.

Action 42: Investigate the urban surface water system and opportunities for retro-fitting sustainable drainage features to manage surface water and flood risk.

Action 43: Undertake a feasibility exercise to identify the constraints that will impact on the upgrading of the B4337 highway culvert.

Action 44: Add flaps to the outfalls of the highway drainage.

Action 45: Investigate the feasibility of diverting the highway drainage to discharge at the downstream end of the B4337 culvert.

Action 46: Identify the land owners and inform them of their riparian duties to maintain the river banks and keep them clear of debris.

WORKING DRAFT

Table 12 Recommended Actions to be taken forward by the relevant RMAs or property / landowners, from the S19 Llanybydder

Investigation into the Storm Callum Flooding.

Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
Highways Authority	Stuart Quick	34	Undertake a CCTV survey of the highways drainage at Station Terrace, to ascertain the condition and standard of service.	Commission a CCTV contractor to undertake the works and produce a condition report. The standard of service will be calculated from the pipe sizes, rainfall and catchment area.	Medium	Oct 2019
DCWW	Richard Davies	35	Ascertain the details of the surface water drainage around Heol Y Dderi.	Undertake site and database investigations.	Medium	Oct 2019
DCWW	Richard Davies	36	Investigate the feasibility of relocation of the sewer pipe at Heol Y Deri	Work with the Highways Authority and CCC FD&CP team to see if the sewer pipe can be relocated as part of the wider potential capital scheme at Heol Y Dderi.	Medium	Oct 2019
NRW	Aneurin Cox	37	NRW to look into upgrading their telemetry network in the Llanybydder area.	NRW feasibility study.	Medium	Nov 2019

Ceredigion, CCC & NRW	Ben Kathrens Rhodri Llwyd Aneurin Cox	38	Carmarthenshire and Ceredigion CC will commission a study to evaluate the effect of the causeway on flood risk and the legality and consequences of its removal or modification. NRW can lead and facilitate the production of flood flow models to illustrate which scenario would achieve the best outcome.	Carmarthenshire CC and Ceredigion CC to write a brief and submit to NRW. NRW will evaluate the work that needs to be undertaken to meet the requirements of the brief and if they do not have adequate resources, contract the services of a framework contractor to interrogate the flood model and provide a report accordingly.	Medium term (agree brief and ToR) Long term (full analysis and reporting)	July 2019 Feb 2020
DCWW	Richard Davies	39	DCWW action to further investigate whether the spoil has affected the flood risk.		Medium	Oct 2019
Carmarthenshire CC & Ceredigion CC Civil Contingency	Richard Elms &	40	Develop a local flood plan and resilience.	Carmarthenshire and Ceredigion Civil Contingency officers to meet with Llanybydder Community Council and help them formulate a flood management plan.	Long	Feb 2020
NRW	Aneurin Cox	41	Investigate opportunities for upland catchment management in the Nant Einon and Afon Duar catchments.	Carry out a desk top study that will provide a list of potential opportunities as to where this could happen and provide benefit. The outcome of this work will then be shared with partners to prompt a decision about how best to proceed.	Long	Feb 2020

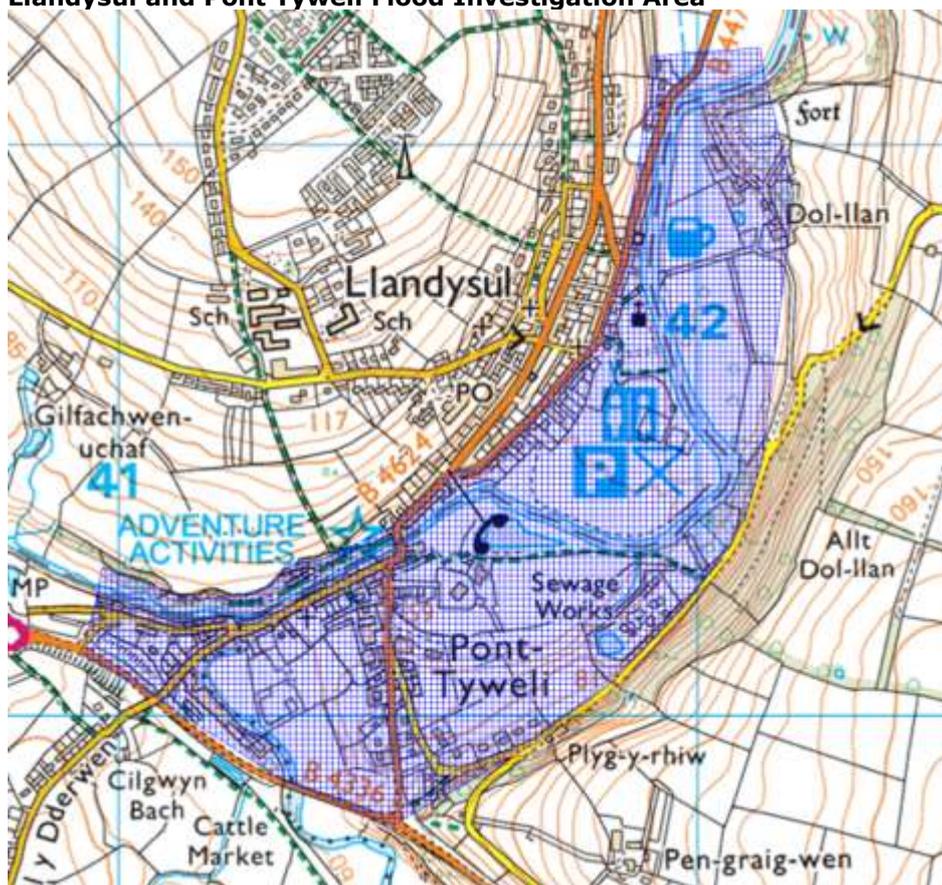
DCWW	Richard Davies	42	Investigate the urban surface water system, and opportunities for retro-fitting sustainable drainage features to manage surface water and flood risk.		Long	Feb 2020
CCC FD&CP	Ben Kathrens	43	Undertake a feasibility exercise to identify the constraints that will impact on the upgrading of the B4337 highway culvert.	Undertake utility searches and run a HEC RAS fluvial model.	Medium	Oct 2019
Highways Authority	Stuart Quick	44	Add flaps to the outfalls at Heol Y Dderi, Llanybydder.	Add flaps to the highway outfalls.	Medium	Oct 2019
Highways Authority	Stuart Quick	45	Investigate the feasibility of diverting the highway drainage to discharge at the downstream end of the B4337 culvert.	Undertake utility searches.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	46	CCC to identify the land owners and inform them of their riparian duties to maintain the river banks and keep them clear of debris.	Undertake land registry searches and issue information letters to riparian owners.	Medium	Oct 2019

7. Flood Investigation, Llandysul and Pont-Tyweli

The town of Llandysul is located in the north of the county approximately 20km north of Carmarthen on the Ceredigion boarder.

This investigation will focus on the flooding in the area highlighted below in figure 23.

Figure 23 Llandysul and Pont Tyweli Flood Investigation Area



1.1 Headline Figures

During the Storm Callum weekend (12th -15th October 2018) Carmarthenshire County Council recorded:

- 32 substantiated incidents of internal property flooding.
- 22 substantiated incident of business flooding.
- The highway network at Lewis Street, Station Road and Cambrian Terrace was unpassable.
- The maximum recorded depth of flood water was 2 metres.
- NRW has stated that Storm Callum was the biggest flood event on record in the Teifi catchment, 35% greater than the 1987 floods.

- The event had a return period of 300-400 years (0.25-0.33% Annual Event Probability).
- Rainfall totals indicate a return period of up to 460 years.

1.2 Flood History

Natural Resources Wales have five recorded flood events in this area dating back to 1979. The biggest event recorded occurred on the 19 October 1987. Since this there have been smaller events in 1992, 2000 and 2005.

Carmarthenshire County Council Flood Defence Team have no recorded incidents of flooding in this area.

The Highways Authority have confirmed that they have recorded incidents of highway flooding previously, however these were predominately issues that related to localised and temporarily blocked highway gullies.

1.3 Drainage Networks

1.3.1 Main Rivers

The River Teifi is the primary watercourse in the area. Under the Flood and Water Management Act 2010, Natural Resources Wales (NRW) are responsible for flood and coastal erosion risk management activities on main rivers. The River Teifi is a main river.

The catchment of the River Teifi above Llandysul Road Bridge is 553km².

The Afon Tyweli is another main river in the investigation area. This has a catchment of 52.71km².

1.3.2 Ordinary Watercourses

There are no ordinary watercourses in this area.

1.3.3 Surface water drainage

There are no known surface water systems in this area.

1.3.4 The Highway Drainage System

The adopted highway network in the area is serviced by highway gullies. The Highways Authority has limited details of the drainage network, its condition or its standard of service.

Action 47: Undertake CCTV surveys to identify the path, standard of service and condition of the highways drainage.

1.4 Flood Risk Management Assets

1.4.1 Natural Resources Wales Flood Risk Management Assets

NRW have no flood risk management assets in this area.

1.4.2 CCC Flood Risk Management Assets

CCC have no flood risk management assets in this area.

1.5 Other Assets

1.5.1 Carmarthenshire County Council Bridges and Structure

There are two county bridge structures in this area. The primary Llandysul A486 bridge (A486_4) a single span arch.

Carmarthenshire Council are also responsible for the Pontwelly road bridge at Station Street (Ref A486_2).

NRW have not commented on the bridges' effect on flood risk. They have however stated that there is a flood model available that can be utilised to extract that information.

1.5.2 DCWW Assets

DCWW suffered damage to three assets in Llandysul during Storm Callum. Two control panels serving a pumping station (Pont Tywelli) and a CSO (Wilkes Head) were washed away and one sewage pumping station (Wilks Head) was completely flooded out. Service was restored to these assets quickly when water levels dropped.

1.6 The details of the flooding event

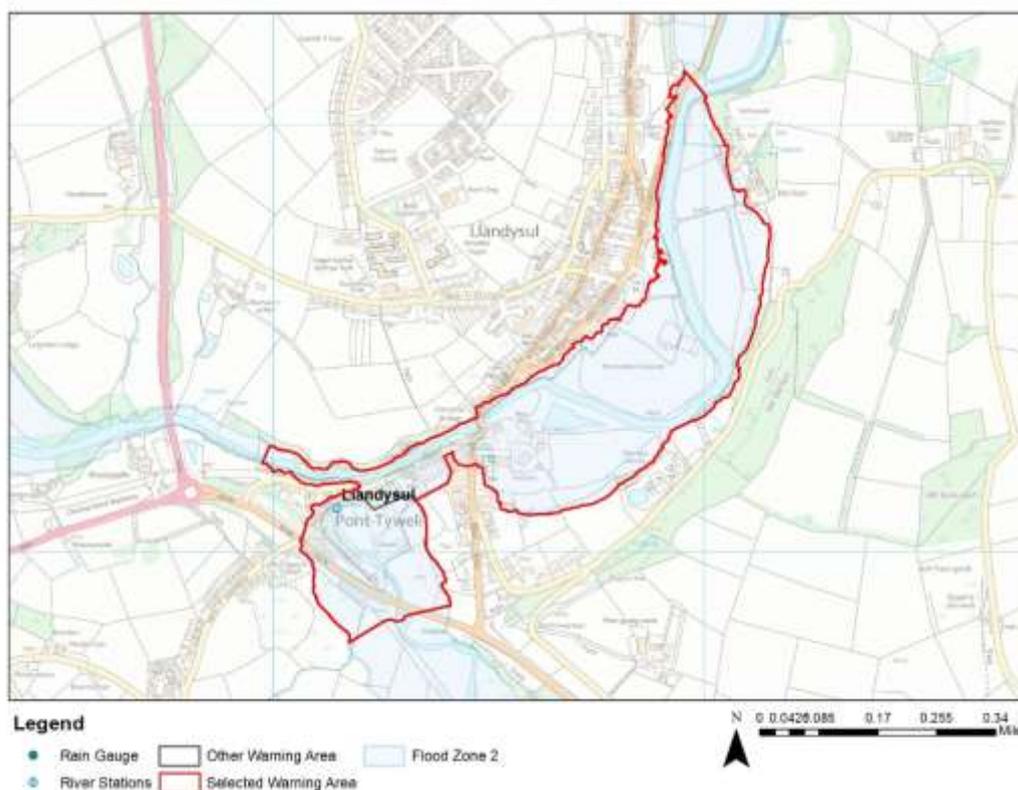
1.6.1 Flood Warnings

There are 2 flood warning areas in Llandysul the first for the river Teifi (NRW reference 102FWF153A) and the second for the River Tyweli (102FWF153B).

102FWF153A - the River Teifi warning area includes Llandysul Bridge, the Fire Station and property in Lewis Street, Cambrian Terrace, the A486 and the B4476. NRW have reported that the "Flood Warning" was issued at 04:54 on Saturday 13th October 2018. This warning is the trigger for immediate action as flooding is expected.

In this flood warning area (as denoted by Figure 24) there are 156 customers registered for the service.

