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# Using NARClIM climate projections at Transport for NSW

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Application and insights

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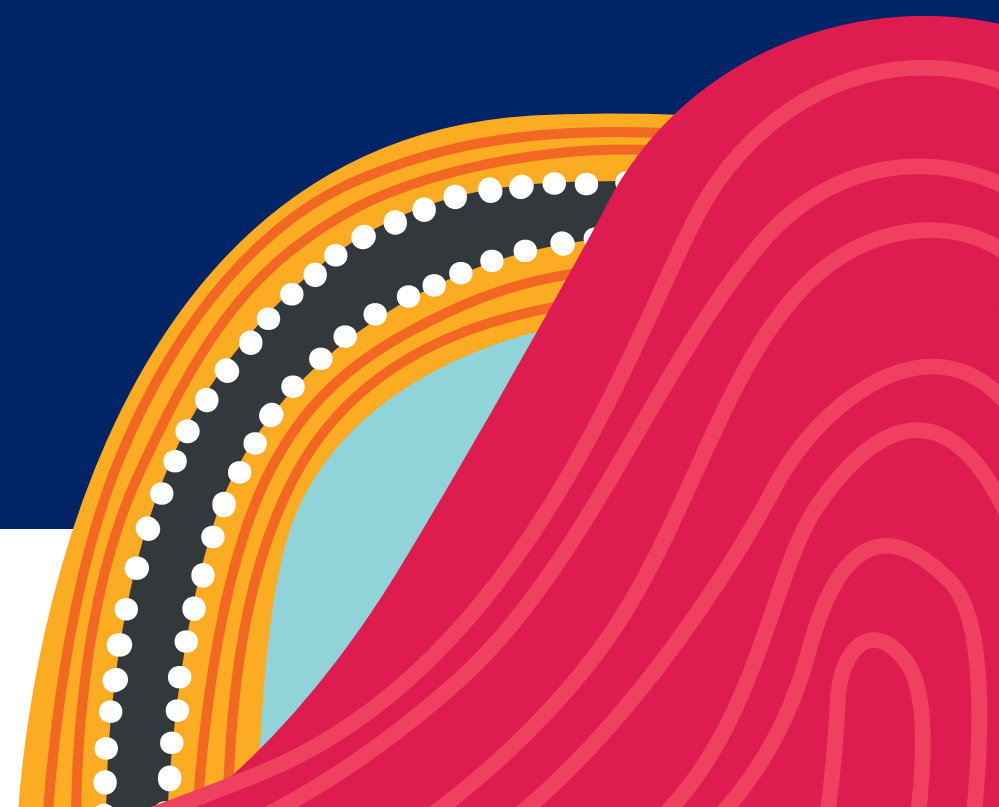
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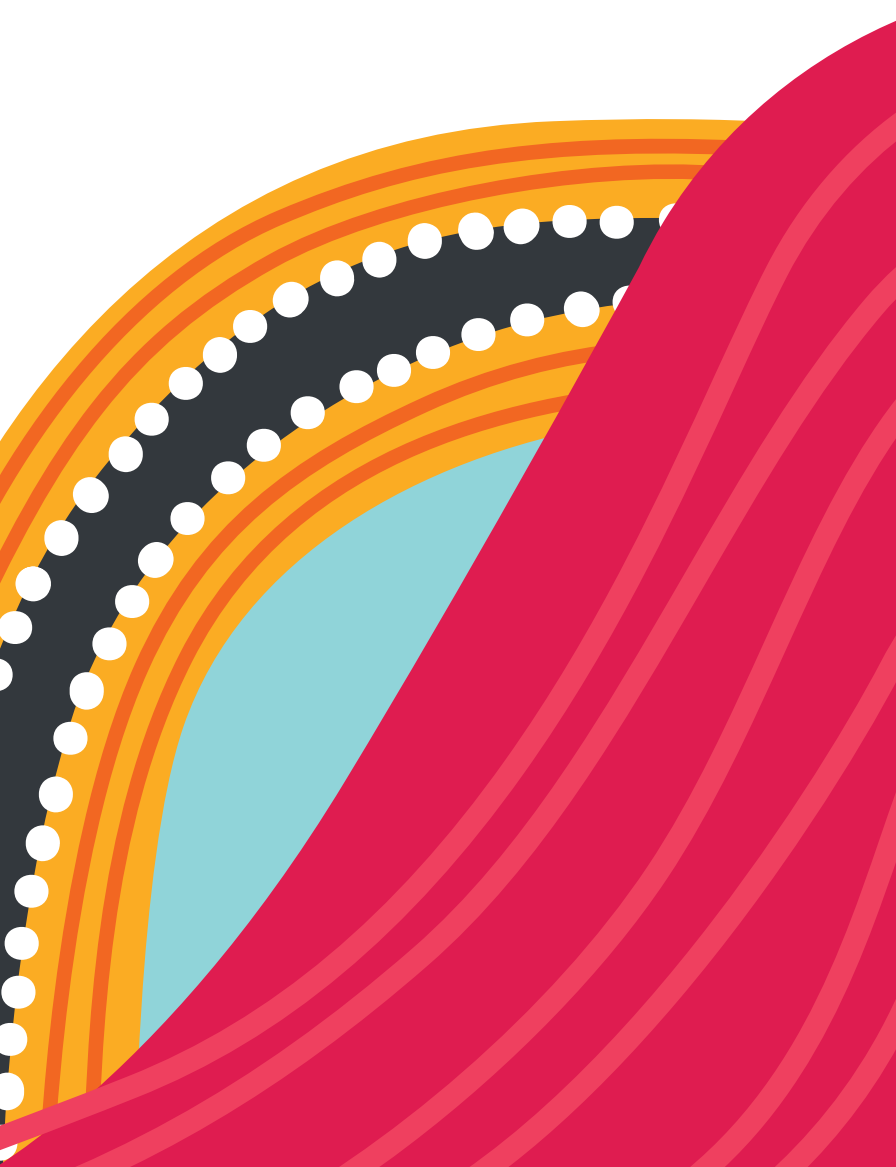
DIRECTOR SUSTAINABILITY



