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Western Wales River Basin District

Preliminary Flood Risk Assessment Report

December 2018



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Foreword

For the second cycle of the Flood Risk Regulations, the focus in Wales is on bringing information about the risk and management of flooding from main rivers, reservoirs, the sea and surface water together in one place. This involves working collaboratively across Welsh Government (WG), Natural Resources Wales (NRW), the Welsh Local Government Association (WLGA) and Lead Local Flood Authorities (LLFAs). This Preliminary Flood Risk Assessment (PFRA) report is an output from that collaborative approach, which all parties wish to grow in the future.

This report is intended to assess and identify those areas within Wales that are most at risk of flooding from any source (main river, reservoirs, the sea and surface water). This begins with an assessment of significant past flooding that has affected Wales from 2011 onwards and then considers the potential adverse consequences of future flooding. Using this information, the report then identifies those areas within Wales where the most significant flood risks exist. These are known as Flood Risk Areas (FRAs). It is these FRAs that will have flood hazard and flood risk mapping completed by 22 December 2019 then Flood Risk Management Plans by 22 December 2021.

In Wales, we have developed a Communities at Risk Register (CaRR) which is a tool that considers a number of factors to help identify where the most vulnerable communities at risk of flooding are located. Whilst many factors influence the risk of flooding and the perception of that risk, the CaRR is a useful tool to compare the risk to communities from all flood risk sources in the same way, and identify where the risk is likely to be the most significant. Those communities at most significant risk have been identified as Flood Risk Areas. There are 33 communities, grouped into 9 Flood Risk Areas across Wales.

This report covers the Western Wales River Basin District (RBD). A RBD covers an entire river system, including rivers, lakes, estuaries and coastal waters. There are three RBDs that cover Wales: the Western Wales; the Severn and the Dee. Each RBD has a PFRA report and together they cover Wales as the first stage of the second cycle Flood Risk Regulations.

1. Introduction and Background

The Floods Directive (Directive 2007/60/EC of the European Parliament and of the European Council on the assessment and management of flood risks¹; the ‘Directive’) establishes a framework for assessing and managing flood risk aimed at reducing the adverse consequences for human health, the environment, cultural heritage and economic activity. It was transposed into UK law by the Flood Risk Regulations 2009² (‘The Regulations’) which came into force on 10 December 2009.

The Regulations require the following:

1. Preliminary flood risk assessment maps and reports by 22 December 2011 (on the basis of which ‘Flood Risk Areas’ should be identified in accordance with Government guidance);
2. Flood hazard maps and flood risk maps by 22 December 2013;
3. Flood risk management plans by 22 December 2015;
4. All assessments, maps and plans to be reviewed and updated every 6 years.

Figure 1: The Floods Directive Cycle



The first cycle is complete, so we are now in the second cycle of implementation which began in 2016 and will end in 2021. This means that those products produced throughout cycle 1 need to be reviewed, and if appropriate, updated. The review and update begins with the Preliminary Flood Risk Assessment (PFRA) stage.

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007L0060&from=EN>

² <http://www.legislation.gov.uk/ukxi/2009/3042/contents/made>

A Preliminary Flood Risk Assessment (PFRA) is a high level screening exercise to identify areas where the risk of flooding is considered to be significant and requires further study through the production of flood hazard and flood risk maps and flood risk management plans.

There is a difference between the dates in legislation by which the PFRA review needs to be undertaken. The Regulations require the PFRA review to be completed by 22nd December 2017; and the Directive requires the review to be completed by 22nd December 2018. To meet the deadline in the Flood Risk Regulations, the 22 Lead Local Flood Authorities (LLFAs) in Wales completed a review of their Cycle 1 PFRAs and have published an Addendum to their reports which outlines this work. The links to these documents can be found on the Natural Resources Wales website [here](#).

In cycle 1, the Environment Agency, responsible for implementing the legislation in England and Wales at the time, made the decision to apply an exemption outlined in Article 13 of the Directive. The exemption permitted Member States to choose not to produce a PFRA for those river basins where it had already been decided, to prepare flood hazard maps and flood risk maps and to establish flood risk management plans in accordance with the relevant provisions in the Directive. The exemption did not apply to surface water flooding but only to flooding from main rivers, reservoirs and the sea. For cycle 2, the exemption is not applicable, making this the first PFRA which considers flood risk from main rivers, the sea and reservoirs, as well as surface water.

Second Cycle Approach in Wales

Welsh Government are seeking a holistic approach for the review and update of the PFRA for the second cycle, which seeks to analyse and identify areas of combined flood risk to provide a better fit with the domestic Flood and Coast Erosion Risk Management (FCERM) policy in Wales. This involves a second cycle PFRA that:

- Seeks to identify ‘hotspots’ of combined flood risk sources in conjunction with the Wales Communities at Risk Register (CaRR) (refer to chapter 5, Flood Risk Areas, for a description of the CaRR);
- Seeks to optimise resource efforts for all Risk Management Authorities by working together across all sources of flood risk while meeting the requirements of the legislation.

To accommodate the different deadlines in the legislation, Welsh Government, in agreement with the Welsh Local Government Association (WLGA) and Natural Resources Wales (NRW), proposed a two-stage approach to second cycle PFRAs:

1. LLFAs undertake a phase 1 review of their existing PFRA, which was reviewed by NRW and published by 22nd December 2017; and
2. NRW and LLFAs work together to produce this consolidated PFRA covering all sources of flood risk using a ‘hot spot’ approach to identify those areas that are at greatest risk of flooding in Wales from all sources by 22nd December 2018.

This two-stage approach was followed to help achieve a more consistent and coordinated approach to flood risk management in Wales.

Roles and Responsibilities

This consolidated PFRA report is published by NRW but has been produced in conjunction with Lead Local Flood Authorities given their responsibility for surface water (which includes flooding from ordinary watercourses and groundwater); Welsh Government; and the Welsh Local Government Agency (WLGA). Natural Resources Wales is responsible for the management of flood risk from main rivers, reservoirs and the sea.

The Floods and Water Management Act 2010 clarified the roles and responsibilities for the different sources of flooding that could affect Wales. In addition, the Welsh Government National Flood and Coastal Erosion Risk Management Strategy identified all the Risk Management Authorities in Wales that need to work in collaboration to deliver the measures and objectives from the National Strategy.

The organisations that are covered by this Western Wales PFRA report are listed in the Table 1 below along with their role.