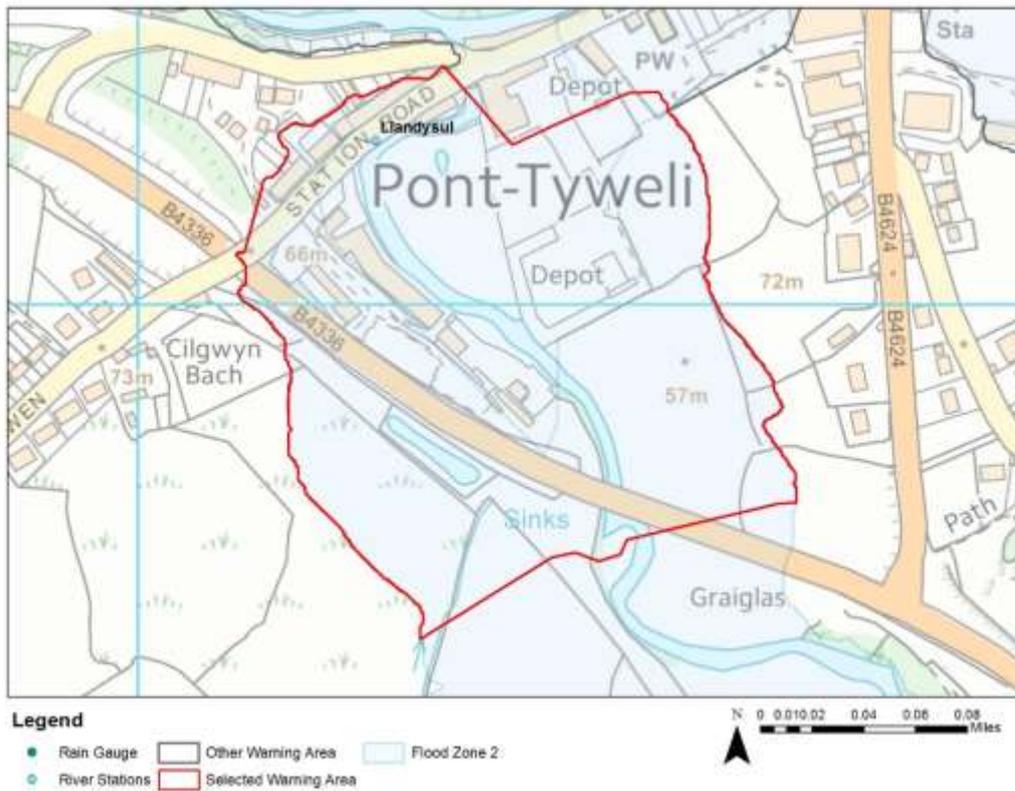
Figure 24 Map depicting the NRW flood warning area in Pont-Tyweli.



102FWF153B - the River Teifi warning area includes properties in Station Road, Pont Tyweli. NRW have reported that the "Flood Warning" was issued at 05:10 on Saturday 13th October 2018. This warning is the trigger for immediate action as flooding is expected.

In this flood warning area (as denoted by Figure 25) there are 135 customers registered for the service.

Figure 25 The Pont Tyweli Flood warning area

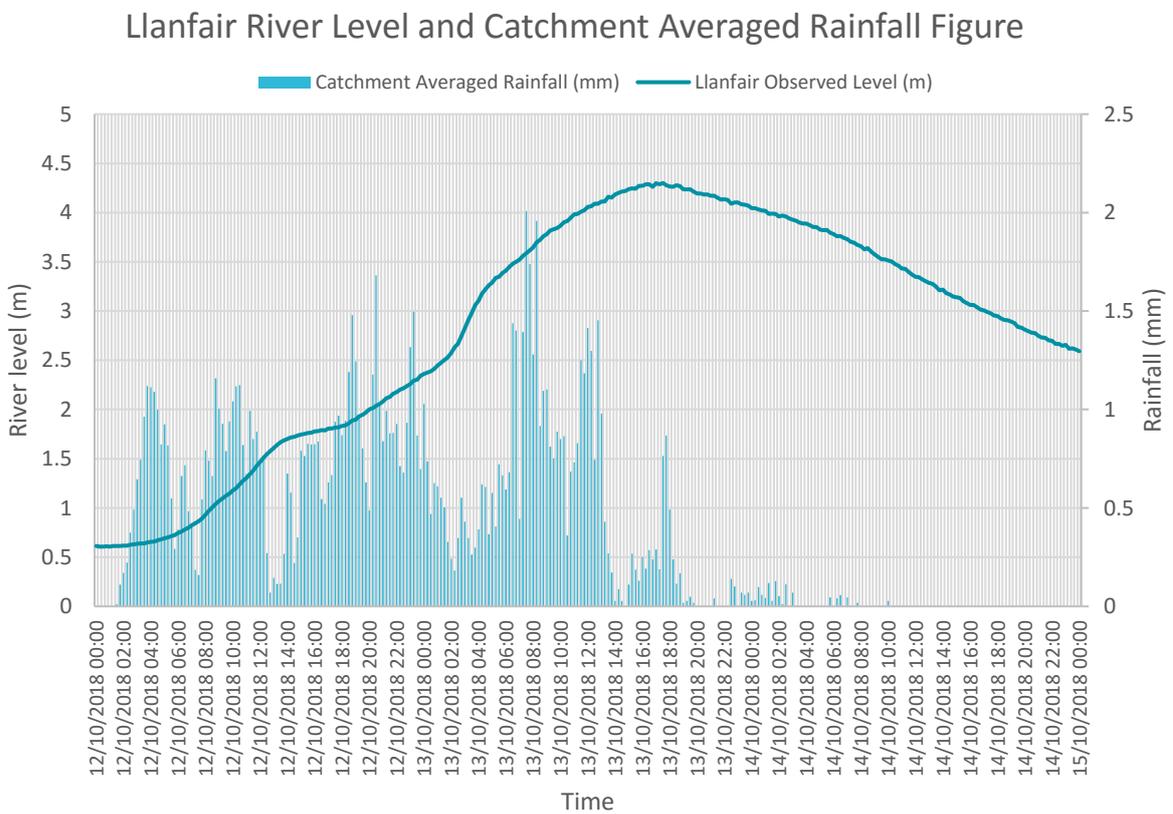
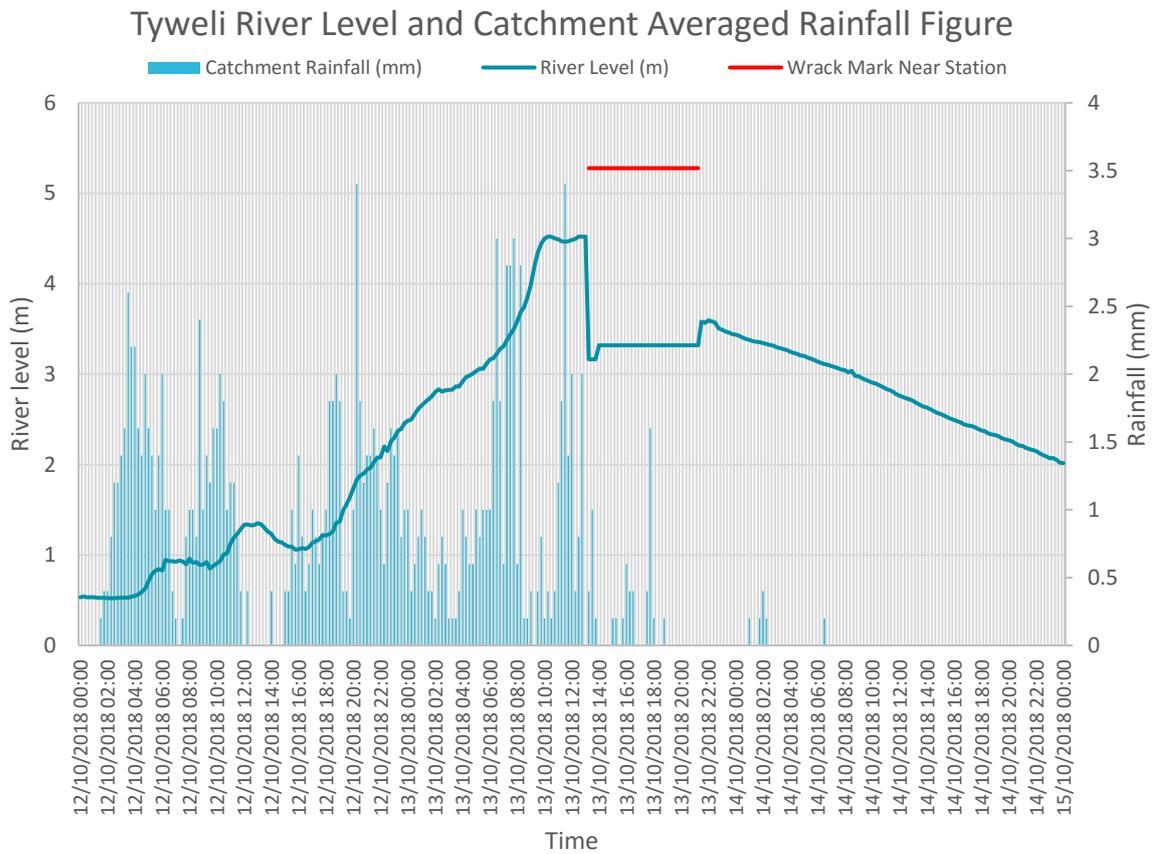


1.6.2 River Levels (Telemetry)

NRW have provided information for both the River Teifi and the River Tyweli. At Llanfair, the nearest gauge on the River Teifi, the water peaked at 4.4m AOD just prior to 8am on Saturday 13th October 2018 (Figure 26).

At Pont Tyweli, the gauge flooded during the event and the peak was therefore not recorded. After the event analysis of wrack marks by the gauge, suggest the peak level was 5.277m AOD (Figure 26).

Figure 26 River Teifi and Tyweli Levels & Catchment Rainfall Figures (NRW)



1.7 Llandysul and Pont Tyweli Investigation findings

1.7.1 Who was affected?

30 residential dwellings and 22 commercial premises were flooded internally. Many more businesses and dwellings were affected by flood waters but only externally. In addition, areas of the highway network were significantly affected including Station Road, Lewis Street, the B4624, the B4476 and Church Street.

1.7.2 What happened?

Water levels in the River Teifi rose to record levels as a result of the exceptional rainfall. The watercourse burst its banks and caused significant damage to Pont Tyweli.

Using data gathered from Glanteifi gauging station, located downstream of Llanybydder between Llechryd and Cenarth, NRW have calculated that this event had a return period of 300-400 years (0.25-0.33% AEP) and rainfall totals indicate a return period of up to 460 years.

NRW has stated that Storm Callum is the biggest flood event on record, being 0.6metres or 200m³/second (35%) greater than the previous highest recorded flood event in 1987.

Eye witnesses report the recreation ground being inundated as the flood flows overwhelmed the tennis courts and the bowling greens.

Water then escaped the left bank of the River Teifi, initially into the Paddlers Lake, but soon overwhelming that area. Analysis of aerial pictures highlights that once out of bank at the Paddlers Lake a flood flow channel was created directing flood flows in an overland flow route, parallel to the River Teifi (Plate 11). This channelled water towards the DCWW pumping station, the fire station and the neighbouring commercial and residential properties.

Plate 11 NRW aerial photo highlighting the path of the overland flood route.



The volume of water was so great that the DCWW pumping station was submerged to a depth of over 2 metres and flood flows reached as far south as the garage and Nisa/Co-op store. This volume of water directed flood flows to the rear of the Lewis Street properties via the lane at the side of the Nisa store.

Plate 12 Flooding at the Llandysul Fire Station.



The main overland flood flows appear to have followed the contours of the land south of the paddling pond, through the car park and towards the new Llandysul paddlers club house. Initially water escaped back into the Teifi, immediately downstream of the road bridge, but as water volumes increased, flood flows were directed along Lewis Street. Plate 13 shows the volume of water trying to re-enter the River Teifi below the Llandysul road bridge.

Plate 13 Flood flows at Llandysul Paddlers escaping back into the Teifi.



It is believed that the highway drainage initially captured the water along Lewis Street but this was quickly overwhelmed. The investigation has highlighted that the overland flood flows could not drain back into the Teifi from Lewis Street as there were insufficient breaks in boundary walls to allow water to re-enter the main channel. As such the flooding was channelled south west towards Pont Tyweli. Plate 14 below shows the level of flood flows along Lewis Street.

Plate 14 Flood water at Lewis Street, Pont Tyweli.



At the southern end of Lewis Street, it was reported that flood water flowed into the OJ Williams yard. Investigation have shown that the yard is lower than the level of the highway and subsequently water naturally flowed there and combined with flood flows from the River Tyweli as shown in Plate 15.

Plate 15 Flood water at the OJ Williams depot in Pont Tyweli



However, as the flood volumes increased water did continue past the depot into Station Road. This investigation has highlighted that the same issues were faced here as in Lewis Street, in that there is little opportunity for overland flood flows to re-enter the watercourses.

In light of the above information it is a recommendation of this report that a detailed flood modelling exercise of the area is undertaken, and a review of the topographical data to understand the risks of this occurring again. The report should also suggest potential mitigation measures for a range of flood events.

1.8 Summary of Actions for the Llandysul and Pont Tyweli Investigation.

Action 47: Undertake CCTV surveys to identify the path, standard of service and condition of the highways drainage.

Action 48: The walls along the north side of Lewis Street should be replaced with a part passive structure (as and when replacement is necessary) to allow overland flood flows to re-enter the River Teifi through specific built-in gaps.

Action 49: Carmarthenshire and Ceredigion CC will commission a study to evaluate the flood risk, the risk of overland flows and any potential mitigation measures. NRW will lead and facilitate the production of flood flow models to illustrate if any mitigation methods would prove successful.

Table 13 Recommended Actions to be taken forward by the relevant RMAs or property / landowners, from the S19 Llandysul and Pont Tyweli Investigation into the Storm Callum Flooding.

Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
Highways Authority	Tony Williams	47	Undertake CCTV surveys to identify the path, standard of service and condition of the highways drainage.	Enlist a CCTV contractor.	Medium	Oct 2019
CCC Highways Bridges and Structures	Peter Morgan	48	The walls along the north side of Lewis Street should be replaced with a passive structure (as and when replacement is necessary) to allow overland flood flows to re-enter the River Teifi.		Long	Ongoing
Ceredigion, CCC & NRW	Ben Kathrens Rhodri Llwyd Aneurin Cox	49	Carmarthenshire and Ceredigion CC will commission a study to evaluate the effect of the causeway on flood risk and the legality and consequences of its removal or modification. NRW can lead and facilitate the production of flood flow models to illustrate which scenario would achieve the best outcome.	Carmarthenshire CC and Ceredigion CC to write a brief and submit to NRW. NRW will evaluate the work that needs to be undertaken to meet the requirements of the brief and if they do not have adequate resources, contract the services of a framework consultant to interrogate the flood model and provide a report accordingly.	Medium term (agree brief and ToR) Long term (full analysis and reporting)	Sept 2019 Feb 2020

8. Generic Actions

1.1 Flood Warnings

It has been a common complaint that the flood warnings issued during Storm Callum came too late or were not received by customers. There was widespread confusion that flooding occurred but no warnings came. In areas such as Pensarn, flooding can occur from surface water prior to any overtopping event. Customers should be made aware of this, and the flood warning system amended accordingly to factor in the surface water flood risk.

Action 50: NRW to review the performance of the flood warning system during Storm Callum.

Action 51: NRW to clarify the limitations of the flood warnings and convey this to its customers or amend the service to provide warnings from other flood sources.

1.2 Communications

Many customers have commented that they were unable to get through to Carmarthenshire Council by telephone as the line was either engaged or they were kept on hold. This report has concluded that Delta Wellbeing, the Council owned company that operates CCC's out of hours call centre services, had 50 telephone lines available for customers and that its call centre staff were doubled on Saturday in response to the event.

However this report concludes that a specific review should be undertaken into the functionality of the call centre during the Storm Callum weekend and identify lessons learned.

Action 52: undertake a review into the functionality of the CCC call centre during Storm Callum and its ability to manage and administer major incidents going forward.

1.3 Landlord Licensing

This investigation has highlighted that many of the residential victims of Storm Callum were renting tenants, rather than the owners of the flooded properties. Whereas during the process of purchasing a property, the legal searches will identify flood risk and inform the purchaser, it has become apparent that many tenants had no knowledge of their flood risk. This report recommends that

private and Council tenants should also be presented with the flood risk information specific to their properties.

Action 53: Investigate a mechanism to inform tenants of the flood risk afforded to their properties.

1.4 Community Resilience

This report has highlighted that in times of austerity, the county councils and NRW can no longer offer the level of responsive services they once did, due to resource limitations. Consequently, it is for the respective communities to understand their flood risk and take appropriate actions to help themselves. NRW and the Civil Contingency Officers in both the local authorities can help facilitate this.

However, this report acknowledges that it is human nature to forget about the impacts of a flooding event over time, and as such any community resilience plan must in itself be resilient.

Action 54: Develop community resilience and flood action plans in those communities at greatest risk of flooding.

Action 55: Further develop collaborative working and development of databases that allows information of flooding to be captured and interrogated efficiently.

1.5 Summary of the generic Storm Callum actions

Action 50: NRW to review the performance of the flood warning system during Storm Callum.

Action 51: NRW to clarify the limitations of the flood warnings and convey this to its customers or amend the service to provide warnings from other flood sources.

Action 52: Undertake a review into the functionality of the CCC call centre during Storm Callum, and its ability to manage and administer major incidents going forward.

Action 53: Investigate a mechanism to inform tenants and landlords of the flood risk afforded to their properties.

Action 54: Develop community resilience and flood action plans in those communities at greatest risk of flooding.

Action 55: Further develop collaborative working and development of databases that allows information of flooding to be captured and interrogated efficiently.

WORKING DRAFT

Figure 34: Recommended generic Storm Callum actions

Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
NRW	Aneurin Cox	50	NRW to review the performance of the flood warning system during Storm Callum.	NRW to undertake an internal review of the flood warning system.	Medium	October 2019
NRW	Aneurin Cox	51	NRW to clarify the limitations of the flood warnings, and convey this to its customers or amend the service to provide warnings about other flood sources.	NRW to develop a communication strategy to inform its customers accordingly.	Medium	October 2019
Delta Wellbeing	Sam Watkins	52	Undertake a review into the functionality of the CCC call centre during Storm Callum and its ability to manage and administer major incidents going forward.	CCC and Delta Wellbeing to undertake a review.	Medium	October 2019
CCC FD&CP	Ben Kathrens	53	Investigate a mechanism to inform tenants of the flood risk afforded to their properties.	FD&CP to work with housing to investigate ways to inform tenants and landlords of their flood risk.	Medium	October 2019

Civil Contingency	Richard Elms (CCC)	54	Develop community resilience and flood action plans in those communities at greatest risk of flooding.	Meet with community leaders and develop plan accordingly.	Medium	Feb 2020
CCC FD&CP Highways Authority Delta Wellbeing	Ben Kathrens, Darren King & Sam Watkins	55	Further develop collaborative working and development of databases that allows information on flooding to be captured and interrogated efficiently.	Work with the Highways Authority and Delta Wellbeing to ensure that accurate reports are captured and that the actions pertaining to those incidents are also captured.	Long	Feb 2020

WORKING DRAFT

9. Conclusions

In the evaluation of flood events during the weekend of Storm Callum, the 12th to the 14th October 2018, this report has concluded that:

- 9.1 The flood event on the River Teifi had a return period of 300-400 years (0.25-0.33% AEP) and rainfall totals indicate a return period of up to 460 years. As such, Storm Callum is the biggest flood event on record, being 0.6metres deeper or 200m³/second (35% greater) than the previous highest recorded flood event in 1987.
- 9.2 The communities on the River Teifi were flooded as a result of the extreme rainfall that resulted in severe fluvial flooding levels.
- 9.3 Given the extreme level of flooding a detailed flood modelling exercise should be undertaken to understand if mitigation is feasible and viable, and the consequences of such mitigation measures.
- 9.4 The flood event on the River Towy had a return period of 50 years and this was the biggest flood event since 1987.
- 9.5 In Johnstown and Pensarn, a mixture of surface water and Main River flooding contributed to the flooding.
- 9.6 The flood defences alongside the River Towy performed to the standard of protection intended; overtopping occurred where the river level exceeded the defence level.
- 9.7 Surface water flooding was a direct consequence of elevated levels in the watercourses that surface water systems were attempting to discharge into.
- 9.8 The level of knowledge pertaining to the surface water network, its condition and standard of service is not complete.
- 9.9 Better communication and collaboration is needed between RMAs to manage flood risk.
- 9.10 All communities and businesses should take responsibility for understanding their respective flood risks, and how to manage them accordingly.

In light of the above conclusions, this report has made **55** actions / recommendations, to be taken forward by the various RMAs, to better understand and manage flood risk and to fill gaps in the current information and knowledge.

A multi-agency Storm Callum flood group has been established, chaired by Ruth Mullen (Director of Environment, CCC), to oversee the delivery of these recommendations. The group has been meeting monthly since the flooding event to work in collaboration to develop this report. Quarterly meetings will be held to discuss progress on the relevant actions.

WORKING DRAFT

10. Appendices

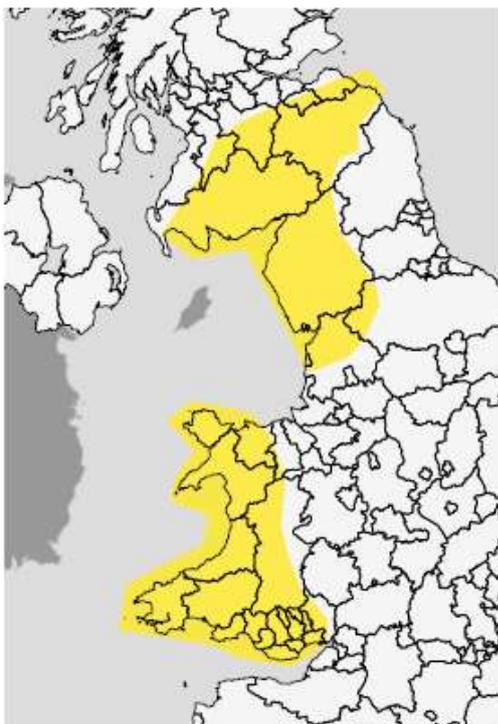
WORKING DRAFT

Appendix A - Weather warnings and Flood Guidance Statement.



Yellow warning
Rain

Between
00:00 Sat 13 Oct 2018 and
23:59 Sat 13 Oct 2018



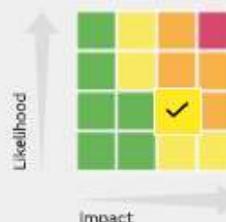
Further heavy and persistent rain all is expected on Saturday, with further flooding possible.

What to expect

- Homes and businesses could be flooded, causing damage to some buildings
- There is a chance of power cuts and loss of other services to some homes and businesses
- Delays or cancellations to train and bus services are possible
- Some communities may be cut off by flooded roads
- Fast flowing or deep floodwater is possible, causing a danger to life

Further details

Following Storm Callum, heavy rain will continue to affect parts of Wales and northwest England along with southern Scotland for much of Saturday. Areas of high ground exposed to the south and south west will be most affected, with the potential for a further 20-40 mm quite widely over hills. Further strong winds may bring down leaves and branches, increasing the likelihood of flooding due to blocked drains or culverts. The winds should ease later today.



✓ Low likelihood of medium impacts

Issued at 11:20 Tue 9 Oct, 2018 Updated at 10:48 Sat 13 Oct, 2018

For enquiries regarding this warning please contact the Met Office Weather Desk

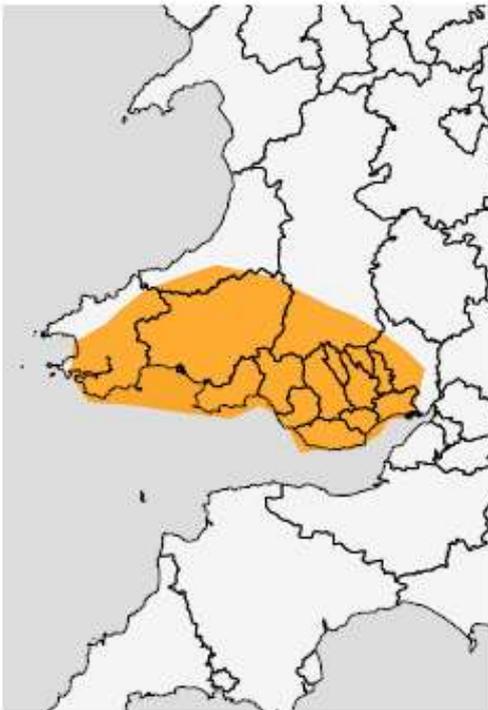
Phone: 0370 900 0100 **E-mail:** enquiries@metoffice.gov.uk

Visit: www.metoffice.gov.uk/premium/hazardmanager



Amber warning
Rain

Between
06:00 Fri 12 Oct 2018 and
18:00 Sat 13 Oct 2018



Further heavy rain through Saturday - particularly over south facing hills.

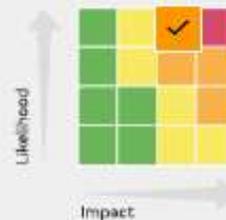
What to expect

- Homes and businesses flooded and damage to some buildings
- Danger to life from fast flowing or deep floodwater
- Delays or cancellations to train and bus services
- Spray and flooding leading to difficult driving conditions and some road closures
- Some communities cut off by flooded roads
- Power cuts and loss of other services to some homes and businesses

Further details

Further spells of persistent and heavy rain are expected at times during Saturday. A further 30-50 mm is likely on top of the very large amounts which have already fallen.

The rain will be accompanied by strong winds, which when combined with high tides may lead to some coastal impacts due to large waves. In addition, leaves and twigs, brought down by the wind, could block drains and culverts, increasing the likelihood of flooding.



High likelihood of medium impacts

Issued at 10:25 Thu 11 Oct, 2018 Updated at 10:25 Sat 13 Oct, 2018

For enquiries regarding this warning please contact the Met Office Weather Desk

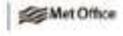
Phone: 0370 900 0100 **E-mail:** enquiries@metoffice.gov.uk

Visit: www.metoffice.gov.uk/premium/hazardmanager

Flood Guidance Statement

10:30hrs Saturday 13 October 2018

FLOODFORECASTINGCENTRE

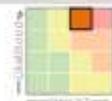
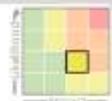
a working partnership between  Environment Agency |  Met Office



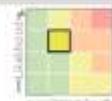
Saturday 13 Oct 2018 10:30-23:59 Trend since Last FGS	Sunday 14 Oct 2018	Monday 15 Oct 2018	Tuesday 16 Oct 2018	Wednesday 17 Oct 2018
Steady →	Steady →	Steady →	Steady →	Steady →

Significant river and surface water flooding impacts are expected in south Wales today (MEDIUM flood risk), and are possible for other parts of Wales. Minor flood impacts are probable today for parts of the north-west of England.

