Cyfoeth Naturiol Cymru
Natural Resources Wales

Western Wales Flood Risk Management Plan

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Natural Resources Wales

On 1 April 2013, Natural Resources Wales brought together the work of the Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales, as well as some functions of the Welsh Government. Our purpose is to ensure that the natural resources of Wales are sustainably maintained, used and enhanced, now and in the future.

We will work for the communities of Wales to protect people and their homes as much as possible from environmental incidents like flooding and pollution. We will provide opportunities for them to learn, use and benefit from Wales' natural resources.

We will work for Wales' economy and enable the sustainable use of natural resources to support jobs & enterprise. We will help businesses and developers to understand and consider environmental limits when they make important decisions.

We will work to maintain and improve the quality of the environment for everyone. We will work towards making the environment and natural resources more resilient to climate change and other pressures.

Cyfoeth Naturiol Cymru
Natural Resources Wales

Contents

Introduction

We are pleased to introduce this Flood Risk Management Plan for the Western Wales River Basin District. This Plan gives an overview of the flood risk in the Western Wales River Basin District and sets out our intended priorities to manage and reduce flood risk over the next 6 years and beyond.

This Flood Risk Management Plan is one of three Flood Risk Management Plans produced by us for Wales in order to meet our statutory requirements set out in the Flood Risk Regulations 2009.

This Flood Risk Management Plan covers flooding from main rivers, reservoirs and the sea. Surface water flooding is also an issue in many areas within the Western Wales River Basin District and is addressed in the Lead Local Flood Authority produced Flood Risk Management Plans.

Although our plans have been produced separately from those produced by the Lead Local Flood Authorities, we will seek opportunities to work together to achieve additional benefits for the people, economy and environment of Wales.

The measures we propose to manage flood risks will be aligned where appropriate with those of the Lead Local Flood Authorities and subject to tests of affordability, value for money and prioritisation in order to deliver the best solutions for local communities and Wales.

Through the production of Catchment Flood Management Plans (covering inland flood risk) and Shoreline Management Plans (covering sea flooding and coastal erosion), we have learnt valuable lessons of how best to plan our flood risk management work. We have built upon our knowledge and experience to produce this Flood Risk Management Plan. We still have much to do to reach integrated flood risk management planning for Wales but this is something we will continue to aim toward and develop throughout this first cycle of the Flood Risk Regulations.

We accept that we cannot reduce flood risk on our own. We will therefore work closely with all our partners and communities affected to improve the co-ordination of flood risk activities and agree the most effective way to manage flood risk in the future.

Gareth O'Shea
Executive Director
Natural Resources Wales

Tim Jones
Executive Director
Natural Resources Wales

1. The purpose of Flood Risk Management Plans in managing flood risk

The Floods Directive (Directive 2007/60/EC of the European Parliament and of the European Council on the assessment and management of flood risks) 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 2009 (The Regulations) which came into force on 10 December 2009.

The Regulations require the following:

- Preliminary flood risk assessment maps[1] 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[3] and flood risk maps[4] by 22 December 2013;
- Flood risk management plans by 22 December 2015;
- All assessments, maps and plans to be reviewed and updated every 6 years.

We are currently in the first cycle of implementation. The preliminary flood risk assessment maps and reports, the flood hazard maps and the flood risk maps have been completed for the Western Wales River Basin District and can be accessed using the references provided in the rear of this report. Once this cycle is complete in 2015, the second cycle will begin in 2016.

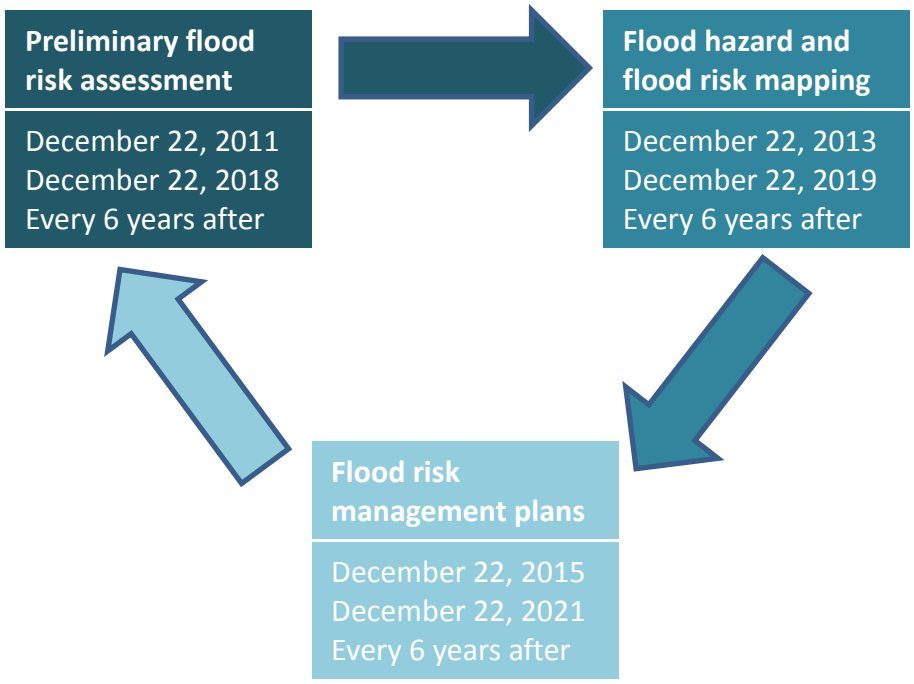


Figure 1: The Flood Risk Regulation cycle

Natural Resources Wales is required to prepare Flood Risk Management Plans for all of Wales covering flooding from main rivers, reservoirs and the sea. This statutory plan has been developed to describe what measures we propose to take that will help to manage the risk of flooding to people, the environment and economic activity across the Western Wales River Basin District.

In conjunction with this Flood Risk Management Plan there are two areas; Neath Port Talbot County Borough Council and the City and Council of Swansea, where local flood risk was identified through the preliminary flood risk assessment as being significant1, and are also required under statute to produce Flood Risk Management Plans. They will produce standalone Flood Risk Management Plans by December 2015.

The remaining ten Lead Local Flood Authorities within the River Basin District that are outside of designated flood risk areas have agreed to produce voluntary, standalone Flood Risk Management Plans. The purpose of undertaking this exercise will be to compliment and build upon their Local Flood Risk Management Strategies and not for the purpose of meeting the Flood Risk Regulations.

[1] For local sources of flood risk in Wales, 'significant' was defined as where there were more than 5,000 people at risk of flooding in one location. This was determined through the preliminary flood risk assessment stage which found flooding from surface water to be the most significant.

Figure 2 illustrates where there will be statutory and voluntary Flood Risk Management Plans produced in the Western Wales River Basin District by the Lead Local Flood Authorities.

Figure 2: Local Authority Boundaries and Areas of Significant Local Flood Risk

2. How this plan works

The layout of this plan

This plan is broadly divided into three parts:

1. The first section describes our approach to managing flood risk in Wales
2. The second section is focused on the Western Wales River Basin District and provides a description of the study area, the conclusions from the flood hazard and flood risk maps, the objectives and an overview of the flood risk management measures, all at the River Basin District scale.
3. The third section is focused on the catchment scale and provides a description of the catchment, the conclusions from the flood hazard and flood risk maps and an overview of the flood risk management measures at a catchment scale. The catchment section includes detailed community specific measures.

What this plan does

In meeting the requirements set out within the Regulations, this Flood Risk Management Plan will also deliver against the Welsh Government's National Flood and Coastal Erosion Risk Management (FCERM) strategy. The National FCERM Strategy provides the framework for flood and coastal erosion risk management in Wales through four overarching objectives that are outlined in Section 3: Flood Risk Management Plan Objectives.

This plan draws on relevant information, in particular, the flood hazard and flood risk maps published under the Regulations, the Catchment Flood Management Plans published in 2009 and the second generation Shoreline Management Plans to summarise the risk of flooding from rivers, the sea and reservoirs. It draws relevant conclusions about the risk of flooding and sets out and prioritises what needs to be done to manage the risk, now and in the future. These are referred to as 'measures' within this plan.

We sought views on the measures within this final plan during the draft FRMP consultation from October 2014 to January 2015. These measures are therefore deemed to have been agreed and are our intention for delivery. However, the majority of these measures are currently unfunded and each with be subject to assessment and justification to secure funding and if appropriate, prioritised on a National basis before delivery.

This Plan has been produced alongside the Second Cycle Western Wales River Basin Management Plan and in order to integrate the two planning processes National FRM Measures have also been proposed.

3. How we currently manage flood risk in Wales

The Welsh Government National Flood and Coastal Erosion Risk Management Strategy – the National framework

The Welsh Government National Flood and Coastal Erosion Risk Management Strategy provides the framework for flood and coastal erosion risk management in Wales. The framework is centred around four key objectives and the measures to meet those objectives.

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

Natural Resources Wales plans and implements flood risk management work for which we are responsible within the framework set by the National Flood and Coastal Erosion Risk Management Strategy. Figure 3 illustrates the planning framework for FCERM work in Wales.

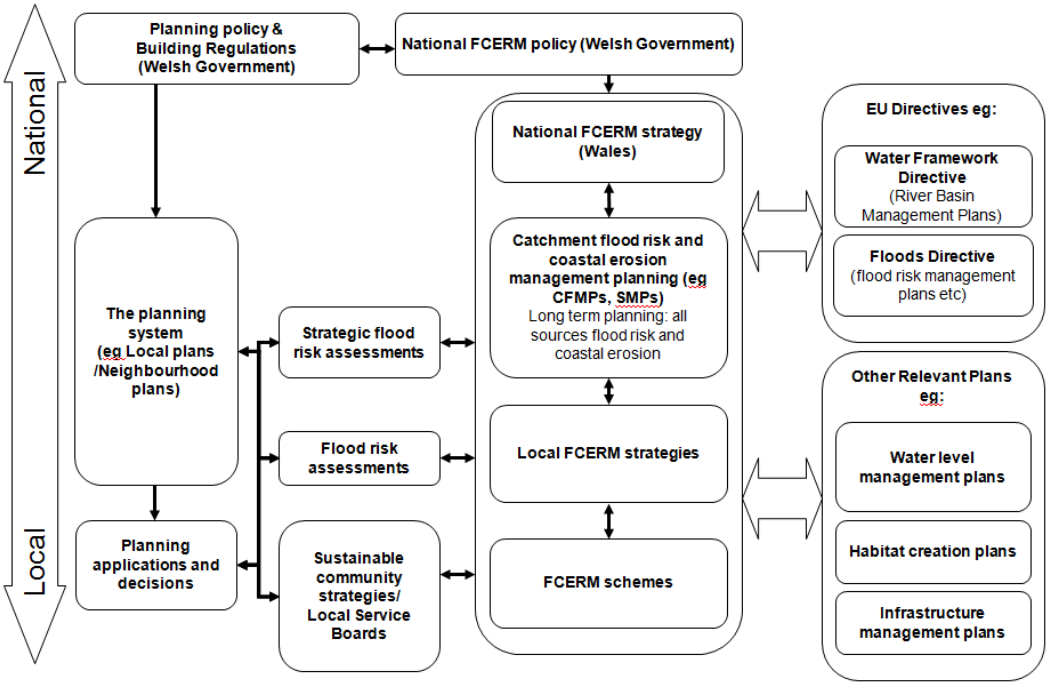


Figure 3: Flood Risk Management Plans and their relationship to other planning initiatives

What we do

Natural Resources Wales is responsible for the following flood and coastal erosion risk management activities:

- We provide advice to Welsh Government;
- We maintain high risk flood and coastal risk management assets, prioritising our efforts on those which counter the highest risks;
- We maintain and operate flood defences and implement innovative ways of managing uplands and lowlands to hold and slow down water to help reduce flood risk to communities;
- We deliver our Flood and Coastal Risk Management Capital Programme which includes building flood defences and implementing innovative ways of managing uplands and lowlands to hold and slow down water to help reduce flood risk to communities;
- We undertake hydrometric monitoring across Wales to inform our flood warning service;
- We undertake flood forecasting, including the Floodline Warnings Direct service to alert households and individuals of potential flood events;
- We map, model and develop plans that identify areas of Wales at risk of flooding and coastal erosion and we use these to influence future sustainable development and emergency response;
- We ensure accurate information on flood risk is available to the public and stakeholders;
- We raise people's awareness of their flood risk and what actions they need to take;
- We regulate reservoir safety as the enforcement authority under the Reservoirs Act 1975;
- We deliver an effective and co-ordinated response to flood incidents and provide a physical response on the ground where required;
- We continue our approach to flood risk management in the light of climate change and take account of future flood risk when making our decisions;
- We create habitat to improve biodiversity and ecosystems through our flood defence work and to offset effects brought about by coastal squeeze;
- We provide flood defence consents for works undertaken on main rivers;
- We provide an advisory role with respect to planning authorities on new developments with regards to flood risk;
- We provide a Flood and Coastal Risk Management strategic oversight role to lead Local Flood Authorities and others to support their work on managing flood and coastal risk erosion.

How we make decisions and prioritise our work

In order to deliver the measures from the National FCERM Strategy, Natural Resources Wales takes a risk based community approach to prioritise where to best direct investment. This is informed by the strategic framework provided by Catchment Flood Management Plans and Shoreline Management Plans. The strategic framework set by these plans enable us to make short term decisions to manage present day risk whilst also considering the longer term projection of risk (for further information on Catchment Flood Management Plans and Shoreline Management Plans please refer to Annex 1).

The risk based community approach of present day risk assessment is done through the Natural Resources Wales Communities at Risk Register. This is a tool that considers a number of factors to give an indication of where the most vulnerable communities at risk of flooding from main rivers and the sea are located across Wales. This is then used to inform, plan and prioritise our investment programme to target investment in the most at risk communities. Prioritisation is then done at a Wales-wide level and takes into account the risk calculation from the Communities at Risk Register but also considers other factors such as the Benefit:Cost appraisal, level of investment to date and other aspects such as the potential for external funding opportunities. There is also a facet of Natural Resources Wales work which is reactive to severe weather events, where severe damage may have occurred, leading to the need for emergency works.

All major flood alleviation schemes in Wales undergo appraisal work to assess options and to understand the costs and benefits of progressing work, this is done in accordance with Defra FCERM-AG (Flood and Coastal Erosion Risk Management – Appraisal Guidance).

How we meet our statutory requirements – Strategic Environmental Assessment

Natural Resources Wales, as an advisor, operator and developer must meet various statutory requirements and must set a good example to others that we regulate and advise.

We undertake statutory and non-statutory Strategic Environmental Assessment and Environmental Impact Assessment[4] on all our flood risk management plans, strategies and projects at a level commensurate with their scale and risk. This ensures we

minimise environmental impact where possible and maximise delivery of environmental benefits.

Through these approaches we ensure we are compliant with Habitats Regulations, Water Framework Directive, Environmental Impact Assessment Regulations, Eel Regulations and others.

We proactively work to deliver directly, or with partners, Biodiversity Action Plan habitat and intertidal habitats to mitigate or compensate impacts caused by existing and future defences. This is undertaken through our National Habitat Creation Programme which is a statutory requirement under the Habitats Regulations and Water Framework Directive. This programme was created to ensure we compensate for the loss of intertidal habitat caused by the sea levels rising against fixed estuarine and coastal defences, as documented in the Second Generation Shoreline Management Plans.

How we meet our statutory obligations – reservoirs

Natural Resources Wales is the enforcement authority for the Reservoirs Act 1975 in Wales, and is provided with powers by this Act to ensure owners/operators of large raised reservoirs in Wales comply with the law. The purpose of the Reservoirs Act 1975 is to reduce the risk to the communities downstream of these reservoirs as a consequence of an uncontrolled release of water. It currently applies to all reservoirs with a capacity of 25,000 cubic metres or more above ground level. It requires these reservoirs to be registered with the enforcement authority (in Wales this is Natural Resources Wales) and places supervision and inspection duties on the reservoirs owners or managers.

Following the 2007 summer floods, Sir Michael Pitt recommended a review of all large raised reservoirs, to identify those presenting the highest risk in the unlikely event they should fail. This was undertaken and all high risk reservoirs that fall under the 1975 Act, were obliged to produce specific on-site plans outlining the processes they would undertake in the event of a potential failure. In conjunction with the reservoir owner/operators the Local Resilience Fora, for the ‘downstream’ areas that would be affected by reservoir failure, produced off-site plans. These plans dealt with how the emergency community would co-ordinate to mitigate the effects of any reservoir failure. These specific plans for the identified reservoirs were also used as the basis for the production by Local Resilience Fora of generic off-site plans that would be used in the case of failure of any large reservoir excluding those with specific plans.

The Reservoirs Act 1975 is currently being amended by Schedule 4 of the Flood and Water Management Act. The objective of these amendments is to broaden and further embed a risk based approach to reservoir management in the interest of public safety. Schedule 4 is expected to reduce the threshold for reservoirs coming under the ambit of the Reservoirs Act 1975 from 25,000 cubic metres to 10,000 cubic metres. Therefore through the implementation of the Reservoirs Act 1975 (as amended), any risk posed by the uncontrolled release of water from a large raised reservoir in Wales is strictly managed by legislation and minimised.

Who we work with to manage flood risk in the Western Wales River Basin District

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. Table 1 identifies the key partners within the Western Wales River Basin District who Natural Resources Wales will work with to deliver this Flood Risk Management Plan.

Table 1: Key Risk Management Authorities in the Western Wales River Basin District

Organisation name	Primary role
Welsh Government	Overall responsibility for all matters relating to flooding and coastal erosion in Wales
Natural Resources Wales	Welsh Government sponsored body that has operational responsibilities for flooding from main rivers, the sea and coastal erosion; and oversight responsibilities in relation to all flood and coastal erosion risk management in Wales. Also responsible for the administration of Internal Drainage Districts that fall within the RBD.
Lead Local Flood Authorities: ○ Vale of Glamorgan County Council; ○ Bridgend County Borough Council; ○ **Neath Port Talbot County Borough Council**; ○ **City and County of Swansea**; ○ Rhondda Cynon Taf; ○ Carmarthenshire County Council; ○ Pembrokeshire County Council; ○ Ceredigion County Council;	Responsible for the management of flood risk from local sources.

○ Powys County Council; ○ Gwynedd Council; ○ Isle of Anglesey County Council; ○ Conwy County Borough Council; ○ Denbighshire County Council; and ○ Flintshire County Council.	
Dwr Cymru – Welsh Water	Responsible for providing a high quality water supply to customers and to take away wastewater and return it to the environment safely.

(bold text indicates LLFA with designated Flood Risk Area)

How we deliver sustainable flood risk management

The purpose of Natural Resources Wales is to ensure that the natural resources of Wales are sustainably maintained, enhanced and used, now and in the future. As a result, Natural Resources Wales adopts a number of practices to ensure that flood risk management work is sustainable. This delivers joint benefits for the people and environment of Wales and contributes towards a more flood resilient Wales now and for the future. As a single environment body for Wales, Natural Resources Wales aims to build upon existing practice to develop an approach to natural resource management that can be applied at a suitable scale.

Sustainable flood risk practice in Wales is increasingly focused on working with natural processes to create more flexible and adaptive solutions that provide increased resilience to our changing and uncertain climate. We actively seek opportunities to undertake natural flood management by using all appropriate tools available to us, such as the Woodland Creation maps. By working with natural processes to deliver flood risk management other benefits are provided such as restoring/maintaining soil drainage capacity, creating/restoring habitats, enhancing biodiversity, capturing carbon, reducing sedimentation and improving water quality. This approach has the potential to achieve greater value for money because it enables the development of multi-functional projects which provide a wide range of ecosystem services and benefits to society.

Through the flood risk management planning and river basin management planning process we have determined where priority water bodies coincide with communities at risk to identify opportunities to deliver more holistic natural resource management through our flood risk management projects and operations.

Where a flooding problem is identified in Wales, the first step is to fully understand the cause to determine what management response might be appropriate. We aim to

consider non-structural solutions first and implement these where it is possible to do so, such as flood warning and awareness raising so people and communities are able to plan and prepare for flooding. If the flood risk is at a level that without intervention will pose a serious threat to people and property, Natural Resources Wales, in consultation with the community and environmental experts, will consider solutions to reduce and manage the threat of flooding.

It is through this process of assessing different risk management options that Natural Resources Wales will consider all the options that could reduce the risk of flooding, including how the river interacts with the natural flood plain and options to retain water, amongst all other solutions. Potential options are considered for their technical feasibility and cost amongst many other factors in order to select the preferred option. If an option is identified as having the potential to retain water close to the point where it has fallen, Natural Resources Wales will aim to work closely with land owners and managers, and communities to develop the solution that will not only slow the flow of water into the watercourse but also can create improved landscape and environment.

Integrated natural resource management

Integrated natural resource management is a key element of the Welsh Government's legislative programme. The Well Being and Future Generations Act, the Planning Act and the Environment Bill, together with the Wales National Marine Plan, set out a new statutory framework and process for the integrated management and sustainable use of natural resources in Wales.

This new framework for managing natural resources, will build on the UN ecosystem approach, defined as 'an integrated strategy for the management of natural resources'. The Environment Bill, expected to receive Royal Assent by spring 2016 will legislate for a more joined-up management process, focused on delivering a healthier, more resilient Wales through economic, social and environmental benefits.

This starts by introducing a new prioritisation process - to identify and characterise the key pressures on our natural resources and to explore the opportunities for the sustainable management of these resources within a defined geographical area. By recognising and better understanding the challenges faced, the tools used to safeguard and deliver environmental benefits (of which flood risk management plans are one) can be applied in a more integrated and joined-up way– better reflecting the needs of that place. An integrated approach to natural resource management is currently being trialled across Wales in three catchment areas, the Dyfi, Tawe and Rhondda.

The natural resource management framework is still being developed in Wales but the flood risk management plans reflect the essential elements of the new approach in the following ways:

Be area based.
The flood risk management plans are set at a variety of spatial scales. This enables the focus for managing flood risk to be delivered at the spatial scale most relevant for communities, stakeholders and level of flood risk.

Involve stakeholder engagement throughout.
It is essential that we involve stakeholders, including local authorities, communities, developers and industry, throughout the process of drawing up and implementing the flood risk management plans. This will ensure we are targeting our effort in the right places.

Plan and present at the most appropriate scale.
The Floods Directive requires that we produce and review management plans at the river basin scale. For some management actions, this scale is appropriate. For others, management actions are best considered at the catchment or community scale. We plan our flood risk management work at the scale which is most appropriate to deliver most for communities and stakeholders.

Plan for the long term.
To create a sustainable Wales we need to consider the opportunities and constraints Wales will face in the long term. Flood risk management plans consider both short term and long term objectives and measures for the management of flood risk are reviewed every six years.

Plan to deliver multiple benefits.
We need to ensure our future activities deliver multiple, long term benefits for the environment and for the economy and society in Wales. All decision making must therefore reflect the long-term well-being goals for Wales and be underpinned by the principles of sustainable management.

Sustainable flood risk practice in Wales is increasingly focused on how working with natural processes can be used to create more flexible and adaptive solutions that provide increased resilience to our changing and uncertain climate.

Be evidence based.

To develop this flood risk management plan we have used the best available evidence from a range of sources, building on both our knowledge and that of our stakeholders and local communities. We will continue to build and improve this evidence base.

People focussed.
The natural resource planning process will need to reflect the principles of co-production and stakeholder engagement. The overarching aim should deliver outcomes that are equitably distributed and focussed on delivering long term benefits for the people of Wales. By working with others the aim is to:

- Understand all the issues (not just flood risk) and how they interact;
- Understand how the issues are affecting the current local benefits and future sustainability;
- Involve local people, communities, organisations and businesses in making decisions that affect their area by sharing evidence, knowledge and experience;
- Identify which issues to tackle as a priority.

Climate change

Since the start of the industrial revolution, emissions from man's activities have raised the level of greenhouse gases in the earth's atmosphere by a third. Average global temperatures have risen by 0.8^{o}C. Global sea levels have risen by around 20 cm, largely as a result of thermal expansion. Even if human emissions were to cease tomorrow, these trends would continue, due to lags in the climate system.

If we fail to make drastic cuts in global emissions, then it is inevitable that global temperatures will continue to rise. Since warmer air can hold more water vapour, and with more heat energy in the atmosphere, the frequency and intensity of storms will also increase. The earth's climate systems are, however, very complex and it is difficult to calculate precisely the rate of change that we will see here in the UK.

The most up to date picture we have is provided by the UKCP09 climate projections. Broadly, these point to: warmer temperatures all year round; drier summers; and wetter winters – with more rain falling as intense events. It is worth noting that the atmospheric phenomena that led to the floods of 2013 and 2014 are consistent with the expected impacts of global warming on the jet stream and winter storms. These are, however, general trends. The UK climate is particularly variable and since the projections were published, the Met Office has undertaken new analysis that suggests we should also plan to be resilient to wet summers and to cold winters throughout this century.

The UKCP09 projections indicate that, by 2100, sea levels at Cardiff are likely to rise by 30 – 45 cm, depending on the level of global emissions. With wider confidence limits, the figures could be from 15 – 80cm. Sea level rise in north Wales will be slightly less, since this part of the land mass continues to "rebound" after the last ice age – but the particular figure is uncertain. The UKCP09 projections also include a high risk, low probability scenario (known as the H++ scenario). The H++ scenario has been included to reflect the fact that there considerable uncertainties about the upper limit of absolute sea-level rise. This scenario relies, in part, on expert judgement and has an upper projection of 2.5m by 2100. Whatever happens, our global monitoring should give us sufficient lead times to plan accordingly.

In dealing with flood risk we must recognise the interactions between different systems. Wetter winters and more intense rainfall will lead to increased surface runoff, placing pressure on both rivers and sewers. Pinch points are likely to cause local impacts. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides so as to affect places a long way inland. In overview, the UK Government's Flood Foresight (2014) re-endorsed the findings of the 2008 foresight work, stating that in general terms climate change is likely to increase river flood risks (frequency and severity) by 2080 by between 2 and 4 times, and coastal flood risk by 4 to 10 times.

Looked at more broadly, how the climate change described above translates into increased flood risk depends crucially upon our levels of vulnerability and resilience. Through our Natural Resource Management approach we aim to work with natural processes, not against them. We will therefore promote land management and urban design approaches that slow the flow of water into rivers and sewers. We will also explore softer approaches to coastal defence, such as managed realignment, that take energy out of the waves before they reach coastal settlements.