[transport.nsw.gov.au](http://transport.nsw.gov.au)

OFFICIAL





Acknowledgement of  
Country

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Transport pays respect to Elders past and present, and recognises and celebrates the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands and waters of NSW.

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# Climate impacts to Transport - Overview

- Transport hugely affected by extreme weather - floods, fires, extreme temperatures, lightning, high winds, storm surge, sea level rise etc.
- Direct cost for asset repair only is c.1-10% of operating budget.
- 2019/20 bushfire impacts in \$100's millions
- 2021/22 flood damage estimate to be >\$1.5Bn
- Doesn't account for lost revenue, the cost of alternative services provision, delay costs or costs to customers.
- This is the baseline - increases in the frequency and severity of events with climate change will have far-reaching effects.
- We can't adapt our way out of everything – we need to design and build assets and systems and embed processes that enable higher resilience.



# Transport approach to Climate Change

- Sydney Trains Climate Change Risk Assessment and Adaptation Management Plan.
- Core Transport assets inputted into 'Cross-dependency initiative' (XDI) to understand interdependent climate change risks.
- TfNSW Asset Resilience Strategy: identifies the principles and objective of asset resilience and the need to consider future climate change (and non-climate risks) and adapt our transport assets to the changes.
- Transport Net Zero and Climate Change Policy (under development) - will articulate our targets, position and levers, and ensure accountability

**Sydney Trains**

**Climate Change Risk Assessment and Adaptation Management Plan**

An evidence-based assessment

**Transport Net Zero and Climate Change Policy**

Transport is a key enabler of economic and social activity. We are committed to delivering transport which contributes to economic prosperity and social inclusion in an environmentally responsible and sustainable manner, consistent with the Future Transport Strategy 2056.