Areas of Concern Map 1 - Saturday 13 October 2018.

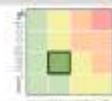
<p>RISK AREA A Impact SIGNIFICANT Likelihood HIGH</p>  <p>Source: River Surface Likely duration: 1 Day</p>	<p>RISK AREA B Impact SIGNIFICANT Likelihood LOW</p>  <p>Source: River Surface Likely duration: 1 Day</p>	<p>RISK AREA C Impact MINOR Likelihood MEDIUM</p>  <p>Source: River Surface Likely duration: 1 Day</p>
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RISK AREA D
Impact **MINOR**
Likelihood **MEDIUM**

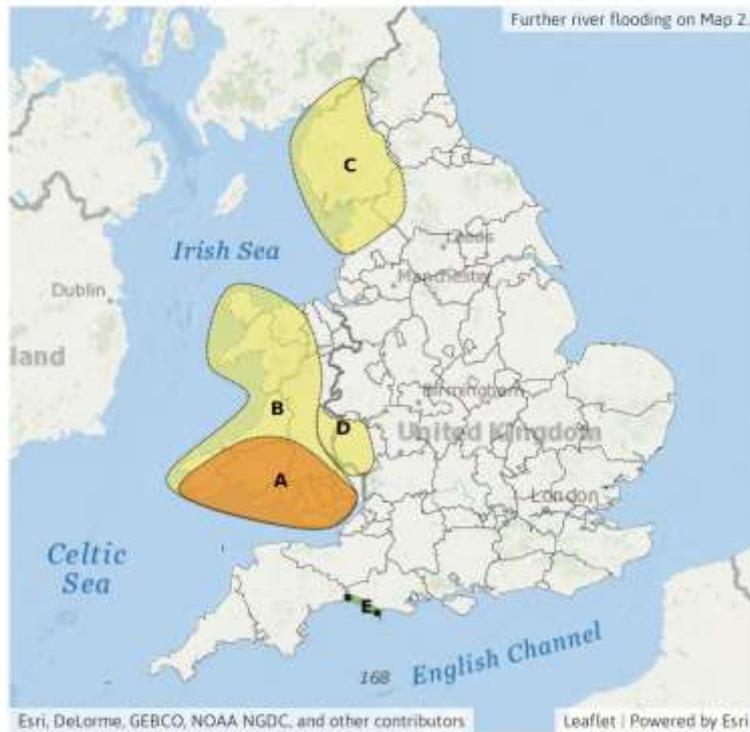


Source: River
Likely duration: 1 Day
River flooding impacts only.

RISK AREA E
Impact **MINOR**
Likelihood **LOW**



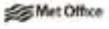
Source: Coastal/Tidal
Likely duration: 1 Day
Impacts possible around this morning's high tide.



Flood Guidance Statement

10:30hrs Saturday 13 October 2018

FLOODFORECASTINGCENTRE

a working partnership between  Environment Agency |  Met Office

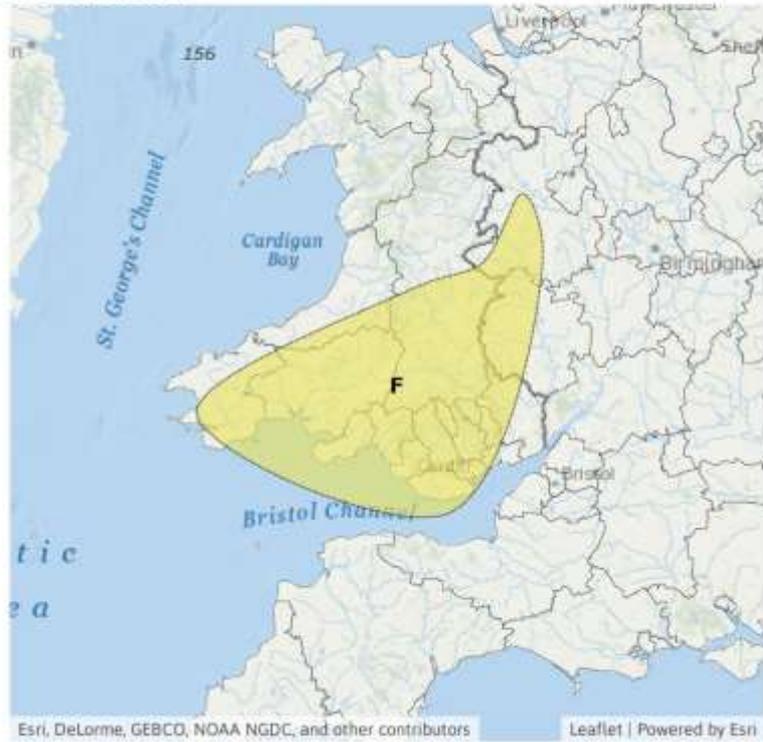
Areas of Concern Map 2 - Sunday 14 October 2018

RISK AREA F
Impact **MINOR**
Likelihood **MEDIUM**



Source: River
likely duration: 1 Day

Wales: Ongoing river flooding. New minor river impacts Stropshire (river Severn).

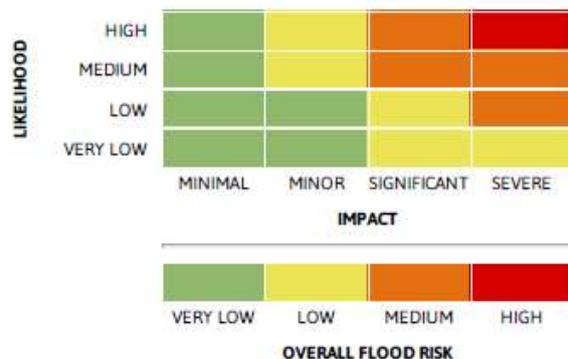


WORKING

Flood Guidance Statement

10:30hrs Saturday 13 October 2018

Flood risk matrix



Summary of potential impacts

MINIMAL

Isolated and minor flooding of low-lying land and roads
Isolated spray/wave on coastal promenades
Little or no disruption to travel, but wet road surfaces

MINOR

Localised flooding of land and roads
Flooding affecting individual properties
Disruption to travel and key sites in flood plans

SIGNIFICANT

Flooding affecting parts of communities
Possible danger to life and damage to buildings/structures
Disruption to travel and key sites in flood plans

SEVERE

Danger to life, severe disruption to travel
Widespread flooding affecting whole communities
Widespread disruption or loss of infrastructure
Large scale evacuation of properties possible

Next statement due **15:00hrs Saturday 13 October 2018 (all times are local)**

Contact details **Flood Forecasting Centre Duty Hydrometeorologist - 0300 12345 01**

More information <http://www.ffc-environment-agency.metoffice.gov.uk>

WORKING

Assessment of flood risk



Surface water

The surface water flood risk is MEDIUM for today (Saturday).

Significant surface water flooding impacts are expected in south Wales (Area A on Map 1) today. This is due to prolonged, heavy rainfall and strong winds, which may lead to wind blown debris blocking drains. Significant surface water flooding impacts are possible elsewhere in Wales (Area B).

Minor surface water impacts are also probable today across parts of the north-west of England (Area C). Elsewhere in the north of England today, local minor surface water impacts are possible but not expected.



Rivers

The river flood risk is MEDIUM for today (Saturday).

Significant river flooding impacts are expected in south Wales (Area A on Map 1) today due to prolonged, heavy rainfall. Significant river flooding impacts are possible elsewhere in Wales (Area B) and minor river flooding impacts are probable in the north-west of England (Area C).

Ongoing minor river flooding may continue into Sunday in south Wales, and on the River Wye. Minor river flooding impacts from the river Severn are also possible in Shropshire on Sunday. See (Area F on Map 2).

Localised minor river flooding impacts are possible but not expected for parts of north-east England on Saturday and Sunday.



Coastal/Tidal

The overall coastal/tidal flood risk is VERY LOW for the next five days.

Minor coastal impacts are possible today for the west Dorset coast around the time of this morning's high tide (coastline E on Map 1).

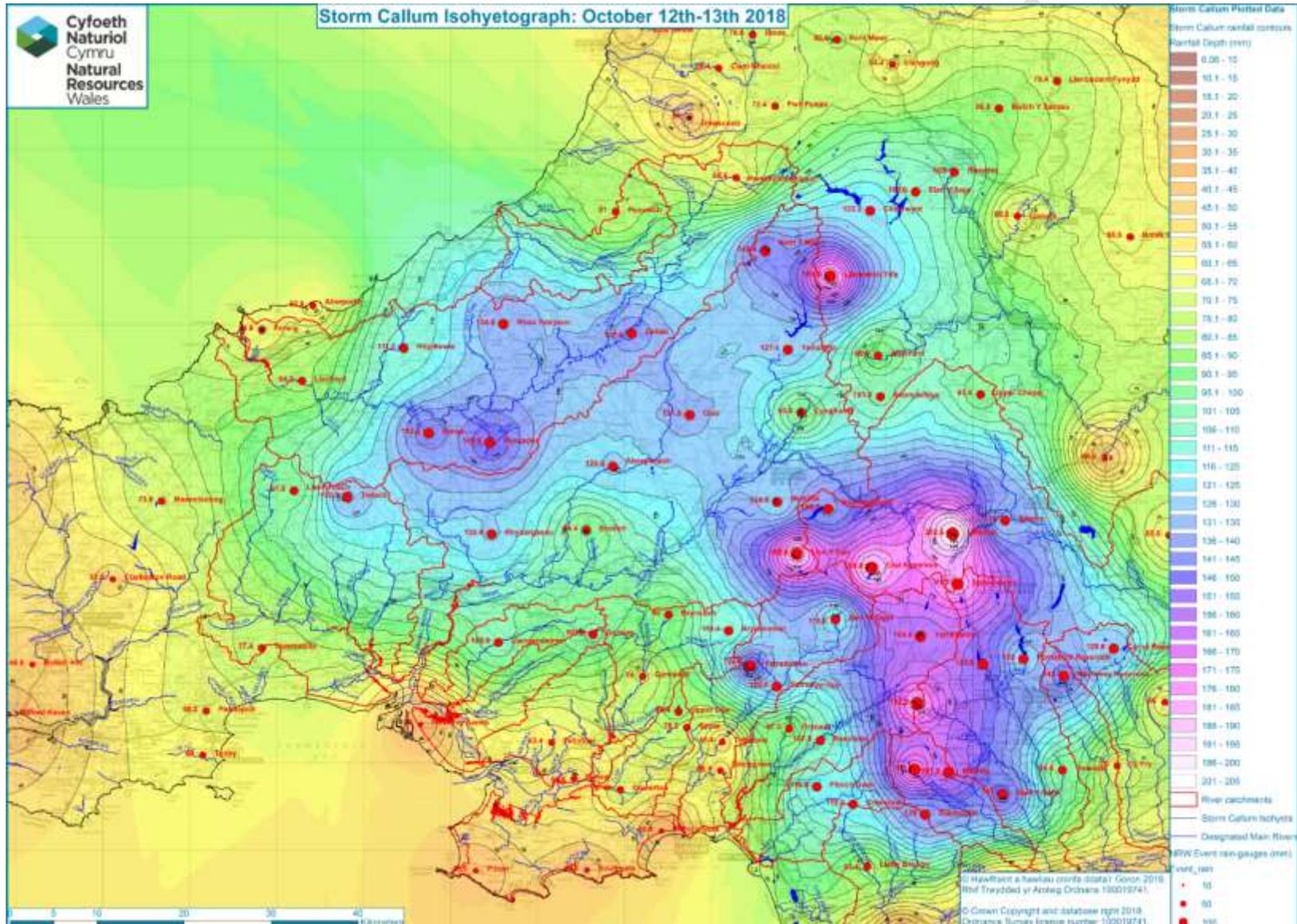
Large waves and strong winds will continue to affect the south coasts of Cornwall and Pembrokeshire but are not expected to lead to more than minimal coastal impacts.