Table 1 – Organisations covered by this report

Name of authority	Role in PFRA
Welsh Government	The Minister for the Environment and Cultural Heritage sets the threshold for Flood Risk Areas
Natural Resources Wales	Responsible for the management of flood risk from main rivers, reservoirs and the sea.
Lead Local Flood Authorities: <ul style="list-style-type: none"> • The Vale of Galmorgan Count Borough Council • Bridgend County Borough Council • Neath Port Talbot County Borough Council • Swansea Council • Carmarthenshire County Council • Pembrokeshire County Council • Ceredigion County Council • Gwynedd Council • Isle of Anglesey County Council • Conwy County Borough Council • Denbighshire County Council • Powys County Council (Small part within RBD boundary only) • Flintshire County Council (Small part within RBD boundary only) 	Lead Local Flood Authority responsible for the management of flood risk from surface water, ground water and ordinary watercourses

Study Area

Figure 2 – Location and land use map of the Western Wales River Basin District

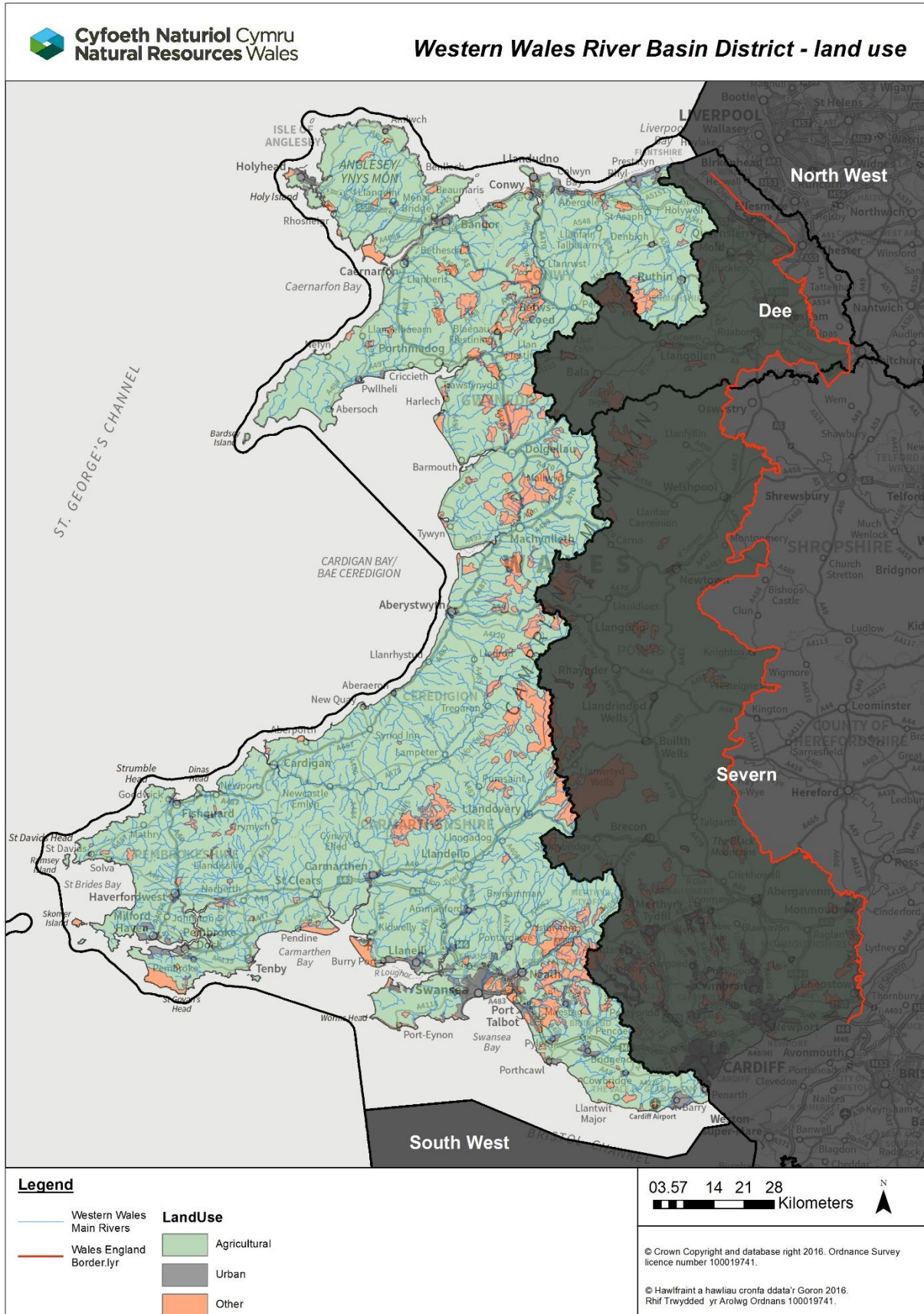
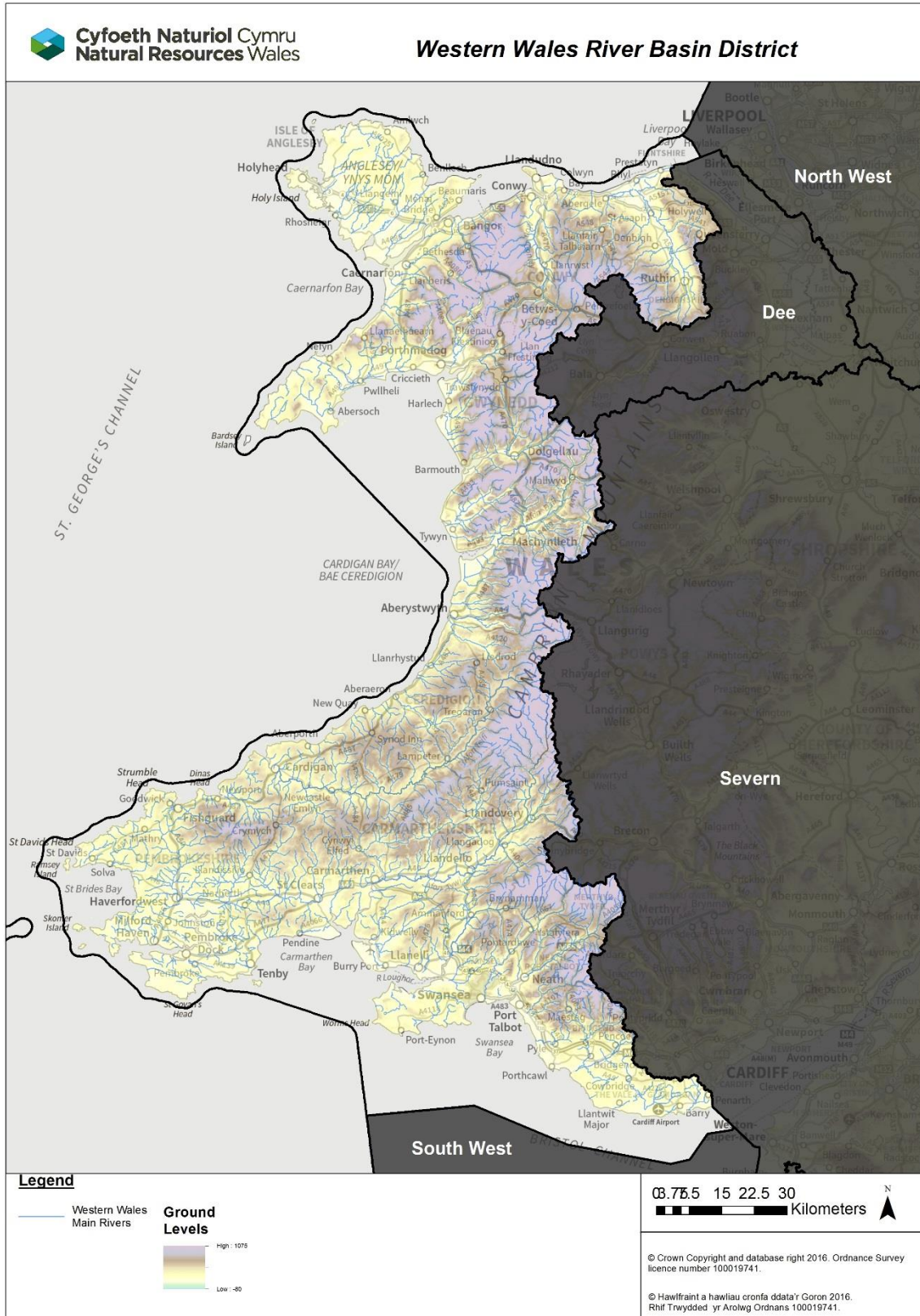


