Llywodraeth Cymru
Welsh Government

Adapting to Climate Change:

Guidance for Flood and Coastal Erosion Risk Management Authorities in Wales

March 2026

This guidance has been prepared by Natural Resources Wales on behalf of the Welsh Government. Its purpose is to assist Risk Management Authorities in Wales consider the impacts of climate change when planning and developing flood and coastal erosion risk management projects and strategies.

For enquiries, please contact the Flood and Coastal Erosion Risk Management team, within the Welsh Government by emailing: **Floodcoastalrisk@gov.wales**

Mae'r ddogfen yma hefyd ar gael yn Gymraeg.
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1 Introduction

Climate change is expected to increase the intensity of rainfall events which are likely to impact the severity and frequency of river and surface water flooding events. Similarly, it is expected that climate change will result in sea level rise and affect wave heights.

This guidance is aimed at Risk Management Authorities (RMAs) in Wales and provides supplementary information to the Welsh Government's Flood and Coastal Erosion Risk Management (FCERM) Business Case Guidance, published June 2019. It should be used to consider the impact of climate change when developing any flood and coastal erosion risk management (FCERM) project and/or strategies.

It replaces the 2022 version of 'Adapting to Climate Change: Guidance for Flood & Coastal Erosion Risk Management Authorities in Wales'.

It provides climate change allowances for peak river flows and rainfall uplifts across Wales, as well as projections for sea level rise and wave action. The allowances use the Met Office UK Climate Change Projections data, published in 2018 (UKCP18). UKCP18 considers different climate scenarios over different epochs, or periods of time over the coming century. It also considers extreme climate change scenarios.

The allowances in this guidance are based on Representative Concentration Pathway (RCP) 8.5, which reflects an increase in global mean surface temperature of around 4.3^{0}C by 2100. While this may be considered precautionary, it takes into account uncertainty in climate change modelling and aligns with the approach adopted by other UK nations.

The allowances for peak river flow and extreme rainfall have been updated to reflect the most recent projections from UKCP18.

The allowances for sea level rise projections have also been updated from previous estimates (published in 2022). The projections have also been extended out to 2130.

There has been **no change** to wave climate projections or storm surge.

Please note: These allowances align with those provided in Climate change allowances and flood consequence assessments, which should be used for Flood Consequence Assessments and to inform development plan allocations.

Given the long lifetime, high costs of the built environment and various FCERM measures, it is important to consider how plans and investment projects can adapt to changing risks over the coming century.

Welsh Government's FCERM Business Case Guidance indicates two main approaches to managing the impacts of climate change.

- Managed Adaptive
- Precautionary Approach

1.1 Schemes seeking Flood and Coastal Erosion Risk Management Grant Funding

This guidance will help RMAs understand how flood or coastal erosion risk could change over time. The allowances should be used when developing projects, schemes and/or strategies that are seeking FCERM Grant in Aid (GiA) funding to show how they can adapt to future climate scenarios. This will help to support Welsh Government funding decisions and ensure investment is directed to where it provides the biggest benefit.

Although this advice is intended for projects or strategies seeking Welsh Government FCERM GiA, it is recommended you use this guidance when developing plans and making FCERM investment decisions, even if you are not applying for central government funding.

You may decide to propose an investment decision that is not based on the allowances presented in this guidance. However, where FCERM GiA is being sought, the supporting business case must include at least one option based on the recommended climate change allowances. This is needed to show how alternative climate change allowances may influence the outcome of the application. This approach ensures that the implications of alternative approaches to risk assessment and management can be more consistently compared and communicated.

Recommended climate change allowances for river flows, extreme rainfall, sea level rise and wave climate are provided in Annex 1. Worked examples are provided in Annex 2 to help you when applying allowances to your schemes/projects.

2 Transitional arrangements

This advice should be applied to all new business cases from 01 April 2026.

For business cases, which are already in development **Table 1** below explains how and when to apply the revised allowances provided in this guidance. This is required to ensure the revised figures would not lead to different decisions.

Any queries regarding the application of this guidance during the transitional period should be directed to Welsh Government Flood and Coastal Risk Branch - FloodCoastalRisk@gov.wales.