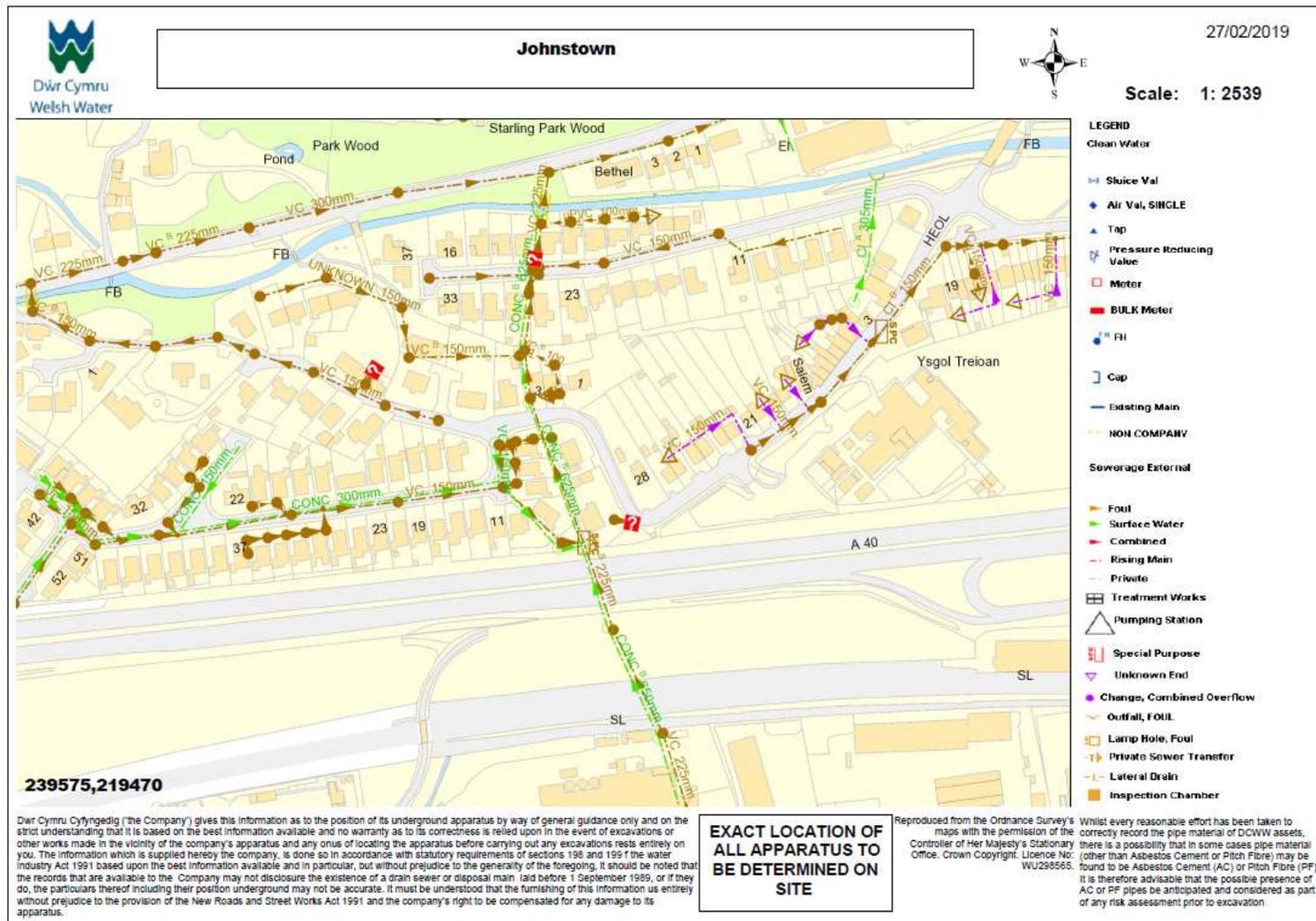
Groundwater

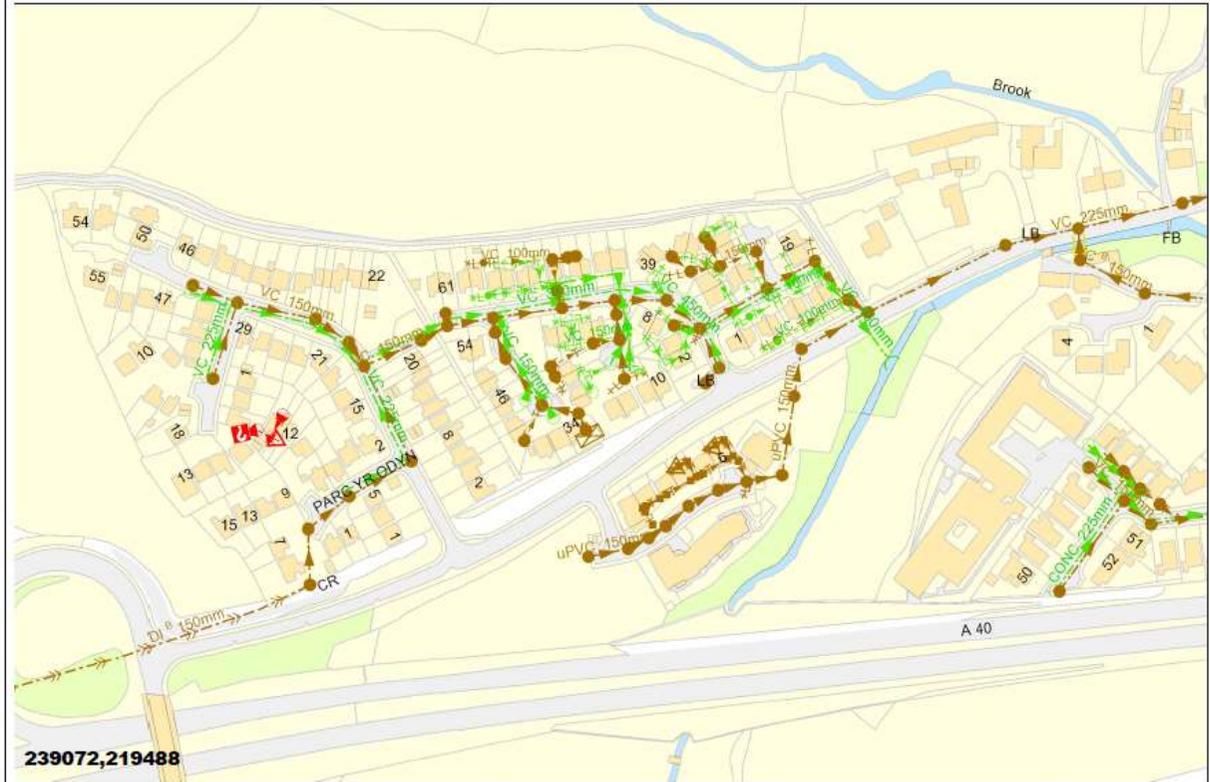
The groundwater flood risk is VERY LOW for the next five days.

Appendix B - NRW isohyet map of south Wales over the 12th and the 13th October.



Appendix C - DCWW database of the drainage network





- LEGEND**
- Clean Water**
- ⇒ Sluice Val
 - ◆ Air Val, SINGLE
 - ▲ Tap
 - ▽ Pressure Reducing Valve
 - Meter
 - BULK Meter
 - FI
 - Cap
 - Existing Main
 - NON COMPANY
- Sewerage External**
- Foul
 - Surface Water
 - Combined
 - Rising Main
 - Private
 - Treatment Works
 - △ Pumping Station
 - Special Purpose
 - Unknown End
 - Change, Combined Overflow
 - Outfall, Foul
 - Lamp Hole, Foul
 - Private Sewer Transfer
 - Lateral Drain
 - Inspection Chamber

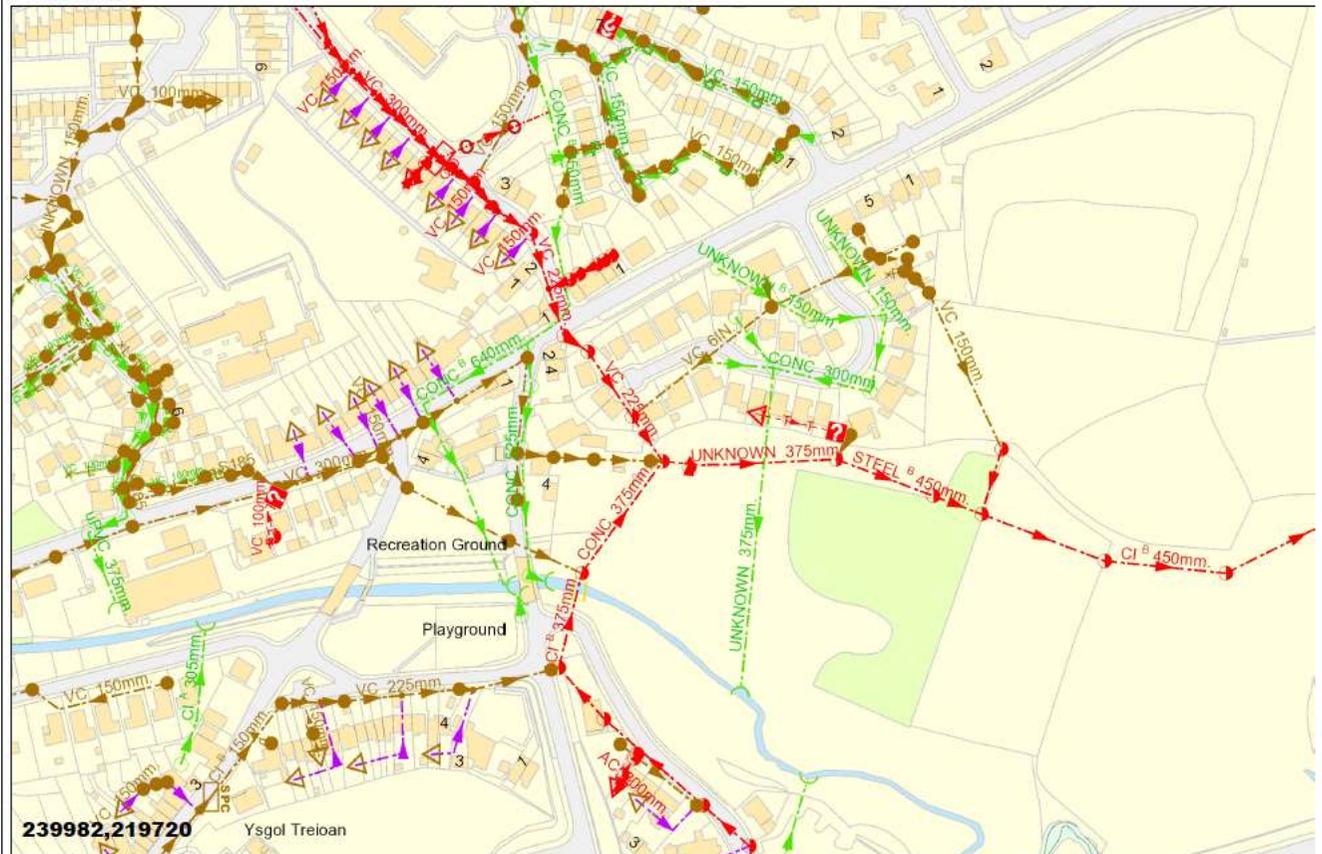
239072,219488

Dŵr Cymru Cyfyngedig (the Company) gives this Information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby by the company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 based on the best information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

EXACT LOCATION OF ALL APPARATUS TO BE DETERMINED ON SITE

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Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be Asbestos Cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.



- LEGEND**
- Clean Water**
- Sluice Val
 - Air Val, SINGLE
 - Tap
 - Pressure Reducing Valve
 - Motor
 - BULK Motor
 - FH
 - Cap
 - Existing Main
 - NON COMPANY
- Sewerage External**
- Foul
 - Surface Water
 - Combined
 - Rising Main
 - Private
 - Treatment Works
 - Pumping Station
 - Special Purpose
 - Unknown End
 - Change, Combined overflow
 - Outfall, FOUL
 - Lamp Hole, Foul
 - Private Sewer Transfer
 - Lateral Drain
 - Inspection Chamber

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon. In the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby by the company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 based upon the best information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

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Appendix D - NRW flood warning (River Towy at Johnstown) issued on 13th October.

Issue Time	15:22 13/10/2018
From	floodline@naturalresourceswales.gov.uk
Subject Heading	Flood Warning: River Towy at Johnstown, Carmarthen
Email Content	<p>IMPORTANT INFORMATION.</p> <p>A Flood Warning has been issued by Natural Resources Wales.</p> <p>Flood Warning in force: River Towy at Johnstown, Carmarthen.</p> <p>Flooding is expected for: Property in low lying areas of Johnstown and in the vicinity of the St Clears Road and Llansteffan Road.</p> <p>Immediate action required.</p> <p>Occasional rainfall is forecast to continue until around 8 PM. The heaviest rainfall has now cleared the area. River levels in the Towy are very high at Carmarthen and are expected to rise until at least 7 PM this evening, Saturday 13th October 2018. Minor impacts of flooding are expected this evening and overnight. Care should be taken to avoid unnecessary risk. You can monitor the situation in your area by using our River Levels Online Service on our website.</p> <p>What you should consider doing now:</p> <p>-----</p> <ul style="list-style-type: none"> * Act on your flood plan if you have one. * Move your family and pets to a safe place. * Move your car or other vehicles to higher ground, if it is safe to do so. * Use flood protection equipment, such as flood barriers, air brick covers and pumps to protect your property. Any equipment should be professionally supplied and installed to help reduce the impact of flood water. * Move important items upstairs or to a safe place in your property, starting with cherished items of personal value that you will not be able to replace (such as family photographs). Next move valuables (such as computers), movable furniture and furnishings. * You may need to leave your property, so pack a bag with enough items for a few nights away. Include essential items including a torch with spare batteries, mobile

phone and charger, warm clothes, home insurance information, water, food, first aid kit and any prescription medicines or baby care items you may need.

* Turn off gas, electricity and water mains supplies before flood water starts to enter your property. Never touch an electrical switch if you are standing in water.

* If it is safe to do so, make sure neighbours are aware of the situation and offer help to anyone who may need it.

* Listen to the advice of the emergency services and be ready to evacuate your property if told to do so. Most evacuation centres will let you bring your pets.

* Avoid walking, cycling or driving through flood water. 30 cm of fast-flowing water can move a car and 15 cm can knock an adult off their feet.

* Flood water is dangerous and may be polluted. Wash your hands thoroughly if you've been in contact with it.