Transport for NSW's activities cover the whole State and its infrastructure will last for generations to come. We have a duty to undertake our activities in the interest of the greater good, moving beyond compliance, and being a genuine leader in environment and sustainability performance.

**We will work towards achieving this for NSW by:**

- Leadership – contributing to and influencing the strategic environment and sustainability agenda of the NSW Government
- Environmental protection – being accountable for addressing and minimising the environmental impacts of our activities to satisfy the expectations and legislative requirements of the NSW Government and community
- Resilience – embedding climate risk and resilience considerations in our activities
- Sustainable procurement – procuring and delivering sustainable, efficient and cost-effective transport options, including responsible supply chains
- Whole of life – considering whole of life benefits and impacts from our activities across all life cycle stages - demand/need, plan, acquire, operate/maintain and disposal
- Social – recognising the social impacts and benefits of our activities, and working for healthy liveable communities
- Awareness – raising the awareness and capacity of our workforce to be accountable for implementing the Policy through their activities to achieve enhanced environmental outcomes and a culture of environmental responsibility
- Communication – communicating openly, transparently and empathetically with our customers, partners and stakeholders on environmental matters and report on our performance

**This Policy applies to the agencies listed below:**

- Transport for NSW
- Department of Transport
- Sydney Trains
- NSW Trains
- RailCorp
- State Transit Authority
- Sydney Metro
- Sydney Trains

**Rob Sharp**  
Secretary  
XX December 2022

Transport for NSW | T 8002 2200 | F 8002 2209  
11 Lark Street, Chippendale NSW 2008 | PO Box 4600, Haymarket NSW 1240

CP20000


# Transport approach to Climate Risk Assessment - Enterprise

- Transitioning to a longer term, strategic planning process to ensure optimal decision-making.
- Transport Climate Change Strategic Risk Management Plan – now represented as one of 15 strategic risks in Transport Enterprise Risk Framework
- TfNSW Sustainability Plan – requires climate change to be considered in all key decisions
- TfNSW Enterprise Climate Change Risk and Adaptation Plan (in progress) – will harness NARClIM



# Transport approach to Climate Risk Assessment - Project

- Climate Risk Assessment (CRA) Guidelines
- Practical “how-to” advice and consistent requirements on conducting a Climate Risk Assessment.
- Provides a library of case studies
- Aligns with Infrastructure Sustainability Council of Australia (ISCA) Rating Tool Technical Manual.




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## TfNSW Climate Risk Assessment Guidelines

DMS-SD-081/4.1  
Supporting Document – Application of the  
Divisional Management System

Status: Final  
Version: 4.1  
Branch: Environment and  
Section: Sustainability  
Business unit: Planning, Environment and  
Date of issue: 27 August 2021  
Review date: 27 August 2022  
Audience: Program Delivery  
TSR/External Relations  
Asset classes:  Heavy Rail;   
 Systems;   
Project delivery model: Rail Project/Alliance  
Project type: For all project types  
Project lifecycle:  Feasibility;   
 Construction;   
 Finalisation;   
Process owner: Director Planning



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### Climate Risk Assessment Tool 1: Climate Data

This tool provides a summary of the CRA model results. The CCRA model is built in Matlab using parametrization and optimization algorithms applied to gridded NARClIM 1.5 data combined with other data sources.

Original NARClIM data contain projections from four Global Circulation Models and three downscaling technique, thus, providing a total of 12 projection scenarios. Our CCRA model combines all 12 ensembles (gridded raw data) and selects the most extreme values for each climate variable and a unique geographical location, thus, creating a new data set that is more suitable for climate change risk assessment. Please, keep in mind that this data is not representative of the exact climate in future and it is built for risk estimation purposes only.