Through our engagement with Public Service Boards, we will promote an integrated approach to dealing with climate change and flooding that recognises the many inter-dependencies involved. At the community level we will continue with our Flood Awareness Wales work, recognising that, when properly coordinated, relatively simple measures can make a significant difference to local resilience. The ongoing reduction in public sector resources, coupled with increased flood risk, means that these new, potentially very cost-effective, partnership approaches will be particularly important.

Given the uncertainty over the rate of climate change, and its eventual level, we need to take a long-term view, encompassing a range of scenarios, when planning developments. We must avoid simply transferring risk to future generations. Local Planning Authorities in Development Planning should recognise this, as should Lead

Local Flood Authorities and Natural resources Wales in exercising their Development Control roles as statutory consultees. The nature of the proposal, the site to be developed and the development's expected lifetime will determine what level of resilience needs to be incorporated at the time of construction and what action(s) can be deferred to be incorporated at a later date It is critical that developments are designed with the ability to incorporate those future actions easily, at minimum overall cost.

4. Western Wales River Basin District Overview

Summary description of the Western Wales River Basin District

The Western Wales River Basin District (Figure 4) 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.

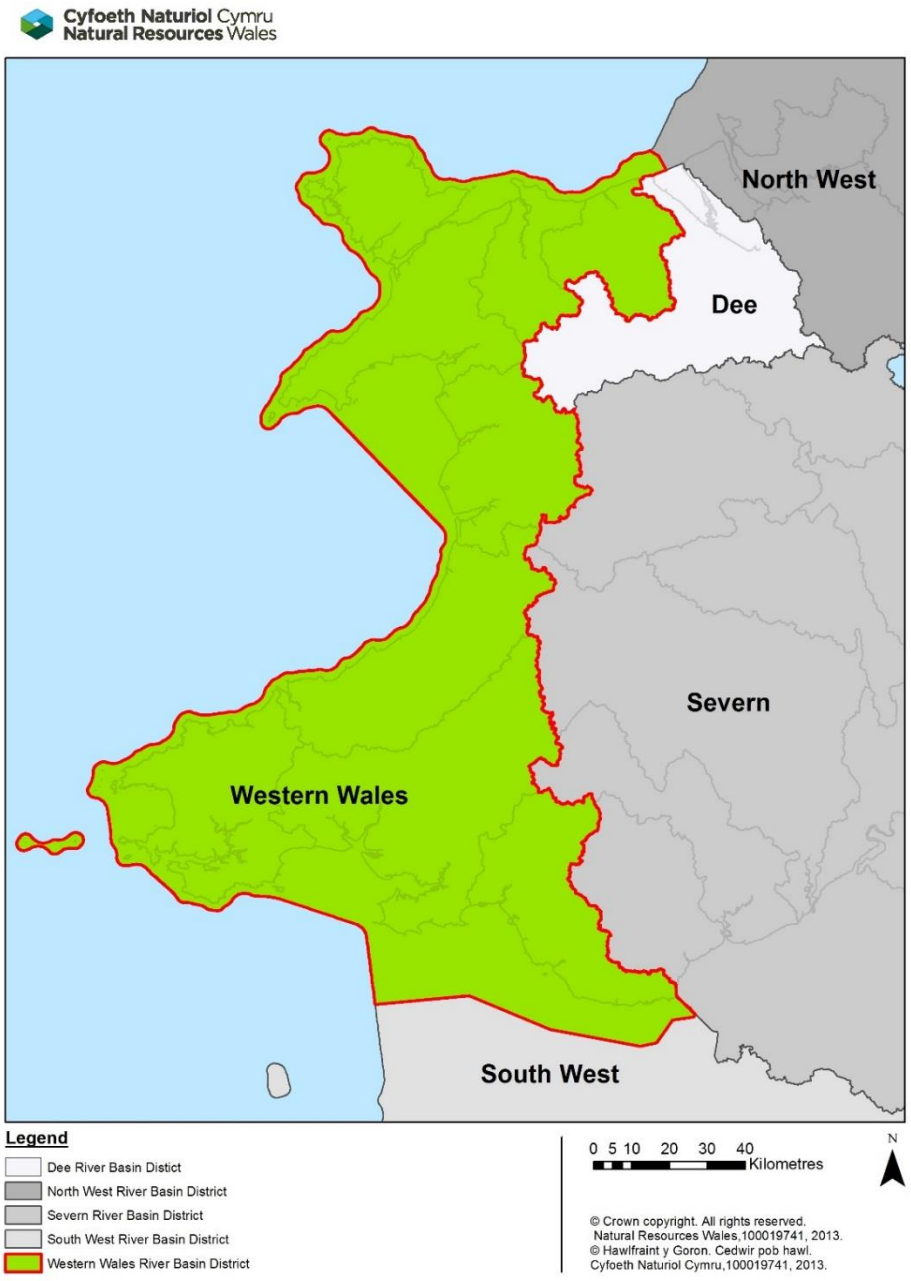


Figure 4: Western Wales River Basin District

People

The population of the Western Wales river district is around 1.5 million people. The two most southern catchments; Tawe to Cadoxton, and Carmarthen Bay and the Gower, have more than half the population of the entire river basin district.

Generally, the population of the district is increasing, but populations in some rural coastal areas are decreasing. The population is projected to get gradually older; with the number of people aged 65 and over projected to increase by around 35% by 2023.

There are some health inequalities evidenced by greater social deprivation along the North Wales coast, northern Anglesey, northwest Gwynedd, parts of Ceredigion, southern Pembrokeshire and the Swansea valleys. A number of outstanding recreational opportunities exist within the district which contribute to people's quality of life, provide employment and other potential economic benefits.

Environment

The landscape of the district varies considerably from the mountains and lakes of Snowdonia and the estuaries of the mid-Wales coast, to the beaches and cliffs of Pembrokeshire, and the industrial heritage of the South Wales Valleys. The river basin district is primarily rural with land mainly used for agriculture and forestry. A large proportion of the district, particularly around mid-Wales and the coast is considered to be a tranquil area, with traffic, settlements and industry disturbance being mainly in the South and North extremities of Wales.

There are three National Parks covering 287,830ha (17%) of the district: Snowdonia, Brecon Beacons and Pembrokeshire Coast National Park. The Brecon Beacons were awarded international dark sky status in February 2013, one of only 5 places in the world to hold this designation. There are substantial areas of the district (65, 926ha, 4%) designated as Areas of Outstanding Natural Beauty (AONB). These include the Llyn Peninsula, Gower, Anglesey and part of the Clwydian Range. Approximately 500km of the Welsh Coast is designated as Heritage Coast.

Approximately 70% of the Welsh Coast is designated as either a Special Area of Conservation (SAC) or a Special Protection Area (SPA) with a range of habitats such as coastal saltmarsh, grazing marsh, mudflats, reedbeds, cliffs, dunes and shingle. There are 7 Ramsar sites within or near the RBD. Of the European sites present in the district, 60 SACs and 12 SPAs are water dependent. Many of the Sites of Special Scientific Interest also have close links with the water environment. Skomer and Lundy Islands, off the Pembrokeshire coast are designated as Marine Nature Reserves.

The district contains many rivers that support salmon and trout (498 Freshwater Fish Waters), and the district supports a number of protected species such as Otters, Allis and Twaite shad, Water Voles, Freshwater White Clawed Crayfish, and Depressed River Mussels. Invasive species in the district include Japanese Knotweed, Himalayan Balsam and North American Signal Crayfish.

The district has 100 beaches which are EC designated bathing waters and attract many visitors to Wales each year, contributing millions of pounds to the Welsh economy. There are 814 water bodies across the district comprising rivers, coastal waters, lakes, groundwater and estuaries. In 2009, 29% of the water bodies were "good" status, this rose to 35% in 2013. Significant water issues identified for the Western Wales River Basin District are: Physical modifications, pollution from sewage and waste water, pollution from towns, cities and transport, pollution from rural areas, pollution from mines and invasive non-native species.

Economy

Infrastructure in the river basin district includes railways (e.g. the mainline from London to Swansea that continues to Pembroke Dock), roads (including the M4 and A55), energy infrastructure (such as power stations on the Pembrokeshire Coast and Wylfa on Anglesey), ports and ferry terminals (including Holyhead, Pembroke Dock, Milford Haven, Port Talbot and Swansea) and industrial and commercial development (such as oil and steel). Wales has a larger manufacturing sector than the UK average. Recently there has been an increasing demand for hydropower, with over 100 sites being investigated.

Sea Fishing, salmon net fisheries, mussel fisheries (such as Menai Strait) and cockle beds (such as Burry Inlet) are important to the local economy, with 25 areas designated as Shellfish Waters in the district. Agriculture is also an important part of the rural economy. Lower grades of agricultural land are predominant and grazing of sheep and cattle dominates over arable crops.

Tourism is a major part of the local economy for the majority of the district, especially within Pembrokeshire, the Brecon Beacons, Snowdonia, Anglesey and the Gower. The dramatic coastline is particularly important for tourism and 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 it opening.

Main Rivers

The Western Wales 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, Glaslyn, Conwy, and Clwyd in north Wales.

Reservoirs

The lakes and reservoirs of Western Wales are mainly used for water supply, recreation and leisure or hydroelectric power generation. Llyn Alaw and Llyn Cefni on Anglesey are both used to supply drinking water to the island. Llyn Cwellyn, on the Afon Gwyrfai in northern Snowdonia, is a reservoir that supplies drinking water to parts of Anglesey and Gwynedd. Further south Llys y Fran, Llyn Brianne, the Lliw reservoirs and the Lliedi reservoirs are the main drinking water supply reservoirs. Llyn Trawsfynydd, located in southern Snowdonia sub-catchment, is the largest lake in Wales (surface area of 5km^2) and is a man-made reservoir originally used to supply cooling water to the nuclear power station, which is now closed. The lake remains in use as the header reservoir for hydroelectric generation. Several other lakes and reservoirs are also used for hydroelectric generation; these include Marchlyn Mawr, Llyn Padarn, Tanygrisiau, Rhediol Nant y Moch, Dinas and Cwm Rheidol reservoirs. None of these lakes or reservoirs currently operates with flood risk management as their primary function, but there may be opportunities in the future to consult with hydroelectric power station operators on changing operational procedures to improve flood risk to locations downstream.

Management Catchments within the Western Wales River Basin District

The Western Wales River Basin District is divided into nine Management Catchments (illustrated in Figure 5). These Management Catchments are used by Natural Resources Wales within this plan in order to plan work at a catchment scale. These are also the same catchments that are used within the River Basin Management Plans so by using the same spatial scales, this will enable opportunities for joined up delivery and effective ways of working.

A good example of joined up delivery is underway as part of the Dolgellau flood alleviation scheme. The removal of the Pont Yr Aran Weir and reinstatement of the river bed to create improved diversity of habitat within the river channel and return the river to a more natural bed level and flow regime. Fish and eel passage should be

improved through the reach as the obstacle created by the weir during lower to moderate flows has been removed. This will contribute to overall WFD objectives for the Wnion water body of which the Aran is a tributary.

The treatment of Japanese knotweed throughout the scheme area is envisaged as being one of the key environmental outcomes that will occur as a result of the wider scheme. This will occur following completion of the construction element of the scheme in 2015 and treatment will run for 2-3 years until eradicated.

The works generated considerable interest from the public as they were highly visible. The removal of the weir, although highly disruptive for a short period of time, resulted in less disruption to the residents, businesses and community than the construction of raised walls would have done.

The Western Wales River Basin District is bordered in the North East by the Dee River Basin District and through the middle (running North to South) by the Severn River Basin District. Flood Risk Management Plans will also be produced for both the Dee and the Severn River Basin Districts.

Figure 5: Western Wales Management Catchments

5. Flood risk in the Western Wales River Basin District

Flood risk present in the Western Wales River Basin District – summary

This plan has been written based upon evidence and understanding of the present day flood risk from the main sources of flooding in the Western Wales River Basin District. Within the Western Wales River Basin District, all sources of flood risk are present (main river, reservoir, the sea and surface water flooding). This Flood Risk Management Plan focuses on flooding from main rivers, reservoirs and the sea.

The following sections illustrate what and where is at risk of flooding across the River Basin District. For the most up to date maps, and the ability to zoom in, please visit our interactive maps for 'Risk of flooding from rivers and the Sea' and 'Risk of flooding from Reservoirs'[3].

Explaining flood risk classifications (risk categories are consistent across all maps)

Table 2: Flood Risk Categories and Descriptions

Risk category for a location	The chance of flooding in any year at that location
High	Greater than or equal to a 1 in 30 chance in any given year (3.3%)
Medium	Less than 1 in 30 (3.3%) but greater than or equal to a 1 in 100 (1%) chance in any given year
Low	Less than 1 in 100 (1%) but greater than or equal to a 1 in 1000 (0.1%) chance in any given year
Very low	Less than a 1 in 1000 (0.1%) chance in any given year

For further information on surface water flood risk in your Area, please contact your Lead Local Flood Authority.

Main rivers and the sea - People

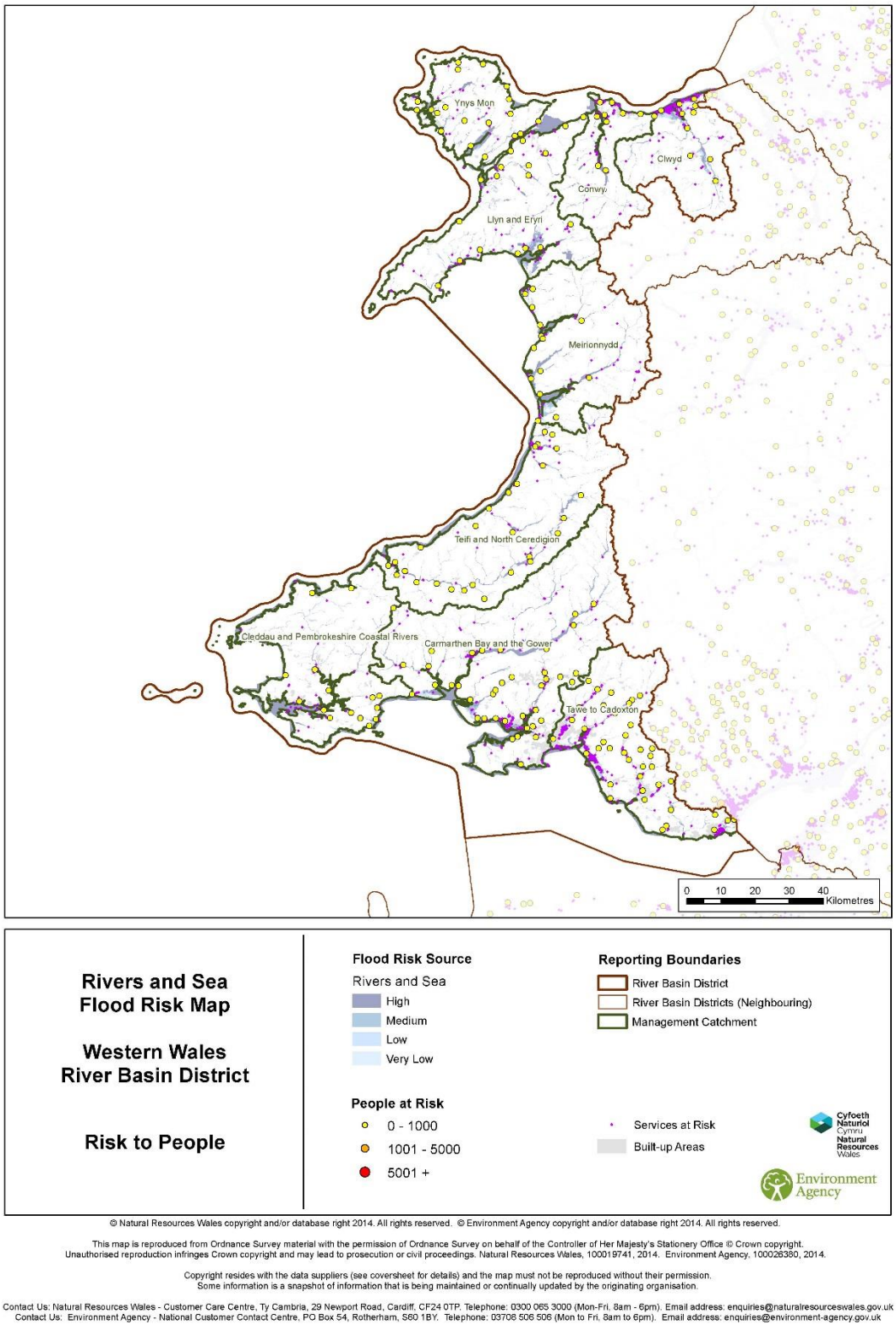


Figure 6: Main Rivers and the Sea – People at Risk

There are 1,551,656 people and 4,282 services in the River Basin District. Of these, 40,952 people and 264 services are considered to be at medium risk of flooding with a 1 in 100 (1%) or greater chance of flooding in any given year. The majority of these high risk communities are located in coastal areas or on main rivers within the southern catchments, where population densities are much higher than in the northern RBD catchments.

Main rivers and the sea - Environment

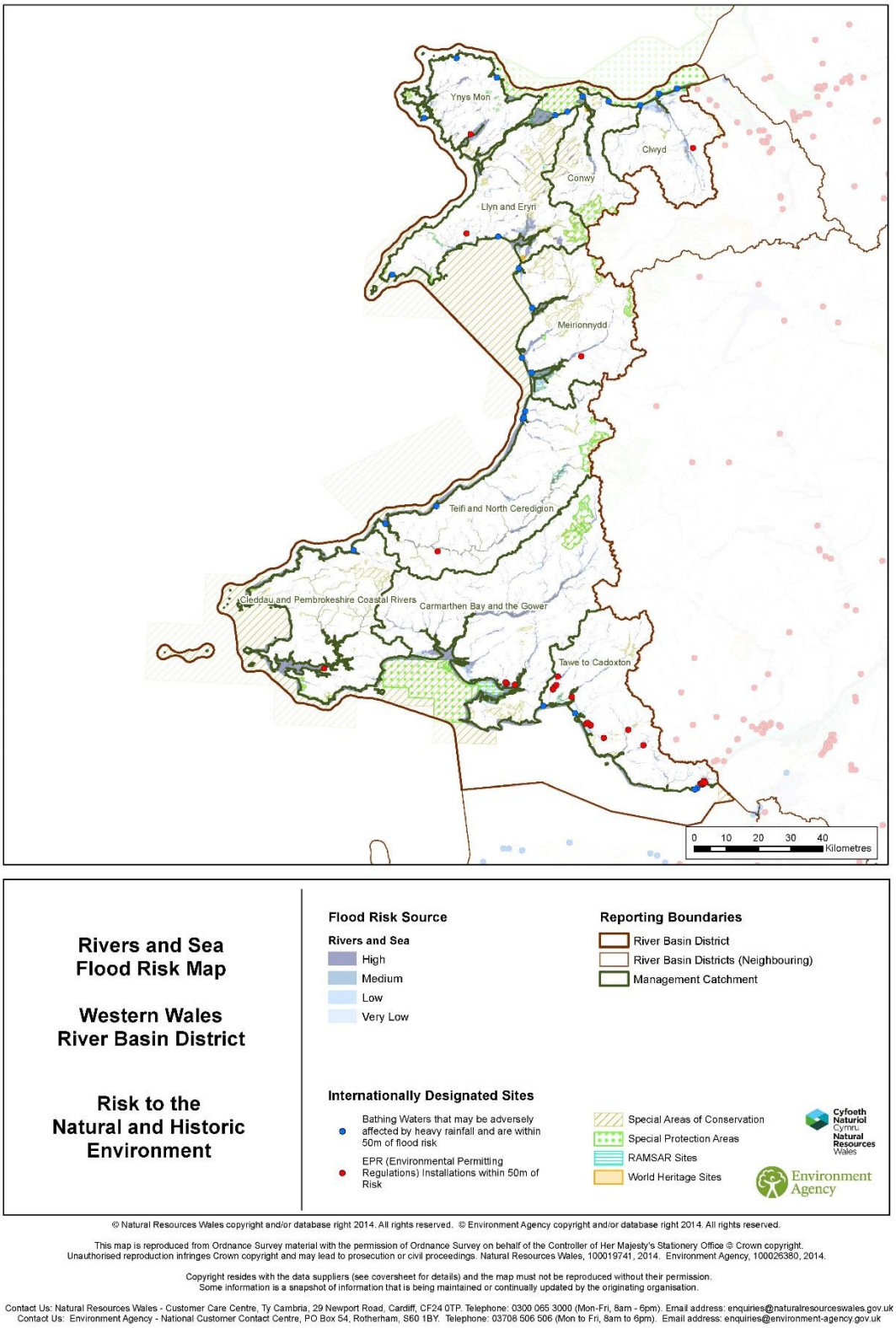


Figure 7: Main Rivers and the Sea – Natural and Historic Environment at Risk

There are significant areas of environmental designations at risk of flooding including; Special Areas of Conservation (SACs), Special Protection Areas (SPAs), World Heritage Sites (WHS), Sites of Special Scientific Interest (SSSI), Areas of Scheduled Ancient Monuments, and parks and gardens. There are 26 bathing waters around the coast that might be adversely affected by heavy rainfall. Over half of the total area of RAMSAR sites within the River Basin District is at high risk of flooding. 1,293 of the 16,956 listed buildings in the RBD are at a 1 in 100 (1%) or greater chance of flooding each year; with 925 of these considered to be high risk.

Main rivers and the sea - Economy

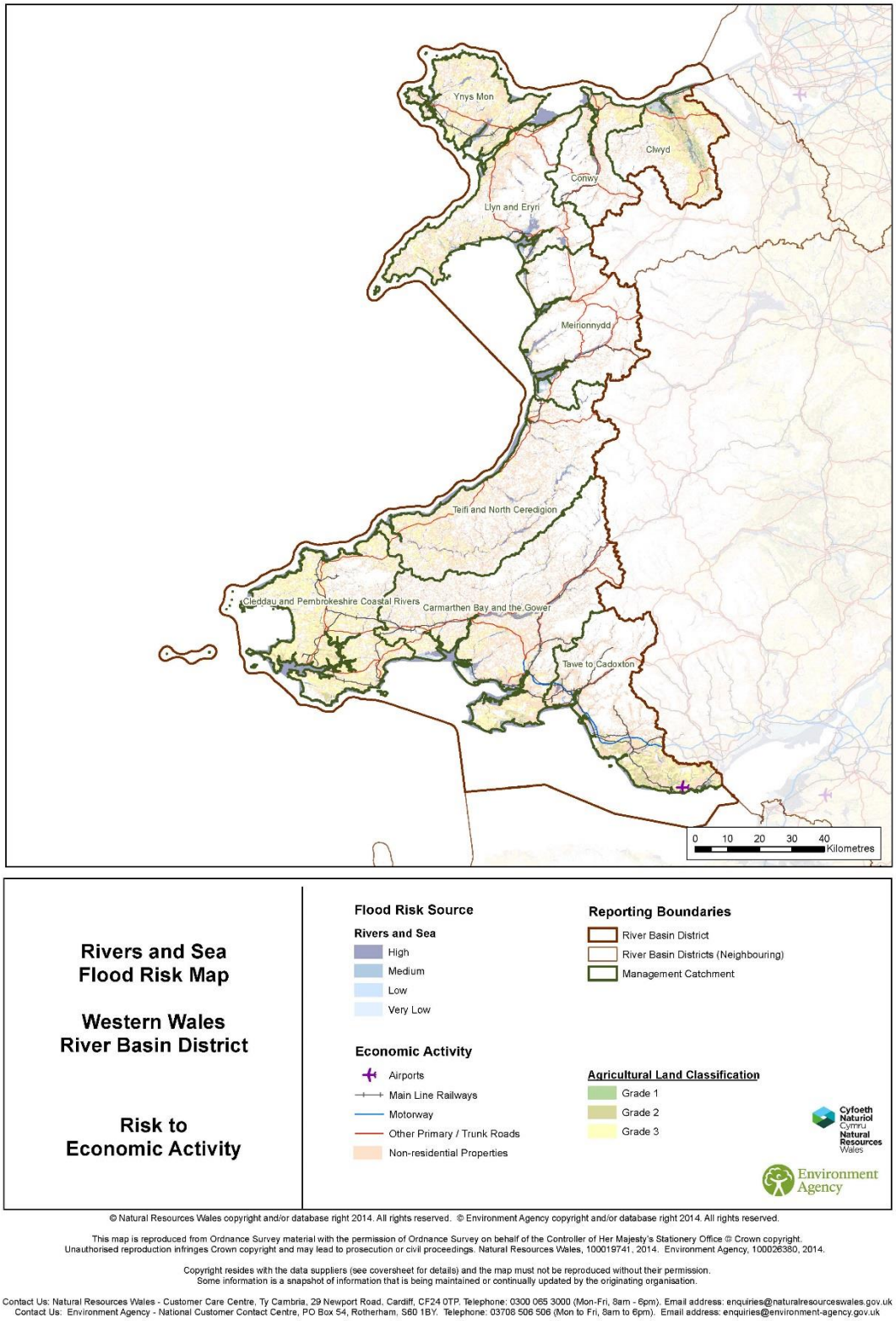


Figure 8: Main Rivers and the Sea – Economic activity at Risk

Out of the 316,598 non-residential properties in the RBD, 13,057 have a 1 in 100 (1%) or greater chance of flooding in any given year, with 6,869 of these considered to be at high risk with a 1 in 30 (3.3%) or greater chance of occurring each year. There is a total of 246,249 hectares of agricultural land in the RBD. Over 10,000 hectares of this has a 1 in 100 (1%) or greater chance of flooding in any given year. Significant lengths of road and railway infrastructure are also at risk.