Figure 3 – Location and topography of Western Wales RBD



The Western Wales River Basin District (RBD) covers an area of 16,653 square kilometres. It extends across the entire western half of Wales, from the Vale of Glamorgan in the south to Denbighshire in the north. The River Basin District contains the largest river that is wholly within Wales; the Towy in Carmarthenshire. Other notable rivers within the RBD include the Teifi in south Wales, the Dovey and Dysynni in mid Wales, and the Mawddach, Conwy, and Clwyd in north Wales. There are a number of lakes and reservoirs in the RBD, which are used for a range of purposes including water supply, recreation or hydroelectric power generation.

There are three National Parks covering 17% of the district: Snowdonia, Brecon Beacons and Pembrokeshire Coast National Park. Substantial areas of the district (4%) are designated as Areas of Outstanding Natural Beauty (AONB) and there are 7 Ramsar sites within or near the RBD. The coastline is also rich and varied; approximately 500km of the Welsh Coast is designated as Heritage Coast and approximately 70% designated as either a Special Area of Conservation (SAC) or a Special Protection Area (SPA). Two of the offshore islands, Skomer and Lundy, are designated as Marine Nature Reserves and over 100 beaches are EC designated bathing waters.

The population of the Western Wales river district is around 1.5 million people and the principal urban centres are Swansea, Bangor and Aberystwyth. The main industrial centres in the RBD are in Milford Haven, the UK's largest energy port supporting oil and gas industries, and in Port Talbot known for its Steel Works. Sea fishing, salmon net fisheries, mussel fisheries and cockle beds are important to the local economy, with 25 areas designated as Shellfish Waters in the district. Agriculture is an important part of the rural economy; the grazing of sheep and cattle generally dominates over arable crops. Tourism is a major part of the local economy for the majority of the district, the dramatic coastline contributes over £350 million each year to the Welsh economy. The Wales Coastal Path attracted approximately 3 million people within the first 12 months of its opening.

What this report contains

This PFRA report is intended to assess and identify those areas within Wales that are most at risk of flooding from any source or combination of sources (main river, reservoirs, the sea, surface water, ground water and from ordinary watercourses). This begins with an assessment of significant past flooding that has affected Wales from 2011 onwards and then considers the potential adverse consequences of future flooding. Using this information, the report then identifies those areas within Wales where most significant flood risks exist. These are known as Flood Risk Areas (FRAs). It is these FRAs that will have flood hazard and flood risk mapping completed by 22 December 2019 then Flood Risk Management Plans by 22 December 2021.

2. Methodology

The PFRA is a high-level screening exercise to identify areas where the risk of flooding is considered to be significant and warrants further examination through the production of flood hazard maps, flood risk maps and flood risk management plans. We have utilised existing information to write this PFRA and to identify Flood Risk Areas.

Whilst both the Regulations and the Directive, clearly state what the preliminary assessment report (PFRA) should comprise, they do not provide a definition of 'significant' flood risk for application within the report. In cycle 1 the decision as to what was locally significant with regards to past flood events and future flood risk, was left to each LLFA. This led to a range of thresholds being used, particularly for recording past flood events. As this PFRA seeks to achieve a consolidated and consistent approach by including flood risk from multiple sources, we have standardised the methodology and thresholds to ensure we can report consistently across Wales.

Thresholds

The thresholds we have agreed to define significant flood risk across Wales for this PFRA are summarised below.

Past flood events: Flood events are deemed to be significant in Wales for the purpose of this PFRA, if 20 or more residential properties were flooded per town or postcode area. Flood events exceeding this threshold for **fluvial, tidal and surface water** sources since 2011 are included within this report.

Potential flood risk: Information and statistics included within this report for potential future flooding are based upon the 0.1% Annual Exceedance Probability (AEP) for risk of flooding.

The central climate change allowance³ has been used for climate change flood flow estimates.

The following sections cover past flooding and potential future flooding and describe some of the information used to help us identify Flood Risk Areas.

³ The central climate change allowance equates to the 50th percentile of a medium (A1B) emissions scenario, as derived from research into regionalised data of climate change on flood flows (EA/DEFRA). It was previously known as the 'change factor'.