This tool can be used to get information about the changes in climate in the near (2020-2039) and far (2060-2079) future. For each of the scenarios you can access detailed projections, a short summary (where you can identify the top values) and a ranking table providing exposure risk ranking based on having higher projected climate variable than other locations. In addition, the tool provided data for sea level rise based on Climate Analytics data (using Bamber et al., 2019) as well as Urban Heat Island Effect, Heat Vulnerability Index and Disaster Resilience Index based on SEED and BNHCRC data.

**Important:**  
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# Transport CRA Tool 1 and 2

- Model built using Matlab software
- Combines 6 raw climate projection data ensembles from NARClIM version 1.5, together with parametrisation and optimisation algorithms
- Assesses multiple climate change projections for any selected geographical location.
- Includes the latest Sea Level Rise projections (from Climate Analytics) and identifies whether a location sits near the coastline.
- Provides data for Urban Heat Island Effect
- Provides CRA pre-screening (per location and asset type).
- Assists with developing risk statements and conducting a compete CRA.

**Climate Risk Assessment Tool 1: Climate Data**

This tool provides a summary of the CRA model results. The CCRA model is built in Matlab using parametrization and optimization algorithms applied to gridded NARClIM 1.5 data combined with other data sources.

Original NARClIM data contain projections from four Global Circulation Models and three downscaling technique, thus, providing a total of 12 projection scenarios. Our CCRA model combines all 12 ensembles (grid-level data) and selects the most extreme values for each climate variable to create a new data set that represents the worst-case scenario. Please, keep in mind that this tool is built for risk estimation purposes only.

This tool can be used to get detailed projections, a short-term ranking table providing expected climate variable than other rise based on Climate Analytics Heat Island Effect, Heat Vulnerability Index (SEED) and BNHCRC data.

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**Climate Risk Assessment Tool 2: Risk Level**

This tool can assist in developing a climate change risk register and evaluating the risk level by estimating the level of risk likelihood and consequence. The risk level estimation is consistent with TfNSW Enterprise Risk Management Standard.

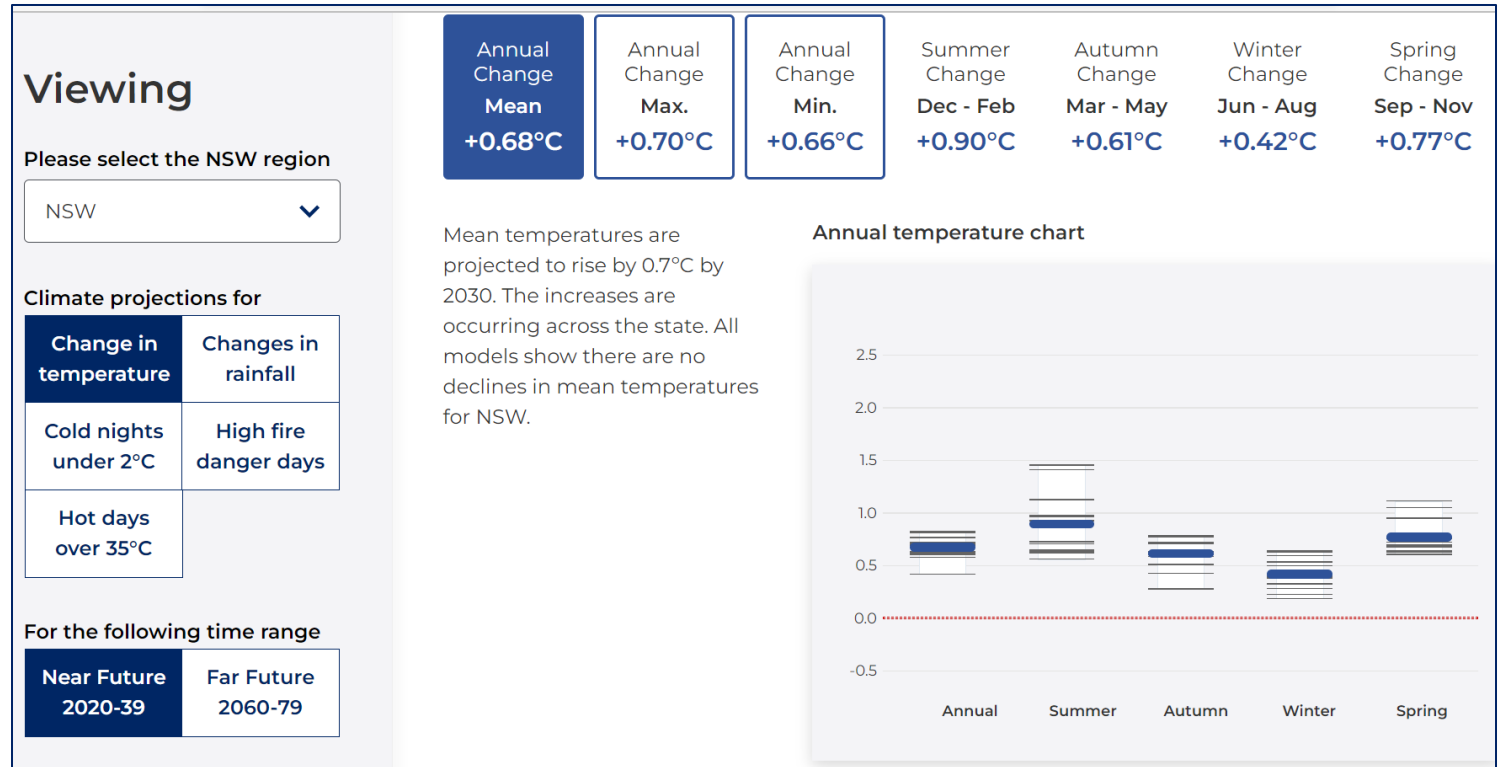
Before running this tool, please ensure you have TfNSW Tool 1 - Climate data in the same directory, and it has been prepopulated with the climate data for your project.