Table 3: Key Statistics for Main Rivers and the Sea

Element	Indicator measured	Number in defined area (RBD)	Number in defined area at high risk	Number in defined area at medium risk	Number in defined area at low risk	Number in defined area at very low risk
People						
People	Number of people	1,551,656	16,857	24,095	105,719	1,170
Services	Number of sites	4,282	175	89	264	2
Environment						
Bathing water	Number of bathing waters that might be adversely affected by heavy rainfall (within 50m of risk band)	26	26	0	0	0
Environmental Permitting Regulations (EPR) Installations	Number of EPR Installations (within 50m of risk band)	116	18	7	9	0
Special Areas of Conservation (SAC)	Area of SAC (in hectares)	325,192	44,991	1,253	2,019	39
Special Protection Areas (SPAs)	Area of SPA (in hectares)	99,134	12,539	146	335	1
RAMSAR	Area of RAMSAR (in hectares)	11,619	6,851	376	574	3
World Heritage Sites (WHS)	Area of WHS (in hectares)	310	34	0	6	1
Sites of Special Scientific Interest (SSSI)	Area of SSSI (in hectares)	144,791	35,378	1,965	2,787	42
Parks and Gardens	Area of Parks and Gardens (in hectares)	9,465	406	146	137	1
Scheduled Ancient Monuments	Area of Scheduled Ancient Monuments (hectares)	3,638	109	25	419	0
Listed Buildings	Number of listed buildings	16,956	925	368	1,039	19
Licensed Abstractions	Number of licensed abstractions	891	195	73	49	0
Economy						
Non-residential properties	Number of non-residential properties	316,598	6,869	6,188	15,718	266
Airports	Number of airports	1	0	0	0	0
Roads	Length of roads (km)	1,237	36	25	63	0
Railways	Length of railway (km)	767	74	34	81	1
Agricultural land (Grades 1, 2, 3)	Area of agricultural land (hectares)	246,249	6,956	3,305	4,277	68

Reservoirs - People

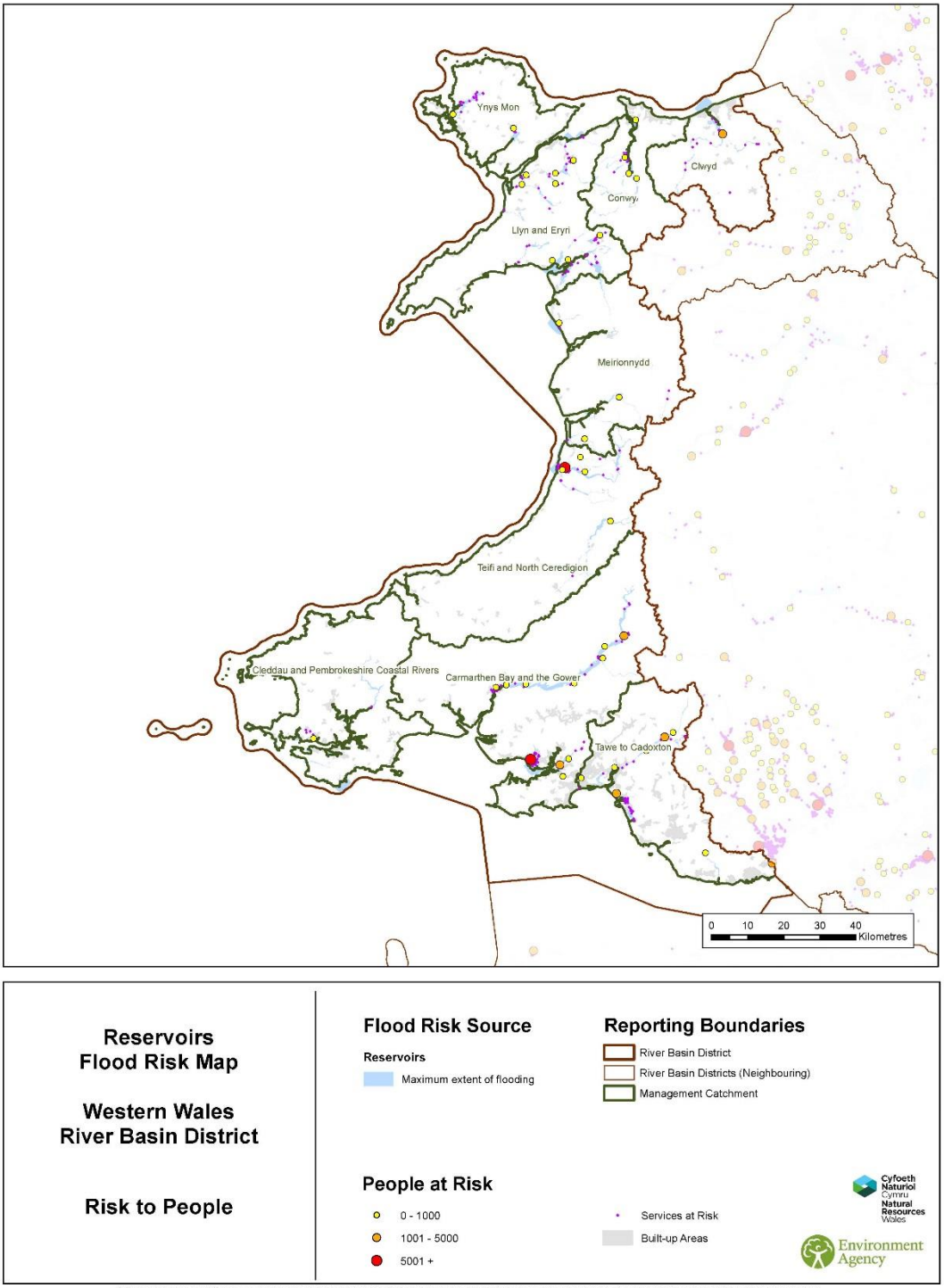


Figure 9: Reservoirs – People at Risk

There are 1,551,656 people and 4,282 services in the River Basin District. Of these, 41,266 people and 186 services are at risk of flooding from reservoirs in the RBD (considering the maximum extent of flooding). The highest areas of risk to people are in Llanelli from the Lliedi reservoirs and in Aberystwyth from Rheidol valley reservoirs that are used for hydropower generation.

Reservoirs - Environment

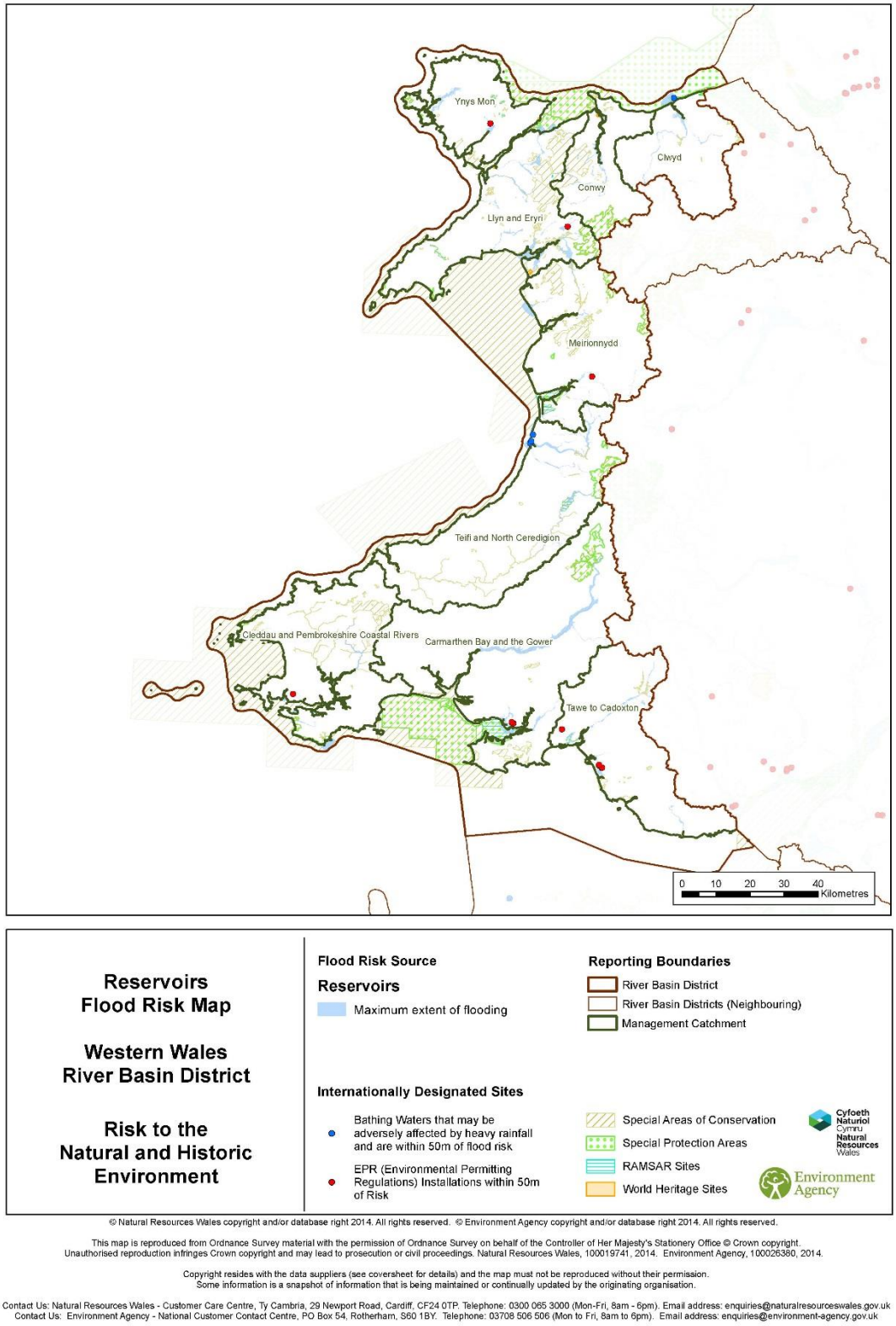
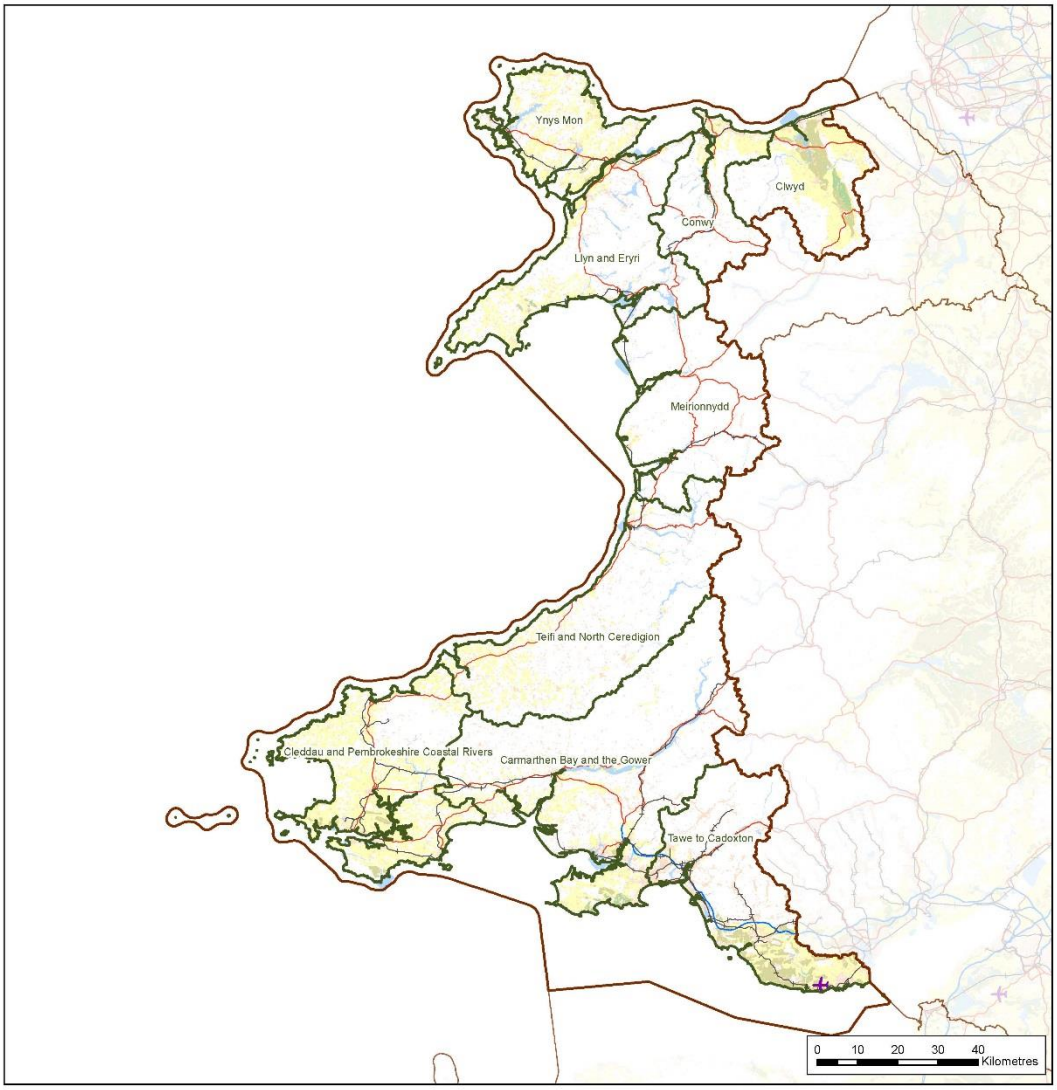


Figure 10: Reservoirs – Natural and Historic Environment at Risk

There are significant areas of environmental designations at risk of flooding from reservoirs in the RBD including; Special Areas of Conservation (SACs), Special Protection Areas (SPAs), World Heritage Sites (WHS), Sites of Special Scientific Interest (SSSI), Areas of Scheduled Ancient Monuments, and parks and gardens. 4 out of the 26 bathing waters around the coast might be adversely affected by flooding from reservoirs. 857 of the 16,956 listed buildings in the RBD are at risk of flooding from reservoirs.

Reservoirs – Economy



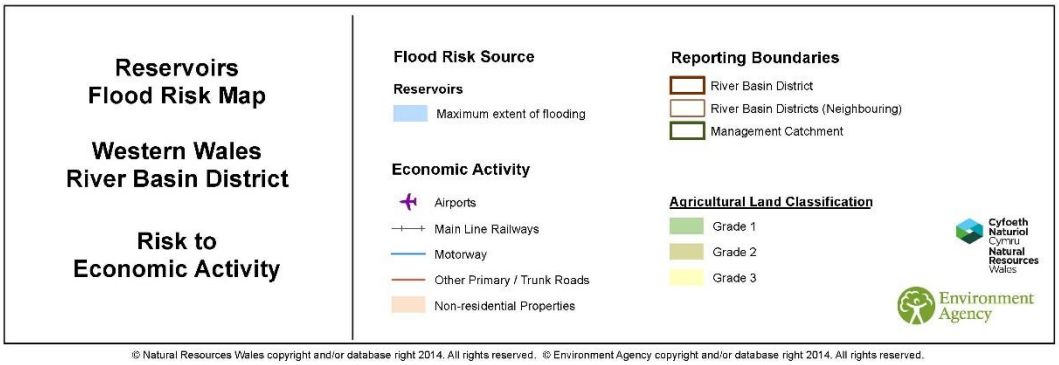


Figure 11: Reservoirs – Economic activity at Risk

Out of the 316,598 non-residential properties in the RBD, 8,965 are at risk of flooding from reservoirs (considering the maximum possible extent of flooding). There is a total of 246,249 hectares of agricultural land in the RBD and 4,400 hectares of this is considered to be at risk of flooding from reservoirs. 69km of road and 63km of railway are also at risk.

Cyfoeth Naturiol Cymru Natural Resources Wales

Table 4: Key Statistics for Reservoirs

Element	Indicator measured	Number in defined area (RBD)	Number in maximum extent of flooding
People			
People	Number of people	1,551,656	41,266
Services	Number of sites	4,282	186
Environment			
Bathing water	Number of bathing waters that might be adversely affected by heavy rainfall (within 50m of risk band)	26	4
Environmental Permitting Regulations (EPR) Installations	Number of EPR Installations (within 50m of risk band)	116	11
Special Areas of Conservation (SAC)	Area of SAC (in hectares)	325,192	10,866
Special Protection Areas (SPAs)	Area of SPA (in hectares)	99,134	2,692
RAMSAR	Area of RAMSAR (in hectares)	11,619	1,712
World Heritage Sites (WHS)	Area of WHS (in hectares)	310	16
Sites of Special Scientific Interest (SSSI)	Area of SSSI (in hectares)	144,791	10,075
Parks and Gardens	Area of Parks and Gardens (in hectares)	9,465	213
Scheduled Ancient Monuments	Area of Scheduled Ancient Monuments (in hectares)	3,638	47
Listed Buildings	Number of listed buildings	16,956	857
Licensed Abstractions	Number of licensed abstractions	891	101
Economy			
Non-residential properties	Number of non-residential properties	316,598	8,965
Airports	Number of airports	1	0
Roads	Length of roads (km)	1,237	69
Railways	Length of railway (km)	767	63
Agricultural land (Grades 1, 2, 3)	Area of agricultural land (hectares)	246,249	4,400

Most at risk communities in the River Basin District

Natural Resources Wales focuses the management of flood risk at a community scale for main rivers and the sea. Using the Natural Resources Wales Communities at Risk Register (refer to Chapter 3 for description), the communities that are most at risk of flooding from main rivers and the sea are identified.

The following tables identify the communities that are at greatest risk of flooding in the Western Wales River Basin District for flooding from main rivers and from the sea (note, communities are listed alphabetically, not ranked).

Table 5: Top communities in the Western Wales River Basin District at risk of flooding from main rivers

Community	Local Authority	Management Catchment
Abergele	Conwy	Clwyd
Ammanford	Carmarthenshire	Carmarthen Bay and the Gower
Denbigh	Denbighshire	Clwyd
Maesteg	Bridgend	Tawe to Cadoxton
Margam	Neath Port Talbot	Tawe to Cadoxton
Morfa Glas	Port Talbot	Tawe to Cadoxton
Pontarddulais	Swansea	Tawe to Cadoxton
Porthmadog	Gwynedd	Llyn and Eryri
Port Talbot	Neath Port Talbot	Tawe to Cadoxton
Resolven	Neath Port Talbot	Tawe to Cadoxton

Table 6: Top communities in the Western Wales River Basin District at risk of flooding from the sea

Community	Local Authority	Management Catchment
Abergele	Conwy	Clwyd
Kinmel Bay	Conwy	Clwyd
Llandudno	Conwy	Conwy
Llanelli	Carmarthenshire	Camarthen Bay and the Gower
Porthmadog	Gwynedd	Llyn and Eryri
Port Talbot	Neath Port Talbot	Tawe to Cadoxton
Prestatyn	Denbighshire	Clwyd
Pwllheli	Gwynedd	Llyn and Eryri
Rhyl	Denbighshire	Clwyd
Towyn	Conwy	Llyn and Eryri

6. Co-ordination with the Western Wales River Basin Management Plan

In addition to the responsibility to deliver against the Flood Risk Regulations, Natural Resources Wales is the Competent Authority for implementation of the Water Framework Directive (WFD) in Wales. This means that we also have responsibility for preparing and delivering River Basin Management Plans (RBMPs). Both plans are required to meet European requirements[6].

There are three River Basin Management Plans that cover Wales, one of which is the Western Wales River Basin Management Plan. River Basin Management Plans aim to take a holistic approach to managing the water environment and ensure that we balance ecological, social and economic values in decision-making. They include statutory commitments to:

- protect the water environment from deterioration;
- achieve the wider objectives of other European Directives e.g. Habitats Directive, and the revised Bathing Water Directive;
- ensure new modifications to water bodies are in line with WFD.

This Western Wales Flood Risk Management Plan has been produced separately but in conjunction with the Western Wales River Basin Management Plan. The alignment of planning programmes and study areas has allowed consideration of how the plans interact and how NRW can work to deliver multiple benefits in the most efficient way, throughout the six year planning cycle.

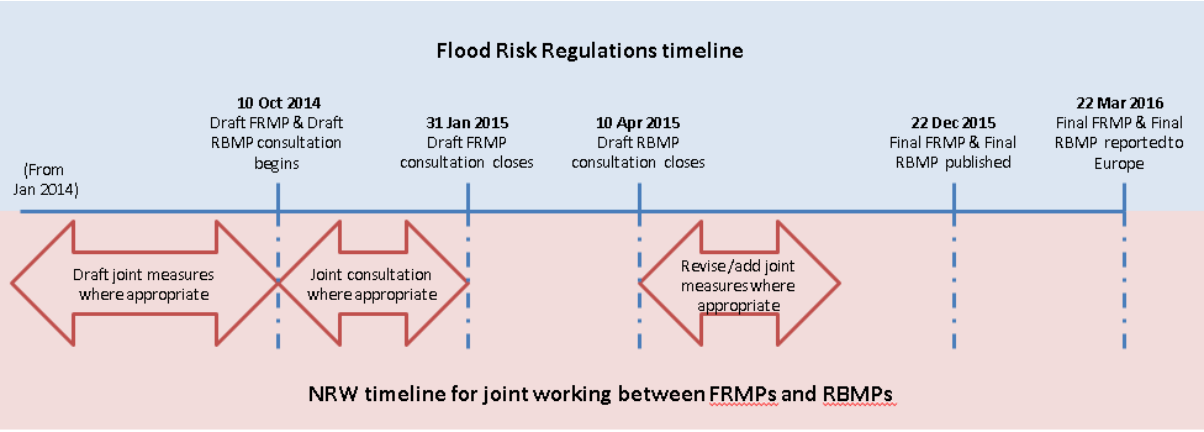


Figure 12: Flood Risk Management Plans and River Basin Management Plan Timelines.

The Western Wales RBMP sets out National Measures proposed for delivery by Flood Risk Management. These measures are set out below and demonstrate NRWs commitment to integrated natural resource management through our activities.

FRM National Measures for RBMP & FRMP

Identify opportunities to improve the water environment through existing programmes of work and scheme designs for Flood Risk Management.
Potential synergies and conflicts between RBMP measures and FRMP measures in specific communities at risk have been identified and will be incorporated into the Communities at Risk Register to identify where multiple benefits can be delivered through projects. Those actions that could be delivered within the next 6year planning window are documented in the delivery plans in Section 9. These measures are those that have been set out in the RBMP as necessary for waterbodies to achieve good ecological status or potential. We have selected those that are either potentially deliverable through FRM operations or projects or could have benefit to FRM, for example:

- Appropriate coastal process and sediment management
- Mitigate impacts of flood and coastal defences
- Mitigate impacts of navigation and dredging
- Sustainable land management / agricultural practices
- Improve fish passage and habitat
- Manage invasive non-native species (INNS)
- Sustainable access and recreation management

At a project level, the options appraisal and design will consider how these measures can be incorporated or how FRM can work with, or influence others to deliver multiple benefits.

NRW will seek opportunities and influence others to utilise natural flood risk management measures where appropriate. FRM will work with the Area Natural Resource Management teams in the development of the Area Based Statements to ensure flood risk is integral in the consideration of Natural Resource Management, including identifying opportunities to deliver Natural Flood Risk Management. FRM will support the work of others to identify opportunities and implement measures to secure flood risk benefits as part of planned programmes of work/projects.

Implement managed realignment and intertidal habitat creation through the National Habitat Creation Programme (NHCP). We will continue with this programme of work, delivering coastal compensation habitat to offset predicted losses brought about through coastal squeeze, as identified in the SMP2's.

In waterbodies designated as heavily modified due to flood and coastal protection, mitigation for NRW owned assets and activities will be reviewed and delivered on a prioritised basis.

Contribute to the achievement of the WFD objective and favourable conservation status at priority Water Level Management sites. We will continue working with protected sites colleagues and land owners in the delivery of Water Level Management Plans.

Contribute to research and development to identify best practice for managing hydromorphological pressures in the water environment. Flood risk management is one of the top ten reasons a waterbody fails to meet the objective set under the WFD in Wales. This is why it is important to ensure that where action is needed to manage the risk of flooding, an option is selected that at least maintains the ecological status or potential of a water body, and also seeks opportunities for improvement.

7. Western Wales Flood Risk Management Plan Objectives

The Welsh Government National Flood and Coastal Erosion Risk Management Strategy objectives set the framework for flood and coastal erosion risk management work within Wales.

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

Every flood risk management action undertaken in Wales has the National Flood and Coastal Erosion Risk Management strategy objectives as the overarching deliverable.

Sitting under the National Strategy objectives, Natural Resources Wales has developed a set of eight objectives for this plan. The majority of these objectives were developed and agreed by the Catchment Flood Management Plan steering groups based upon understanding of flood risk and issues that are important now or in the future. Their suitability has been reviewed against the National Strategy and Flood Risk Management Plan requirements and are deemed to still sufficiently reflect the key objectives of flood risk management work in Wales. The sub-objectives were developed by considering the three main aspects of sustainable flood risk management:

1. Social: people and communities
2. Economic: potential cost and economic benefit
3. Environment: cultural heritage, landscape and habitat diversity.

The principles of sustainable flood risk management remain the key deliverables for the flood risk management work of Natural Resources Wales.

Table 7 provides details on the eight FRMP sub-objectives and how they link to the Welsh Government National Flood and Coastal Erosion Risk Management Strategy and the aspects of sustainable flood risk management.

Table 7: Flood Risk Management Plans Objectives and Links to the National FCERM Strategy

FRMP Objective Number	Wales FRMP Objective	Link to Welsh Government National Flood and Coastal Erosion Risk Management Strategy Objectives	Principles of Sustainability		
			People	Environment	Economy
Objective 1	Reduce the risk of harm to life from flooding to people and communities from main rivers, reservoirs and the sea.	1, 3	Y		Y
Objective 2	Increase resilience of services, assets and infrastructure to current and future risk of flooding.	1, 3	Y		Y
Objective 3	Improve understanding of current and future flood risk so that decisions are based upon the best available information.	1, 3	Y	Y	Y
Objective 4	Improve community awareness and resilience to current and future flood risk.	2	Y		Y
Objective 5	Work with others to provide an effective and sustained response to flood events.	3	Y		Y
Objective 6	Allocate funding and resources for all sources of flooding on a risk basis.	4	Y	Y	Y
Objective 7	Incorporate natural resource management into the delivery of flood risk management.	1, 4	Y	Y	Y
Objective 8	Seek opportunities to deliver RBMP measures through Flood Risk Management	1	Y	Y	Y

Selecting measures to achieve objectives

Any measure that Natural Resources Wales undertakes as part of this Flood Risk Management Plan will be for the purpose of meeting the sub-objectives set out above, and ultimately, those set out in the Welsh Government National Flood and Coastal Erosion Risk Management Strategy. The measures within this plan have been selected after

- considering the source and severity of the risk;
- what risk management processes are already in place;
- how the risk might change in the future; and

- what the options to address the risk are.