3. Past Flood Risk

Historical flood records held by NRW and LLFAs were used to collate information on past flooding for the purpose of this PFRA. We have identified those events which have occurred since the production of cycle 1 PFRA in 2011, and exceeded our definition of a significant flood event (20 or more residential properties flooded in a town or village for fluvial, tidal and/or surface watersources. This information is presented in table 2.

It should be noted that flood events have been recorded by community rather than by date. We recognise that through setting this threshold, there may be some communities which experience regular flooding but only comprise of less than 20 residential properties and therefore have not been captured as part of this assessment.

When there has been flooding experienced, we combine information on the flood extent with data on the areas affected, from the National Receptor Database (NRD). The NRD enables us to capture information regarding social, economic, environmental and cultural receptors to help us understand the consequences from the flood. We have also looked at the pathways by which flooding occurred, or flood conveyance routes. Flood extents, conveyance routes and receptors affected are all sources of information that help to improve our flood models for future flooding predictions.

Groundwater flooding

Groundwater flood events in Wales are rare. The geology (underlying rock type) and topography (steep sided valleys) mean that groundwater flooding is very unlikely to occur. Due to the history of mining in certain areas of Wales, flooding recorded as groundwater may actually be from disused mine workings. Whilst this is becoming more of a concern for some LLFAs it still remains very low likelihood.

Since 2011, there have been no recorded events of groundwater flooding within the Western Wales River Basin District.

Reservoir flooding

Flooding from a reservoir is a high consequence, low likelihood event. All reservoirs in Wales that are greater than 10,000 cubic meters of water retained above ground level, are covered by the Reservoirs Act 1975 (as amended). The Act was brought in to reduce the risk to the communities downstream of these reservoirs as a consequence of an uncontrolled release of water. The risk from reservoir flooding is greatly minimised by strict preventative legislation making it very low likelihood.

There have been no incidences of reservoir flooding in Wales since 2011 (the timeframe for this report). NRW is the enforcement authority for the Reservoirs Act 1975 in Wales and we regulate the sector to ensure that reservoirs are inspected regularly and essential safety work is carried out.

Table 2 – Flooding events in the Western Wales RBD since 2011

Start date of flooding	Location	Duration	Frequency	Source**	Mechanism**	Characteristics of flooding**	Consequences for people**	Consequences for environment**	Consequences for cultural heritage**	Consequences for economics**
9 th June 2012	Aberystwyth, Ceredigion	2 Days	Approximate 1 in 75 years	Fluvial Main River: Afon Rheidol	Natural Exceedance, Defence Exceedance	Medium Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 35 properties and 90 caravans affected.
9 th June 2012	Capel Bangor, Ceredigion	1 day	Unknown	Fluvial Main River: Afon Melinddwr	Natural Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 1 commercial property, 18 residential properties and a caravan park affected.
9 th June 2012	Tal y Bont, Ceredigion	1 day	Unknown	Fluvial Non Main River: Afon Ceulan and Afon Leri	Natural Exceedance	Rapid Onset, Debris, High Velocity, Deep Flood	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 26 properties affected, mainly residential with some commercial.
9 th June 2012	Dol y Bont, Ceredigion	1 day	Unknown	Fluvial Main River: Afon Leri	Natural Exceedance, Defence Exceedance	Rapid Onset, High Velocity, Deep Flood	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 19 properties and 110 caravans affected across 2 caravan sites
9 th June 2012	Borth, Ceredigion	1 day	Unknown	Fluvial Main River: Afon Leri	Defence Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 15 properties and 40 caravans affected across 2 sites affected
11 th October 2012	Cardigan, Ceredigion	< 1 day	Unknown	Pluvial and Fluvial Main River: Afon Mwdan	Natural Exceedance	Flash Flood	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 27 properties affected at 2 distinct locations. Pluvial flooding of the Strand area in Cardigan resulted in the most significant flooding.
22 nd November 2012	Llanberis, Gwynedd	2 days	Unknown	Fluvial and Pluvial	Blockage / Restriction	Rapid Onset	Community Impacts	Not applicable	Other	Property Flooding: 38 residential and 34 commercial properties affected. Infrastructure: 1 critical service affected. Economic activity
22 nd November 2012	Tal Y Bont (Bangor), Gwynedd	2 days	Unknown	Fluvial and Pluvial	Natural Exceedance	Rapid Onset	Community Impacts	Not applicable	Not applicable	Property Flooding: 20 properties Infrastructure
22 nd November 2012	Deiniolen, Gwynedd	2 days	Unknown	Fluvial and Pluvial	Natural Exceedance	Rapid Onset	Community Impacts	Not applicable	Not applicable	Property Flooding: 29 properties.
27 th November 2012	Llanfair Talhaiarn, Conwy	<1 day	Unknown	Fluvial Main River: Nant Barrog	Blockage / Restriction	Flash Flood	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 21 Properties affected
27 th November 2012	Glasdir Estate, Ruthin	1 day	Unknown	Fluvial Main River: Afon Clwyd	Natural Exceedance, Defence Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 122 Properties affected within this newly constructed housing estate
27 th November 2012	St Asaph & Lower Denbigh Road, Main River - Afon Elwy	1 day	Unknown	Fluvial Main River: Afon Elwy	Natural Exceedance, Defence Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 326 properties and 70 caravans affected.
25 th January 2013	Solva, Pembrokeshire	< 1 day	Unknown	Fluvial Main River: River Solva	Natural Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 18-20 Properties affected, mix of residential and commercial.
5 th December 2013	Kinmel Bay, Coastal	<1 day	Unknown	Sea Water	Natural Exceedance, Defence Exceedance	Medium Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 155 residential and 5 commercial properties affected.
5 th December 2013	Rhyl, Coastal	<1 day	Unknown	Sea Water	Natural Exceedance, Defence or	Medium Onset, Debris, High Velocity	Community Impacts	Pollution Sources, Other Potential	Not Applicable	Property Flooding: It is estimated that more than 170 properties were affected; these were primarily dwellings