Scheme Development Stage	Assumption	Action
• New Business • Case • SOC/OBC/BJC in development	Hydraulic Modelling/Economic Appraisal work not yet commenced.	Appraise scheme using the revised allowances within this guidance document.
• OBC/BJC Completed • Detailed Design/FBC in Development	Economic Appraisal completed in OBC/BJC using climate change allowances from 2022 guidance.	Assess preferred option against revised allowances within this guidance to ensure that results would not lead to significantly different decisions at Detailed Design stage. Undertake Detailed Design using revised allowances if work not too far progressed to allow this.
• Detailed Design/FBC • Complete • Scheme • Construction • Ready	Detailed Design completed using allowances from 2022 guidance.	Consider the implications of using the revised allowances within this guidance and report any significant findings to the relevant funding authority.
• Existing approved plans and strategies	Plans or Strategies are subject to ongoing review process.	At next review, appraise plan or strategy using the revised allowances within this guidance document.

Table 1 - Use of revised climate change allowances at each stage of the 5BCM

SOC – Strategic Outline Case
OBC – Outline Business Case
FBC – Full Business Case
BJC – Business Justification Case

3 Provision of climate change allowances

To ensure flood risk management options can remain resilient and effective in a changing climate, you should assess your project/plan against the relevant allowances provided in this guidance for the whole of the decision lifetime.

The central and upper end estimates of climate change allowances are provided in Annex 1 of this guidance. For sea level rise, the 'upper' central allowance is provided. This section sets out how the central and upper allowances should be applied.

3.1 Scheme Design

3.1.1. Design event

In Wales, FCERM schemes should be designed in line with Welsh Government's FCERM Business Case guidance. This notes that the impacts of climate change need to be considered as part of the supporting economic assessment.

The central estimate or the 'design' climate change allowances should be applied to each appraisal option. This will help you understand the effect on each design option over time.

If you want to achieve a particular standard of protection, you'll need to allow for suitable mitigation in your design. This helps you to:

- compare different options based on potential performance over time.
- identify options to best meet your project objectives.
- identify design options for further testing.

3.1.2 Sensitivity Testing

Appropriate sensitivity testing against potential future climate change impacts will help you determine and plan for appropriate mitigation measures within your scheme design and support a 'managed adaptive' approach, e.g. through a strategy for managed adaptation. Taking an adaptive approach allows planned actions to be implemented when particular thresholds are triggered. This helps to avoid over-engineering assets and provides flexibility to manage future climate change uncertainties.

3.1.3 Peak River Flows

Peak river flow allowances are provided for each of the three River Basin Districts in Wales. These allowances should be used for fluvial modelling studies where design flow hydrographs are applied to the model. The central allowance should be used as your 'design' allowance. The upper allowance is provided for 'sensitivity testing' to help understand how higher scenarios of climate change may impact your scheme/plan.

3.1.4 Rainfall Uplifts

Rainfall uplift allowances for the whole of Wales is provided for studies where rainfall is applied directly to the model. This could include surface water studies, small or urbanised catchments where there are considerable impermeable surfaces or for urban drainage systems. The central allowance should be used as your design allowance and the upper allowance used for sensitivity testing.

3.1.5 Sea Level Rise

Sea level rise allowances are provided for projected sea level rise around the coast of Wales. These are presented as regionalised data, with the impact of climate change dependent on location. Allowances are provided for each coastal local authority administrative area[1] You should refer to the appropriate regional allowance in to assess the impact on your scheme/plan design. The upper central allowance should be used as your design allowance and the upper allowance used for sensitivity testing.

3.1.6 Wave climate

Wave heights may change due to increased water depths and changes to the frequency, intensity and duration of storm events. Sensitivity ranges for offshore wind speed and wave height up to 2125 are provided. These allowances provide the current national representation of how climate change is likely to influence flood risk from this source.

3.2 H++ Scenario

Currently, there is no requirement to undertake sensitivity testing against the High ++ (H++) scenario for fluvial risk management schemes in Wales.

Additional sensitivity testing is not normally required for sea level rise; however, you may want to assess your scheme/plans against the H++ scenario where the consequences of flooding or erosion could be extreme. Further information on H++ can be obtained from the Met Office.

4 Limitations and Managing Exceptions

The allowances provided in this guidance have been derived from national scale research. There may be cases where local evidence might support using other data to reflect local change factors. For example, the impact of climate change on peak river flow may vary within a river basin district. In such cases, it will be up to you to justify exceptions on a case-by-case basis. The reason for using other data and the implications will need to be transparent and recorded within any investment decision documentation. Where GiA is being sought, the Welsh Government will need to be satisfied that the evidence is robust to support such an exception.

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[1] Based on UK Met Office dataset: Assessment of climate change up to 2100

Annex 1

Climate Change Allowances

1. Changes to river flood flows by river basin district

Peak river flow allowances across each epoch, for each river basin district in Wales are provided in **Table 2**. These allowances should be used for fluvial modelling studies where design flow hydrographs are applied to the model. The whole design event flood hydrograph should be scaled up by the relevant percentage allowance. Further guidance is set out in Annex 2.