To check the latest information for your area

* Visit our website to see the current flood warnings, view river and sea levels or check the 5-day flood risk forecast: <http://naturalresources.wales/flooding/check-flood-warnings/detail?lang=en&id=102FWF134C>

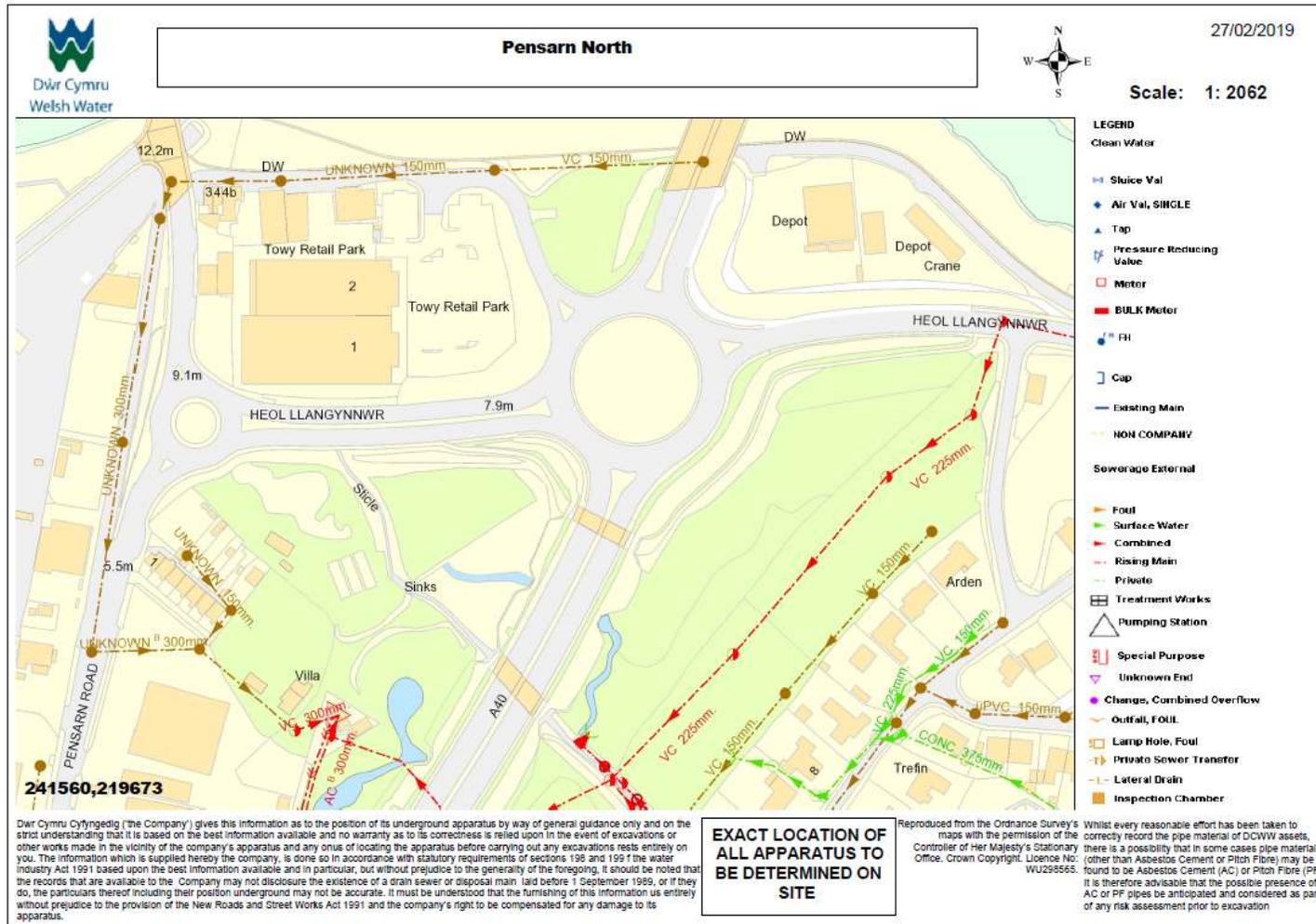
* Or call Floodline on 0345 988 1188 using quickdial code: 603091.

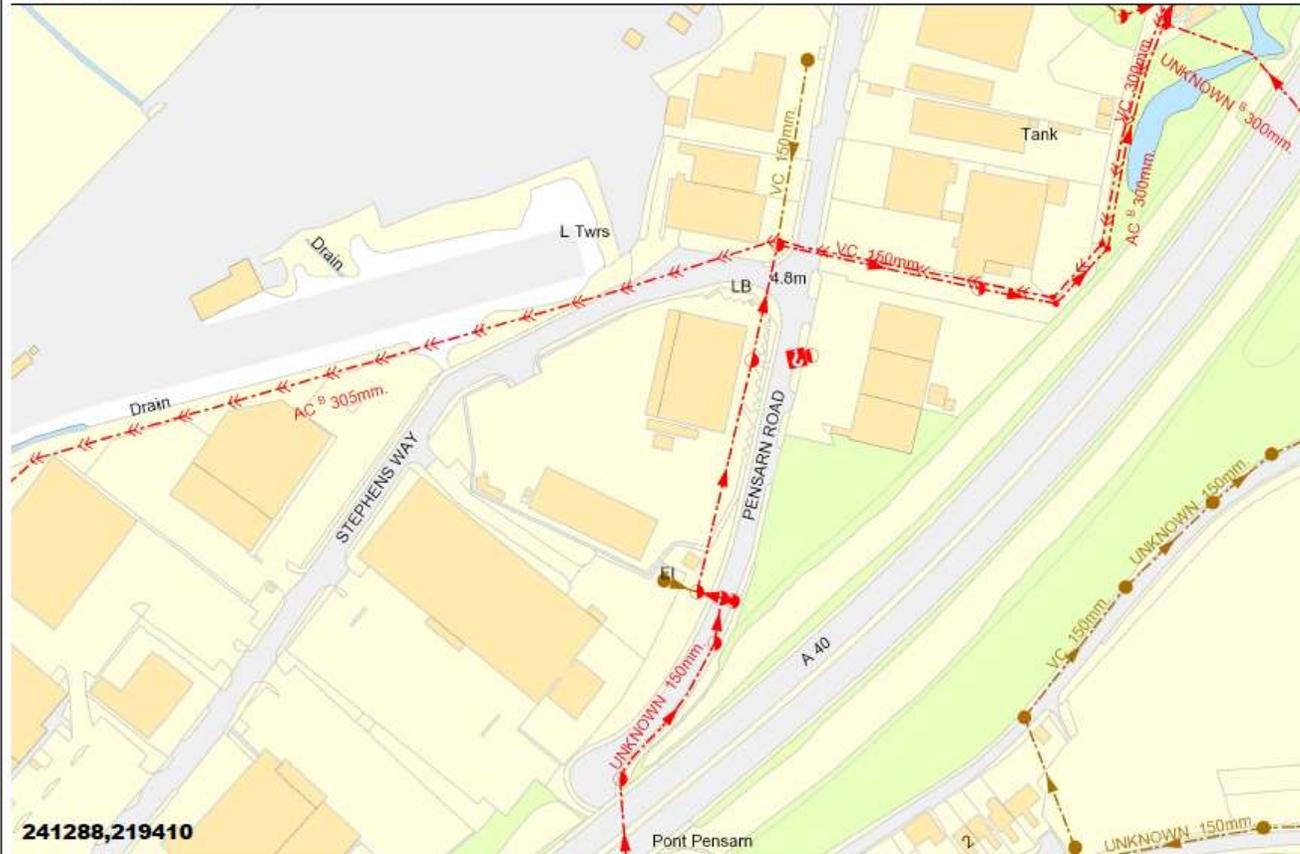
* Follow @NatResWales and #floodaware on Twitter

* Tune into weather, news and travel bulletins on local television and radio.

To stop receiving these emails you can manage your account online at <https://www.naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/?lang=en>. Or call Floodline on 0345 988 1188. If you need to contact us please call Floodline. Please do not reply to this email.

Appendix E - The details of the DCWW infrastructure servicing Pensarn.





LEGEND

- Clean Water**
- Swiuce Val
 - Air Val, SINGLE
 - Tap
 - Pressure Reducing Valve
 - Meter
 - BULK Meter
 - FH
 - Cap
 - Existing Main
 - NON COMPANY
- Sewerage External**
- Foul
 - Surface Water
 - Combined
 - Rising Main
 - Private
 - Treatment Works
 - Pumping Station
 - Special Purpose
 - Unknown End
 - Change, Combined Overflow
 - Outfall, FOUL
 - Lamp Hole, Foul
 - Private Sewer Transfer
 - Lateral Drain
 - Inspection Chamber

241288,219410

Dwr Cymru Cyfyngedig (the Company) gives this Information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The Information which is supplied hereby the company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 based upon the best information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

EXACT LOCATION OF ALL APPARATUS TO BE DETERMINED ON SITE

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Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be Asbestos Cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.

Appendix F - NRW flood warning (River Towy at Pensarn) issued on 13th October.

Issue Time	15:13 13/10/2018
From	floodline@naturalresourceswales.gov.uk
Subject Heading	Flood Warning: River Towy at Pensarn, Llangunnor and Old Station Road, Carmarthen
Email Content	<p>IMPORTANT INFORMATION.</p> <p>A Flood Warning has been issued by Natural Resources Wales.</p> <p>Flood Warning in force: River Towy at Pensarn, Llangunnor and Old Station Road, Carmarthen.</p> <p>Flooding is expected for: Property in Pensarn, Llangunnor between the B4300 road and the river, Bridge Wharf, Old Station Road and the A40 road, including property between the A40 road and the river.</p> <p>Immediate action required.</p> <p>Occasional rainfall is forecast to continue until around 8 PM. The heaviest rainfall has now cleared the area. River levels in the Towy are very high at Carmarthen and are expected to rise until at least 7 PM this evening, Saturday 13th October 2018. Minor impacts of flooding are expected this evening and overnight. You can monitor the situation in your area by using our River Levels Online Service on our website. Please be aware that surface water flooding is on-going within this area. Care should be taken to avoid unnecessary risk.</p> <p>What you should consider doing now:</p> <p>-----</p> <ul style="list-style-type: none"> * Act on your flood plan if you have one. * Move your family and pets to a safe place. * Move your car or other vehicles to higher ground, if it is safe to do so. * Use flood protection equipment, such as flood barriers, air brick covers and pumps to protect your property. Any equipment should be professionally supplied and installed to help reduce the impact of flood water. * Move important items upstairs or to a safe place in your property, starting with cherished items of personal value that you will not be able to replace (such as family

photographs). Next move valuables (such as computers), movable furniture and furnishings.

* You may need to leave your property, so pack a bag with enough items for a few nights away. Include essential items including a torch with spare batteries, mobile phone and charger, warm clothes, home insurance information, water, food, first aid kit and any prescription medicines or baby care items you may need.

* Turn off gas, electricity and water mains supplies before flood water starts to enter your property. Never touch an electrical switch if you are standing in water.

* If it is safe to do so, make sure neighbours are aware of the situation and offer help to anyone who may need it.

* Listen to the advice of the emergency services and be ready to evacuate your property if told to do so. Most evacuation centres will let you bring your pets.

* Avoid walking, cycling or driving through flood water. 30 cm of fast-flowing water can move a car and 15 cm can knock an adult off their feet.

* Flood water is dangerous and may be polluted. Wash your hands thoroughly if you've been in contact with it.

To check the latest information for your area:

* Visit our website to see the current flood warnings, view river and sea levels or check the 5-day flood risk forecast: <http://naturalresources.wales/flooding/check-flood-warnings/detail?lang=en&id=102FWF134B>

* Or call Floodline on 0345 988 1188 using quickdial code: 603090.

* Follow @NatResWales and #floodaware on Twitter.

* Tune into weather, news and travel bulletins on local television and radio.

To stop receiving these emails you can manage your account online at <https://www.naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/?lang=en>. Or call Floodline on 0345 988 1188. If you need to contact us please call Floodline. Please do not reply to this email.

Appendix G – DCWW reply regarding Llyn Brianne.

From: Daniel Aled [<mailto:Aled.Daniel@dwrwymru.com>]

Sent: 31 October 2018 10:59

To: Richard Elms <RLElms@carmarthenshire.gov.uk>

Subject: RE: Storm Callum -Request for information from local Member

Richard,

The answer to this question is not as straightforward as you might think! Llyn Brianne is a 'Regulating Reservoir' i.e. it regulates the flow in the Tywi by holding back flows when they are high and releasing water when they are low. The dam always has to be 'open' otherwise parts of the Tywi could dry up completely. This is known as the 'Compensation Flow'. Which compensates for any water we abstract at Manorafon or Nantgaredig. This is agreed and monitored by NRW. It is the water you can see coming out below the building in the photo.

During wet conditions, such as a normal winter, the reservoir will eventually fill and the spillway, on the right in the photo, will operate to prevent the dam from overtopping which can cause serious damage. This is part of the normal operation of any reservoir and needs no intervention for it to happen i.e. nothing has to be 'opened'.

The spillway started to operate at 12:06 on the 14th October so the reservoir would have been filling and 'holding back' the rainfall from the 12th to the 14th. Flows then returned to the level they would have been had the dam not been there.

So in summary the total volume of Flow in the Tywi was less over this period than it would have been had the dam not been there, the difference being the volume retained between the level in the reservoir when it started raining and the point at which the spillway started to operate.

I hope this explains things!

Aled

Appendix H - NRW flood warning (River Teifi at Llanybyther) issued on 13th October.