Start date of flooding	Location	Duration	Frequency	Source**	Mechanism**	Characteristics of flooding**	Consequences for people**	Consequences for environment**	Consequences for cultural heritage**	Consequences for economics**
					Infrastructural Failure			Impacts on the Environment		but also included 1 commercial property, Rhyl Golf Club House and an electricity substation.
3 rd January 2014	Aberystwyth, Ceredigion	1 day	Approximate 1 in 30 years	Sea Water	Natural Exceedance, Defence Exceedance	Medium Onset, Debris, High Velocity	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Cultural Assets: Damage to seafront including a grade II listed building.	Property Flooding: Exact number of properties affected unknown, estimated to be greater than 20, including student accommodation, residential and commercial properties
3 rd January 2014	Borth, Ceredigion	1 day	Approximate 1 in 30 years	Sea Water	Natural Exceedance, Defence Exceedance	Medium Onset, Debris, High Velocity	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 14 residential properties and 2 commercial properties affected.
3 rd January 2014	Cardigan, Ceredigion	<1 day	Approximate 1 in 30 years	Sea Water	Natural Exceedance	Medium Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 27 properties affected, predominantly residential with some commercial.
3 rd January 2014	Kidwelly, Carmarthenshire	<1 day	Approximate 1 in 30 years	Sea Water	Natural Exceedance	Medium Onset, High Velocity	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 70 holiday chalets affected, most unoccupied at the time of flood.
7 th November 2014	Cardigan, Ceredigion	<1 day	Approximate 1 in 30 years	Pluvial	Natural Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 20 properties affected in the Strand area of Cardigan
26 th December 2015	River Conwy	1 day	Unknown	Fluvial Main River: Afon Conwy	Defence or Infrastructure fail	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 33 Caravans affected
26 th December 2015	Tal Y Bont (Bangor), Gwynedd	2 days	Unknown	Fluvial and Pluvial	Natural Exceedance	Rapid Onset	Community Impacts	Not applicable	Not Applicable	Property Flooding: 20 properties Infrastructure
3 rd September 2016	Ystalyfera and Godre'r Graig, Swansea	<1 day	Unknown	Fluvial Non-main river: Minor Watercourses	Blockage / Restriction	Flash Flood	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 20 residential properties affected
22 nd November 2017	Llangefni	<1 day	1 in 31 year rainfall event	Fluvial Main River: Afon Cefni and Afon Clai	Natural Exceedance	Rapid Onset	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: 6 residential and 27 commercial properties affected.
13 th October 2018	Llandysul	1-2 days	Between 1 in 200 and 1 in 400 year flow return period	Fluvial Main Rivers: Teifi and Tyweli	Natural Exceedance	Rapid Onset, Debris, High Velocity	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Approximately 63 commercial and residential properties from the River Teifi and Tyweli
13 th October 2018	Newcastle Emlyn	1-2 days	Between 1 in 200 and 1 in 400 year flow return period	Fluvial: Main River Teifi, Pluvial	Natural Exceedance	Medium Onset,	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Approximately 34 properties flooded from the main river Teifi, some surface water issue in the town.
13 th October 2018	Carmarthen	1 - 2 days	Approximately 1 in 50 year flow return period	Fluvial: Main River Towy, Pluvial	Natural Exceedance, Defence Exceedance	Medium Onset,	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Approximately 82 commercial and residential properties in the Carmarthen area. Locations include Pensarn (defence overtopping and surface water), Carmarthen Quay, Johnstown, Abergwilli and some other small surrounding villages.
13 th October 2018	Llechryd	1 - 2 days	Between 1 in 200 and 1 in 400 year flow return period	Fluvial: Main River Towy, Pluvial	Natural Exceedance, Defence Exceedance	Medium Onset,	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Approximately 27 predominantly residential properties from the River Teifi

Start date of flooding	Location	Duration	Frequency	Source**	Mechanism**	Characteristics of flooding**	Consequences for people**	Consequences for environment**	Consequences for cultural heritage**	Consequences for economics**
13 th October 2018	Llanybydder	1 - 2 days	Between 1 in 200 and 1 in 400 year flow return period	Fluvial: Main River Towy, Pluvial	Natural Exceedance, Defence Exceedance	Medium Onset,	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Approximately 47 predominantly residential properties from the River Teifi
13 th October 2018	Lampeter	1 - 2 days	Between 1 in 200 and 1 in 400 year flow return period	Fluvial: Main River Towy, Pluvial	Natural Exceedance, Defence Exceedance	Medium Onset,	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Approximately 49 predominantly residential properties from the River Teifi
10 th November 2018	Milford Haven	1-2 days	Unknown	Fluvial: Non main rivers, draining into Milford Docks	Blockage / Restriction: Capacity exceeded	Medium Onset,	Community Impacts	Pollution Sources, Other Potential Impacts on the Environment	Not Applicable	Property Flooding: Number of properties to be confirmed with the expectation that numbers exceed 20 residential and commercial properties.

** Definitions of terms used within the table above can be found in the Glossary.

4. Potential Flood Risk

The risk of flooding across the Western Wales River Basin District can be assessed through flood risk modelling and mapping. Through this we are able to understand where and what is currently at risk by assessing the likelihood and consequence of predicted flood flows for fluvial, tidal and surface water sources.

The following factors are used as input data during modelling to help assess flood risk:

- Topography;
- Land use;
- Location of watercourses;
- Representation of watercourse structures;
- Location of flood plains that retain water;
- Characteristics of watercourses (lengths, modifications);
- Effectiveness of any works constructed for the purpose of flood risk management;
- Location of populated areas;
- Areas in which economic activity is concentrated.

We produce maps to visually illustrate the areas at risk of flooding and these are available on the [NRW website](#). These maps show information on the risk of flooding to communities for all sources of flood risk. Our maps enable us to extract information on where and what is most at risk and what actions are needed to address the risk. For the purpose of this report, we have looked at the 0.1% Annual Exceedance Probability (AEP) risk of flooding and assessed what is at risk from a flood of this magnitude for people, economics, the environment and cultural heritage within the River Basin District. We have captured this data from the best available information at this time and used table 3 in the following section to present this information. This data will be reviewed and updated through the next stage of this Floods Directive cycle.

The impact of climate change

By using flood risk modelling, we are also able to assess how modelled flood risk could change in the future as a result of climate change impacts. We have run our flood risk models with the most current climate change allowances to provide an indication of what is likely to be at risk in the future in comparison to the present day risk.

The climate change allowance for Fluvial and Tidal flooding is based upon the Welsh Government Guidance Note⁴ on adapting to climate change. The climate change allowance for Surface Water flooding is based upon Environment Agency Guidance⁵.