The most appropriate measure is selected after considering all of these factors along with the technical feasibility and the cost. The appropriate measure is then assessed against the plan objectives to ensure the proposed measure is in keeping with the preferred Welsh approach.

The measures within the latter sections of this plan are linked to the relevant plan objectives so it is possible to see which measures will deliver which objectives.

8. Measures already underway in the Western Wales RBD to manage flood risk – summary

In the following chapters of this Flood Risk Management Plan, we will introduce the measures that are that are being proposed along with those already underway, to manage and reduce flood risk throughout the Western Wales River Basin District. The following table introduces the terminology used to describe and categorise these measures.

Table 8: Measure terminology

Measure Type	Description
Prevention	Preventing damage caused by floods: 1. By avoiding construction of houses and industries in present and future flood-prone areas; 2. By adapting existing receptors to the risk of flooding; and ensure that future developments take flood risk into account; 3. By promoting appropriate land-use.
Protection	Taking measures, both structural and non-structural, to reduce the likelihood of floods in a specific location.
Preparedness	Informing the population about flood risk and what to do in the event of a flood, including emergency response; developing emergency response plans in the case of a flood.
Recovery and Review	Returning to normal conditions as soon as possible and mitigating both the social and economic impacts on the affected population. (Note – we will only use this measure type where flooding has been experienced and we are undertaking a recovery and review action)
Priority score	**Description**
1	Critical - Needs attention - immediately
2	Very High - Needs attention - short term (year 1)
3	High - Needs attention - medium term (year 2 - 3)
4	Medium - Needs attention - medium term (year 4 - 6)
5	Low - Good status - no intervention required for > 6 years
Implementation status	**Description**
Not started	Could mean that: • The technical and/or administrative procedures necessary for starting the construction or building works of a project have not started. • The advisory services are not yet operational and have not provided any advisory session yet. • The research, investigation or study has not started, i.e. contract has not been signed or there has not been any progress.

	• The administrative file has not been opened and there has not been any administrative action as regards the measure.
On-going	Could mean that: • The administrative procedures necessary for starting the construction or building works have started but are not finalised. • The advisory services are operational and are being used. • The research, investigation or study has been contracted or started and is being developed. • An administrative file has been opened and at least a first administrative action has been taken.
Complete	Could mean that: • The works have been finalised and the facilities are operational. • An advisory service that has been implemented and has been finalised, • The research, investigation or study has been finalised and has been delivered. • The administrative act has been concluded (e.g. the regulation has been adopted, etc.).

There are already measures underway across the Western Wales River Basin District to manage flood risk. A combination of measures are used to manage and reduce flood risk. This section outlines the RBD scale measures that are already ongoing in the Western Wales River Basin District and will continue to be delivered by Natural Resources Wales.

Table 9: Ongoing measures within the Western Wales River Basin District

Measure Type	Measures
Prevention	• We provide advice and support to the Government. • We regulate all 'high-risk' reservoirs in accordance with the Reservoirs Act 1975. • We work closely with local planning authorities, developers, businesses and infrastructure operators to help them understand the consequences of flood risk in the locations they choose for development. We provide advice on how new development can be designed to be more resilient to flooding and help to avoid inappropriate development through the planning process • We ensure no increase in run-off from new developments through planning advice and appropriate floodplain compensation in undefended fluvial floodplains to mitigate development, through the planning process. • We ensure works in, over, under and next to main rivers do not increase flood risk or cause pollution through effective consenting. Use

	consenting process to identify opportunities to improve the water environments. • We undertake a prioritised programme of mapping and modelling to ensure our flood risk information remains up to date and fit for purpose. We use this data to prioritise and allocate funding in locations that are most at risk, and to influence sustainable development and emergency response. • We contribute to research and development, and work with partners to identify best practice for reducing runoff through land use change, whilst contributing wider benefits where possible (biodiversity, soil conservation and water quality improvements). • We work with local authorities, emergency services and other key partners and explore opportunities for joint outcomes. • We seek opportunities to undertake Natural Flood Management by using all appropriate tools available, such as the Woodland Creation maps. • We seek to work collaboratively with our partners to find innovative approaches to managing flood risk.
Preparedness	• We undertake work to maintain and improve our flood forecasting, flood warning and flood incident management services. We focus on areas for improvement as highlighted by recent flooding events and routine exercises. • We undertake a risk based programme to increase awareness of flood risk and registration to Floodline Warnings Direct. • We review System Asset Management Plans regularly with regard to maintenance, funding requirements and asset condition related works across each catchment. • We provide a flood incident response service 24 hours a day, 7 days a week, 365 days a year. • We provide advice and information to Local Resilience Fora to enable them to reduce the impact of flooding. • We have on-site reservoir plans in place for all ‘high-risk’ reservoirs.
Protection	• We undertake a maintenance programme to replace/refurbish flood risk management assets, including pumping stations and outfalls, when needed to reduce flood risk. • We undertake an asset inspection programme to ensure our flood risk management assets are at the appropriate standard • We secure funding and deliver emergency works where needed for our assets.
Recovery and Review	• We will continue to improve and develop our services based on lessons identified following flood event and feedback from communities and partners.

	• We will undertake our actions in the Delivery Plan resulting from our Wales Coastal Flooding Review into the winter 2013/14 coastal storms and flood events in Wales.

In addition to those measures that are already ongoing across the Western Wales RBD, there are a number of measures that are on-going, agreed or proposed for specific communities across the Western Wales RBD. The latter catchment specific sections of this Flood Risk Management Plan describe the measures that we propose to take in addition to the ongoing RBD measures. These are specific measures where extra attention is required to manage or reduce flood risk.

Box 1. Case study box

The Lower Swansea Valley Flood Scheme

The Lower Swansea Valley Flood Scheme is located two miles north of Swansea City Centre. It comprises a series of business parks of regional economic importance and residential areas. The wooded river corridor of the river Tawe is flanked with public footpaths and green spaces.

The area has a history of flooding. The largest flooding on record occurred in 1979 and most recently in 1998. We estimated that if nothing was done the cumulative cost of flood damage to property alone over 100 years totalled £40 million in today's prices. Flood hazard was exacerbated by the relatively low 1 in 10 annual chance onset of overtopping, with a higher risk to life due to the high depths and velocities of flood waters travelling to properties up to 2km from the river corridor.

The Lower Swansea Valley flood scheme now reduces the risk of flooding to some 300 properties and the many shoppers and employees visiting the vibrant Swansea Enterprise Park. We have increased the flow capacity of the River Tawe over a 4km reach, by creating more space for water, removing restrictions and raising low spots along the river banks. We moved flood embankments back from the river to create a 6 hectare wetland habitat, a reinstatement of the natural floodplain. The project also improved flood warning, community flood awareness and piloted a multi-agency flood plan.

The £7m project was funded by Welsh Government and the European Regional Development Fund.

Figure 13: Aerial view of site during construction in September 2013 looking south. The new set-back flood embankment is now operational as the old embankment is being removed. Landscaping of the wetland habitat is under construction.

9. How we manage flood risk – Catchment scale

Catchment 1: Tawe to Cadoxton

Figure 14: Location of the Tawe to Cadoxton Management Catchment

Catchment description / overview - Tawe to Cadoxton

From the mountainous regions of the Brecon Beacons to the lowlands in the Vale of Glamorgan, this management catchment is rich and varied. In this region you can find stunning waterfalls and gorges, woodlands, sandy beaches, as well as bustling towns built on heavy industry. The main rivers are the Tawe, Neath, Afan, Ogmore, Thaw and Cadoxton.

The rivers Tawe and Neath both rise in the foothills of the Brecon Beacons, one of three designated National Parks in Wales. The upper and middle reaches of these catchments are predominantly agricultural, with some areas of forestry. Dispersed small towns are built around historic mining areas, often adjacent to the river. The larger main towns in both catchments are located in the lowlands, towards the coast. The river Tawe passes though Swansea, the second largest city in Wales, built on heavy industry. In Swansea today the manufacturing and service industries are important to the local economy. The city overlooks the vast Swansea Bay, and is directly connected to the Gower Peninsula, a designated Area of Natural Outstanding Beauty popular with tourists. The largest town on the river Neath is the town of Neath and it lies within the tidal limit of the river. Canals running adjacent to the river in this area are a legacy of historic mining in the catchment.

The rivers Ogmore and the Afan drain primarily from the Glamorgan hills. The Afan in particular has large amounts of Forestry providing both economic value and attraction for walkers and mountain bikers. The Ogmore has three main river branches the Llynfi, Garw and the Ewenny. The main town in the Ogmore catchment is Bridgend, a historic market town. Today, manufacturing companies based in the industrial estates surrounding the town are important for the local economy. Below Bridgend the river Ogmore flows through the picturesque Merthyr Mawr estate. The sand dunes here are designated as a Site of Special Scientific Interest. The main town in the Afan catchment is Port Talbot, it is located in the lower reaches of the Afan. Heavy industry is important for the local economy and the river Afan provides a reliable source of water to the industry based around Port Talbot docks. Just downstream of the docks is the beach of Aberavon, one of many beautiful sandy beaches on the coastline.

The Cadoxton river is small, relatively flat and urbanised. The river flows through the communities of Palmerstown and Dinas Powys towards the town of Barry. At this point the watercourse flows through an artificial channel towards its manmade estuary at the Bendricks; a stretch of coastline with fantastic geological features of particular interest to Paleontologists. The river Thaw is longer, approximately 20km in length and it flows through the main community of Cowbridge and the residential area of Llanblethian. Similarly, it also has a manmade estuary, that was diverted to the west of Aberthaw power station and a seawall was built to provide an area for ash disposal and protect the site from flooding.

There are six special areas for conservation, three national nature reserves, 37 sites of special scientific interest and 19 scheduled monuments located within the area. There are also fantastic beaches, many designated as European Union bathing waters. Tourism is an important economy in the area and visitors are attracted by the natural beauty, diverse wildlife, fascinating heritage and the variety of outdoor activities available.

Historical flooding in the catchment

A summary of significant flood events is provided below:

- December 1979 was one of the largest floods of the 20th century and flooding was widespread through this management catchment. The Tawe was the worst affected. The highest flows on record were observed and estimates suggest the flooding was between a 1 in 75 and 1 in 100 year flood event with hundreds of properties flooded throughout the valley. In the Neath and Afan catchment, estimates suggest the flooding was approximately a 1 in 50 year flood event. The highest and the second highest river levels were observed on the rivers Afan and Neath, respectively. Flooding was widespread in both catchments.
- October 1998 flooding was comparable to that of 1979. River levels on the Tawe were marginally smaller than that of 1979, whereas river levels on the river Neath were marginally higher. Widespread flooding was reported. Flooding was also recorded in the Vale of Glamorgan at Pencoed, Waterton, Bridgend, Maesteg and Aberkenfig.
- October 2000 was relatively smaller event, impacts were mainly seen in the Vale of Glamorgan affecting the Ogmore and the Ewenny.
- December 2012, flooding in this event was primarily localised to the Hoddnant Brook at Boverton, in the Vale of Glamorgan, approximately 11 properties and 1 electricity substation flooded.
- 3rd January 2014, the combination of high tides, strong winds and large waves produced the worst coastal flooding for over 15 years. The beach at Llantwit Major was most severely damaged, with flooding to the one commercial property on the seafront and damage to the car park. Water overtopped defences in the areas surrounding Porthcawl and Swansea Bay but no properties were officially reported as flooded.

Current flood risk in the catchment

The area of Port Talbot is the highest risk community in this management catchment, and is one of the top 50 highest risk communities in Wales. It is at risk from both tidal and fluvial flooding. The community is mainly flat in its nature, densely populated with roads and services in the flood plain. A flood scheme designed in response to the December 1979 flooding gives good protection to the centre of town. To the east the community labelled Margam, is also one of the top 50 flood risk communities in Wales. This community is at risk from the Ffrwd Wyltt, a relatively small, steep and largely wooded catchment that can respond quickly to rainfall. The watercourse has been modified considerably at the lower end as it flows into Port Talbot docks.

In the Neath valley the communities of Morfa Glas, Glyn-neath, Neath town, and Briton Ferry are at highest risk of flooding. The area of Morfa Glas is at risk from relatively small watercourses draining from the steep slopes of Aberpergwm woods that respond extremely quickly to rainfall. Glyn-neath is primarily at risk from the river Neath itself. A flood defence scheme completed in 2008 provides protection to the large residential housing areas. Flooding in the Neath town area is complicated by interaction between the tide, the network of canals, and feeding tributaries, such as the river Dulais. The area at Briton Ferry is predominantly at tidal flood risk.

There is a long history of flooding in the Tawe valley. Communities at risk include Ystalyfera, Pontardawe and Ystradgynlais. The area at highest risk is considered to be further down the Swansea valley in the community labelled Llansmalet. Here, the Swansea Enterprise Zone is densely populated with commercial and residential properties. Flooding risk is from the river Tawe and the Nant Fendrod.

On the river Ogmore the main towns at risk of flooding are Bridgend and Maesteg. The Cadoxton river is the smallest watercourse in the management area, however, flood risk is still high in the communities of Palmerstown and Dinas Powys. Palmerstown is considered to be one of the top 50 highest risk communities in Wales.

Future flood risk and issues in the catchment

Future flood risk will be influenced by climate change and changes in land use such as urban development and rural land management. The predicted increased frequency and intensity of rainfall is likely to increase flood risk, particularly in the smaller, faster responding catchments affecting communities such as Ogmore vale, Morfa Glas, Glyn-neath, Ystalyfera and Ystradgynlais. Climate change is also predicted to cause a rise in sea levels; this is likely to increase the risk in coastal communities and those communities where rivers are tidally influenced, such as Port Talbot, Swansea and Briton ferry. Land use is also important; urban development is likely to increase the risk of fluvial and surface water flooding. Rural land management could influence fluvial flooding in either a positive or negative manner depending on

how it is managed. In general, without intervention, flood risk is likely to increase in all communities. The greatest modelled increase in future flood risk is likely to be seen in Swansea, Resolven and Glyn-neath.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Understanding flood risk is key to understanding how best to protect communities. Detailed specific models have recently been completed in the communities of Port Talbot, Margam, Briton Ferry, Llansamlet, Briton Ferry, Ystalyfera, Ystradgynlais and Cwmafan.

Flood warning services are vital to provide communities with time to prepare for flooding, in order to protect themselves and their property. Flood warning services are available for most communities at high risk. Port Talbot has had a flood warning service for a number of years and recently we have introduced an additional flood warning service that will warn the community of tidal flooding events. To help us improve our forecasting in this area we have installed a new river level gauge at Green Park Weir. We have also introduced a new flood warning areas in the communities of Llansamlet and Dinas Powys. In addition to providing flood warning services, it is equally as important to ensure people are signed up to the services and understand their flood risk. We have undertaken flood awareness campaigns in many of the communities with warning services available. Recently, we have completed awareness door knocking campaigns in the communities of Swansea and Dinas Powys.

We also build and maintain flood defences as this is critical to reduce the likelihood of flooding. We have assets throughout this management catchment in the highest risk areas. Recently, we have made significant improvements to the town of Ystradgynlais, including new raised defence walls and flood gates. We have also recently completed the Lower Swansea Valley Flood Scheme, as detailed in section 8 above. In the river Thaw catchment, the communities of Cowbridge and Llanblethian benefit from a flood attenuation scheme completed in 2007 which holds back flood water near the Comprehensive school, deliberately flooding farmland and then releasing the flood waters in a controlled flow as the river levels begin to fall.

For properties that are at high risk of flooding we also implement measures to help property owners protect themselves. In the community of Dinas Powys, in conjunction with the new flood warning service, we have supplied flood gates to a number of properties. This new service was advertised to local communities through a series of drop-in surgeries in partnership with the local authority.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 10: Key Communities (as labelled on figure below)

Label	Community Name	Label	Community Name
1	Aberdulais	14	Neath
2	Aberkenfig	15	Ogmore Vale
3	Bridgend	16	Palmerstown
4	Briton Ferry	17	Pencoed
5	Crynant	18	Pontardawe
6	Cwmgledd	19	Port Talbot
7	Dinas Powys	20	Pyle
8	Glyn – Neath	21	Resolven
9	Glyncorrwg	22	Swansea
10	Llansamlet	23	Treoes
11	Maesteg	24	Ystalyfera
12	Margam	25	Ystradgynlais
13	Morfa Glas		

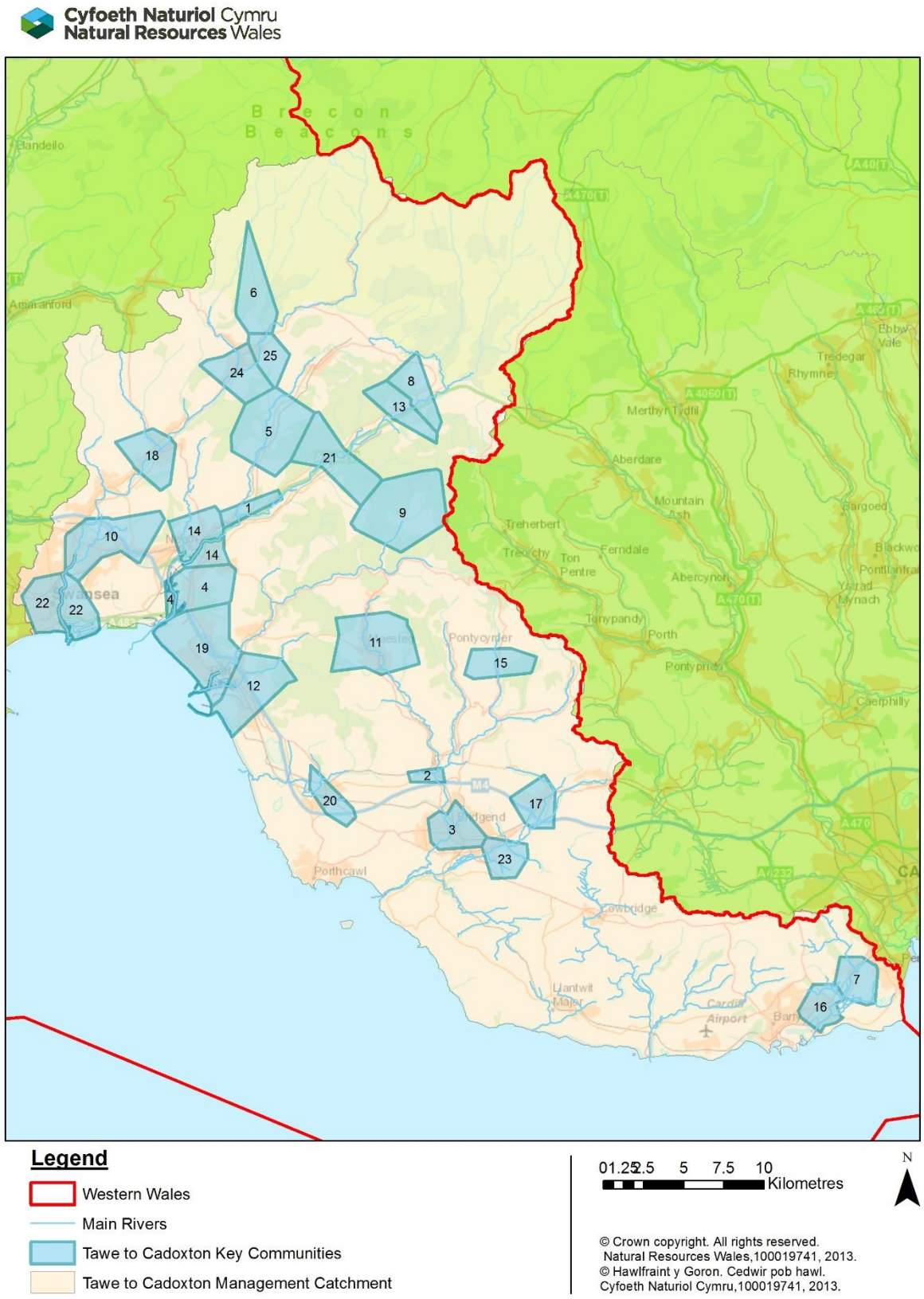


Figure 15: Key Communities within the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 11: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Aberdulais	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	Very High	Not Started
Aberdulais	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Aberdulais	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Ongoing
Aberkenfig	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	Low	Ongoing
Aberkenfig	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Not Started
Aberkenfig	Main River	Maintain existing flood warning service	Preparedness	1, 2, 4	High	Not Started
Aberkenfig	Main River	Develop new flood forecasting model	Preparedness	1, 2, 3, 4	High	Ongoing
Bridgend	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Ongoing
Bridgend	Main River	Develop new flood forecasting model	Preparedness	1, 2, 3, 4	High	Ongoing
Bridgend	Main River	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Ongoing
Bridgend	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	High	Not Started
Briton Ferry	Sea	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Briton Ferry	Sea	Maintain existing flood warning service	Preparedness	1, 2, 4	Very High	Ongoing
Briton Ferry	Sea	Design and construction of flood alleviation scheme	Protection	1, 2, 8	High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Briton Ferry	Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	Very High	Not Started
Crynant	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	High	Not Started
Cwmgiedd	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	High	Ongoing
Cwmgiedd	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Dinas Powys	Main River	Review / update hydrology	Prevention	1, 2, 3	Very High	Ongoing
Dinas Powys	Main River	Upgrade hydraulic model	Prevention	1, 2, 3	Very High	Ongoing
Glyn - Neath	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Not Started
Glyncorrwg	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Glyncorrwg	Main River	Build hydraulic model	Prevention	1, 2, 3	Very High	Ongoing
Llansamlet	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	High	Ongoing
Llansamlet	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Not Started
Llansamlet	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Ongoing
Maesteg	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Not Started
Maesteg	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Not Started
Maesteg	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	Low	Ongoing
Margam	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	High	Ongoing
Margam	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	Very High	Ongoing
Margam	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Ongoing
Morfa Glas	Main River	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Neath	Main River / Sea	Build hydraulic model	Prevention	1, 2, 3	High	Ongoing
Neath	Main River / Sea	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Neath	Main River / Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	Very High	Not Started
Ogmore Vale	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	Low	Ongoing
Ogmore Vale	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Not Started
Ogmore Vale	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Ogmore Vale	Main River	Derive hydrology	Prevention	1, 2, 3	High	Not Started
Palmerston	Main River	Raise flood awareness within the community	Preparedness	1, 4, 5	Very High	Not Started
Palmerston	Main River	Review / update hydrology	Prevention	1, 2, 3	Very High	Ongoing
Palmerston	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Palmerston	Main River	Upgrade hydraulic model	Prevention	1, 2, 3	Very High	Ongoing
Palmerston	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Not Started
Pencoed	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Not Started
Pencoed	Main River	Develop new flood forecasting model	Preparedness	1, 2, 3, 4	High	Ongoing
Pontardawe	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Ongoing
Pontardawe	Main River	Build hydraulic model	Prevention	1, 2, 3	Very High	Ongoing
Port Talbot	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Ongoing
Port Talbot	Main River / Sea	Raise flood awareness within the community	Preparedness	1, 4, 5	Very High	Ongoing
Pyle	Main River	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Resolven	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	Low	Ongoing
Resolven	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	Very High	Not Started
Swansea	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	Medium	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Treoes	Main River	Build hydraulic model	Prevention	1, 2, 3	Low	Not Started
Treoes	Main River	Develop new flood forecasting model	Preparedness	1, 2, 3, 4	High	Ongoing
Treoes	Main River	Derive hydrology	Prevention	1, 2, 3	Low	Not Started
Ystalyfera	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Not Started
Ystradgynlais	Main River	Maintain existing flood warning service	Preparedness	1, 2, 4	High	Ongoing
Ystradgynlais	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Not Started
Aberkenfig	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started

Catchment 2: Carmarthen Bay and the Gower

Figure 16: Location of Carmarthen Bay and the Gower Management Catchment

Catchment description / overview - Carmarthen Bay and the Gower

The main rivers in this management catchment drain into Carmarthen Bay, a designated Special Area of Conservation. From the Gower Peninsula in the east to Tenby in the west, Carmarthen Bay is fringed with sandy beaches, magnificent cliffs, salt marshes and vast estuaries rich in wild-life.

This management catchment contains the river Towy that rises in the foothills of the Cambrian Mountains and is the largest river completely contained within Wales. Approximately 80km of the river is also designated as a Special Area of Conservation. Land use in the catchment is predominantly agricultural with sheep farming in the uplands and mixed livestock rearing in the lowlands. There are also extensive areas of forestry towards the headwaters, mainly located in the area surrounding the vast Llyn Brianne reservoir, a man-made water supply reservoir. The Towy is also renowned for its salmon and sea trout fishing. Attracting large numbers of anglers is a great benefit for the local economy. The river flows through the main towns of Llandeilo, Llandovery and the county town of Carmarthen, where the river becomes tidally influenced. The river has a long and stunning estuary and is eventually joined by the river Taf from the west and the Gwendraeths from the east, congregating into an area commonly known as the Three Rivers estuary. Here the vast expanse of estuary is overlooked by the 12th century castle located in the village of Llansteffan; just one of many popular historic attractions in the area.

The river Loughor is the other main river in the catchment, rising in the foothills of the Black Mountains, this predominantly rural catchment flows past the main towns of Ammanford and Pontarddulais, where the river becomes tidally influenced. The Loughor estuary provides a wide and varied habitat, including sandflats and mudflats, salt marshes, and sand dunes. The estuary is well known for its cockles, the gathering and processing of cockles contributes to the economy of the local area. The estuary is also home to the largest town in this management area, Llanelli. Located on the north side of the estuary, Llanelli has a long industrial history and this continues to be of importance to the local economy. The area boasts fantastic outdoor space (the Millennium coastal path spans 22km from Llanelli to the popular destination of Pembrey) as well as urbanised areas.

The Gower peninsula is located to the south of the Loughor estuary and is designated as an Area of Outstanding Natural Beauty. Its wooded valleys, beautiful bays, and sandy beaches are popular with tourists. Tourism is a particularly important part of the local economy throughout this management catchment.