Issue Time	13:05 13/10/2018
From	floodline@naturalresourceswales.gov.uk
Subject Heading	Flood Warning: River Teifi at Llanybyther
Email Content	<p>IMPORTANT INFORMATION.</p> <p>A Flood Warning has been issued by Natural Resources Wales.</p> <p>Flood Warning in force: River Teifi at Llanybyther.</p> <p>Flooding is expected for: The caravan site, property in Station Terrace, Bridge Street, Highmead Terrace and the Highmead Arms Hotel.</p> <p>Immediate action required.</p> <p>The rainfall is forecast to continue until 8 PM on Saturday 13th October 2018.</p> <p>Further heavy rainfall is expected before the weather front finally clears away. River levels in the River Teifi at Llanybyther are expected to rise until at least 3 PM on Saturday 13th October 2018. You can monitor the situation in your area by using our River Levels Online Service on our website.</p> <p>What you should consider doing now:</p> <p>-----</p> <ul style="list-style-type: none"> * Act on your business flood plan if you have one. * Move your staff and customers to a safe place. * Move cars or other vehicles to higher ground, if it is safe to do so. * Use flood protection equipment, such as flood barriers, air brick covers and pumps to protect your property. Any equipment should be professionally supplied and installed to help reduce the impact of flood water. * Move stock and other valuable items upstairs or to a safe place in your building. * Turn off gas, electricity and water mains supplies before flood water starts to enter your building. Never touch an electrical switch if you are standing in water. * If it is safe to do so, make sure neighbouring businesses are aware of the situation and offer help to anyone who may need it.

- * Listen to the advice of the emergency services and be ready to evacuate your building if told to do so.
- * Avoid walking, cycling or driving through flood water. 30 cm of fast-flowing water can move a car and 15 cm can knock an adult off their feet.
- * Flood water is dangerous and may be polluted. Wash your hands thoroughly if you've been in contact with it.

To check the latest information for your area

- * Visit our website to see the current flood warnings, view river and sea levels or check the 5-day flood risk forecast: <http://naturalresources.wales/flooding/check-flood-warnings/detail?lang=en&id=102FWF151B>
- * Or call Floodline on 0345 988 1188 using quickdial code: 603115.
- * Follow @NatResWales and #floodaware on Twitter.
- * Tune into weather, news and travel bulletins on local television and radio.

To stop receiving these emails you can manage your account online at <https://www.naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/?lang=en>. Or call Floodline on 0345 988 1188. If you need to contact us please call Floodline. Please do not reply to this email.

Appendix I – Llaybydder Community Council Public Meeting - Questions raised.

Llaybydder Community Council Public Meeting on Flooding

Questions with corresponding notes:

Ref	Query Detail	Responsibility	Comments
A	Primary Flooded Areas:		
1	Station Terrace – all properties, including businesses, under at least 3 foot of water and had to be evacuated.	NRW, CCC	Investigations underway to establish flood defence scheme referred to after the 1987 storm. No information seems to be available on this issue. Scope and feasibility of any potential new scheme yet to be determined. Carmarthenshire County Council (CCC), Ceredigion County Council (CC) and Natural Resources Wales (NRW) are aware of the impact of the flooding. All three have made enquiries internally and with retired engineers. No records or evidence exists of a scheme having been funded or designed.
2	Highmead Dairy/Glanduar – blocked tributary resulting in flooding.	CCC	CCC have identified a number of issues in the area that would have culminated to cause the flooding reported. This will be detailed fully in the report. CCC are already progressing with a feasibility study looking at upgrading and/or re-aligning the highway culvert beneath the B4337 and modifying the highway drainage to better manage surface water flooding in the area.

3	Duar river near Smithfield, Llanybydder – flooding as a result of Natural Resources Wales insisting that tributary should be cow-proofed to protect fish/spawning.	NRW	<p>Reply from NRW.</p> <p>The protective fencing and swing gates across the Afon Duar were put in place by Natural Resources Wales to protect the watercourse from livestock entering and damaging the river banks to improve the habitat for fish and wildlife.</p> <p>This work was carried out with the landowner's permission and it was agreed that upon completion they would be responsible for the maintenance and upkeep.</p> <p>It could well be the case that the swing gates had collected debris which caused the flow of the river to come out of channel and flow over the land nearby. We will contact the landowner to remind them of their responsibilities of making sure debris is regularly cleared away from the swing gates.</p>
4	As above, a consequence of planning conditions not being adhered to, raising ground level in lorry park – resident advised that all correspondence regarding this is available for inspection.	CCC Planning	<p>Planning permission for the lorry park dates back to 1988. There are a number of different applications pertaining to the development but the drawing on the full application clearly states that the site is to be made level. As such, it can be inferred that land raising was agreed as part of the permission.</p> <p>Operation development has an enforcement window of 4 years and as such no enforcement action could be taken.</p>
5	Highmead Terrace – road flooded, retaining walls (in parts) saved many of the properties from extensive flooding.	NRW CCC, CC	NRW have confirmed that they have a fluvial flood model that can be utilised to provide answers to the residents' questions.

			<p>NRW to lead on the commissioning of a model review in collaboration with CCC and possibly Ceredigion CC.</p> <p>Please note that any capital flood defence works cannot adversely impact on third party flood risk (Planning Policy Wales, Technical Advice Note 15 Section 9) and that works within 8 metres of the River Teifi will require a Flood Risk Permit from NRW.</p>
B	Key Issues Identified by Community Council:		
1	A flood warning was received for the Teifi in Llanybydder at 13.06 on the 13th October at Ceredigion County Council by which time the properties in Station Terrace had been under water for 3 hours.	NRW	NRW are undertaking an internal review into the flood warnings issued during Storm Callum.
2	Being informed by Fire & Rescue services that they could not attend until water was in the houses.	MWWFRS	<p>On behalf of Mid and West Wales Fire and Rescue Service:-</p> <p>Over the 24 hour period midnight to midnight on 13th October the Service received a substantial high volume of calls, receiving 495 calls to the Joint Fire Service Control centre in Bridgend, 385 of those specifically for Mid and West Wales area. The Service responded to 84</p>

			<p>separate large scale flooding incidents. Specifically for Llanybydder, 19 calls were received to 13 separate addresses. 10 of the incidents were specifically on Station Road and Highmead Terrace.</p> <p>Due to the call activity and the treacherous road conditions in the area, the incidents which were not responded to at the time were based on several factors and advice or follow up calls were given to callers. Below is a summary of the protocol undertaken in the tactical command cell set up in joint fire service control:-</p> <p>Life risk calls prioritised. Where water was not entering the property, callers were advised to ring back if conditions worsened.</p> <p>Request to provide sandbags – callers were advised to contact local authority.</p> <p>Control staff were ringing callers back to check on conditions in area and to assess with the callers if the situation had deteriorated.</p>
3	Despite calls to Carmarthenshire County Council (by Nerys Morris) and Ceredigion Council (by Cllr Euros Davies) requesting road closure signs, traffic continued to attempt to drive through floods.	CCC Highways CC Highways	<p>There were highway maintenance response gangs available over the whole period dealing with widespread flooding. It was seen at other locations that even when there were road closed signs in place, drivers ignored the warnings and continued driving through.</p> <p>A suggestion for the future could be that arrangements are made through a local community group to deal with this type of scenario by utilising local volunteers. This will need to be considered for future</p>

			events in terms of practicality, control and appropriate arrangements/triggers.
4	Natural Resources Wales – request for sand-bags was declined and resident told to contact Council or B & Q.	NRW	<p>NRW's policy is that they do not provide sandbags. CCC will only provide sandbags in an emergency when there is an imminent risk of flooding to property, or where highway systems are causing potential flooding problems. We will review our policy shortly.</p> <p>The demand on all organisations was too great to distribute sandbags to all those who requested them.</p> <p>It was agreed in the public meeting that sandbags would not have helped the majority of those who flooded, due to the depth of the water.</p>
5	Council lorry turned up with sand-bags too late to be of any benefit.	CCC (Highways)	<p>A pallet full of sandbags was delivered to the area. Response times were difficult given the nature and extent of the simultaneous widespread flooding. Responses were prioritised based on the information received.</p> <p>As stated above, the policy is being reviewed.</p>
6	Natural Resources Wales stated "...they had bigger communities to protect." And cannot dredge rivers.	NRW	NRW clarified their position with regards to dredging in the community meeting. It is currently viewed as an unsustainable means of managing flood risk but they would review causes on a site by site basis.

7	County Council telephone numbers were permanently engaged, or when they did ring, were unanswered.	CCC	<p>50 phone lines were available through Carmarthenshire's out of hours call centre facility. The number of staff usually available over the weekend was doubled as a result of Storm Callum. The level of calls was unprecedented, given the scale of the event.</p> <p>A review of the adequacy of the provision/arrangements for future storm events will be undertaken.</p> <p>In addition, our Communications team were constantly updating information on our website and through digital/social media to provide the most up-to-date information available.</p>
8	Carmarthenshire County Council offered support in the week immediately after floods but nothing since.	CCC	<p>Support continues to be available, if individuals wish to get in touch with the County Council to explain the particular aspect of support required. The Department best placed to deal with the matter will respond where help can be provided.</p> <p>CCC set up an immediate flood recovery fund to support residents whose homes were damaged. In Llanybydder 21 households received the £200 payment and 8 households received a further £1000 in payments.</p> <p>CCC undertook clearance of damaged household items.</p>

			<p>Arrangements were made through Xcel Bowl in Carmarthen to provide items of furniture for householders in need via their furniture bank scheme.</p>
9	<p>Re-housing: Many residents, especially Station Terrace, had to find their own accommodation as all the properties were devastated and had to be evacuated. Of particular concern was the refusal to house displaced persons in Cwm Aur, the sheltered housing complex in Llanybydder, although there were vacancies and despite meeting criteria of being "Over 55". As Carmarthenshire County Council has a major interest in this complex, surely there could have been some concessions for short-term occupation.</p>	<p>CCC Steven Jones (Housing)</p>	<p>Cwm Aur is not a CCC run facility. Enquiries were made and subsequent agreement had to be negotiated with the owners – Pobl Group (formerly Gwalia Housing).</p> <p>The owners of the facility were immediately contacted following the flood to assess suitability and availability of space to house affected families. Consent was provided by the owners on the 26th October 2018. As a result, spaces were offered but there was no take up at that time. There was no availability of CCC property for use as temporary accommodation locally and understandably, families did not want to travel away from their locality.</p> <p>CCC dealt with 7 households (in Llanybydder) regarding re-housing queries. Of these - 4 were private tenants, 3 were private occupiers/owners.</p> <p>2 of these households stayed with family and friends, 1 was found an alternative by the landlord, 1 found their own accommodation, 1 was re-accommodated through insurance; the remaining 2 were offered a place in Cwm Aur when that alternative became available, but did not take up the offer.</p>

			<p>General Difficulties have been highlighted as the availability of suitable housing and those affected not wanting to leave the locality and their local support networks.</p> <p>Any household still having difficulties can contact CCC so that we can reassess the position.</p>
10	Residents were advised to apply on-line to Carmarthenshire County Council for immediate financial support of £200, but many without internet access have been unable to do so, thus being doubly disadvantaged.	CCC Deina Hockenhu11	<p>CCC Housing officers and Hub staff visited the location and were available to help fill in forms (on line and paper based) on behalf of residents; Two specific drop-in sessions were arranged at the Rugby Club to help with applications for financial help and of course, Hwb Bach y Wlad visited the site and continues to visit every Tuesday.</p> <p>30 forms were completed this way on behalf of householders.</p>
11	The cost of business disruption – shops and garage and workshops in Station Terrace in particular – run into several hundreds of thousands of pounds.	CCC Rhian Phillips	<p>Financial help was available to businesses to help recover. Further information can be provided to business if necessary.</p> <p>1 business in Llanybydder has received financial support.</p>
12	Residential property insurance claims are, conservatively, in the region of £30 - £40k.		<p>A matter for the individuals and their insurance companies.</p> <p>In Llanybydder:</p>

			X21 £200 payments; X8 £1000 payments; Made to help those in difficulty in the short term.
13	The emotional well-being of residents is now a major concern, especially as they may not be able to return to their homes for many months and are experiencing financial loss as many insurance companies will only cover basic temporary accommodation.	CCC	Further advice can be provided to householders relating to their specific circumstances. CCC will help out on a case by case basis where appropriate.
14	Ceredigion County Council published a Storm Callum Flood Bulletin within a week of the floods, and Council officials visited Highmead Terrace, but no financial support was offered along the lines of Carmarthenshire.	Ceredigion	
C	Key Points for Discussion		
1	Contingency Planning – is there an Emergency Plan, including how both Counties can over-ride County boundaries – in this case the River Teifi.	Carms & Ceredi CCs	There is no emergency plan specifically for Llanybydder. However, Emergency Planning Officers from Carmarthenshire and Ceredigion can provide advice specifically on this and how to develop community response plan in the event of future flooding. This could potentially include measures to manage road closures etc. The Community Council is advised to contact CCC's Emergency Planning Officer Richard Elms on 01267 225147. Richard will arrange

			to visit you with his CC counterpart and assist with the development of a community flood plan.
2	Does Natural Resources Wales/River Authority have any plans for the future and how do they anticipate dealing with the River Teifi and its environs in Llanybydder to avert future flooding risk?	NRW	This was answered in the public meeting.
3	Is there an opportunity for Llanybydder Community Council to have an input into any plans?	NRW, Carmarthen, Ceredigion	Yes, input into specific response plans can be developed with the respective Emergency Planning officers from both counties (see C1 above). This could potentially include measures to manage road closures etc.
4	What additional support, including financial, is available to residents and businesses directly affected by the flooding?	CCC	If anybody has not received any financial help to date, then let us know. If you make us aware of the specific issues, we can investigate and advise further to assess what support can be provided. £100,000 hardship relief fund for residents <ul style="list-style-type: none"> • £200 per household • £1000 if not insured

Appendix J – Summary of Recommended Actions to be taken forward by the relevant RMAs or property / landowners, from the Investigations into the Storm Callum Flooding.