There are separate allowances for river flows, rainfall intensity and sea level rise which provide the best estimate of what the likely impacts are in the future. We have used the

⁴ <http://gov.wales/docs/desh/publications/160831guidance-for-flood-consequence-assessments-climate-change-allowances-en.pdf>

⁵ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

central allowance over a 100-year time horizon to assess the likely increase to areas at risk of flooding in the future.

Consequences for people, the environment, cultural heritage and economic activity

Table 3 gives a numerical summary of what is at risk in the Western Wales River Basin District for present day risk and with climate change allowances added. The data includes flooding from fluvial, tidal and surface water sources within the 0.1% AEP flooding outline. The data presented below is the best available at this point in time.

Table 3 – What is at risk from all sources of flooding in the Western Wales RBD now and in the future

Element	Indicator measured	Number in defined area (RBD)	Number in maximum extent of flooding	Number in maximum extent of flooding with climate change
People				
People*	Number of people	1,618,358	97,705	160,277
Services	Number of infrastructure sites	8,785	1,152	1,658
Properties	Number of residential properties	688,663	41,577	68,203
Environment				
Special Areas of Conservation (SAC)	Area of SAC (in km ²)	3,251	335	360
Special Protection Areas (SPAs)	Area of SPA (in km ²)	2,037	135	140
RAMSAR	Area of RAMSAR (in km ²)	116	88	88
Sites of Special Scientific Interest (SSSI)	Area of SSSI (in km ²)	1,470	441	476
Scheduled Ancient Monuments	Area of Scheduled Ancient Monuments (in hectares)	38	2	2
Licensed Abstractions	Number of licensed abstractions	947	547	592
Economy				
Non-residential properties	Number of non-residential properties	25,499	3,783	5,780
Airports	Number of airports	10	1	3
Railways	Number of railway properties	36	6	11
Agricultural land (Grades 1, 2, 3)	Area of agricultural land (km ²)	2,460	180	200

*The number of people at risk of flooding has been calculated using guidance from the Office for National Statistics General Lifestyle Survey, 2011 and is based on the number of residential properties.

Groundwater flooding

Due to the nature of groundwater flooding, it is difficult to map and model. Geological maps can give an indication of areas which may be susceptible to groundwater flooding, of which there are very few in Wales. This means that we have little need to include groundwater flooding in our models in the same way as we do for fluvial, tidal and surface water sources of flood risk due to the very low likelihood of occurrence.

In Wales, groundwater flooding is most likely to occur from disused mineworkings which makes it even more difficult to forecast, map and model as detailed mine works mapping is not available, and is best done on a small-scale, case by case basis when the need arises.

Reservoir flooding

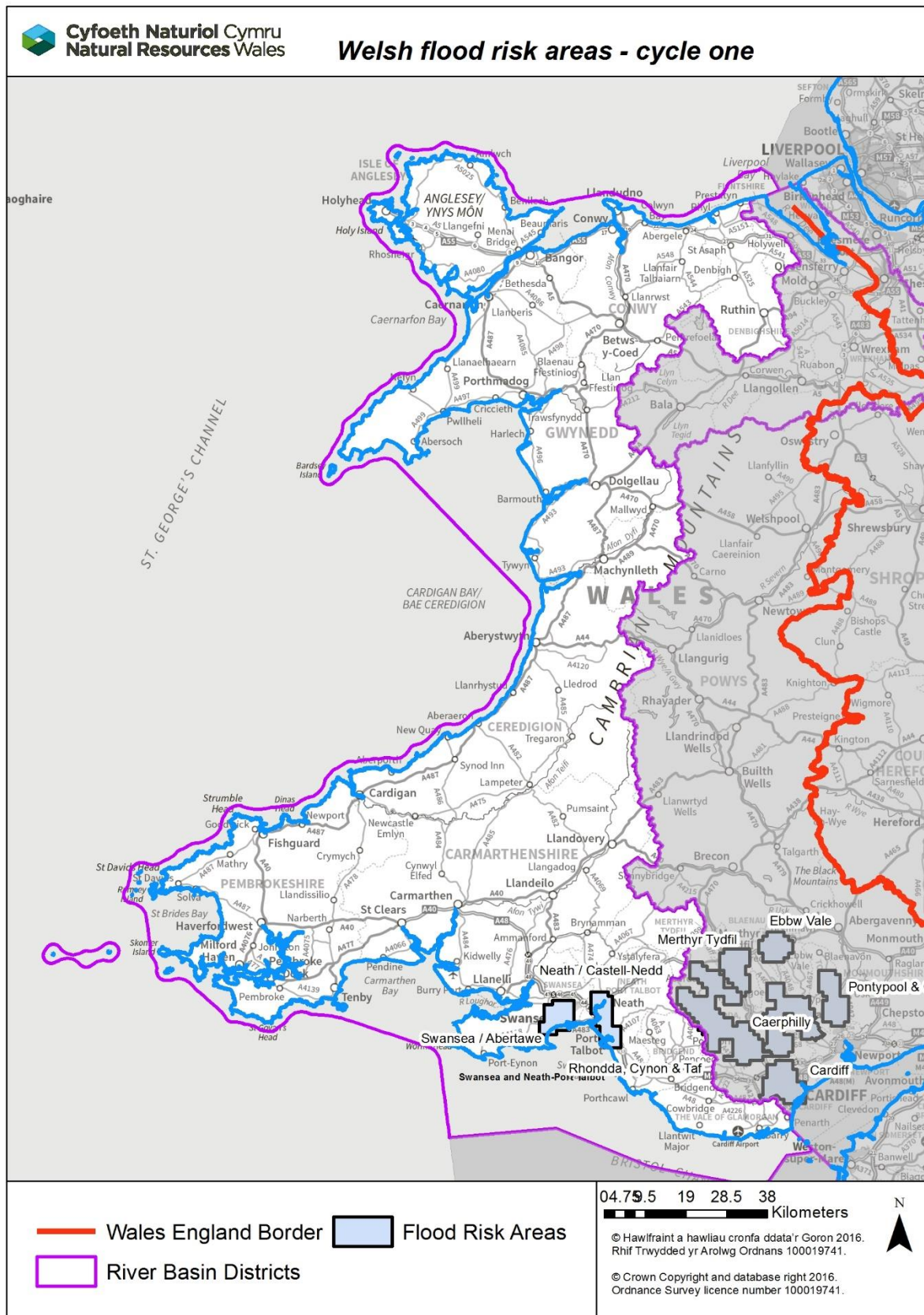
Reservoir mapping was completed for reservoirs across Wales during 2013. [These maps](#) are still the best available information for identifying areas likely to be inundated by reservoir flooding and are available to view on our website. We are currently in the process of updating our reservoir maps to include all reservoirs that are greater than 10,000 cubic meters. Reservoir maps indicate where could be at risk but do not indicate any likelihood of a flood occurring. We know that through the strict regulation from the Reservoirs Act (1975) (as amended), that flooding from reservoirs is very low likelihood and it is for this reason that despite the high consequences should a reservoir flood occur, we have not included reservoir flooding in the process for identifying Flood Risk Areas. The reservoirs that have the greatest potential impact, in the unlikely event of failure, have been identified and multi-agency plans to deal with these specific reservoirs have been developed.