The allowances are based on analysis of new climate change information and its impacts on fluvial flood peaks, using data from UKCP18. Fluvial uplifts across Wales were analysed and averaged out to provide river basin district averages.

The central allowance should be used as your design allowance. The upper allowance is provided for sensitivity testing against higher scenarios of climate change.

The 2080s epoch allowances should be used for changes beyond the 2080s (i.e. 2125 onwards).

River Basin District	Percentile	2020s (present day to 2039)	2050s (2040 to 2069)	2080s (2070-2125)
Dee	Central	10%	15%	25%
	Upper	15%	30%	50%
West Wales	Central	10%	20%	35%
	Upper	20%	40%	70%
Severn	Central	10%	20%	35%
	Upper	20%	40%	70%

Table 2: peak river flow allowances for each River Basin District.

Figure 1 (Annex 2) shows how the climate change allowances for peak river flows should be applied.

2. Change to extreme rainfall

Increases in rainfall intensity due to climate change is likely to affect river levels, particularly within smaller catchments and on urban drainage systems.

Rainfall allowances across each epoch are provided in **Table 3**. The allowances are applicable for the whole of Wales and should be applied in studies where rainfall is applied directly to the model. This could include surface water studies, small or urbanised catchments where there are considerable impermeable surfaces and for urban drainage systems.

The allowances are based on analysis of new climate change information and its impacts on rainfall intensity, using data from UKCP18. Fluvial uplifts across Wales were analysed and averaged out to provide Wales wide figures.

Location	Percentile	2050s (present day -2060)	2070s (2061-2125)
Wales	Central	20%	30%
	Upper	35%	40%

Table 3: rainfall uplifts for Wales

The central allowance should be used as your design allowance. The upper allowance is provided for sensitivity testing against higher scenarios of climate change.

The 2070s allowances should be used when considering any time beyond 2061.

The use of peak rainfall allowances is less appropriate for modelling larger areas where conventional fluvial modelling approach using design flow hydrographs is likely to be more suitable. In such instances, the peak river allowances from Table 2 should be applied.

There may be examples where different modelling approaches are applied across distinct parts of a catchment e.g. fluvial inflow design hydrographs applied to the larger, more rural areas and a direct rainfall modelling component for a small/urban part of the catchment. In such instances the relevant allowances from Table 2 and 3 should be applied based on the specific modelling approach.

3. Change to relative mean sea levels

Sea level rise allowances based on UKCP18 data are provided for each coastal local authority area up to 2100 and 2130. Location specific allowances, projections for different epochs and projections beyond 2100 can be obtained from the UK Climate Projections (Met Office) user interface.

The UKCP18 dataset projects from 2007 to 2100. To calculate epochs beyond 2100 and up to 2130, the average incremental increase from the last 5 years of

the dataset for the site location should be used (2094 to 2099) from RCP8.5, multiplied by 30.

To perform an extra assessment for the lifetime of the scheme after 2130, you should use the UKCP18 data set 'Sea level anomalies for marine projections around UK coastline using exploratory method, 2007-2300' (RCP8.5 scenario). This can be can be obtained from the UK Climate Projections (Met Office) user interface.

Table 4 presents uplift figures for each coastal local authority administrative area from 2007 to 2100 and from 2007 to 2130. The 2130 allowance has been calculated using the average incremental increase method for each local authority administrative area.

You should use the upper central allowance (70th percentile) as your scheme design. The upper allowance (95th percentile) is provided for sensitivity testing against higher scenarios of climate change.

Local Authority Area	Allowance (percentile)	Mean sea level rise (metres) by 2007-2100 *(UKCP18 baseline 1981-2000)	Mean sea level rise (metres) by 2007-2130 *(UKCP18 baseline 1981-2000)
Flintshire	70th	**0.78**	**1.13**
	95th	**1.05**	**1.56**
Denbighshire	70th	**0.78**	**1.13**
	95th	**1.05**	**1.55**
Conwy	70th	**0.77**	**1.12**
	95th	**1.05**	**1.55**
Anglesey	70th	**0.77**	**1.12**
	95th	**1.05**	**1.55**
Gwynedd	70th	**0.82**	**1.18**
	95th	**1.09**	**1.61**
Powys	70th	**0.82**	**1.18**
	95th	**1.09**	**1.61**
Ceredigion	70th	**0.83**	**1.20**
	95th	**1.10**	**1.63**
Pembrokeshire	70th	**0.86**	**1.24**
	95th	**1.13**	**1.67**
Carmarthenshire	70th	**0.86**	**1.24**
	95th	**1.13**	**1.67**
Swansea	70th	**0.86**	**1.24**
	95th	**1.14**	**1.67**
Neath Port Talbot	70th	**0.86**	**1.24**
	95th	**1.14**	**1.67**
Bridgend	70th	**0.87**	**1.25**
	95th	**1.14**	**1.68**
Vale of Glamorgan	70th	**0.87**	**1.26**