Historical flooding in the catchment

A summary of significant flood events is provided below:

- December 1979, much of the Loughor catchment was affected with notable flooding at Ammanford, Llandybie and Pontarddulais. On the River Towy the second highest recorded flood level was observed, flooding areas at Pensarn, Carmarthen, Abergwili and Llandovery.
- March 1981, flooding predominantly affected the river Taf, the highest recorded level was observed at the Clog y Fran gauging station. Flooding of 21 properties was recorded in Whitland, and 11 properties in St.Clears.
- December 1986, Flooding was recorded in Whitland from the River Gronw, a tributary of the river Taf. Approximately 200 properties and 30 businesses were flooded; a flood alleviation scheme has since been completed on the river Gronw.
- October 1987, the highest recorded river levels on the River Towy were observed. Flooding was reported throughout the catchment with approximately 200 properties flooded. Most notably flooding was recorded in Carmarthen Town, despite the Carmarthen flood defence scheme that was completed 3 years before the event. Pensarn walls breached flooding much of the industrial estate including the railway. This was estimated to be a 1 in 250 year flood event.
- November 2005, the highest recorded level on the river Loughor at the Tir y Dail gauging station was observed. Other areas were also affected included parts of Llanelli, from the river Dafen.
- October 1998, at Dolau Bran, Llandovery, the highest recorded river level was observed on the Nant Bran. Approximately 150 properties flooded in Llandovery. Flooding was also reported in the Gwendraeth rivers at Pontyates.
- March 2008, Tidal flooding affected approximately 11 properties in Laugharne, and 30-40 caravans flooded in a Caravan Park in Carmarthen Bay.
- January 2013, the village of Llanddowror was flooded from the river Hydfron, a tributary of the Taf. 27 properties were flooded. A similar extent of flooding was observed in this village in November 2009.
- January 2014, the combination of high tides, strong winds and large waves, delivered conditions that caused the worst tidal flooding for over 15 years. Properties were affected on north side of the Gower at Penclawdd and Crofty. In Carmarthen Bay approximately 70 caravans were affected. Flooding was also noted at Llangennch, Llansteffan, Carmarthen Quay and Laugharne.

Current flood risk in the catchment

Llanelli is the community with the highest flood risk in the management catchment and is one of the top 50 highest risk communities in Wales. The community covers a large geographic area and is densely populated. The area is at risk of tidal, fluvial and surface water flooding. The tidal risk is reasonably mitigated by the presence of defences. A number of surface water flood events have been experienced; more work is required to understand the surface water flood mechanisms in the area. The primary risk is from the watercourses that intersect the town. The rivers Dafen, Lliedi and Dulais all pose flood risk, these watercourses have been significantly altered as the town has developed. Flood walls and embankments help to mitigate the risk of flooding in some places.

The town of Pontarddulais is another town noted at high risk of flooding. The river Loughor poses some risk of flooding, although it is largely mitigated by the flood bank protection. The primary flood risk is from the river Dulais, a narrow and steep-sided rural catchment that responds rapidly to rainfall. Elsewhere in the Loughor catchment the community of Ammanford has a high flood risk, with flood pathways from both the rivers Amman and the Loughor.

The river Taf is predominantly a rural catchment, the main areas of flood risk are in Whitland and St Clears, these communities have a long history of flooding. Flood alleviation schemes in the towns have afforded some protection though flood risk still remains.

In the vast river Towy catchment, many of the dispersed communities have some risk of flooding and the communities of Llandovery and Llandeilo are noted as having the highest flood risk. The rivers Bran, Gwydderig and the Towy pass the town of Llandovery where flood defences have a 1 in 100 year protection level and these help to reduce the impact of flooding. Within the estuary the county town of Carmarthen has also experienced notable flooding in the past. The tide can significantly influence river flows here, however most of the town is well protected following the completion of a flood defence scheme in 1984. The quayside at Carmarthen was not protected as part of the scheme and as a result, a very limited number of mainly commercial properties are often reported to have flooded.

Future flood risk and issues in the catchment

Future flood risk will be influenced by climate change and changes in land use such as urban development and rural land management. The predicted increased frequency and intensity of rainfall is likely to increase flood risk, particularly in the smaller, faster responding catchments. Climate change is also predicted to cause a rise in sea levels. This is likely to increase the risk in coastal communities and those communities where rivers are tidally influenced such as Carmarthen and St Clears.

Furthermore, with the predicted increases in storm intensities, increased wave action may pose further risk to the exposed coastal areas such as those of Llansteffan, and Ferryside. Land use is also important; urban development is likely to increase the risk of fluvial and surface water flooding. Rural land management could influence fluvial flooding in either a positive or negative manner depending on how it is managed. In general, without intervention, flood risk is likely to increase in all communities. The greatest modelled increase in future flood risk is likely to be seen in the towns of Llanelli, Carmarthen, Ammanford, Whitland and Llandovery.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Understanding flood risk is key to understanding how best to protect communities. Detailed specific models have recently been completed for the river Dulais in Llanelli, Ammanford, Llandybie, Llangennech, Bury Port and Whitland.

Flood warning services are vital to provide communities with time to prepare for flooding; to protect themselves and their property. Flood warning services are available for most communities at high risk in this management catchment. The river Dulais in Llanelli is one such area that has recently received a new flood warning service. In addition to providing a flood warning service, it is equally as important to ensure people are signed up to the services and understand their flood risk. We have undertaken flood awareness campaigns in many of the communities with warning services available. Recently, we have targeted the area in the community of Llanelli.

We also build and maintain flood defences as this is critical to reduce the likelihood of flooding and as a result, we have assets throughout the area. Recently, we have completed a flood alleviation scheme on the river Dulais in Llanelli (Pwll). The scheme allows flood waters to by-pass the river channel to reduce flood peaks. The scheme included the installation of two new river level gauges and CCTV cameras to help us forecast and respond to flood events. Ensuring our existing defences are up to standard is also critical, and recently we undertook repairs to some of our floodwalls in Llanwrda on the river Towy. For properties that are at high risk of flooding we also implement measures to help individuals protect themselves. One example of this is

through the provision of flood gates. Over the past few years, 35 flood gates have been provided to properties in Llanddowror.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 12: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Abergwili		11	Llandybie
2	Ammanford		12	Llanelli
3	Burry Port		13	Llangennech
4	Carmarthen		14	Llansteffan
5	Dafen		15	Llwynhendy
6	Ferryside		16	Pembrey
7	Garnant		17	Pen-Clawdd
8	Glanaman		18	Pontarddulais
9	Llandeilo		19	St Clears
10	Llandovery		20	Whitland

Figure 17: Key Communities with the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 13: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Abergwili	Main River	Design and construction of flood risk asset improvements	Protection	1, 2	Very High	Ongoing
Abergwili	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Abergwili	Main River	Derive hydrology	Prevention	1, 2, 3	Medium	Not Started
Abergwili	Main River	Build hydraulic model	Prevention	1, 2, 3	Medium	Not Started
Ammanford	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Ammanford	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Ongoing
Ammanford	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	High	Not Started
Ammanford	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Ongoing
Burry Port	Main River / Sea	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Carmarthen	Main River / Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Carmarthen	Main River / Sea	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Carmarthen	Main River / Sea	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Not Started
Carmarthen	Main River / Sea	Build hydraulic model	Prevention	1, 2, 3	Medium	Not Started
Carmarthen	Main River / Sea	Derive hydrology	Prevention	1, 2, 3	Medium	Not Started
Dafen	Main River	Design and construction of flood alleviation scheme	Protection	1, 2, 3, 8	Very High	Not Started
Dafen	Main River	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Dafen	Main River	Upgrade hydraulic model	Prevention	1, 2, 3	High	Ongoing
Ferryside	Sea	Develop new flood warning service	Preparedness	1, 2, 4	Low	Not Started
Garnant	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Garnant	Main River	Derive hydrology	Prevention	1, 2, 3	High	Not Started
Garnant	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Glanaman	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Glanaman	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Glanaman	Main River	Derive hydrology	Prevention	1, 2, 3	High	Not Started
Llandeilo	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Llandovery	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Llandybie	Main River	Undertake initial assessment and feasibility work for a reducing flood risk	Prevention	1, 2, 3, 8	High	Ongoing
Llandybie	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	High	Not Started
Llanelli	Main River / Sea	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Ongoing
Llanelli	Main River / Sea	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Llanelli	Main River / Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Llanelli	Main River / Sea	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Ongoing
Llanelli	Main River / Sea	Upgrade hydraulic model	Prevention	1, 2, 3	High	Ongoing
Llanelli	Main River / Sea	Raise flood awareness within the community	Preparedness	1, 4, 5	High	Ongoing
Llanelli	Main River / Sea	Undertake initial assessment and feasibility work for a reducing flood risk	Protection	1, 2, 3, 8	Very High	Not Started
Llangennech	Main River / Sea	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Llansteffan	Sea	Build hydraulic model	Prevention	1, 2, 3	Very High	Not Started
Llansteffan	Sea	Design and construction of flood risk asset improvements	Protection	1, 2	Very High	Not Started
Llansteffan	Sea	Derive hydrology	Prevention	1, 2, 3	Very High	Ongoing
Llwynhendy	Main River / Sea	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Ongoing
Llwynhendy	Main River / Sea	Upgrade hydraulic model	Prevention	1, 2, 3	High	Ongoing
Llwynhendy	Main River / Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Pembrey	Sea	Maintain existing flood warning service	Prevention	1, 2, 3	Medium	Ongoing
Pen-Clawdd	Sea	Maintain existing flood warning service	Preparedness	1, 2, 4	Very High	Not Started
Pontarddulais	Main River	Develop new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Pontarddulais	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Not Started
Pontarddulais	Main River	Update flood map based on model outputs'	Prevention	1, 2, 3	High	Not Started
Pontarddulais	Main River	Improve existing flood warning service	Preparedness	1, 2, 4	High	Not Started
St Clears	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Whitland	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started

Catchment 3: Cleddau and the Pembrokeshire Coast

Figure 18: Location of Cleddau and the Pembrokeshire Coast Management Catchment

Catchment description / overview - Cleddau and the Pembrokeshire Coast

The Pembrokeshire Coast is famous for its geological features, rugged cliffs, bays and inlets, wooded estuaries and stunning sandy beaches, of which 29 are European Union designated bathing waters. The coastline is protected as it forms part of the Pembrokeshire Coast National Park. In addition, approximately three quarters of the coastline is designated as a Special Area of Conservation. The famous offshore island of Skomer is designated as one of the few Marine Nature Reserves in the UK. Most famous for its coastline, Pembrokeshire's rivers are often overshadowed. The main rivers are the Eastern Cleddau and Western Cleddau. The smaller coastal streams such as the unspoilt wooded valleys of the Gwaun and Nevern are just as important and valuable to the County. The natural beauty that Pembrokeshire offers makes it a popular tourist destination and the local economy relies heavily on tourism.

The Eastern and Western Cleddaus, both rise on the foothills of the Preseli Hills, which lie to the north of the county within the National Park. These rivers provide varied habitat supporting a diverse range of species. Many features are nationally important, and both rivers are designated as Special Areas of Conservation. Land use in the catchment is predominantly mixed agriculture including dairy cows, and arable crops. Agriculture is an important industry; Pembrokeshire produces 50% of the potatoes and 25% of the milk in Wales. The Western Cleddau flows directly through the historic county town of Haverfordwest, where the river becomes tidally influenced. Many properties, both commercial and residential line the river. The Eastern and Western Cleddau meet to form the Milford Haven Waterway, a superb natural deep water harbour that allows trafficking of large vessels, including tankers and ferries. The waterway plays an important role in the UK's energy sector. It has been utilised since the 1950's for refining oil and more recently for importation of Liquefied Natural Gas. The waterway is an important part of the economy and provides many jobs for the people of Pembrokeshire.

Historical flooding in the catchment

A summary of significant flood events is provided below:

- November 1986, flooding was reported at 14 properties in Solva. This was the highest recorded river level prior to construction of Pont-y-Cerbyd flood storage reservoir in 1989.
- October 1987, floodwaters from the River Western Cleddau overtopped defences and inundated the floodplain to the east of the river. This was predominantly a fluvial event with no significant tidal influence at Haverfordwest. A total of 52 properties were reported flooded.

- October 1997, flooding occurred from the Cartlett Brook, a tributary of the Western Cleddau in the community of Haverfordwest. A number of commercial properties, residential properties and a caravan park were reported as flooded. The event occurred prior to the construction of the Cartlett flood defence wall.
- November 2005, two very closely spaced rainfall events caused flooding at Ford's Lake stream, with 0.7 metre depth of floodwater reported in residential cottages in the community of Stepaside.
- January 2013, the highest river level on record for the river Solva. Although the flood storage reservoir at Pont y Cerbyd reduced the impact of flooding, 3 properties were flooded in the community of Middle Mill and 18-20 properties in the village of Solva.
- January 2014, the combination of high tides, strong winds and large waves resulted in the worst tidal flooding in Pembrokeshire for approximately 15 years. Approximately 50 properties were flooded in areas including Haverfordwest, Lower Town Fishguard, Newgale, Amroth, Dale, Angle, Little Haven and the Parrog.

Current flood risk in the catchment

Haverfordwest is one of the highest risk communities in Pembrokeshire, affected by both tidal flooding and fluvial flooding from the Western Cleddau. A tributary of the Western Cleddau, the Cartlett Brook, flows partly underneath the town and also contributes to flood risk.

Fluvial flood risk is also high on some of the smaller coastal streams. By their nature these streams often react quickly to rainfall, and the flood hazard can be high. The river Solva is one such smaller coastal stream. It poses a risk to a limited number of properties in the idyllic hamlet of Middle Mill and also to the larger coastal community of Solva itself. Solva is a picturesque coastal village characterised by a coastal inlet providing natural shelter for boats into which the river Solva flows. Its location leaves it susceptible to both tidal and fluvial flooding. A flood storage reservoir in the catchment has reduced the likelihood of flooding in both communities, but has not reduced the risk completely.

The Ford's Lake watercourse in the South of the county is similar in its nature to the Solva. By rapidly responding to rainfall, it has a long flood history affecting a limited number of properties in the community at Stepaside.

The picture postcard community of Tenby is one of the most famous coastal towns in Pembrokeshire and is predominantly at risk of flooding from the river Ritec. Set predominantly on South Pembrokeshire limestone, the Ritec, becomes locked at high tides by a flap value. This protects the area from tidal inundation but causes river levels to rise and fall with the tidal cycle. Most winters, water levels will raise enough to affect local road networks. In more extreme events, local caravan parks and a limited number of properties can become at risk.

With 186 miles of coastline, tidal flooding is also an issue in Pembrokeshire. The larger towns of Fishguard, Pembroke and Pembroke Dock are at risk from tidal flooding even though they are naturally well protected from the full force of large Atlantic swells. At the more exposed locations, the combination of high tides, strong winds and large Atlantic waves, brings tidal risk and flood hazard. These locations include the popular seaside communities of Saundersfoot, Amroth and Newgale; all of which are popular with water sport fanatics.

Future flood risk and issues in the catchment

Future flood risk will be influenced by climate change and changes in land use such as urban development and rural land management. The predicted changes frequency and intensity of rainfall is likely to increase flood risk, particularly in the smaller, faster responding catchment such as that of the River Solva or Ford's Lake. Climate change is also predicted to cause a rise in sea levels; this is likely to increase the risk in coastal communities and those communities where rivers are tidally influenced. Together with the predicted changes in storm intensities, increased wave action may pose further risk to the exposed coastal areas such as those of Amroth, Saundersfoot, Little Haven and Newgale. Land use is also important; urban development is likely to increase the risk of fluvial and surface water flooding. Rural land management could influence fluvial flooding in either a positive or negative manner depending on how it is managed. In general, without intervention, flood risk is likely to increase in all communities. The greatest modelled increase in future flood risk is likely to be seen in the main towns of Haverfordwest, Fishguard and Pembroke.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any

previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Understanding flood risk is key to understanding how best to protect communities. Detailed specific models have recently been completed in the communities of Pembroke, Fishguard and Saundersfoot.

Flood warning services are vital to provide communities with time to prepare for flooding; to protect themselves and their property. Flood warning services are available for most communities at high risk in the County. Saundersfoot is one such high risk community that has recently received a brand new flood warning service. In addition to providing a flood warning service, it is equally as important to ensure people are signed up to the service and understand their flood risk. With this is mind we have undertaken flood awareness campaigns in many of the communities with warning services available. Recently we have targeted the communities of Haverfordwest, Saunderfoot, Pembroke Dock and Fishguard.

We also build and maintain flood defences as this is critical to reduce the likelihood of flooding and as a result, we have assets throughout the county including a flood storage reservoir on the river Solva, slipway flood gates in Dale, and flood walls in Haverfordwest. For properties that are at high risk of flooding we also implement measures to help them protect themselves. One example of this is through the provision of flood gates which have been delivered to numerous properties particularly in the communities of Solva, Fishguard, Haverfordwest and Stepaside.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 14: Key Communities (as Labelled on Figure Below)

Label	Community Name		Label	Community Name
1	Amroth		9	Newgale
2	Angle		10	Parrog
3	Dale		11	Pembroke Dock
4	Haverfordwest		12	Saundersfoot
5	Little Haven		13	Solva
6	Llawhaden		14	Stepaside
7	Merlin's Bridge		15	Tenby
8	Middle Mill			

Figure 19: Key Communities in the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 15: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Amroth	Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Angle	Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Dale	Sea	Design and construction of flood risk asset improvements	Protection	1, 2	High	Ongoing
Haverfordwest	Main River / Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Haverfordwest	Main River / Sea	Undertake initial assessment and feasibility work for a reducing flood risk	Protection	1, 2, 8	High	Ongoing
Haverfordwest	Main River / Sea	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Haverfordwest	Main River / Sea	Improve existing flood warning service	Preparedness	1, 2, 4	High	Not Started
Haverfordwest	Main River / Sea	Derive hydrology	Prevention	1, 2, 3	Low	Not Started
Little Haven	Sea	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Low	Not Started
Little Haven	Sea	Implement alternative risk reduction measures	Protection	1, 2, 8	High	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Llawhaden	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Low	Not Started
Merlin's Bridge	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Middle Mill	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Middle Mill	Main River	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Not Started
Newgale	Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Parrog	Sea	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Low	Not Started
Pembroke Dock	Main River / Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Saundersfoot	Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Solva	Main River / Sea	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Not Started
Solva	Main River / Sea	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Ongoing
Solva	Main River / Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Solva	Main River / Sea	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Ongoing
Stepaside	Main River	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Not Started
Tenby	Main River / Sea	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Ongoing
Tenby	Main River / Sea	Design and construction of flood risk asset improvements	Protection	1, 2	Medium	Not Started

Catchment 4: Teifi and North Ceredigion

Figure 20: The location of Teifi and North Ceredigion Management Catchment

Catchment description / overview - Teifi and North Ceredigion

This region is bordered by the rugged coastline of Cardigan Bay to the west and by the spectacular Cambrian Mountains to the east. Cardigan Bay is designated as a Special Area of Conservation, and is home to 13 designated bathing water beaches. Inland, the area within this catchment is predominantly rural in nature, with scattered villages and larger towns mainly situated towards the coast. The land use is predominantly agricultural, with sheep farming in the uplands and dairy farming in the lowlands. Historically much of this area was utilised for metal mining, a legacy which still affects many of the watercourses today in terms of water quality and landscape in some areas. The main rivers in the catchment are the Teifi, Ystwyth, Rheidol and the Aeron.

At approximately 122km long, the river Teifi is the largest river in this management catchment. The river has its source in the Cambrian Mountains in the Teifi pools; a series of legendary lakes partly used for potable water supply. As the river descends to Cardigan Bay it passes forestry, pasture land, gorges, marshes, and the raised bog of Tregaron, a designated National Nature reserve. The river is popular with Anglers, and angling tourism is important to this region. The river supports a variety of habitats and a diverse range of species. Many features of the river are nationally important and the river is also designated as a Special Area of Conservation. Communities are sparsely dispersed throughout the catchment; the largest town on the Teifi is Cardigan, located in the estuary of the river.

The town of Aberystwyth supports the biggest population in this management catchment, a university town and popular tourist destination. The town lies on the coast of Cardigan Bay and supports two of the coastlines' European Union designated bathing water beaches. The rivers of the Ystwyth and the Rheidol meet in the town and both valleys provide some stunning scenery popular with visitors. The Rheidol is used for hydroelectric power generation, and the three manmade reservoirs of Nant y Moch, Dinas and Cwm Rhediol dominate the uplands of the catchment.

The river Aeron is a smaller catchment by contrast. The main town on the river is the quaint town of Aberaeron, located at the mouth of the river overlooking Cardigan Bay. Tourism is important to the economy throughout this management catchment and this town in particular is popular with tourists.

Historical flooding in the catchment

A summary of significant flood events is provided below:

- October 1987, flooding was widespread across this management catchment and the highest recorded river levels on the Teifi were observed. A significant

number of properties were flooded in Tregaron, Lampeter, Llanybydder and Llandysul. The river Aeron also experienced flooding to approximately 10 properties throughout the catchment.

- June 1993, the river Mwldan running through the centre of Cardigan flooded 39 residential and 14 commercial properties. A flood alleviation scheme has since been constructed.
- November 2005, the second highest river levels were recorded on the Teifi and a number of communities and properties were affected.
- June 2012, intense prolonged rainfall in North Ceredigion caused widespread flooding in the area. The highest river levels were recorded on the river Rheidol and the river Clarach. Extensive flooding was observed in Aberystwyth, Capel Bangor and Penrhyncoch.
- January 2014, the combination of high tides strong winds and large waves caused widespread flooding around the welsh coast. One of the worst affected areas was Aberystwyth where the sea front promenade was severely damaged and approximately 30 properties were flooded. Approximately 30 properties were also flooded in Cardigan.

Current flood risk in the catchment

The town of Aberystwyth is the highest risk community in this management catchment. Risk is predominantly from the river Rheidol, however the river Ystwyth also feeds into the town from the south. The town is also at risk tidally. In the lower end of the Rheidol estuary, flood walls raised in 2000, protect the Trefechan area of the town. Large waves have been seen to pound the exposed seafront at high tides causing flooding and extensive damage.

In the Teifi catchment the highest risk communities are Llanybydder, Lampeter and Cardigan. Lampeter and Llanybydder are located approximately halfway along the length of the river Teifi where the river rises slowly, influenced in part by the natural capacity of Tregaron Bog upstream in storing and slowly releasing water. The town of Lampeter is also affected by the river Dulais. Formal flood defences line this river affording some protection. The town of Cardigan is primarily affected by tidal flooding and individual flood gates have been issued to many of the properties at highest risk here. Historically the river Mwldan has been a major source of flooding in the town, however the flood alleviation scheme completed in 1999, has significantly reduced the risk of flooding from this source.

Future flood risk and issues in the catchment

Future flood risk will be influenced by climate change and alteration in land use such as urban development and rural land management. The predicted change in frequency and intensity of rainfall is likely to increase flood risk, particularly in the smaller, faster responding catchments. Climate change is also predicted to cause a rise in sea levels and this is likely to increase the risk in coastal communities and those communities where rivers are tidally influenced. Together with the predicted increase in storm intensities, increased wave action may pose further risk to these coastal areas that are exposed to wave action such as Aberystwyth. Land use is also important; urban development is likely to increase the risk of fluvial and surface water flooding. Rural land management could influence fluvial flooding in either a positive or negative manner depending on how it is managed. In general, without intervention, flood risk is likely to increase in all communities. The greatest modelled increase in future flood risk is likely to be seen in the communities of Aberystwyth, Llanybydder, Aberaeron and Llanrhystud.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Understanding flood risk is key to understanding how best to protect communities. A large scale detailed model has been completed for the river Rheidol and can be used to run various scenarios to help us understand how best to plan additional defences for Aberystwyth.

Flood warning services are vital to provide communities with time to prepare for flooding; to protect themselves and their property. Flood warning services are available for most communities at high risk in the county. In addition to providing a flood warning service, it is equally as important to ensure people are signed up to the service and understand their flood risk. With this is mind we have undertaken flood awareness campaigns in many of the communities with warning services available. Recently we have targeted the areas in and around Aberystwyth.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 16: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Aberystwyth		10	Llandysul
2	Bow Street		11	Llangorwen
3	Bridgend, Cardigan		12	Llanrhystud
4	Capel Bangor		13	Llanybydder
5	Cardigan		14	Llechryd
6	Cenarth		15	Pencader
7	Cwrtnewydd		16	Penrhyn-Coch
8	Drefach		17	Pontrhydfendigaid
9	Lampeter		18	Tregaron

Figure 21: Key Communities in the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 17: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Aberystwyth	Main River / Sea	Undertake initial assessment and feasibility work for a reducing flood risk	Prevention	1, 2, 3, 8	Medium	Not Started
Aberystwyth	Main River / Sea	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	High	Ongoing
Aberystwyth	Main River / Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Aberystwyth	Main River / Sea	Improve existing flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Bow Street	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	High	Not Started
Bridgend, Cardigan	Main River	Maintain existing defences and inspection regime	Protection	1, 2, 8	High	Ongoing
Capel Bangor	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Ongoing
Capel Bangor	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	Very High	Ongoing
Capel Bangor	Main River	Develop new flood warning service	Preparedness	1, 2, 4	Very High	Ongoing
Cardigan	Main River / Sea	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Cardigan	Main River / Sea	Design and construction of flood risk asset improvements	Protection	1, 2	High	Ongoing
Cardigan	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	High	Ongoing
Cardigan	Main River / Sea	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Cenarth	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Cwrtnewydd	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Low	Not Started
Drefach	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Low	Not Started
Lampeter	Main River	Develop new flood warning service	Preparedness	1, 2, 4	High	Not Started
Lampeter	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Lampeter	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Lampeter	Main River	Derive hydrology	Prevention	1, 2, 3	High	Not Started
Lampeter	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	Medium	Not Started
Llandysul	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Llandysul	Main River	Upgrade hydraulic model	Prevention	1, 2, 3	High	Not Started
Llangorwen	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Llanrhystud	Main River	Investigate feasibility for new flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Llanrhystud	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Llanrhystud	Main River	Maintain existing defences and inspection regime	Protection	1, 2, 8	Very High	Ongoing
Llanybydder	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Prevention	1, 2, 3	Medium	Not Started
Llanybydder	Main River	Derive hydrology	Prevention	1, 2, 3	High	Not Started
Llanybydder	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Llanybydder	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Llechryd	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Llechryd	Main River	Implement alternative risk reduction measures	Protection	1, 2, 8	High	Ongoing
Pencader	Main River	Investigate feasibility for new flood warning service	Preparedness	1, 2, 4	Medium	Not Started
Penrhyn-Coch	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1, 2, 4	Very High	Ongoing
Penrhyn-Coch	Main River	Engage with community to establish community flood plan	Preparedness	1, 4, 5	Very High	Not Started
Penrhyn-Coch	Main River	Develop new flood warning service	Preparedness	1, 2, 4	Very High	Ongoing
Pontrhydfendigaid	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started
Tregaron	Main River	Review / update hydrology	Prevention	1, 2, 3	High	Not Started
Tregaron	Main River	Build hydraulic model	Prevention	1, 2, 3	High	Not Started
Tregaron	Main River	Improve existing flood forecasting model	Preparedness	1, 2, 3, 4	High	Not Started

Catchment 5: Meirionnydd

Figure 22: Location of the Meirionnydd Management Catchment

Catchment description / overview - Meirionnydd

The Meirionnydd catchment covers the south of Snowdonia and the Dyfi Valley, which includes mountainous areas and coastal lowlands of Barmouth, Fairbourne, Tywyn and Borth. Most of the Meirionnydd catchment lies in the Snowdonia National Park with parts of the south of the catchment in an Environmentally Sensitive Area. The main rivers that drain the Meirionnydd catchment are the Afon Mawddach, Wnion, Dyfi, Dysynni, Ysgethin, Artro, Arran, and Leri. The Afon Dyfi is the largest river in the catchment and drains a catchment of 480km^2.