5. Flood Risk Areas

This report is intended to assess and identify those areas within the Western Wales River Basin District in Wales that are most at risk of flooding from any source (main river, reservoirs, the sea, surface water, ground water and from ordinary watercourses). The previous two chapters cover the assessment of significant past flooding and the potential adverse consequences of future flooding. Using this information, along with other information available, this chapter covers the identification of those areas that are most at risk of flooding. These are known as Flood Risk Areas (FRAs). It is these FRAs that will have flood hazard and flood risk mapping completed by 22 December 2019 then Flood Risk Management Plans by 22 December 2021.

For the first cycle of the Directive, an arbitrary threshold was used to define Flood Risk Areas across Wales for **surface water flooding only**. The threshold used in Wales was set by Welsh Ministers of 5,000 people or more affected in the 1% annual exceedance probability event. This generated eight Flood Risk Areas in Wales, two in the Western Wales RBD. The location of the first cycle Flood Risk Areas are shown in figure 4.

Figure 4 – Cycle 1 Flood Risk Areas



An exemption in the legislation was applied that meant that Flood Risk Areas did not need defining for flooding from main rivers, reservoirs and the sea in the first cycle. Despite this, flood hazard and flood risk mapping and Flood Risk Management Plans were produced covering all of Wales for flooding from main rivers, reservoirs and the sea.

The exemption used in the first cycle does not apply to the second cycle. This means that Flood Risk Areas are required to identify significant flood risk from main rivers, reservoirs and the sea. In addition, those Flood Risk Areas that were set in the first cycle for surface water sources need to be reviewed and updated. The Flood Risk Areas in Wales for this cycle cover all sources of flood risk.

Methodology for defining Flood Risk Areas

In Wales, we have developed a tool to help identify the locations of greatest risk of flooding. This is called the Communities at Risk Register (CaRR), and it considers a number of factors to identify the locations (communities) at greatest risk of flooding. The CaRR is used to inform, plan and prioritise our investment programme to target investment in the most at risk communities. It is not an absolute ranking of risk, it is an indicator of relative significance of risk from location to location. As it is done on a consistent basis, different locations can be compared across Wales. For these reasons, we have used the CaRR to define our Flood Risk Areas.

The CaRR uses outputs from flood models to consider the number of people at risk, the hazard they are exposed to over a range of probabilities, the speed of onset of flooding and their ability to respond in terms of social vulnerability to flooding. It also uses factors such as availability and standard of flood warnings and flood defences. The CaRR then calculates a score for each community which enables communities to be ranked based upon the risk of flooding. This is carried out across Wales for flooding from the sea, main rivers and surface water to create a consistent picture of flood risk. The CaRR has been used to identify and rank communities from high to low, and identify those that are at significant risk of flooding from any source.

