Frequently Asked Questions

Update to the Climate Change Considerations chapter in Australian Rainfall and Runoff: A guide to Flood Estimation

This document supports practitioners and decision makers to apply the updated Climate Change Considerations chapter, which replaces the 2019 edition in Book 1, Chapter 6 of *Australian Rainfall and Runoff: A guide to Flood Estimation* (Ball et al. 2019).

The update was published in August 2024. The guidance, and these FAQ, may be updated in 2025 following user feedback on the draft version.

About the guidance and the update

What is the guidance and why was it updated?

Australian Rainfall and Runoff: A Guide to Flood Estimation, published by Engineers Australia, is one of the most widely used references to help practitioners, designers, and decision makers assess flood risk for the built environment.

Australia's climate is changing and the Climate Change Considerations chapter update incorporates the latest peer-reviewed climate change science to enable practitioners and decision makers to appropriately consider and account for climate change in flood estimation and management.

Key updates to the chapter include:

- No longer recommending a uniform rainfall adjustment per degree of likely future temperature increase.
- Adjustments to historical rainfall data to reflect climate change to date.
- Provision of 'climate change adjustment factors' for different storm durations across a range of future climate scenarios. These take into account that warmer air holds more moisture – but also that the relationship between temperature and additional moisture varies with the duration of the storm.
    - The evidence is quite strong that short-duration rainfalls intensify more than longer-duration rainfall
    - For every degree of warming, the new draft guidance estimates 1-hour rainfall events to yield 15 per cent more rain, while 24-hour rainfall will increase by 8 per cent.
- Provision of guidance for other factors that influence design flood estimates; (e.g. changes in rainfall losses, temporal patterns, and sea level rise).
- Inclusion of worked examples for real life applications to demonstrate application of the guidance to possible future climate scenarios.

Who was involved in the update?

- The update was a partnership between government, industry and scientists.

- The Department of Climate Change, Energy, the Environment and Water (DCCEEW), in partnership with Engineers Australia led the update of the chapter.
- A Technical Working Group of engineers, hydrologists and climate scientists from a diverse range of institutions including the Australian Climate Service, the Bureau of Meteorology, state government agencies, industry, universities, and the National Environmental Science Program Climate Systems Hub, reviewed the latest science relevant to the guidance and drafted the update.
- A Project Control Group provided advice on translation of the science into useable guidance. It included members from Insurance Council of Australia, Infrastructure Australia, Natural Hazards Research Australia, Geoscience Australia, Engineers Australia, Australian Climate Service and the University of Melbourne.

Who was consulted about the update?

- The update was informed by stakeholder input via two rounds of public consultation in June 2023 and early 2024 to ensure that the guidance met user needs.
- Over 90 submissions from engineering practitioners, designers and government decision makers across Australia were received across the two consultations.
- This online consultation was complemented by discussions and presentations at more than 4 workshops and conferences.

Do practitioners have to follow the guidance?

No. As with the rest of Australian Rainfall and Runoff, the Climate Change Considerations chapter is not mandatory, however it is endorsed by Australia's peak body for engineers, Engineers Australia. Some states and territories such as NSW have their own specific flood risk management guidance that draws on this guidance, whereas others, for example Queensland, use this guidance directly.

Technical questions for guidance users

How can I choose a future climate scenario?

Australian Rainfall and Runoff does not prescribe the use of a particular climate scenario for a given application of the guidance. For further information, the user is directed to relevant jurisdictional documents, for example the NSW Flood Risk Management Manual and associated guidelines.

Climate change is very uncertain – how do I account for uncertainty?

Both climate change factors and non-climate change factors influence the design flood uncertainty.

A consequence of climate change is an increase in the uncertainty of a design flood estimate. Where possible, uncertainties in the estimates of change have been presented and can be used in conjunction with the uncertainty in non-climate change factors to derive uncertainties around the design flood estimation (See Section 6.4.6). As for all climate related investigations, decisions should consider the sensitivity of uncertainty upon the outcome of interest.

Why was global temperature used for standardisation rather than local temperature?