	95th	**1.15**	**1.68**
Cardiff	70th	**0.87**	**1.25**
	95th	**1.14**	**1.68**
Newport	70th	**0.87**	**1.25**
	95th	**1.14**	**1.68**
Monmouthshire	70th	**0.87**	**1.25**
	95th	**1.14**	**1.68**

Table 4: Estimated sea level rise (in metres) for local authority areas by 2100 and 2130 (as of July 2025).

4. Storm surge

It is not known whether storm surges will become more severe, less severe or remain the same with climate change. UKCP18 modelling suggests a relatively small change to future storm surge and this is expected to have a smaller impact on coastal flooding than sea level rise.

Present day levels in the Coastal design sea levels - coastal flood boundary extreme sea levels (2018), normally used within flood consequence assessments, already accounts for storm surge.

There is no requirement currently to incorporate an allowance for increased storm surge when estimating design flood levels for future scenarios.

5. Wave action

Wave action can have an impact at coastal locations, including overtopping of sea defences. It may also contribute to coastal erosion. Wave heights may change due to increased water depths and from changes to the frequency, duration and severity of storm events. However, there remains significant uncertainty in how climate change will impact offshore wave climate.

As such, no changes have been made to the offshore wind speed and extreme wave height projections provided in this guidance.

Recommended allowances to assess sensitivity against offshore wind speed and wave height are provided in **Table 5.**

The allowances should be applied to any coastal hydraulic modelling of climate change impacts.

A sensitivity analysis should be undertaken where the flooding impacts could be extreme to understand the potential impacts.

The allowances for 2056-2125 should be used for schemes/plans beyond 2125.

Parameter	**2000 - 2055**	**2056- 2125**
Offshore wind speed allowance	+5%	+10%

Extreme wave height allowance	+5%	+10%

Table 5 - Recommended sensitivity ranges for offshore wind speed and wave height.

Annex 2

How to apply the allowances

This annex provides worked examples for applying climate change allowances to your schemes/plans. They are provided to support Annex 1 and the wider principles set out within the guidance.

1. River example

Using the allowances in Table 2, you should apply the:

- central climate change allowance as the design allowance to each appraisal option
- upper climate change allowance to assess the impacts of higher scenarios of climate change
- 2080s epoch allowance for a 100-year lifetime of development (or beyond)
- allowance to the whole design event flood hydrograph.

1.1 Applying the allowances

To apply the allowance for your scheme/plan you should:

- determine which river basin district is applicable to your assessment
- apply the relevant peak river flow allowance to your hydrological estimate for the 2050s and 2080s.

In practice this means multiplying all points on the inflow hydrograph(s) by the relevant percentage allowance.

- assess your scheme design against the upper bound increases to understand potential future impacts and scheme sensitivity against severe climate impacts and identify any extra mitigation requirements.
- if an assessment is required between present day and the 2050s epoch (i.e. up to 2039), you should interpolate (adjust) the peak river flow allowance between the current year and 2039.

Figure 1 shows how the central allowances should be applied using the Severn RBD Area as an example.