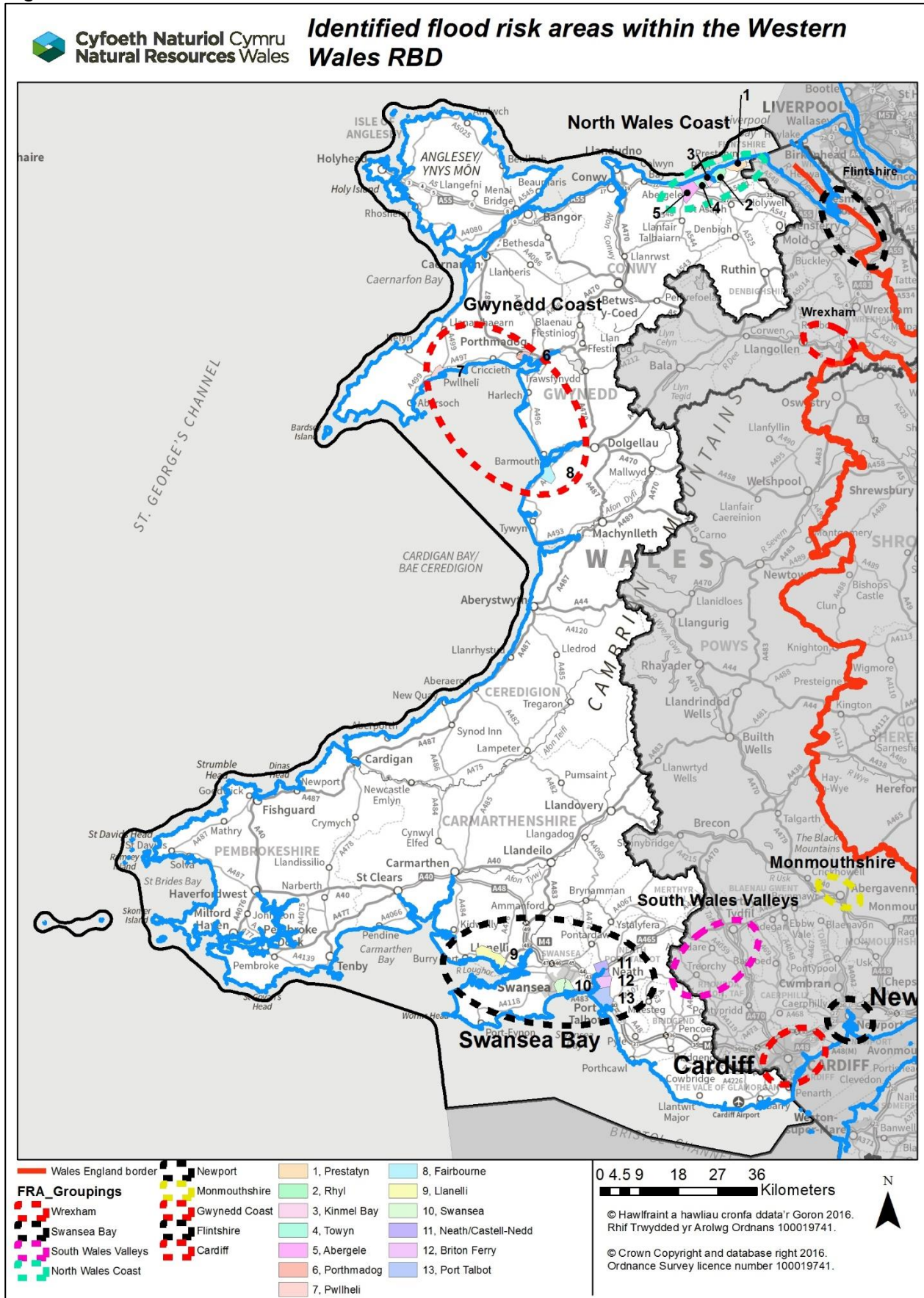
Flood Risk Areas

The ranking of communities in the CaRR is done on a Wales-wide basis and the Flood Risk Areas have been identified at this scale to define those communities that are most at risk in Wales. The threshold for communities at significant risk of flooding was set by Welsh Government with input from Natural Resources Wales and the Welsh Local Government Association (representing Lead local Flood Authorities).

Within the Western Wales River Basin District, there are 3 Flood Risk Areas that include 13 individual communities. These shown in figure 5 and are:

- North Wales Coast, including the communities of Rhyl, Kinmel Bay, Prestatyn, Towyn and Abergele (shown as locations 1-5 in Fig 5);
- Gwynedd, including the communities of Porthmadog, Pwllheli and Fairbourne (shown as locations 6-8 in Fig 5);
- Swansea and Neath Port Talbot, including communities of Llanelli, Swansea, Neath, Briton Ferry and Port Talbot (shown as locations 9-13 in Fig 5).

Figure 5 – Identified Flood Risk Areas within the Western Wales RBD



6. Conclusion and Summary

This PFRA report will be published on our website by 22nd December 2018 alongside the other PFRAs for Wales, and we will report to the European Commission on the content of our PFRA reports by 22nd March 2019. The next step is then to produce flood hazard and flood risk maps for the Flood Risk Areas we have identified within this PFRA report by 22nd December 2019. The final step to complete the second cycle will be to produce Flood Risk Management Plans by 22nd December 2021.

A review of the information contained in this PFRA report is required to be undertaken every six years so the next review will be complete by December 2024.

We have ongoing work that will inform the future work we do and this could mean that the results look different to those we have presented in this PFRA. The content of the PFRA will not change, but work to complete the flood risk and hazard mapping as well as the FRMPs will take account of the most up-to-date and relevant data and information. This work includes:

- a major revision to the Wales Flood Risk Assessment has recently been completed which has enabled us to improve our understanding of risk in relation to the CaRR;
- updated UK climate projections, that are due in late 2018;
- updated reservoir flood mapping, which should be available by the end of 2019; and
- flood investigations into any major flood events that change our national understanding of flood risk.

All Risk Management Authorities covered by this report will continue to fulfil their roles with respect to managing flood risk. They will continue to collect, assess and record new flood risk events and information in order to contribute to the next stages and future cycles.

As this is the first time consolidated Preliminary Flood Risk Assessments have been completed in Wales, a focus for the next steps in the cycle will be on working collaboratively across Risk Management Authorities to better manage flood risk across Wales.

Glossary

Definitions to accompany table 2: Flooding events in the Western Wales RBD since 2011

Fluvial: Flooding of land by waters originating from part of a natural drainage system, including natural or modified drainage channels. This source could include flooding from rivers, streams, drainage channels, mountain torrents and ephemeral watercourses, lakes and floods arising from snow melt.

Pluvial: Flooding of land directly from rainfall water falling on, or flowing over, the land. This source could include urban storm water, rural overland flow or excess water, or overland floods arising from snowmelt.

Groundwater: Flooding of land by waters from underground rising to above the land surface. This source could include rising groundwater and underground flow from elevated surface waters.

Sea Water: Flooding of land by water from the sea, estuaries or coastal lakes. This source could include flooding from the sea (e.g., extreme tidal level and / or storm surges) or arising from wave action or coastal tsunamis.

Natural Exceedance: Flooding of land by waters exceeding the capacity of their carrying channel or the level of adjacent lands.

Defence Exceedance: Flooding of land due to floodwaters overtopping flood defences.

Defence or Infrastructural Failure: Flooding of land due to the failure of natural or artificial defences or infrastructure. This mechanism of flooding could include the breaching or collapse of a flood defence or retention structure, or the failure in operation of pumping equipment or gates.

Blockage / Restriction: Flooding of land due to a natural or artificial blockage or restriction of a conveyance channel or system. This mechanism of flooding could include the blockage of sewerage systems or due to restrictive channel structures such as bridges or culverts or arising from ice jams or landslides.

Flash Flood: A flood that rises and falls quite rapidly with little or no advance warning, usually the result of intense rainfall over a relatively small area.

Rapid onset: A flood which develops quickly, other than a flash flood.

Medium onset flood: An onset of flooding that occurs at a slower rate than a flash flood.

Debris Flow: A flood conveying a high degree of debris.

High Velocity Flow: A flood where the floodwaters are flowing at a high velocity.

Deep Flood: A flood where the floodwaters are of significant depth.

Community: Adverse consequences to the community, such as detrimental impacts on local governance and public administration, emergency response, education, health and social work facilities (such as hospitals).

Pollution Sources: Sources of potential pollution in the event of a flood, such as IPPC and Seveso installations, or point or diffuse sources.

Other potential adverse environmental impacts: Such as those on soil, biodiversity, flora and fauna, etc.

Cultural Assets: Adverse consequences to cultural heritage, which could include archaeological sites / monuments, architectural sites, museums, spiritual sites and buildings.

Property: Such as homes and businesses



**Cyfoeth
Naturiol**
Cymru
**Natural
Resources**
Wales

Published by:
Natural Resources Wales
Cambria House
29 Newport Road
Cardiff
CF24 0TP

0300 065 3000 (Mon-Fri, 8am - 6pm)

enquiries@naturalresourceswales.gov.uk
www.naturalresourceswales.gov.uk

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