Global temperature is a good indicator of the available moisture in the atmosphere that drives extreme rainfalls. The adoption of global temperature enabled a diverse set of studies on the influence of climate change on rainfall and flooding to be considered on a comparable basis. Research has shown that local temperatures co-vary with many other factors making them a poor indicator of the available moisture.

Why are regional climate model (RCM) projections not explicitly mentioned?

Regional climate model projections were considered in the available evidence for deriving the recommended rates of change and the reader is referred to Wasko et al. (2024) for a summary of the studies considered. While RCMs can provide localised details, limitations remain, particularly in their ability to simulate extreme rainfall. The guidance provided here has been based on multiple lines of evidence, and this includes RCMs.

Why wasn't more geographically diverse advice provided in regard to Intensity-Frequency-Duration (IFD) changes?

When reviewing the evidence of climate change on extreme rainfall across Australia the reviewers found there was insufficient evidence to quantity the difference between regions with few studies outside populated areas of the eastern seaboard (Wasko et al., 2024). No one consistent continental-scale analysis was identified that could be relied upon definitively at the expense of other information.

Is it possible then to consider local or regional information on changes to IFDs in preference to the continental-scale changes?

Whilst we encourage the use of best-available information on changes to IFDs and other flood drivers, there are limitations to any single line of evidence (e.g., observed trends, climate model outputs or physical reasoning). Section 6.5 of the guidance presents methods for evaluating evidence linked to climate change and the reviewers recommend that this approach, which carefully considers multiple-lines-of-evidence, is considered when assessing whether there is merit in developing local or regional estimates.

How do we adjust continuous rainfall sequences for climate change?

Because the application of continuous simulation methods tends to be problem-specific, general guidance cannot be provided at this time. However, it is noted in the guidance that any method used to adjust climate inputs should aim to be as consistent as possible with the rates of change provided in the guidance.

What about changes in the frequency or severity of different storm types, e.g. East Coast Lows?

IFDs do not separate different storm types or the mechanisms driving extreme rainfall. The update therefore implicitly includes changes in different storm types, their frequency, and magnitude.

Did you attempt to distinguish the baselines for factoring IFDs according to the rainfall duration?

Yes. While sub-daily rainfall data is obtained from an observational network that has a representative baseline closer to the present day than the daily gauge observational network, the difference in baseline is small. If a user wishes to adopt a different baseline this can be done as per Example 1c.

How does the guidance here relate to Probable Maximum Precipitation (PMP) estimation methodologies?

Probable maximum precipitation estimates are based on maximisation of historical storms to the persisting dewpoint temperature. Differences between the baseline of the historical storm data base used to derive inputs into the PMP methodology and the baseline used in the guidance are small and likely to have little practical implication. If a user has evidence of a better baseline, it should be used. The rates of change recommended in the guidance are based on a multiple-lines-of-evidence approach that considered both the physical processes that lead to PMP events, as well as empirical and modelling

evidence from more frequent annual exceedance probabilities (AEPs) that explored how changes in precipitation extremes varied with AEP. This is discussed further in Wasko et al. (2024).

Can the rates of change in initial losses/continuing losses (IL/CL) with climate change be used for adjusting other loss models?

The guidance on adjustment factors for IL/CL should not be applied to other loss models. Other loss models such as the soil water balance model and Initial loss / constant proportional loss model are based on differing assumptions to the IL/CL loss model. Currently, there is little research on how climate change impacts on these loss models and thus no guidance on these models has been provided.

Why wasn't baseflow considered in the guidance?

Baseflow is generally a small proportion of the overall hydrograph considered for design flood estimation and currently there is little research on changes in baseflow and its impact in the context of flood risk estimation.

References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia.

Wasko, W., Westra, S., Nathan, R., Pepler, A., Raupach, T., Dowdey, A., Johnson, F., Ho, M., McInnes, K., Jakob, D., Evans, J., Villarini, G., Fowler, H.: A systematic review of climate change science relevant to Australian design flood estimation in https://hess.copernicus.org/articles/28/1251/2024/hess-28-1251, 2024.

Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.