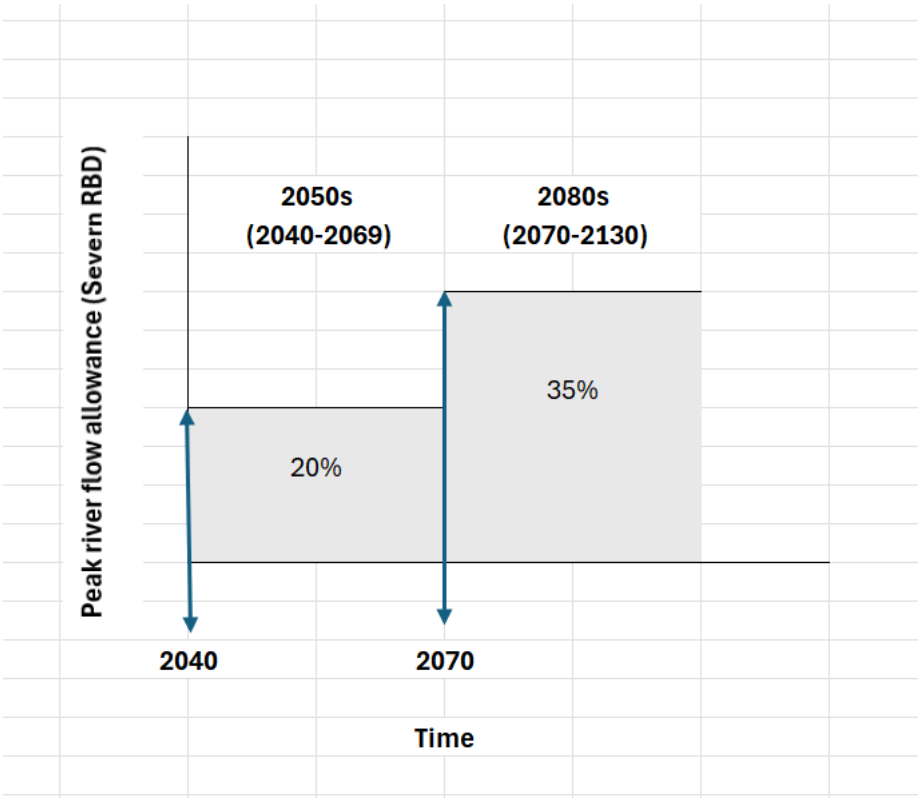

Figure 1: application of peak river flows (central allowance) (Severn RBD)

2. Small catchment/surface water example

Using the allowances in Table 3, you should apply the:

- central climate change allowance as your design allowance to each appraisal option
- upper climate change allowance to assess the impacts of higher scenarios of climate change
- 2070s epoch allowance for a 100-year lifetime of development (or beyond)
- rainfall allowance to the hyetograph.

2.1 Applying the allowances

You should:

- apply the central rainfall allowance to the total rainfall depth for the event for the 2050s and 2070s

In practice this means multiplying all points on the hyetograph by the percentage allowance so that the total event rainfall increases by that amount.

- assess your scheme design against the upper bound increases to understand scheme sensitivity against severe climate impacts and identify any extra mitigation requirements.

3. Coastal example

Using the allowances in Table 4, you should use the:

- upper central allowance (70th Percentile) as the design allowance
- upper allowance (90th Percentile) to assess against more severe climate impacts.

3.1. Applying the allowances

To apply the allowance for your scheme/plan you should add together the:

- appropriate present day extreme sea level estimate for location being assessed from coastal flood boundaries dataset (CFBD)
- relevant climate change allowance for the scheme location provided in Table 4 (Annex 1).

3.2. Worked example: Coastal scheme at Mumbles, Swansea

Location Mumbles, Swansea (chainage 492)	**Extreme Sea Level T200 with baseline 2017 from CFBD**	**CC allowance using data from Table 4 (2007 –2100)**	**Total Water Level**
CC allowance 70th Percentile (2007 –2100[1])	6.34m	0.86m	7.20m
CC allowance 95th Percentile (2007 –2100[1])	6.34m	1.14m	7.48m

Table 6: calculated sea level rise for Mumbles, Swansea[2]

Please note:

- this does not take into account any wind, wave or other local affects that may need to be considered
- further detailed methods can be applied that adjust for differing baselines. These methods will require more detailed calculations, records and justification. Where possible these should be checked against Future extreme sea levels around the UK coastline found on the UK Climate Projections User Interface

[1] Relative rise from 2007-2100 when compared against UKCP18 baseline of 1981-2000.
[2] Figures are correct at time of publication but may be subject to change.

3.3. 2100 and beyond

The UKCP18 dataset projects to 2100. To calculate epochs from 2100 up to 2130, use the average incremental increase from the last 5 years of the dataset (years 2094 to 2099 from RCP8.5). Table 4 provides regional calculations up to 2130.

To perform an extra assessment for the lifetime of the scheme after 2130, use the sea level rise projections to 2300 for RCP 8.5. You can get sea level rise projections for the appropriate location and year from the UKCP18 user interface.

3.4. Coastal erosion

Sea level rise is likely to increase the rate of coastal erosion. You should use the coastal erosion risk maps to plan for any changes in the position of the coastline. They show:

- erosion predictions for the short, medium and long term where there is 'no active intervention' policy to maintain defences

- the shoreline management plan policy for each stretch of coast.

The allowances for sea level rise may help inform your coastal erosion scenarios.

Please note: The estimates provided from the CFB dataset are known as "still water levels". The impact of any localised wave action at the site being assessed will also need to be considered as part of the coastal engineering design. *(N.B. With an increase in sea level due to climate change, water depths at the toe of a Sea Defence will increase. In some cases, the effect of "depth-limitation" on wave heights could be reduced, allowing larger waves to impact on the defence.*