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This tool is developed by Dr Veronika Emetc  
For more information please contact: **Start (~30sec)**

# Value of NARClIM for TfNSW

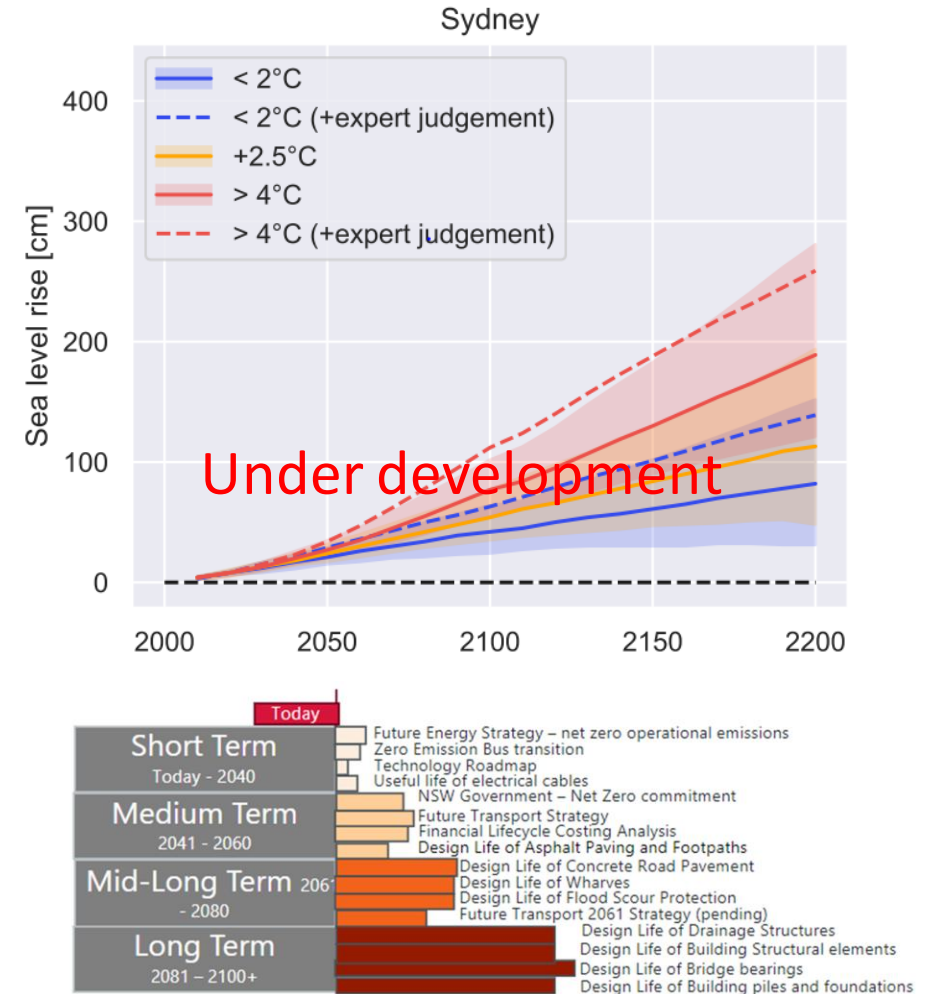
- TfNSW uses NARClIM data as first port of call for climate projections
- NARClIM data used in both project and enterprise risk climate assessments
- The GIS mapping is valuable for location-specific information
- Regional resolution is much higher than with other models.