Rainfall across the catchment varies from 1000mm per year on the coast up to 2400mm per year on the higher ground. The impermeable geology and soils, coupled with the steep topography and high rainfall results in rapid responses to rainfall events, and flooding can occur very quickly. There are a few small rivers and streams in this catchment located in the coastal areas which have much flatter topography and therefore much slower responses to rainfall.

This catchment is mostly rural with the main urban areas being Dolgellau, Barmouth, Fairbourne, Abergynolwyn, Tywyn, Machynlleth and Borth. Agriculture and forestry are the predominant land uses in the Meirionnydd catchment, with sheep and beef grazing predominant in the upland areas and dairy farming on the more fertile lowlands. Tourism is of great economic importance to the area. There are also many sites designated for conservation and biodiversity purposes, which are important in attracting tourists to the area.

Historical flooding in the catchment

The historic records for the catchment show that flooding is mainly made up of flash flood events following prolonged periods of rainfall. In general very few properties are affected, but often disruption is caused as roads and railways are affected. Flooding tends to be localised and it is often the case that a heavy rainfall event experienced in one part of the catchment is not experienced elsewhere. An example of this is the July 2001 flash flood event in Ganllwyd, which was not experienced anywhere else in the Meirionnydd catchment.

A summary of significant flood events is provided below:

- In February 1946, many areas in north west Wales were affected by severe and widespread flooding after over 155mm of rain fell in 24 hours (Llyn Llydaw intake, Snowdonia).

- In March 1947, abnormal flooding from large winter snowmelt undermined the approach embankment to Railway Bridge near Machynlleth. In February 1952 the railway bridge submerged during flooding at Machynlleth
- In October and November 2000, widespread flooding affected many areas. October rainfall across most of Wales was double the amount normally expected and in western parts of Wales it was the wettest October for 20 years. Rainfall was exceptional in terms of duration and intensity, and fell on already saturated soils. Many embankments protecting primarily agricultural land across Gwynedd were overtopped but there were no serious breaches other than in the Dysynni valley. In north Wales as a whole, over 300 properties were flooded, and 12 homes in Fairbourne were only protected by sandbagging. The Dysynni Valley, and Harlech and Maentwrog Internal Drainage Districts were overloaded leading to extensive flooding. Transport routes were severely disrupted including the A470 Dolgellau Bypass which was closed. In total approximately 37 homes and 5 businesses were flooded throughout north west Wales.
- In July 2001 the worst flash floods in living memory occurred in the Mawddach valley in Ganllwyd, between Trawsfynydd and Dolgellau, and Cwm Prysor to the east of Trawsfynydd, estimated to be a 300 year event. Very intense rainfall created streams of hillside run-off in the area and many roads were made impassable due to flooding and associated boulder debris being swept across roads and blocking culverts. Several road bridges in the valley were seriously damaged or destroyed.
- In February 2004, several roads and agricultural land flooded in the Wnion, Mawddach and Dyfi catchments. Damage was caused to the A478 across Afon Dyfi in Machynlleth, although no properties were affected.
- In October 2005, heavy rainfall over several days caused large amounts of water to flow down the mountainsides, causing flooding along the major river valleys and parts of the Dyfi and Mawddach/Wnion. Some A-roads were affected.
- In June 2012, an intense rainfall event led to flooding in several communities after rivers overtopped their banks. Villages including Tal y Bont, Dol y Bont, Bryncrug and Pennal were affected with properties and transport routes affected.
- January 2014, the combination of high tides strong winds and large waves caused widespread flooding around the welsh coast. 15 properties were affected in Barmouth and approximately 12 properties were affected in the community of Borth, where a series of recently installed manmade offshore reefs helped to reduce the impact of flooding.

Current flood risk in the catchment

Flood risk varies throughout the Meirionnydd catchment with Borth and coastal lowlands at most risk. In Borth, the potential flood risk to property, infrastructure and the Cors Fochno designated site, from tidally influenced flooding is significant. Raised defences on the Afon Leri are predominantly made of earth, are extensive and if overtopped are likely to breach, which has occurred in the past. Borth has a complex interaction of defences, flood sources and environmental features.

The onset of flooding is rapid in Fairbourne, Llanbedr and Tal-y-Bont with property, infrastructure, caravan parks, and campsites along the coast at risk of flooding. The present flood risk in Dolgellau is assessed as low to medium given regular and sustained levels of channel maintenance, however the protection of the defences is affected by sediment accumulation in the river channel. Property and infrastructure including the A470 road and A49 are at risk from flooding. Flood risk is fairly low in the south of Snowdonia, with run-off from the mountains causing localised surface water and rapid response flooding from rivers and streams. This affects towns and villages in the foothills, such as Machynlleth. Snowmelt in winter can also contribute to flooding.

Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by alteration in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future.

Future risk to coastal communities such as Borth, Fairbourne and Tywyn is expected to increase due to sea level rise, increased storminess and wave action. In Dolgellau extreme flood events could occur at any time, either now or in the future. These have a low likelihood of occurrence but could have serious consequences, and climate change will potentially have a significant impact on flood risk in this area.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Work to reduce flood risk is ongoing within the Meirionnydd catchment. A new tidal river gauge has recently been installed at Ynys Las on the River Leri. This will enable the collection of data which will help with flood risk analysis and flood forecasting in the future.

A new detailed modelling study has recently been completed for Pennal. This study has improved our understanding of flood risk at this location, which was limited to broad scale national modelling beforehand. The outputs from the study are being used to assess how flood risk could be reduced in this community in the future.

A flood alleviation scheme has recently been completed in Fairbourne. The £6.8 million scheme has involved strengthening 1.8 miles of tidal and river defences at Fairbourne, Arthog and Fegla Fawr to protect local people.

Flood forecasting models have recently been updated for Machynlleth and Derwenlas. These will help us to continue providing accurate and timely warning to provide communities with time to prepare for flooding; to protect themselves and their property.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 18: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Aberdyfi		11	Llanbedr
2	Abergynolwyn		12	Llwyngwril
3	Barmouth		13	Machynlleth
4	Bontddu		14	Penegoes
5	Borth		15	Pennal
6	Brithdir		16	Rhyd-yr-Onen
7	Bryncrug		17	Rhydymain
8	Dol-Fâch		18	Tal-y-Bont
9	Dol-y-Bont		19	Tywyn
10	Dolgellau		20	Ynyslas

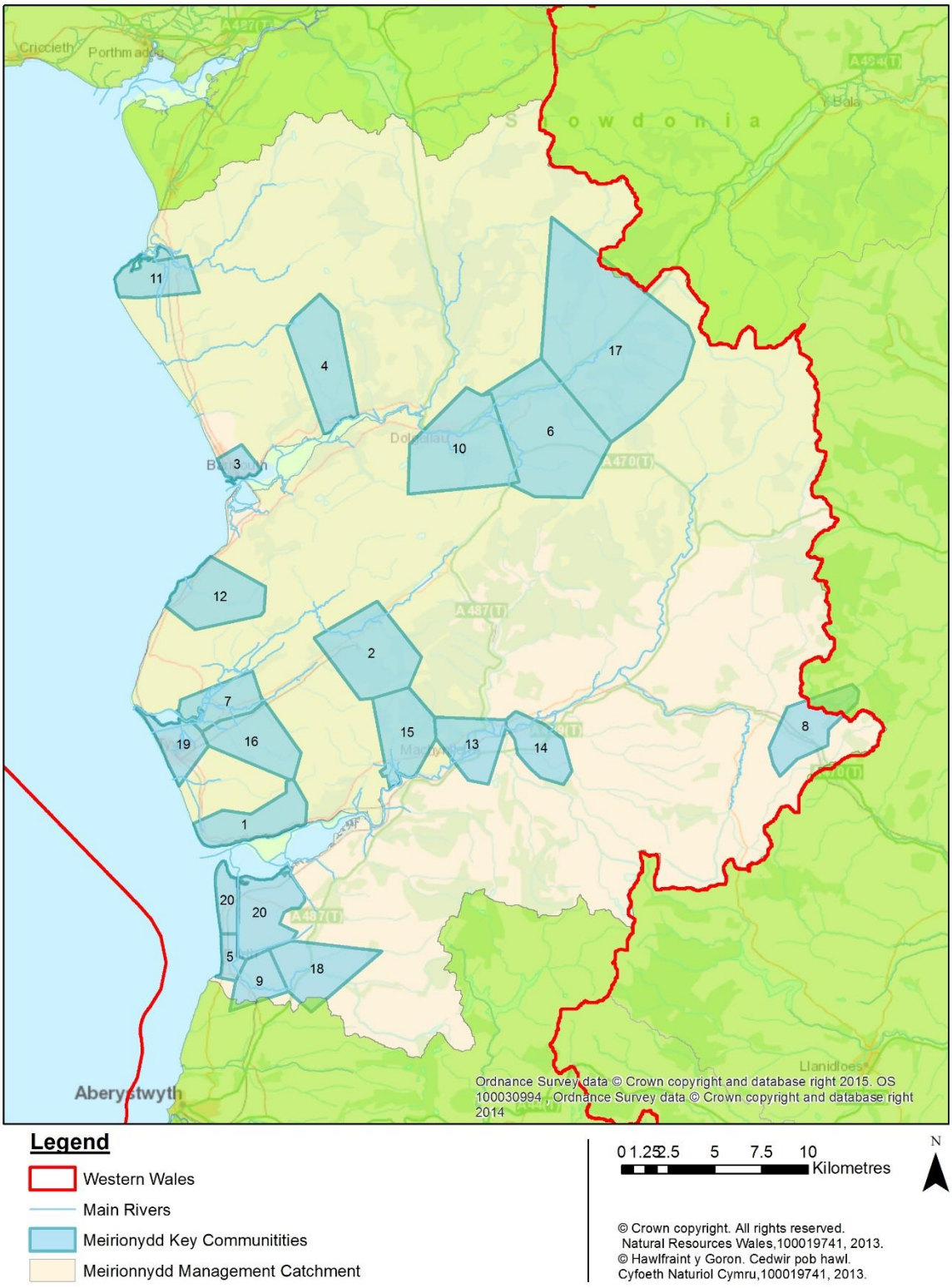


Figure 23: Key Communities with the Management Catchment

Cyfoeth Naturiol Cymru
Natural Resources Wales

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 19: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Aberdyfi	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	Low	Not Started
Abergynolwyn	Main River	Undertake hydrometric surveys	Prevention	1,2,3	High	Not Started
Abergynolwyn	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Abergynolwyn	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	Medium	Not Started
Barmouth	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Barmouth	Sea	Raise flood awareness within the community	Preparedness	1,4,5	Medium	Ongoing
Bontddu	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Borth	Sea	Review / update hydrology	Prevention	1,2,3	Medium	Not Started
Borth	Sea	Review or update hydraulic model	Prevention	1,2,3	Medium	Not Started
Borth	Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	High	Ongoing
Brithdir	Main River	Develop new flood forecasting model	Preparedness	1,2,4	High	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Bryncrug	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	High	Not Started
Bryncrug	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Dol-ffch	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Dolgellau	Main River	Improve existing flood warning service	Preparedness	1,2,4	Very High	Not Started
Dolgellau	Main River	Design and construction of flood alleviation scheme	Protection	1,2,8	Very High	Ongoing
Dolgellau	Main River	Develop new flood forecasting model	Preparedness	1,2,4	High	Ongoing
Dol-y-Bont	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1,2,4	Very High	Ongoing
Dol-y-Bont	Main River	Design and construction of flood alleviation scheme	Protection	1,2,8	Critical	Complete
Dol y Bont	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	Medium	Not Started
Llanbedr	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	High	Not Started
Llanbedr	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Llwyngwril	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Low	Ongoing
Machynlleth	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Penegoes	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Pennal	Main River	Undertake hydrometric surveys	Prevention	1,2,3	Very High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Pennal	Main River	Carry out assessment on existing structures to ensure they are fit for purpose	Protection	1,2,8	High	Not Started
Pennal	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	High	Not Started
Rhydymain	Main River	Develop new flood forecasting model	Preparedness	1,2,4	High	Ongoing
Rhyd-yr-onen	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Tal-y-bont	Main River	Implement alternative risk reduction measures	Protection	1,2,8	Critical	Complete
Tal-y-bont	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1,2,4	Very High	Ongoing
Tywyn	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Tywyn	Main River / Sea	Raise flood awareness within the community	Preparedness	1,4,5	Low	Ongoing
Ynyslas	Sea	Develop scheme appraisal for flood alleviation scheme	Protection	1,2,8	High	Ongoing

Catchment 6: Llyn and Eryri

Figure 24: Location of the Llyn and Eryri Management Catchment

Catchment description / overview - Llyn and Eryri

The Llyn and Eryri catchment covers the Lleyn Peninsula, extending south to the Glaslyn estuary and north eastwards to Dwygyfylchi and Snowdonia. The main rivers draining the area are the Afon Soch, Erch, Rhyd-hir, Dwyfach, Adda, Ogwen, Cegin, Carrog, Heulyn, Cadnant, Seiont, Gwyrfai, Dwyryd, Glaslyn, and Afon Cyt.

Rainfall across the catchment varies from 1000mm per year on the west coast to over 4000mm per year in the mountainous areas of the east. The numerous rivers originate in the Snowdonia Mountains and therefore have very steep channels in their headwaters slackening as the rivers flow towards the coast. Most of the rivers flow through coastal towns, for example Llanfairfechan, Bangor and Porthmadog, before entering the sea. The majority of the rivers in the Lleyn Peninsula have moderately gentle slopes and therefore tend to react relatively slowly to a rainfall event. The high rainfall and steep slopes throughout the catchment mean that this area experiences high run-off rates and water arrives at the rivers very quickly, which can cause flash flooding.

This area is mainly rural with scattered settlements and areas of locally important agricultural land. The eastern half is mountainous upland, dominated by sheep farming. Further west on the low lying land of the Lleyn Peninsula, dairy farming is more common.

Bangor, Caernarfon and Porthmadog are the main urban areas within the catchment, with the remainder of the population mainly scattered in small villages and isolated dwellings.

Historical flooding in the catchment

The historic records for the catchment show that flooding is mainly made up of flash flood events following prolonged periods of rainfall. In general very few properties are affected, but often disruption is caused as roads and railways are affected.

A summary of recent significant flood events is provided below:

- In February 1946, many areas in north west Wales were affected by severe and widespread flooding after over 155mm of rain fell in 24 hours (Llyn Llydaw intake, Snowdonia).
- In October and November 2000, widespread flooding affected many areas. October rainfall across most of Wales was double the amount normally expected and in western parts of Wales it was the wettest October for 20 years. Rainfall was exceptional in terms of duration and intensity, and fell on

already saturated soils. Many embankments protecting primarily agricultural land across Gwynedd were overtopped but there were no serious breaches. In north Wales as a whole, over 300 properties were flooded and five businesses were flooded in Pwllheli due to overloading of the surface water sewerage system. Transport routes were severely disrupted with the A55 at Abergwyngregyn and the A5 between Bethesda and Bangor closed. In total approximately 37 homes and 5 businesses were flooded throughout north west Wales.

- In March 2010 large waves overtopped defences in Llanfairfechan and caused flooding to approximately 20 basement properties

Current flood risk in the catchment

Flood risk is varied throughout the Llyn and Eryri catchment. In the Lleyn Peninsula flood risk is generally low, and the River Soch and Rhyd-Hir are influenced by tidal levels. Flood risk management activity is currently disproportionately high relative to the broad level of risk due to the large geographical area with dispersed properties and communities. In the northern Snowdonia area, run-off from the mountains, causes localised surface water and rapid response flooding from rivers and streams. This affects towns and villages in the foothills, such as Llanberis, Waunfawr and Bethesda. Snowmelt in winter can also contribute to flooding.

The areas that are most at risk of tidal flooding are Pwllheli, Porthmadog and Llanfairfechan. In Pwllheli tidal influence on the outfall of the Afon Rhyd Hir and Afon Penrhos can restrict river outflows and result in overtopping upstream. Significant flood risk management measures are already in place to manage river and tidal flooding in this town. In Porthmadog flooding takes the form of tidally influenced river flooding, tide locking of the Cyt outfall, tidal flooding in coastal areas on the River Glaslyn and surface water and sewer flooding. Properties and infrastructure in Porthmadog are all at risk from flooding and Porthmadog is dependent on defences to prevent regular inundation from the sea. This is a heavily managed area, with a complex interaction of defences, flood sources and environmental features. The risk of flooding in Llanfairfechan is high, and extreme flood events could occur at any time, either now or in the future. These have a low likelihood of occurrence but could have serious consequences.

Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up

an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future.

Climate change could significantly increase flood risk in Pwllheli, Porthmadog and Llanfairfechan, with sea level rise, increased storminess, wave action, and potential additional development would considerably increase the flood risks.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Work to reduce flood risk is ongoing within the Llyn and Eryri catchment. River gauges have recently been updated upstream and downstream of the tidal doors in Porthmadog. A level gauge has also been installed on Y Cyt. These will allow monitoring of levels and improved flood forecasting at these locations.

A detailed modelling study has recently been completed for Porthmadog and Tremadog. This has improved our understanding of flood risk and the complex flooding mechanisms at this location. The outputs from the study are being used to assess how flood risk could be reduced in the future.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 20: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Aberdaron		14	Oakley Square
2	Abererch		15	Penrhyndeudraeth
3	Bangor		16	Plas Brondanw
4	Beddgelert		17	Plas Gwynant
5	Bethania		18	Pontllyfni
6	Borth-y-Gest		19	Porthmadog
7	Caernarfon		20	Portmeirion
8	Chwilog		21	Prenteg
9	Garreg		22	Pwllheli
10	Llanbedrog		23	Rhyd-y-Sarn
11	Llanfairfechan		24	Talsarnau
12	Llanfihangel-y-Traethau		25	Tremadog
13	Minffordd		26	Y Felinheli

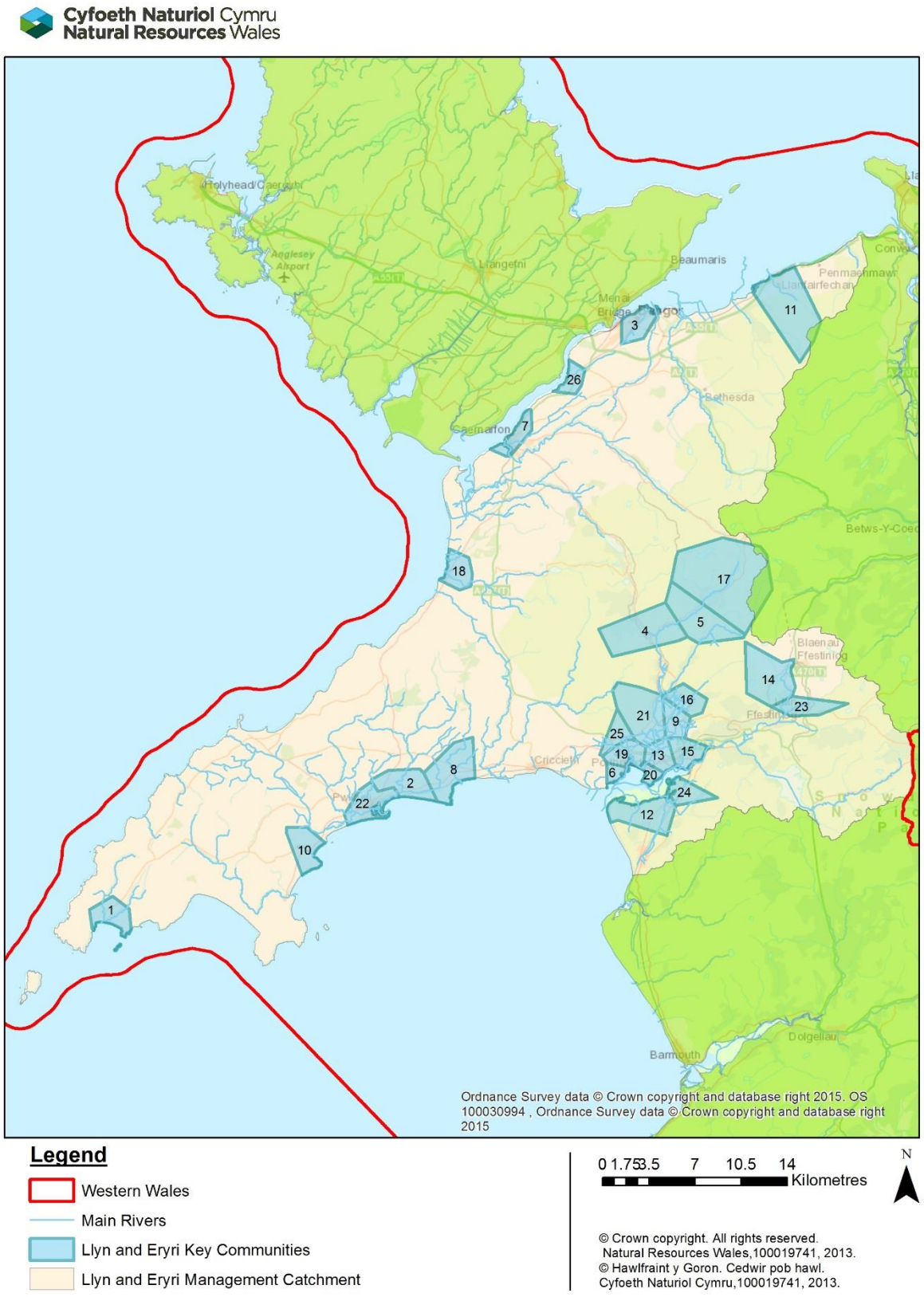


Figure 25: Key Communities in the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 21: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Aberdaron	Main River / Sea	Review / update hydrology	Prevention	1,2,3	High	Ongoing
Aberdaron	Main River / Sea	Review or update hydraulic model	Prevention	1,2,3	High	Ongoing
Aberdaron	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Abererch	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Bangor	Main River / Sea	Improve existing flood warning service	Preparedness	1,2,4	Very High	Not Started
Bangor	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Bangor	Main River / Sea	Work with partners to improve resilience within the community	Preparedness	1,4,5	High	Ongoing
Beddgelert	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,	High	Not Started
Beddgelert	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Bethania	Main River	Develop new flood forecasting model	Preparedness	1,2,4	Very High	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Borth-y-Gest	Main River / Sea	Develop scheme appraisal for flood alleviation scheme	Protection	1,2,8	Very High	Ongoing
Caernarfon	Main River / Sea	Build hydraulic model	Prevention	1,2,3	High	Not Started
Caernarfon	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	Medium	Not Started
Chwilog	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Garreg	Sea	Investigate feasibility for new flood warning service	Preparedness	1,2,8	Medium	Not Started
Llanbedrog	Main River	Derive hydrology	Prevention	1,2,3	Very High	Ongoing
Llanbedrog	Main River	Build hydraulic model	Prevention	1,2,3	Very High	Ongoing
Llanfairfechan	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Llanfairfechan	Main River	Maintain completed community flood plan	Preparedness	1,4,5	Very High	Ongoing
Llanfihangel-y-Traethau	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	High	Not Started
Minffordd	Main River / Sea	Develop new flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Oakley Square	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Penrhyndeudraeth	Main River / Sea	Carry out assessment on existing structures to ensure they are fit for purpose	Protection	1,2,8	High	Not Started
Plas Brondanw	Main River	Develop new flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Plas Gwynant	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Plas Gwynant	Main River	Develop new flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Pontllyfni	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Medium	Ongoing
Porthmadog	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	Very High	Ongoing
Porthmadog	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Porthmadog	Main River / Sea	Develop new flood warning service	Preparedness	1,2,4	High	Not Started
Porthmadog	Main River / Sea	Raise flood awareness within the community	Preparedness	1,4,5	High	Ongoing
Portmeirion	Sea	Develop new flood forecasting model	Preparedness	1,2,4	Low	Ongoing
Prenteg	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Prenteg	Sea	Develop new flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Pwllheli	Main River / Sea	Improve existing flood warning service	Preparedness	1,2,4	Very High	Ongoing
Pwllheli	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	Very High	Ongoing
Pwllheli	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Pwllheli	Main River / Sea	Maintain completed community flood plan	Preparedness	1,2,4	Very High	Ongoing
Rhyd-y-Sarn	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Talsarnau	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Tremadog	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	Very High	Ongoing
Tremadog	Main River / Sea	Develop new flood warning service	Preparedness	1,2,4	High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Tremadog	Main River / Sea	Raise flood awareness within the community	Preparedness	1,4,5	High	Ongoing
Y Felinheli	Main River / Sea	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	Medium	Not Started

Catchment 7: Ynys Mon

Figure 26: Location of the Ynys Môn Management Catchment

Catchment description / overview - Ynys Mon

The Ynys Mon catchment covers the Isle of Anglesey and several rivers drain the island, including the Afon Cefni, Wygyr, Crigyll, Alaw, Goch, Lligwn and Braint. The Afon Cefni is the main river on the island and is used to supply drinking water.