JOHNSTOWN						
Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Term	Target Date
DCWW	Richard Davies	1	DCWW to evaluate the standard of service and the condition of the surface water sewers servicing Johnstown.	<p>CCTV survey of the network identifying defects accordingly.</p> <p>Utilise the information gathered on pipe sizes, along with catchment and rainfall information to calculate the standard of service.</p>	Medium	Oct 2019
Highway Authority	Ian Thomas	2	CCC Highways Authority to work with DCWW to evaluate the standard of service and the condition of the highway drainage in Johnstown (Generic).	<p>Ian Thomas (CCC) and Richard Davies (DCWW) to look at asset records and CCTV surveys and document the condition of their assets.</p> <p>From the culvert survey information the standard of service can be calculated and recorded.</p>	Medium	Oct 2019

CCC		3	Repair the flood bank at Johnstown Recreation Park.		Short	COMPLETE
CCC & NRW		4	Investigate why the flood bank was removed.		Short	COMPLETE
CCC (FD&CP)		5	Undertake CCTV of the drainage system in Llansteffan Road.		Short	COMPLETE
CCC (FD&CP)		6	Clarify drainage asset owners and responsibilities (Llansteffan Road).		Short	COMPLETE
Highways Authority	Ian Thomas	7	Investigate the presence and functionality of the non-return valves in the highways drainage systems (Heol Llansteffan, Johnstown).	Undertake a review of the CCTV survey or implement a monitoring programme to test the functionality of the NRVs.	Short	COMPLETE
Highways Authority	Ian Thomas	8	Jet the drainage and action repairs accordingly (Heol Llansteffan, Johnstown).	Utilise framework contractor to undertake the works.	Medium	Oct 2019
Highways Authority	Ian Thomas	9	Implement a highways flooding management plan (Heol Llansteffan, Johnstown).	Work with NRW, FD&CP and CCC Emergency Planning to agree triggers and actions to manage risk	Medium	Oct 2019
NRW	Aneurin Cox	10	Investigate the standard of service of the flood defence embankment (Heol Llansteffan, Johnstown).	Undertake an assessment of the flood banks and deliver works to ensure the standard of service can be achieved.	Short	COMPLETE

Highways Authority	Ian Thomas	11	Highways Authority to undertake investigations to clarify the layout of the drainage in St Clears Road, Johnstown.	Undertake a CCTV survey of the highway network to identify its location, size and condition.	Medium	Oct 2019
DCWW & Highways Authority	Richard Davies DCWW Ian Thomas CCC	12	DCWW and the Highways Authority to evaluate the standard of service that is afforded by the drainage system in St Clears Road, Johnstown.	Utilise the CCTV information gathered on pipe sizes, along with catchment and rainfall information to calculate the standard of service.	Medium	Oct 2019
DCWW & Highways Authority	Richard Davies DCWW Ian Thomas CCC	13	DCWW and the Highways Authority to evaluate management options for exceedance in St Clears Road, Johnstown.	Formulate a flood risk management plan to manage highway flooding.	Medium	Oct 2019
NRW	Aneurin Cox	14	NRW to evaluate the need to raise the flood bank at Maes Y Dderwen, Johnstown, Carmarthen.	Undertake an assessment of the flood banks and deliver works to ensure the standard of service can be achieved.	Medium	Nov 2019
CCC & NRW	Ben Kathrens Aneurin Cox	15	Evaluate surface water management options on the landward side of the defence at Maes Y Dderwen, Johnstown, Carmarthen.	CCC will calculate the volume of water that can potentially accumulate behind the defence and, if necessary NRW will suggest preferred methods to remove that water through their flood bund.	Medium	Oct 2019

PENSARN						
Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
DCWW	Richard Davies	16	DCWW to check the accuracy of the surface water maps in the Llangunnor area of Carmarthen and update accordingly.	Internal review of the data.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	17	Investigate the effects of the attenuation lagoons and basins on flows entering the Sticle surface water sewer.	Utilise WG grant money to evaluate flooding in Pensarn including the effects of the lagoons.	Long	April 2020
CCC FD&CP	Ben Kathrens	18	Undertake a CCTV survey of Old Llangunnor Road and the Currys PC World car park to ascertain its network, and structural and service condition, and its future maintenance liability.	Enlist CCTV contractor.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	19	Undertake a CCTV survey of Old Llangunnor Road (north of the A40) to ascertain its network, and structural and service condition, and its future maintenance liability.	Enlist CCTV contractor.	Medium	Oct 2019

CCC FD&CP	Ben Kathrens	20	Collate information on the drainage systems that serve the A40 and A48.	Liaison with SWTRA and evaluation of the Highway Authority WDM database.	Short	COMPLETE
DCWW	Richard Davies	21	DCWW to confirm that there are no DCWW assets in Stephens Way.		Short	COMPLETE
CCC FD&CP	Ben Kathrens	22	Develop a better understanding of the outputs from the Sticle lagoon system.	Utilise WG grant money to evaluate flooding in Pensarn including the effects of the lagoons.	Long	April 2020
CCC FD&CP	Ben Kathrens	23	Re-evaluate the effectiveness of the pump.	Utilise WG grant money to evaluate flooding in Pensarn, including the effectiveness of the pump.	Long	April 2020
NRW	Aneurin Cox	24	NRW to arrange for a structural inspection of the flood defence wall to be undertaken.	NRW to enlist the services of a Panel Engineer to evaluate the flood walls at Pensarn.	Medium	COMPLETE
Network Rail	Robert Knapman	25	Network Rail to investigate and repair the section of blocked culvert at Old Llangunnor Road, West.		Short	July 2019
CCC FD&CP	Ben Kathrens	26	Evaluate culvert capacity in Pensarn Road.	Use CCTV survey data and FSR or FSR rainfall data.	Short	COMPLETE
CCC FD&CP	Ben Kathrens	27	Evaluate inputs from the Llangunnor Estate.	Evaluate DCWW network and CCTV surveys.	Short	COMPLETE

CCC FD&CP	Ben Kathrens	28	Liaise with SWTRA on the discharges from the A40 and the level of attenuation provided by the lagoon and ponds at Sticle.	Liaise with SWTRA.	Short	COMPLETE
CCC FD&CP	Ben Kathrens	29	Bid for financial assistance to evaluate the flood mechanisms at Pensarn and comprise a list of potential mitigation and management measures- COMPLETE	Submit an application to Welsh Government for funding under the capital work flood risk management pipeline programme.	Short	COMPLETE
CCC Civil Contingency officer	Richard Elms	30	Formulate a short to medium term flood management plan to manage exceedance.	NRW and CCC Civil Contingency officers to formulate a plan.	Long	Feb 2020
CCC FD&CP	Ben Kathrens	31	Identify the owners / benefactors of the Sticle Storm water Sewer.	Undertake land registry searches and evaluate inputs into the system.	Short	June 2019
CCC FD&CP	Ben Kathrens	32	Ensure the necessary repairs are undertaken to the Sticle storm Water Sewer.	Write to the benefactors requesting a financial contribution and if unsuccessful evaluate issuing a notice under the Land Drainage Act 1991.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	33	Inform the drainage system benefactors of their obligations with regards to the drainage system and advise them to make the repairs identified at Stephens Way.	Write to the benefactors requesting a financial contribution and if unsuccessful evaluate issuing a notice under the Land Drainage Act 1991.	Medium	Oct 2019

LLANYBYDDER						
Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
Highways Authority	Stuart Quick	34	Undertake a CCTV survey of the highways drainage at Station Terrace, to ascertain the condition and standard of service.	Commission a CCTV contractor to undertake the works and produce a condition report. The standard of service will be calculated from the pipe sizes, rainfall and catchment area.	Medium	Oct 2019
DCWW	Richard Davies	35	Ascertain the details of the surface water drainage around Heol Y Dderi.	Undertake site and database investigations.	Medium	Oct 2019
DCWW	Richard Davies	36	Investigate the feasibility of relocation of the sewer pipe at Heol Y Deri	Work with the Highways Authority and CCC FD&CP team to see if the sewer pipe can be relocated as part of the wider potential capital scheme at Heol Y Dderi.	Medium	Oct 2019
NRW	Aneurin Cox	37	NRW to look into upgrading their telemetry network in the Llanybydder area.	NRW feasibility study.	Medium	Nov 2019

Ceredigion CC, CCC & NRW	Ben Kathrens Rhodri Llwyd Aneurin Cox	38	Carmarthenshire and Ceredigion CC will commission a study to evaluate the effect of the causeway on flood risk and the legality and consequences of its removal or modification. NRW can lead and facilitate the production of flood flow models to illustrate which scenario would achieve the best outcome.	Carmarthenshire CC and Ceredigion CC to write a brief and submit to NRW. NRW will evaluate the work that needs to be undertaken to meet the requirements of the brief and if they do not have adequate resources, contract the services of a framework contractor to interrogate the flood model and provide a report accordingly.	Medium term (agree brief and ToR) Long term (full analysis and reporting)	July 2019 Feb 2020
DCWW	Richard Davies	39	DCWW action to further investigate whether the spoil has affected the flood risk.		Medium	Oct 2019
CCC & Ceredigion CC Civil Contingency	Richard Elms	40	Develop a local flood plan and resilience.	Carmarthenshire and Ceredigion Civil Contingency officers to meet with Llanybydder Community Council and help them formulate a flood management plan.	Long	Feb 2020
NRW	Aneurin Cox	41	Investigate opportunities for upland catchment management in the Nant Einon and Afon Duar catchments.	Carry out a desk top study that will provide a list of potential opportunities as to where this could happen and provide benefit. The outcome of this work will then be shared with	Long	Feb 2020

				partners to prompt a decision about how best to proceed.		
DCWW	Richard Davies	42	Investigate the urban surface water system, and opportunities for retro-fitting sustainable drainage features to manage surface water and flood risk.		Long	Feb 2020
CCC FD&CP	Ben Kathrens	43	Undertake a feasibility exercise to identify the constraints that will impact on the upgrading of the B4337 highway culvert.	Undertake utility searches and run a HEC RAS fluvial model.	Medium	Oct 2019
Highways Authority	Stuart Quick	44	Add flaps to the outfalls at Heol Y Dderi, Llanybydder.	Add flaps to the highway outfalls.	Medium	Oct 2019
Highways Authority	Stuart Quick	45	Investigate the feasibility of diverting the highway drainage to discharge at the downstream end of the B4337 culvert.	Undertake utility searches.	Medium	Oct 2019
CCC FD&CP	Ben Kathrens	46	CCC to identify the land owners and inform them of their riparian duties to maintain the river banks and keep them clear of debris.	Undertake land registry searches and issue information letters to riparian owners.	Medium	Oct 2019

LLANDYSUL & PONT TYWELI						
Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
Highways Authority	Tony Williams	47	Undertake CCTV surveys to identify the path, standard of service and condition of the highways drainage.	Enlist a CCTV contractor.	Medium	Oct 2019
CCC Highways Bridges and Structures	Peter Morgan	48	The walls along the north side of Lewis Street should be replaced with a passive structure (as and when replacement is necessary)		Long	Ongoing
Ceredigion, CCC & NRW	Ben Kathrens Rhodri Llwyd Aneurin Cox	49	Carmarthenshire and Ceredigion CC will commission a study to evaluate the effect of the causeway on flood risk and the legality and consequences of its removal or modification. NRW can lead and facilitate the production of flood flow models to illustrate which scenario would achieve the best outcome.	Carmarthenshire CC and Ceredigion CC to write a brief and submit to NRW. NRW will evaluate the work that needs to be undertaken to meet the requirements of the brief and if they do not have adequate resources, contract the services of a framework contractor to interrogate the flood model and provide a report accordingly.	Medium term (agree brief and ToR) Long term (full analysis and reporting)	Sept 2019 Feb 2020

GENERIC ACTIONS						
Lead RMA & Action Responsibility	Lead Contact	Action No.	Action	How will this be achieved	Period	Target Date
NRW	Aneurin Cox	50	NRW to review the performance of the flood warning system during Storm Callum.	NRW to undertake an internal review of the flood warning system.	Medium	October 2019
NRW	Aneurin Cox	51	NRW to clarify the limitations of the flood warnings, and convey this to its customers or amend the service to provide warnings about other flood sources.	NRW to develop a communication strategy to inform its customers accordingly.	Medium	October 2019
Delta Wellbeing	Sam Watkins	52	Undertake a review into the functionality of the CCC call centre during Storm Callum and its ability to manage and administer major incidents going forward.	CCC and Delta Wellbeing to undertake a review.	Medium	October 2019
CCC FD&CP	Ben Kathrens	53	Investigate a mechanism to inform tenants of the flood risk afforded to their properties.	FD&CP to work with housing to investigate ways to inform tenants and landlords of their flood risk.	Medium	October 2019

Civil Contingency	Richard Elms (CCC)	54	Develop community resilience and flood action plans in those communities at greatest risk of flooding.	Meet with community leaders and develop plan accordingly.	Medium	October 2019
CCC FD&CP Highways Authority Delta Wellbeing	Ben Kathrens, Darren King & Sam Watkins	55	Further develop collaborative working and development of databases that allows information on flooding to be captured and interrogated efficiently.	Work with the Highways Authority and Delta to ensure that accurate reports are captured and that the actions pertaining to those incidents are also captured.	Long	Feb 2020

WORKING DRAFT