# Building on NARCLIM for robust Transport asset planning

- We supplement NARCLiM with other projection data e.g. sea level rise projections
- NARCLiM results produce a value range. We have to interpolate this for engineers who want an exact design threshold.
- Fixed time brackets and lack of far future projections makes it difficult to match the projections to asset life. We are evaluating projections out to 2150, based on 120 year design lives.



# How we are refining our approach

- Historically used conservative projections - risk of over-engineering or sub-optimal funding decisions – re-adjusting this based on evolution of climate projections.
- Developing our own common planning assumptions for assets, depending on core conditions.
- Climate models provide information about climate variables (e.g. temp, rainfall). However, they do not predict hazards (flood, bushfire) – we are refining our understanding of hazards.
- Seeking high resolution information for individual assets such as a particular road, signal, intersections and rail assets will allow us to deal with highly localised factors in our planning.

## Transport for NSW Climate Change Adaptation Position Statement

Transport for NSW is supporting thriving communities by proactively adapting to the changing climate.

This position statement outlines Transport for NSW’s approach to climate change adaptation for its networks, assets and services.

Climate change is a material risk with widespread consequences for the people of NSW, and everything Transport does. Climate change increases the frequency and severity of acute hazards.

**Figure 1 What was Once Extreme Becomes More Frequent and Intense Weather**

Future Climate Scenario	Transport for NSW Application
Possible worst-case Fossil-fuelled Development SSP5-8.5 or RCP 8.5	Use in cost-benefit analysis and climate change risk assessment (DMS-SD-081/4.1). This applies to all assets and projects that meet one of the following conditions: <ul style="list-style-type: none"> <li>• Functional asset or project design life exceeds 40 years</li> <li>• CAPEX value exceeds \$50 million</li> <li>• Integrated network team client defines the asset as*:                             <ul style="list-style-type: none"> <li>• ‘Highly critical’ or plays a significant role in network reliability.</li> <li>• ‘Highly vulnerable’; or</li> <li>• Impacts future adaptive capacity of the asset</li> </ul> </li> </ul> *Considerations can include economic activity dependency, access routes for communities, and lead time in reparations
Current global emissions trajectory	Broader socioeconomic and environmental benefits and costs are encouraged in assessment to determine if it is sensible to adopt a no-regret investment or future-proof adaptation at present rather than in the future.
Paris Agreement Pledges SSP2-4.5 or RCP 4.5	Minimum standard of climate adaptation.  This requirement applies to all transport assets and services to maintain target service levels consistent with the historical climate.
Paris Agreement Net Zero by 2050 Limit to Two Degrees SSP1-2.6 or RCP 2.5	This future climate scenario is only applicable if the cost of adaptation does not justify the expenditure.  Justification can include: <ul style="list-style-type: none"> <li>• Functional asset life is known to be retired and disposed of before 2050 (e.g. temporary works)</li> <li>• Location of asset is significantly exposed and/or likely to become functionally redundant in the intermediate to long-term (e.g. low-lying coastal assets)</li> </ul> Before adopting this climate scenario for assessment and implementation, this approach must be justified and approved by the following: (EO level delegation) <ul style="list-style-type: none"> <li>• The Client,</li> <li>• Asset operator and the AMB concession process, and</li> </ul>