Rainfall on Anglesey varies from approximately 825mm per year in the west to approximately 1100mm per year in the east. In general, the catchments on Anglesey are impermeable and have moderately gentle slopes and broad floodplains, which result in relatively slow responses to rainfall. The eastern peninsula of the island has slightly steeper slopes and response to rainfall events can be quick. This causes localised flooding in places such as Beaumaris and Menai Bridge, where small rivers and streams run through the urban areas into the Menai Straits.

The catchment is predominantly rural apart from the towns of Holyhead, Llangefni and Llanfairpwll. The landscape is dominated by agriculture. Tourism is of great economic importance to the island and maintaining the quality of the general environment, bathing waters and associated water-based recreation is a high priority. The island's entire rural coastline has been designated an Area of Outstanding Natural Beauty and features many sandy beaches, dramatic cliffs and small bays.

Historical flooding in the catchment

The historic records show that flooding is mainly made up of flash flood events following prolonged periods of rainfall. Flooding tends to be localised and it is often the case that a heavy rainfall event experienced in one part of the catchment is not experienced elsewhere.

A summary of recent significant flood events is provided below:

- In February 1946, many areas in north west Wales were affected by severe and widespread flooding after over 155mm of rain fell in 24 hours (Llyn Llydaw intake, Snowdonia).
- In October and November 2000, widespread flooding affected many areas. October rainfall across most of Wales was double the amount normally expected and in western parts of Wales it was the wettest October for 20 years. Rainfall was exceptional in terms of duration and intensity, and fell on already saturated soils. Many embankments protecting primarily agricultural land across Anglesey were overtopped but there were no serious breaches. Saturated ground in the Malltraeth Marsh area led to slumping of the flooding

banks near known areas of quicksand at the railway viaduct. In north Wales as a whole, over 300 properties were flooded. In total approximately 37 homes and 5 businesses were flooded throughout north west Wales.

Current flood risk in the catchment

Flood risk is fairly low for this catchment, however across the island there is localised river flooding and some evidence of surface water flooding. Tidally influenced flooding of Malltraeth Marsh from the Afon Cefni can be extensive. Llangefni is the largest town on the Isle of Anglesey that is affected by flooding from a river, and several smaller villages and settlements on the island are also at risk from river flooding, however the number of people at risk in each location is less than ten. Property and infrastructure are at risk in a number of small towns and villages including Amlwch, Beaumaris and Menai Bridge, and the A5 and A55 Trunk roads are also at flood risk.

Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future.

Climate change is unlikely to have a significant effect on the number of people and properties at risk of flooding in Anglesey. This is likely to be the case across most of the villages and settlements in Anglesey with only small increases in flood risk due to climate change. More people may be affected by increased surface water and sewer flooding. Also wetter winters with more frequent and more severe storm events are expected to increase river flows.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Current flood risk is relatively low in this catchment and as a result, flood risk management activity is also generally low. However, work planned in the catchment

for this Flood Risk Management Plan cycle include; building or updating hydraulic models for 3 locations to improve our understanding of risk and assessing whether there are options to reduce flood risk in these areas. Flood alleviation schemes are also planned for Beaumaris and Malltraeth. We are also continuing our ongoing work in this area including; providing advice on development and flood risk; maintaining existing defences and providing flood warnings.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 22: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Amlwch		4	Holyhead
2	Beaumaris		5	Llangefni
3	Dyffryn		6	Malltraeth

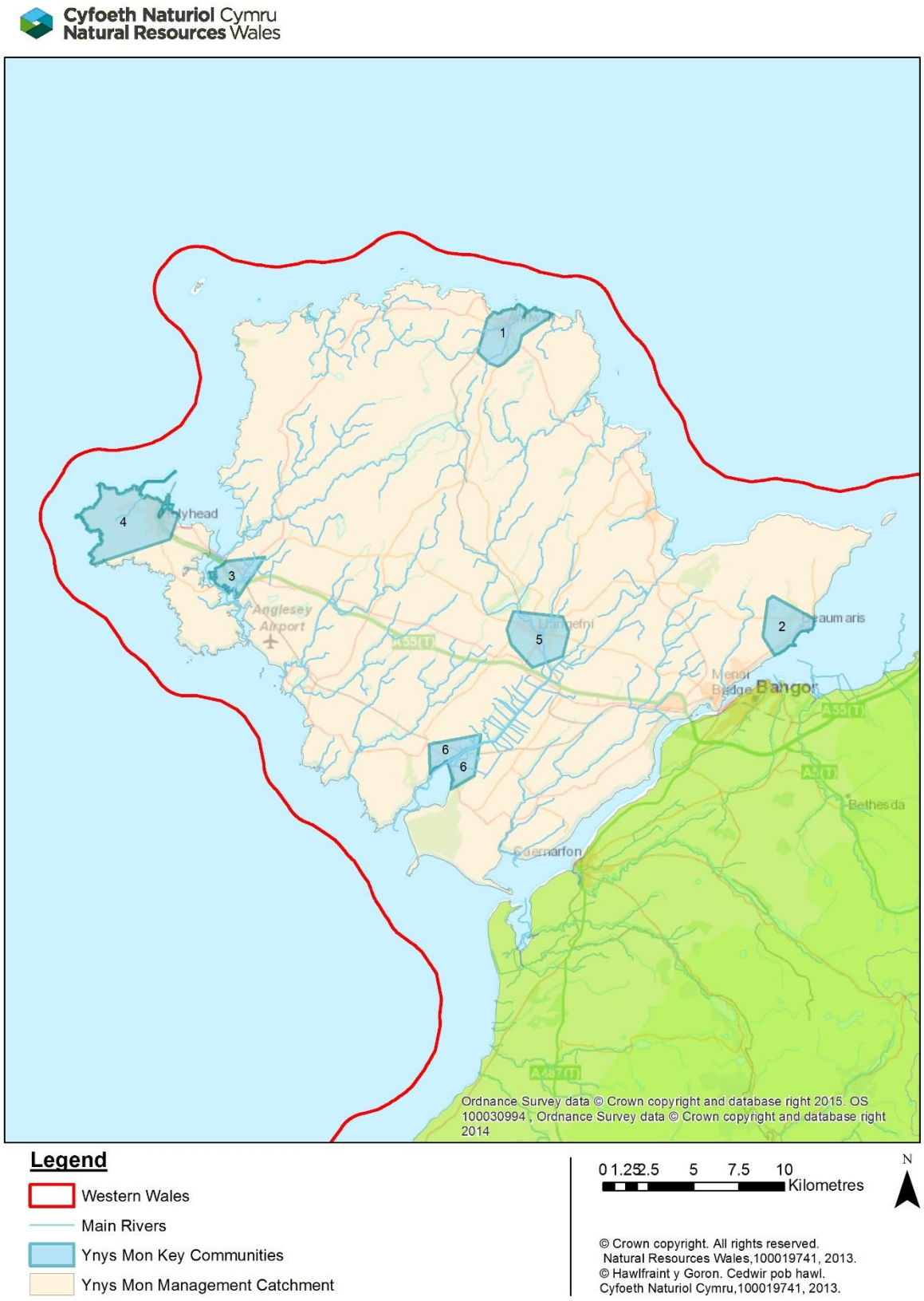


Figure 27: Key Communities in Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 23: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Amlwch	Main River	Review / Update hydrology	Prevention	1,2,3	High	Not Started
Amlwch	Main River	Review or update hydraulic model	Prevention	1,2,3	High	Not Started
Amlwch	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	High	Ongoing
Beaumaris	Main River / Sea	Design and construction of flood alleviation scheme	Protection	1,2,8	Critical	Complete
Beaumaris	Main River	Maintain completed community flood plan	Preparedness	1,2	High	Ongoing
Dyffryn (Valley)	Main River / Sea	Derive hydrology	Prevention	1,2,3	High	Not Started
Dyffryn (Valley)	Main River / Sea	Build hydraulic model	Prevention	1,2,3	High	Not Started
Dyffryn (Valley)	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Holyhead	Main River / Sea	Implement alternative risk reduction measures	Protection	1,2,8	Medium	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Llangefni	Main River	Review / Update hydrology	Prevention	1,2,3	High	Not Started
Llangefni	Main River	Review or update hydraulic model	Prevention	1,2,3	High	Not Started
Llangefni	Main River	Undertake initial assessment and feasibility work for reducing flood risk	Protection	1,2,8	High	Not Started
Malltrateh	Main River/ Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing

Catchment 8: Conwy

Figure 28: Location of the Conwy Management Catchment

Catchment description / overview - Conwy

The River Conwy rises on Migneint Moor, approximately 11km south of Betws-y-Coed and discharges into the Irish Sea at the town of Conwy. Upland parts of the Conwy catchment are steep and mountainous within Snowdonia National Park. Here, high rainfall leads to fast flowing and rapidly responding rivers. The lower reaches are flat and in part are affected by the tide, with high tides extending far up the Conwy Valley to near Trefriw. To the east of the Conwy estuary, the River Ganol and other minor rivers and watercourses flow at shallow gradients. The Conwy catchment drains an area of approximately 590km^2.

The catchment is predominantly rural with improved and acidic grassland comprising almost half of the area. Approximately 17% of the catchment is woodland. These areas occur mainly to the west of Betws-y-Coed and comprise largely of conifer plantations. Rural areas are heavily dependent on agricultural production, with sheep farming being the predominant activity. Recreation and tourism are also important to the local economy. Urban areas account for a small area of the land use and include the more densely populated coastal towns of Colwyn Bay and Llandudno, in addition to smaller towns such as Conwy, Llanwrst and Trefriw.

The natural environment is a key asset with a large part of the catchment situated within the Snowdonia National Park. In addition there are internationally important sites including Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs) and National Nature Reserves (NNRs).

Historical flooding in the catchment

There has been a long history of flooding in the Conwy catchment, with a number of significant events in recent years. Land in the Conwy Valley has been extensively drained for agriculture and defences have been constructed to protect communities from both fluvial and tidally influenced flooding.

A summary of recent significant flood events is provided below:

- In 2004, flooding to property was experienced in Llanwrst after the River Conwy exceeded its capacity. The Afon Llugwy also overtopped its banks at Dolwyddelan causing flooding. Agricultural land and roads were also affected.
- In 2005, 44 properties were affected by flooding in Llanwrst, Trefiw and Betws-y-Coed. Roads were flooded and the Conwy valley railway line was damaged and closed.

- In December 2013, the combination of high tides, strong winds and large waves caused flooding along the Conwy coastline. Communities such as Deganwy and Llanddulas experienced property flooding.

Current flood risk in the catchment

Flooding from the River Conwy presents a risk to the Conwy Valley. Tributaries of the Conwy pose a notable risk to Betws-y-Coed, Llanrwst, Trefriw and Mochdre. Coastal areas including Llandudno Junction and Conwy are at risk from tidally influenced river flooding on the River Conwy.

Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future. There will also be increases in flood risk from rivers in localities such as, Conwy and Llandudno Junction.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Work to reduce flood risk is ongoing within the Conwy catchment. A flood risk study has recently been completed for the River Ganol through Mochdre and Penrhyn Bay. This included hydrological analysis and building a new hydraulic model for the study area. The study has significantly improved our understanding of flood risk in this area and has enabled us to make improvements to the Flood Map.

A piece of work completed in 2013 was a review and update of the River Conwy flood forecasting model. This forecasting model is now live and enables NRW to give improved information and warnings to our partners and the public.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 24: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Conwy		7	Mochdre
2	Llanddulas		8	Penrhyn Bay
3	Llandudno		9	Rhôs-On-Sea
4	Llandudno Junction		10	Rowen
5	Llanrwst		11	Tal-y-Cafn
6	Maenan and Llanddoged		12	Trefriw

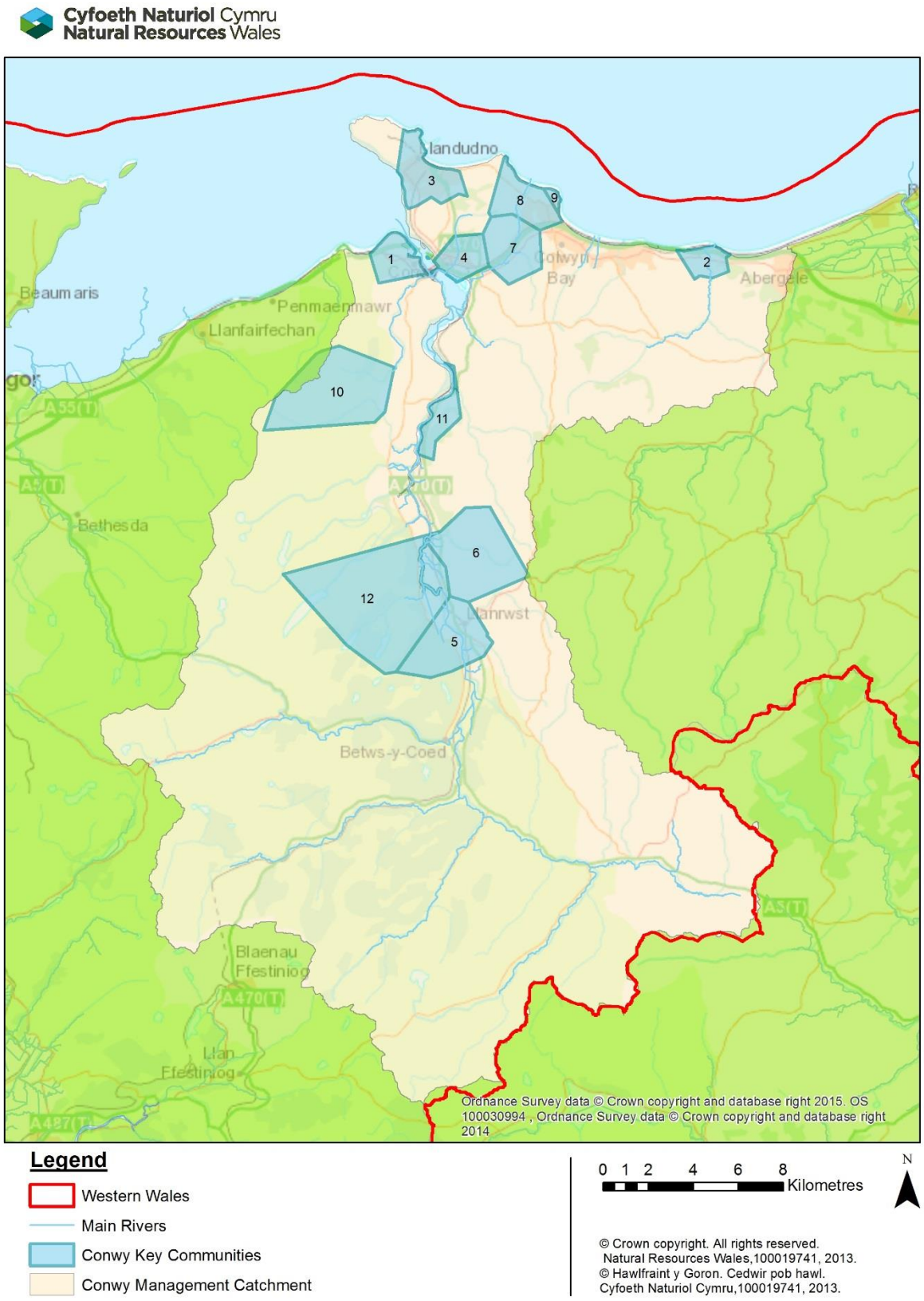


Figure 29: Key Communities in the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 25: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Conwy	Main River / Sea	Improve existing flood warning service	Preparedness	1,2,4	High	Not Started
Conwy	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,,8	Very High	Ongoing
Conwy	Main River / Sea	Review / update hydrology	Prevention	1,2,3	High	Ongoing
Conwy	Main River / Sea	Review or update hydraulic model	Prevention	1,2,3	High	Ongoing
Llanddulas	Sea	Design and construction of flood alleviation scheme	Protection	1,2,8	Critical	Complete
Llanddulas	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Llandudno	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Llandudno	Sea	Work with partners to improve resilience within the community	Preparedness	1,2,4	High	Ongoing
Llandudno Junction	Main River	Derive hydrology	Prevention	1,2,3	High	Not Started
Llandudno Junction	Main River	Build hydraulic model	Prevention	1,2,3	High	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Llandudno Junction	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	Medium	Not Started
Llandudno Junction	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
LLanrwst	Main River	Work with partners to improve resilience within the community	Protection	1,2,8	High	Ongoing
LLanrwst	Main River	Review / update hydrology	Prevention	1,2,3	High	Ongoing
LLanrwst	Main River	Review or update hydraulic model	Prevention	1,2,3	High	Ongoing
Llanrwst	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Maenan and Llanddoged	Main River	Design and construction of flood alleviation scheme	Protection	1,2,8	Critical	Complete
Mochdre	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1,2,4	High	Not Started
Mochdre	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Medium	Not Started
Mochdre	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	High	Not Started
Penrhyn Bay	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Rhos-on-Sea	Main River	Maintain inspection regime	Protection	1,2,8	Very High	Ongoing
Rowen	Main River	Undertake hydrometric surveys	Preparedness	1,2,4	Very High	Not Started
Rowen	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	High	Not Started
Tal-y-cafn	Main River	Undertake hydrometric surveys	Preparedness	1,2,4	High	Not Started
Tal-y-cafn	Main River	Maintain existing flood warning service	Preparedness	1,2,4	Medium	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Trefriw	Main River	Review / update hydrology	Prevention	1,2,3	High	Ongoing
Trefriw	Main River	Review or update hydraulic model	Prevention	1,2,3	High	Ongoing

Catchment 9: Clwyd

Figure 30: Location of the Clwyd Management Catchment

Catchment description / overview - Clwyd

The River Clwyd rises in the Clocaenog Forest approximately 8km north west of Corwen. The River Clwyd catchment, although not as steep as other catchments in the Western Wales River Basin District, responds rapidly to rainfall, flattening out near the coast to form a wide floodplain. The River Elwy is the main tributary of the River Clwyd and is faster responding than the Clwyd itself. There are also a small number of watercourses with varying but shallow gradients which flow across a wide coastal plain; the main watercourse to the east being Prestatyn Gutter and to the west, the River Gele.

The Clwyd catchment is predominantly rural, with improved and acidic grassland comprising over half of the area. Rural areas are heavily dependent on agricultural production, with sheep farming being the predominant activity. Dairying and some arable crops are more common in the lower reaches. Urban areas account for a small area of the catchment, with the population centred in the coastal towns of Abergele, Rhyl and Prestatyn, Denbigh, Ruthin and St Aspah.

The urban coast serves as a centre for economic activity and is dominated by service sector industries. Tourism is important to the local economy, particularly in the coastal plain. The catchment has several important environmental sites including Sites of Special Scientific Interest (SSSIs) and Special Areas of Conservation (SACs).

Historical flooding in the catchment

There has been a long history of flooding in the Clwyd catchment, with a number of significant events in recent years. Land in the Clwyd Valley has historically been extensively drained for agriculture, and defences have been constructed to protect communities from both fluvial and tidally influenced flooding.

A summary of recent significant flood events is provided below:

- In October and November 2000, there was extensive flooding in Ruthin from the River Clwyd. This resulted in major disruption to services and a large number of properties damaged or affected.
- In 2012, several areas in the Clwyd catchment experienced significant flooding following intense rainfall. Large areas of St Aspah were flooded from the River Elwy resulting in significant damage and disruption. Parts of Ruthin were also badly affected after the River Clwyd overtopped its banks. Llanfair Talhaiarn was flooded twice from the Nant Barrog and the community of Brookhouse was affected from the River Ystrad.

- In December 2013, a spring high tide coincided with a large storm surge along the north Wales coast causing flooding to large numbers of properties, the majority in located within Rhyl and Kinmel Bay.

Current flood risk in the catchment

Flooding from large main rivers presents a significant risk to Ruthin, St Asaph and the Clwyd Valley. Tributaries and small watercourses also pose a notable flood risk to Abergele, Llanfair Talhaiarn and Denbigh. Tidally influenced river flooding and coastal flooding poses a risk to coastal areas including the main urban areas of Rhyl, Kinmel Bay and Prestatyn. Defences are present at many of these locations known to be at risk.

Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future. The most significant increases in future risk are likely to occur in Abergele, Prestatyn, Rhyl and Kinmel Bay. This is primarily due to the expected increase in sea level due to climate change. There are also notable increases in flood risk from rivers in localities such as St Asaph.

Recent flood risk management activity in the catchment

Over recent years we have undertaken many measures within this management catchment to manage and where possible, reduce the risk of flooding. This section provides a brief summary of the most recent measures we have taken. For more detailed information on any of the recent measures, or for information on any previous measures within this catchment, please contact us using the contact information at the beginning of this report.

Work to reduce flood risk is ongoing within the Clwyd catchment. A review of the hydrology and hydraulic models for St Asaph and Ruthin was undertaken following significant flood events in these locations in November 2012. The updated models have improved our knowledge of flood risk and have helped to assess a range of options for reducing the flood risk.

The 2012 flood on the River Elwy in St Asaph affected over 400 properties and there was also a fatality. The flood defences of the town have now been reviewed and renovations are underway. In order to build some climate change resilience into engineered works it is now recognised that we must look up stream and find ways to slow the flow of flood waters.

Working in partnership with Cadwyn Clwyd, NRW commissioned a study into the potential of natural flood risk management measures to slow the flow through land management changes in the main Vale of Clwyd. A similar study was then carried out for the Elwy catchment. Both studies identified where changes to land management and the implementation of a range of natural flood risk measures could reduce downstream peak flows at the lower end of the flood range.

In addition to modelling, the potential effectiveness of measures for flood risk management were also appraised for ecosystem benefits such as habitat connectivity, biodiversity and water quality improvement.

The next stage of these projects is to engage local stakeholders, which include the Welsh Government, farmers, local authorities and other conservation organisations to identify funding streams for implementation.

A flood risk study has recently been completed for the Brookhouse community near Denbigh following flooding to properties in 2012. This included building a new hydraulic model to improve our understanding of flood risk at this location. The outputs are helping to investigate the potential options for reducing risk in the future.

Our Assets team continually inspect defences to ensure they are in good condition and maintaining them to the required standard. Low spots on the tidal embankments at Gronant have recently been raised to improve coastal protection along this stretch.

Following the coastal flood event experienced across the north Wales coast in December 2013, flood warning areas have been reviewed and updated for Rhyl, Kinmel Bay and Prestatyn based on evidence from this event. Flood Awareness Wales Officers have also visited these locations to promote community flood plans and help people to prepare for future events.

Key communities within this catchment

There are a number of communities within the catchment where we feel there is still more to be done to manage and reduce the risk of flooding. These communities and associated measures are detailed below. Section 3 of this report sets out how we

prioritise our work on a risk basis so that those communities that are most at risk are addressed first.