Transport for NSW’s Sustainability Plan considers climate change risks in a...  
 Transport for NSW is enhanced...  
**all decisions by:**


1. Embedding the latest climate lifecycle phase. To ensure th...

# Managing Public Perceptions

## Build Back Better Optimally - Windsor Bridge

<https://www.news.com.au> > environment > news-story


**NSW floods: Hawkesbury River swallows Windsor bridge whole**  
A bridge designed to be "floodproof" has gone almost completely under water as residents in Windsor wait anxiously while the worst flooding ...  
22 Mar 2021



**Town centre access cut off as 'floodproof' Windsor bridge goes ...**  
Sky News Australia  
23 Mar 2021


[www.theaustralian.com.au](http://www.theaustralian.com.au) > breaking-news

**NSW floods: Hawkesbury River swallows Windsor bridge whole**  
A bridge designed to be "floodproof" has gone almost completely under water as residents in Windsor wait ...  
The Australian · 22 Mar 2021




**Footage shows 'floodproof' \$101million bridge swallowed ...**  
<https://www.msn.com/en-au/news/australia/footage-shows-floodproof...>  
The newly built Windsor Bridge on the Hawkesbury River in Windsor - which cost the taxpayer \$101million and was pitched to locals as 'flood proof' - ...


**News.com.au**  
**Major roads flood, plunge drivers into chaos**  
In northwest Sydney, the much condemned Windsor Bridge has also ... "It kind of sucks, because the bridge is supposed to [be] floodproof, ..."  
5 July 2022




**9News**  
**Floodwaters in Windsor reach highest point since 1978**  
In March 2022 the river peaked at 13.8, and in March 2021 it reached 12.93 metres. ... Windsor Bridge, which was built to be flood proof, ...  
5 July 2022




**The Guardian**  
**NSW flooding: drone footage shows extent of floods around ...**  
The Windsor Bridge, which was previously thought to be flood-proof, went underwater for the third time this year leaving Hawkesbury Road one...




**9News**  
**Bridge worth \$137m built to beat floods submerged by historic deluge**  
Locals gathered yesterday as waters rose and crested over the supposedly flood-proof bridge. Windsor Bridge has been submerged in rising ...  
23 Mar 2021



**The Australian**  
**'Floodproof' Windsor Bridge visible again after being swallowed by Hawkesbury River in mass floods**  
The "floodproof" bridge was closed on Sunday after being submerged by flood waters. Picture: Tim Hunter. The Hawkesbury River region last week ...  
26 Mar 2021



**Daily Telegraph**  
**\$137m Windsor Bridge flood 'resilience' slashed**  
\$137m Windsor Bridge flood 'resilience' cut to one-in-three year event. An expensive Hawkesbury River crossing had its ability to withstand ...  
9 Mar 2022



- Need for clear communication on uncertainty and resilience.
- Public perception that Windsor Bridge was 'flood-proof'.
- It was constructed 2.8m higher than previous bridge (higher than 60% of surrounding road).
- Designed to be overtopped.
- Higher level would not improve access as surrounding roads were flooded.
- Improved evacuation times, reduces bridge closures.
- It is designed to be climate-resilient, not climate adapted.