Table 26: Key Communities (as labelled on figure below)

Label	Community Name		Label	Community Name
1	Abergele		8	Rhuddlan
2	Denbigh		9	Rhyl
3	Dyserth		10	Ruthin
4	Hafod-y-Green		11	St Asaph
5	Kinmel Bay		12	Towyn
6	Prestatyn		13	Ystrad Communities
7	Rhewl			

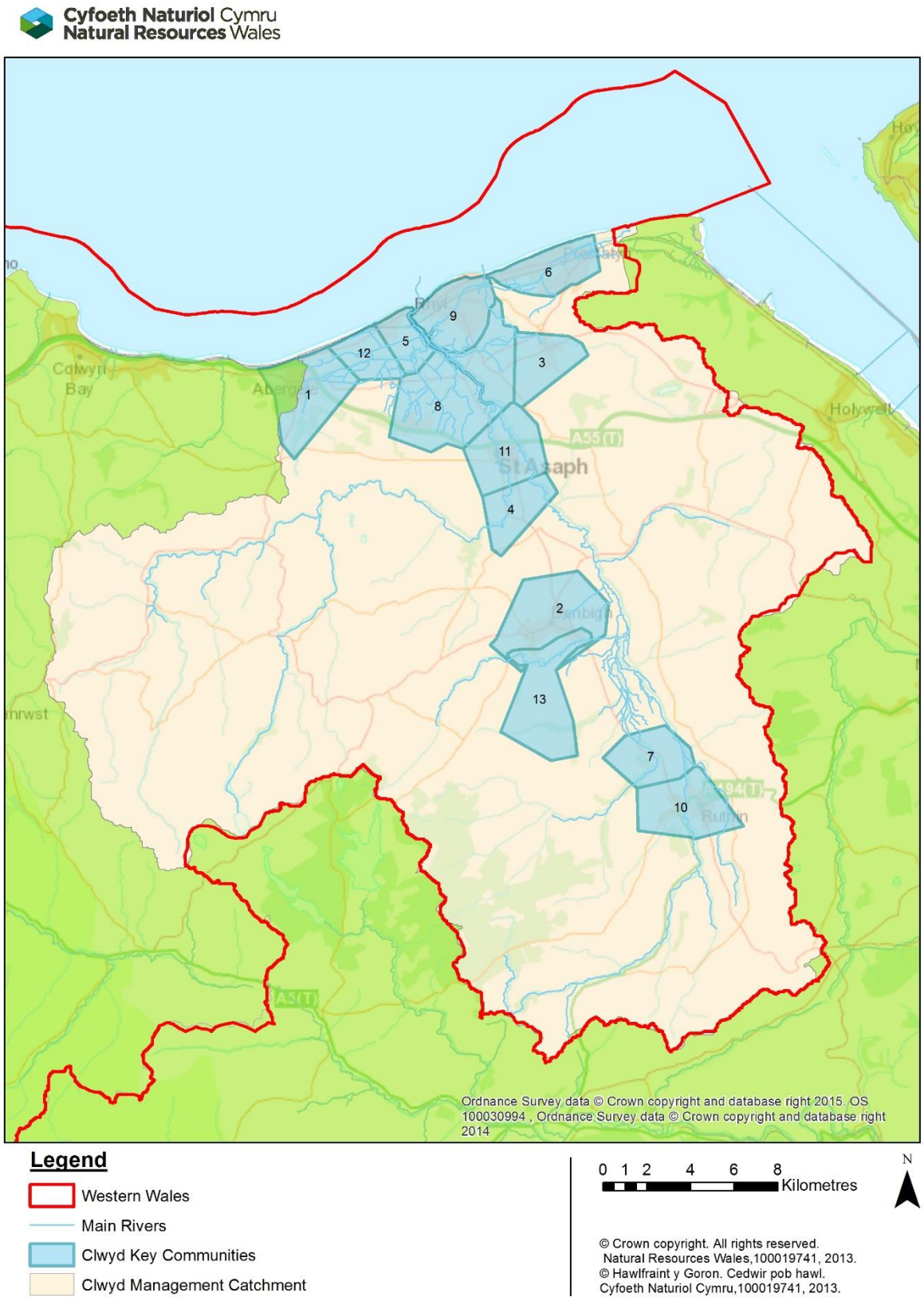


Figure 31: Key Communities in the Management Catchment

Delivery plan

The following catchment delivery plan sets out on a community basis, the measures that we have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures we intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Table 27: Delivery Plan List of Measures in Key Communities

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Abergele	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Abergele	Sea	Build hydraulic model	Prevention	1,2,3	High	Ongoing
Abergele	Sea	Undertake hydrometry and telemetry improvements	Preparedness	1,2,4	Medium	Ongoing
Abergele	Sea	Work with partners to improve resilience within the community	Preparedness	1,2,4	High	Ongoing
Denbigh	Main River	Maintain existing defences and inspection regime	Protection	1,2,8	High	Ongoing
Dyserth	Main River	Build hydraulic model	Prevention	1,2,3	Very High	Complete
Dyserth	Main River	Derive hydrology	Prevention	1,2,3	Very High	Complete
Hafod-y-Green	Main River	Improve existing flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Kinmel Bay	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Kinmel Bay	Sea	Build hydraulic model	Prevention	1,2,3	High	Not Started
Prestatyn	Sea	Build hydraulic model	Prevention	1,2,3	High	Not Started
Rhewl	Main River	Develop new flood forecasting model	Preparedness	1,2,4	Medium	Not Started
Rhuddlan	Main River / Sea	Improve existing flood warning service	Preparedness	1,2,4	Medium	Not Started

Location	Source	Measure Name	Measure Type	Link to FRMP objective	Priority	Status
Rhuddlan	Main River / Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Rhuddlan	Main River / Sea	Improve existing flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Rhyl	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Rhyl	Sea	Build hydraulic model	Prevention	1,2,3	High	Not Started
Ruthin	Main River	Develop new flood forecasting model	Preparedness	1,2,4	Medium	Not Started
St Asaph	Main River	Improve existing flood warning service	Preparedness	1,2,4	Very High	Not Started
St Asaph	Main River	Undertake hydrometry and telemetry improvements	Preparedness	1,2,4	Very High	Ongoing
St Asaph	Main River	Develop scheme appraisal for flood alleviation scheme	Protection	1,2,8	Very High	Complete
St Asaph	Main River	Improve existing flood forecasting model	Preparedness	1,2,4	Very High	Ongoing
Towyn	Sea	Maintain existing defences and inspection regime	Protection	1,2,8	Very High	Ongoing
Towyn	Sea	Build hydraulic model	Prevention	1,2,3	High	Not Started
Towyn	Sea	Maintain completed community flood plan	Preparedness	1,4,5	Very High	Ongoing
Ystrad Communities	Main River	Undertake hydrometric surveys	Preparedness	1,2,4	Very High	Not Started
Ystrad Communities	Main River	Investigate feasibility for new flood warning service	Preparedness	1,2,4	Medium	Not Started

10. Monitoring and review

It is a requirement of the Flood Risk Regulations that this Flood Risk Management Plan must be reviewed, and if necessary updated, before the 22nd December 2021. Natural Resources Wales will undertake and publish the review, and will also prepare an updated Flood Risk Management Plan if required.

In the interim years leading to the formal review, Natural Resources Wales will review the measures within the Flood Risk Management Plan on an annual basis. This is likely to occur during summertime so there is up to date information to inform the allocations process. The progress of delivery of each measure will be assessed and updated at this point.

We may also need to add actions in response to flooding that may be experienced during the six year cycle of this Flood Risk Management Plan. If this is the case, measures will be added and monitored by Natural Resources Wales without an update to this report on an ad-hoc basis.

11. Report on consultation

We consulted on the contents of the draft Western Wales Flood Risk Management Plan from Friday 10th October 2014 until Sunday 31st January 2015. The Draft Flood Risk Management Plan was published on the NRW webpage at the start of the consultation period along with a consultation proforma that respondents were encouraged to complete. The consultation was launched on the same day as the Draft River Basin Management Plan for the Western Wales River Basin District.

We used the following tools to raise awareness of the consultation and encourage response:

- Emails to stakeholders
- Social media
- Articles in newsletters (our own and our partners)
- Verbal updates at meetings
- Awareness raising at drop in events
- Briefing NRW staff to share knowledge when meeting partner and stakeholders

Respondents to the Western Wales Flood Risk Management Plan:

- City and County of Swansea
- Energy UK
- RWE Innogy UK Ltd
- Coed Cymru
- Ceredigion County Council
- Welsh Dee Trust
- Member of public
- Confor
- Vale of Glamorgan
- NFU Cymru
- Natural Resources Wales
- ADA Cymru
- WLGA
- Flood Prevention Society
- Wildlife Trusts Wales
- Keep Wales Tidy
- Dwr Cymru Welsh Water
- Farmers' Union of Wales
- CLA Cymru
- Wales Wild Land Foundation
- Snowdonia National Park Authority
- Conwy County Borough Council

Consultation questions

Consultation Question 1
Do you agree this draft plan sets out the most significant flood risk issues for your area? (yes / no). If not, please explain what you think is missing.

Consultation Question 2
What do you consider to be the highest priorities for managing the risk of flooding in your area?

Consultation Question 3
It is important to have the right objectives for managing the risk of flooding, taking account of the impacts of flooding on people, property and the environment. Do you understand the objectives as described in the draft plan? (yes / no). If not, what would help you understand them better?

Consultation Question 4
Is the balance right between the 'social', 'economic' and 'environmental' objectives, as explained in the draft plan? (yes / no). If not, what would you change and why?

Consultation Question 5
Are there other flood risk management objectives that should be included? (yes / no). If so, please explain what they are and why they should be included?

Consultation Question 6
This draft plan proposes new 'measures' to manage flood risk, alongside measures which are already 'agreed' and 'ongoing'.
Do you understand the difference between ongoing, agreed and proposed measures, as explained in the draft plan? (yes / no). If not, what would help you understand them better?

Consultation Question 7
Across all proposed, agreed and ongoing measures, the plan describes 'prevention', 'preparation', 'protection' and 'recovery and review' approaches. Is the balance right between these different types of approach, as explained in the draft plan? (yes / no)
a. If not, which proposed measures would you change, and why?

Consultation Question 8
Are there other proposed measures that should be included? (yes / no). If yes, please explain what they are and why they should be included.

Consultation Question 9
How can you support the work set out in the draft flood risk management plan to reduce flood risk?

As well as draft flood risk management plans, the Environment Agency and Natural Resources Wales are consulting on draft updates to river basin management plans as part of the Water Framework Directive, which set out measures to improve water in rivers, lakes, estuaries, coasts and in groundwater.

Consultation Question 10
Are there things you think should be done to improve co-ordination of river basin and flood risk management planning?

Strategic Environmental Assessment Consultation Questions

Consultation Question 11
Do you agree with the conclusions of the environmental assessment? (yes / no). If not, please explain why.

Consultation Question 12
Are there any further significant environmental effects of the draft plan which you think should be considered? (yes / no). If yes, please describe what they are. We have described potentially 'negative effects' of the draft plan on the environment which would need mitigation, as well as wider opportunities to achieve 'positive effects'.

Consultation Question 13
Are there further mitigations or opportunities that should be considered for the plan? (yes / no). If yes, please give details.

Western Wales Flood Risk Management Plan – summary of responses

- 53% of respondents agreed that the draft Western Wales Flood Risk Management Plan sets out the most significant flood risk issues.
- 88% of respondents understood the objectives in the draft plan.
- 47% of respondents agreed the balance is right between 'social', 'economic' and 'environmental' objectives. 41% did not agree and 12% did not have a view.
- In response to the question of if there are other flood risk management objectives that should be included, respondents were divided with 47% thinking that others should be included and 47% thinking that others are not needed.
- 81% of respondents understood the difference between on-going, agreed and proposed measures in the draft plan.
- 47% of respondents agreed the balance is right between the types of measures as explained in the plan. 29% did not agree and 24% did not have a view.
- 59% of respondents felt that there were additional measures that should be included in the plan. The additional measures suggested include: closer working with other RMAs; realistic payments for farmers for environmental schemes; Natural Flood Management, investigating options for reservoirs; forestry grants; and certain local community specific measures.

Overview of key issues raised and our response

We have summarised the responses under topic areas and presented the action we have taken in relation to these topic areas.

Theme: Climate change
Consultation comments: Some respondents noted that there is very little reference to climate change and the potential impacts on flood risk, particularly from the risk of sea level rise.
Action for FRMP: Climate change is out of scope in the legislative requirements for this first cycle of the Floods Directive but will be required for the second cycle. The plan has been amended to include a section on climate change and better considering of future flood risk in the objectives and measures.

Theme: Definitions
Consultation comments: Respondents raised that definitions are needed for 'working with natural processes', 'ecosystem approach' and 'resilience'. There also needs to be a clearer description of sources of flood risk, priority timescales and measure parameter 'Progress of Implementation'.
Action for FRMP: Definitions have been improved throughout the plan and in the glossary for the terms highlighted.

Theme: Land management
Consultation comments: Some respondents felt that agriculture and the rural economy should be a priority for local flood risk management and existing schemes, efforts and cross compliance requirements that are already in place for farmers to manage soils should be referred to. Land use change and management should be the priority to help reduce flood risk in areas where these will make a useful contribution but communities must be consulted first
Action for FRMP: We do not propose to make substantial changes to the measures in the Flood Risk Management Plans on this theme because we prioritise our flood risk budget in accordance with the investment policies set out by the Welsh Government in their National Flood and Coastal Erosion Risk Management Strategy and therefore prioritise our resources on where the risk to people and property is highest. We feel the measures set out within the plans reflect this. However the text included within the plan on land management has been improved to reflect emerging policy in Wales from the Environment Bill, particularly that of Natural Resources Management and how this will improve the way we manage flood risk in Wales.

Theme: Link to River Basin Management Plans (RBMPs)
Consultation comments: Many respondents felt that there should be improved linkages between the draft FRMPs and RBMPs. One respondent felt that NRW should aim for one single holistic RBD plan that provides the framework for all relevant plans

(RBMPs, FRMPs, local FRMPs, Shoreline Management Plans, etc) to deliver efficiencies and ensure no contradictory measures. Others also felt that NRW should look to hold regular meetings between all Risk Management Authorities so information can be shared and co-ordinated across functions where possible. There needs to be better cross over between the Floods Directive and Water Framework Directive, particularly where conflict exists.

Action for FRMP: We have demonstrated better integration with the RBMP adding a set of River Basin District measures that are common across both plans to deliver both WFD and flood risk benefits. We have also improved the text within the plans explaining the links between both plans.

Theme: Natural Flood Management

Consultation comments: Many respondents felt that the benefits of natural flood management are included but more 'location specific' measures should be included in the plans. Some respondents felt that options should be taken on a case by case basis with more effort made to engage and communicate with landowners / interested parties on the options and benefits. One respondent suggested that spatial mapping should be performed in Wales to identify opportunities for woodland creation and associated benefits.

Action for FRMP: Opportunities for woodland creation maps have been developed for Wales and will be published shortly. The FRMP has been updated to include reference to these maps. There has also been a new River Basin District measure included on Natural Flood Management and additional location specific measures delivering Natural Flood Management.

Theme: Objectives

Consultation comments:

The following were raised as potential additions to the Flood Risk Management Plan objectives:

- There should be objectives on working with others and / or partners; climate change adaptation; and co-ordinating our work more effectively with others so that there is an integrated approach to overall water management for the benefit of people, the environment and the economy;
- The objectives should take a more environmental focus. There is only one objective focusing on the natural environment and the ecosystem approach needs to be fully embedded and not just a bolt on;
- The objectives should explicitly mention reducing loss of life; and
- There should be a specific objective focused on integrating with the RBMP.

Action for FRMP: The Flood Risk Management Plan objectives have been updated in response to the consultation comments received. A new objective linking to the RBMP has been added.

12. Links to other plans

The Western Wales Flood Risk Management Plan has been written in conjunction with the Western Wales River Basin Management Plan and the local Flood Risk Management Plans within the River Basin District. This plan also builds upon existing plans which can be a useful source of information.

This section provides a brief description of other plans that may be of relevance and who to contact for further information.

Plan or Strategy	Purpose and scope of plan or strategy	Drivers	Lead authority
River Basin Management Plans (RBMPs)	Establish a framework to deliver an integrated approach for the protection and sustainable use of the water environment.	Statutory requirement under the Water Framework Directive.	Natural Resources Wales
Local Flood Risk Management Plans	To manage flooding from surface water.	Statutory requirement under the European Floods Directive; implemented by the Flood Risk Regulations 2009.	City and County of Swansea and Neath Port Talbot County Borough Council.
Catchment Flood Management Plans (CFMPs)	Current and future inland flood risk management across all catchments. These plans set out preferred policies for river flooding in Wales. Note – This plan builds upon and replaces the CFMPs within the Western Wales RBD.	Voluntary plans. Published in 2009-10.	Natural Resources Wales.
Shoreline Management Plans (SMPs)	Current and future coastal flood and coastal erosion risk management. These plans set out preferred policies for the coastline of Wales. Note – SMPs remain current and sit alongside this plan.	Voluntary plans. Second round of SMPs published in 2010-13.	Coastal Groups (comprising LLFAs, NRW, EA and others).

Plan or Strategy	Purpose and scope of plan or strategy	Drivers	Lead authority
Local Flood Risk Management Strategy	Sets out responsibilities for managing flooding in each Lead Local Flood Authority, objectives and measures for the management of local flood risk (i.e. from surface water, groundwater and ordinary watercourses).	Statutory requirement under the Flood and Water Management Act 2010. No statutory deadline for production.	All Lead Local Flood Authorities must prepare a Local Flood Risk Management Strategy.
Water Level Management Plans (WLMPs)	Approach to managing water levels in environmentally sensitive areas. These plans are developed to enable agreement between different users of water.	Voluntary plans.	Natural Resources Wales, Drainage Authorities and land owners
Reservoir Flood plans in Wales	These include on-site and off-site flood plans that set out procedures for the management of flood risk in the event of an emergency. On-site plans deal with the management of the on-site risk and off-site plans deal with the risk in areas adjacent to the reservoir.	Voluntary plans.	On-site Flood Plans are developed by the owners of the reservoir. Off-site Flood Plans are developed by the Local Resilience Forums.
System Asset Management Plans	Plans that set out the maintenance regime for asset systems.	Voluntary plans.	Owners and operators of assets.

Annex 1: CFMP and SMP Policies

Catchment Flood Management Plans

The Catchment Flood Management Plans published by Environment Agency Wales[2] in 2009 cover all of Wales and set out the preferred policy approach to managing flood risk from the main rivers in Wales through broad areas known as policy units. The policy units and associated policies within the Catchment Flood Management Plans were determined by considering the extent, nature and scale of current and future flood risk across the whole catchment in order to show the broad area where the policy decision should be applied.

The six pre-defined policies that were applied across Wales are illustrated in Fig 31 and can be described as:

- **Policy 1** – no active intervention (including flood warning and maintenance). Continue to monitor and advise.
- **Policy 2** - Reduce existing flood risk management actions (accepting that flood risk will increase over time).
- **Policy 3** - Continue with existing or alternative actions to manage flood risk at the current level.
- **Policy 4** - Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change).
- **Policy 5** - Take further action to reduce flood risk.
- **Policy 6** - Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

It is important to note at this point that these are our current strategic policies for undertaking flood risk management work in Wales and will be adopted by this plan. Future review will be included within the overall Regulations cycle of delivery.

[2] From 01 April 2013, Natural Resources Wales took over the functions that were previously carried out by the Countryside Council for Wales, Forestry Commission Wales and the devolved functions of Environment Agency Wales.

The action plans contained in the CFMPs are now largely complete. Where actions are outstanding and yet to be delivered, they have been brought forward into this FRMP. This Plan now contains all the actions applicable to main river flood risk.

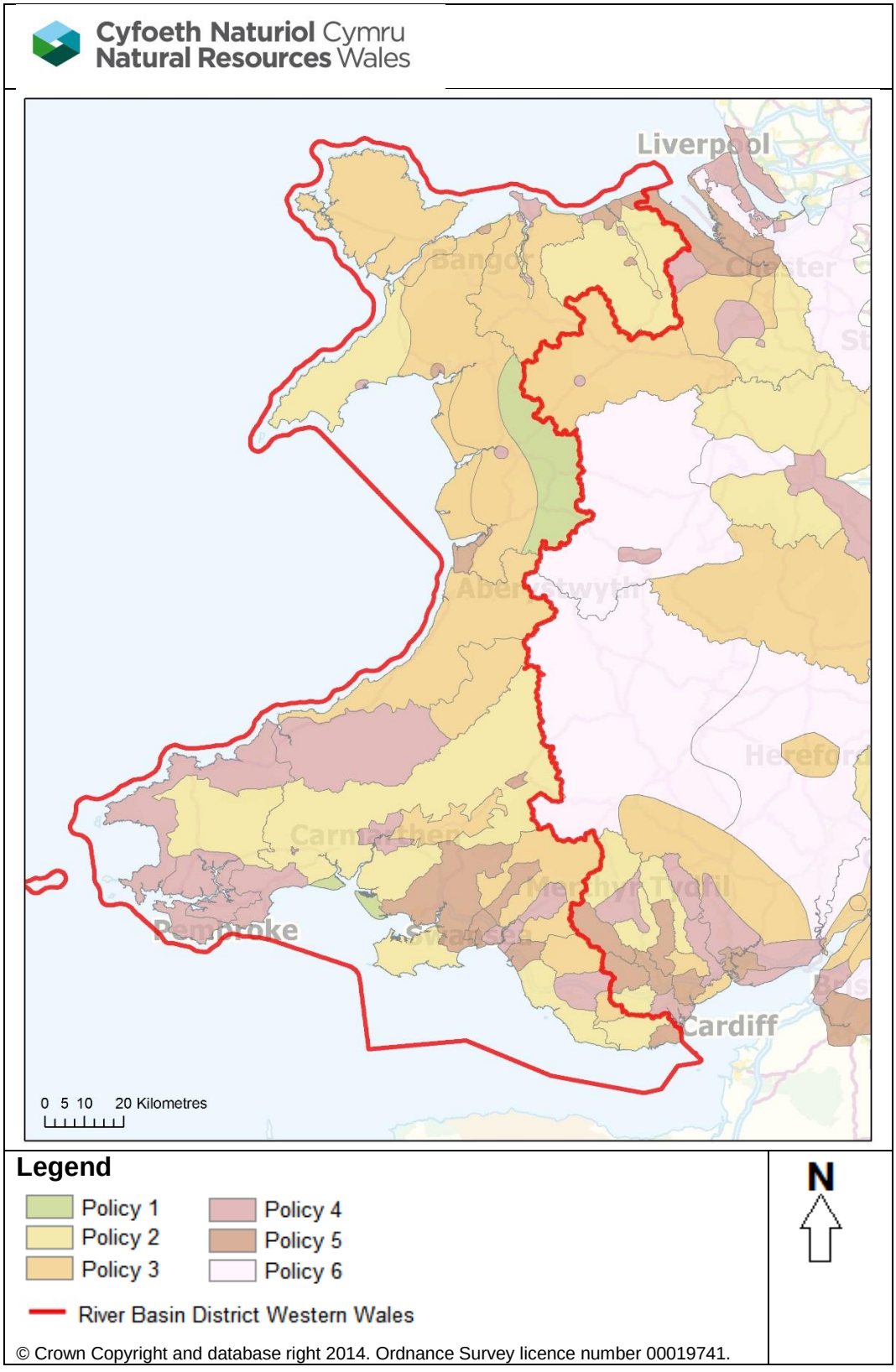


Figure 32: Catchment Flood Management Plan Policies

Shoreline Management Plans

In addition to Catchment Flood Management Plans, Shoreline Management Plans were produced in partnership by the Coastal Groups in Wales to set the strategic direction for the management of the coast for the next 100 years. Shoreline Management Plans (SMPs) are non-statutory policy documents for coastal defence management planning. They provide a large-scale assessment of the risks associated with coastal evolution and present a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner.

The first edition SMPs were created in the late 1990s. The second edition plans (SMP2s) were produced by consultants for Coastal Groups in Wales from typically 2005 onwards and largely funded by Welsh Government. There are five Coastal Groups in Wales, but for the exercise of SMP2 development the Ynys Enlli to Great Orme Coastal Group collaborated with the Cardigan Bay Coastal Group, resulting in four SMP2s for Wales namely:

- **SMP no 19**: Anchor Hard to Lavernock Point, being the 'Severn Estuary' SMP2[7].
- **SMP no 20**: Lavernock Point to St Ann's Head, being the 'South Wales' SMP2[8].
- **SMP no 21**: St Ann's Head to the Great Orme, being the 'West of Wales' SMP2[9].
- **SMP no 22**: The Great Orme to the Scottish Border, being the 'North Wales and North West England' SMP2.

The four SMP2s for Wales have been adopted locally by respective Local Authorities and are awaiting formal sign off from Welsh Government.

SMP2s address a 100 year timeframe across 3 epochs being Epoch 1 (short-term) = years 0 to 20, Epoch 2 (medium term) = years 20 to 50 and Epoch 3 (long term) = 50 to 100 for proposed management of our coastline.

One of four policies can be applied per Epoch to each coastal management unit (i.e. defined length of coastline) and these policies are:

- **No Active Intervention (NAI)**: where there is no planned investment in coastal defences or operations, regardless of whether or not an artificial defence has existed previously.
- **Hold the Line (HTL)**: an aspiration to build or maintain artificial defences so that the current position of the shoreline remains.

- **Managed Realignment (MR)**: by allowing the shoreline to move backwards or forwards naturally, but managing the process to direct it in certain areas.
- **Advance the Line (ATL)**: by building new defences on the seaward side of the original defences.

As the SMP2s were recently completed, they will remain as plans in their own right and where applicable and appropriate, certain sea flooding actions have been brought forward into this Flood Risk Management Plan.

References

1. National Archives – Preliminary flood risk assessment
2. Defra - Selecting and reviewing Flood Risk Areas for local sources of flooding
3. Natural Resources Wales – Flood risk map
4. Natural Resources Wales – Flood risk maps for river basin districts
5. Legislation UK - The Environmental Assessment of Plans and Programmes (Wales) Regulations 2004
6. Natural Resources Wales – Water Framework Directive
7. Severn Estuary Coastal Group – Severn Estuary Shoreline Management Plan Review (SMP2)
8. South Wales SMP – Lavernock Point to St Ann's Head Shoreline Management Plan (SMP2)
9. West of Wales SMP – West of Wales Shoreline Management Plan 2
10. Natural Resources Wales – Wales Coastal Flooding Review Phase 1
11. Natural Resources Wales – Wales Coastal Flooding Review Phase 2
12. Natural Resources Wales – Wales Coastal Flooding Review Delivery Plan Phase 2 Recommendations

Glossary and abbreviations

Catchment	The watershed of a surface water river system
CFMP	Catchment Flood Management Plan
Coastal Groups	Voluntary coastal defence groups made up of maritime district authorities and other bodies with coastal defence responsibilities.
EA	Environment Agency
FCERM	Flood and coastal erosion risk management
Floods Directive	The European Floods Directive (2007/60/EC) on the assessment and management of flood risks.
Flood Risk Area (FRA)	Areas where the risk of flooding from local flood risks is significant as designated under the Flood Risk Regulations.
FRMP	Flood Risk Management Plan – plan produced to deliver the requirements of the Regulations.
Groundwater flooding	Occurs when water levels in the ground rise above the natural surface. Low-lying areas underlain by permeable strata are particularly susceptible.
HRA	Habitats Regulations Assessment: an assessment undertaken in relation to a site designated under the Habitats and Birds Directives
LLFA	Lead local flood authority
Local FRM Strategy	Local flood risk management strategy produced by LLFAs under the Flood and Water Management Act 2010.
Main river	A watercourse shown as such on the main river map, and for which the Environment Agency and Natural Resources Wales has responsibilities and powers
National FCERM Strategy	National flood and coastal erosion risk management strategy: this strategy was prepared under the Flood and Water Management Act 2010, by the Welsh Government for Wales.
Natural Resource Management	The taking care of (or management of) natural resources such as land, water, air, soil, plants and animals with a particular focus on how their management affects the quality of life for both present and future generations.
NRW	Natural Resources Wales. The NRW took over the functions of the Environment Agency in Wales on 1st April 2013.
Ordinary watercourses (OW)	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards.
PFRA	Preliminary Flood Risk Assessment – these were required to be published by December 2011 and were the first stage in delivering the Regulations.
Reservoir	A natural or artificial lake where water is collected and stored until needed. Reservoirs can be used for irrigation, recreation, providing water supply for municipal needs, hydroelectric power or controlling water flow.
Risk management authorities (RMAs)	Organisations that have a key role in flood and coastal erosion risk management as defined by the Act. These are the Environment Agency, Natural Resources Wales, lead local flood authorities, district councils where there is no unitary authority, internal drainage boards, water companies, and highways authorities.

River Basin District (RBD)	These are the reporting units to the European Commission for the Water Framework Directive and the Floods Directive.
RBMP	River Basin Management Plan – plan required by the European Water Framework Directive.
River flooding	Occurs when water levels in a channel overwhelms the capacity of the channel.
SEA	Strategic environmental assessment
SMP	Shoreline Management Plan
Surface water flooding	Flooding from rainwater (including snow and other precipitation) which has not entered a watercourse, drainage system or public sewer.
WFD	Water Framework Directive
Working with natural processes	Means taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating function of catchments, rivers, floodplains and coasts. An example of this is using land to temporarily store flood water away from high risk areas.
WG	Welsh Government

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