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Strategic Climate Resilience in First Nations Social Housing: Actuarial Tools for Economic and Social Impact

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Abstract

With climate change amplifying the frequency and severity of natural hazards—NSW recording a record 35 disaster declarations in FY 2023–24, more than any previous year—the NSW Government Aboriginal Housing Office (AHO) recognised the urgent need to enhance the resilience of its housing portfolio. In collaboration with Finity and the Resilient Building Council (RBC), the project combined dwelling-level resilience ratings, peril modelling, and wellbeing-informed cost–benefit analysis to guide strategic investment in housing upgrades. This initiative is a vital step toward safeguarding First Nations (Aboriginal and Torres Strait Islander) housing stock against future climate risks.

Surveys of representative properties identified resilience to flood, bushfire, storm and heat, informing targeted retrofit pathways such as re-roofing, window replacement and passive cooling. The results show that the investment case varies by peril: flood adaptation is most compelling where raising a home is feasible (within realistic limits), bushfire resilience where exposure and improvability align, and storm resilience when tenant wellbeing benefits are considered. Heat resilience emerged as a portfolio-wide priority due to substantial wellbeing gains, even where insured losses are nil.

By quantifying both asset protection and tenant wellbeing outcomes, the framework demonstrates why public-sector resilience decisions should extend beyond insured losses alone. The assessment provides AHO with a robust, socially meaningful basis for undertaking property resilience upgrades, demonstrating duty of care, and prioritising investment under a changing climate. More broadly, it offers a scalable blueprint for climate adaptation in public and First Nations housing across Australia.

The challenge for actuaries lies in developing funding frameworks for resilience programs and extending this work to include commercial buildings and infrastructure.

Keywords: Climate change adaptation; cost-benefit analysis; disaster loss mitigation; housing resilience; natural hazard risk; physical climate risk; social equity; wellbeing model.

Glossary

Term	Meaning
AAL	Annual average loss
AHO	Aboriginal Housing Office
ACHP	Aboriginal Community Housing Providers
ARI	Average recurrence interval
BAL	Bushfire Attack Level
DALY	Disability-adjusted life years
IPCC	Intergovernmental Panel on Climate Change
PCA	Property Condition Assessments
RCP	Representative Concentration Pathway
WBGT	Wet bulb globe temperature

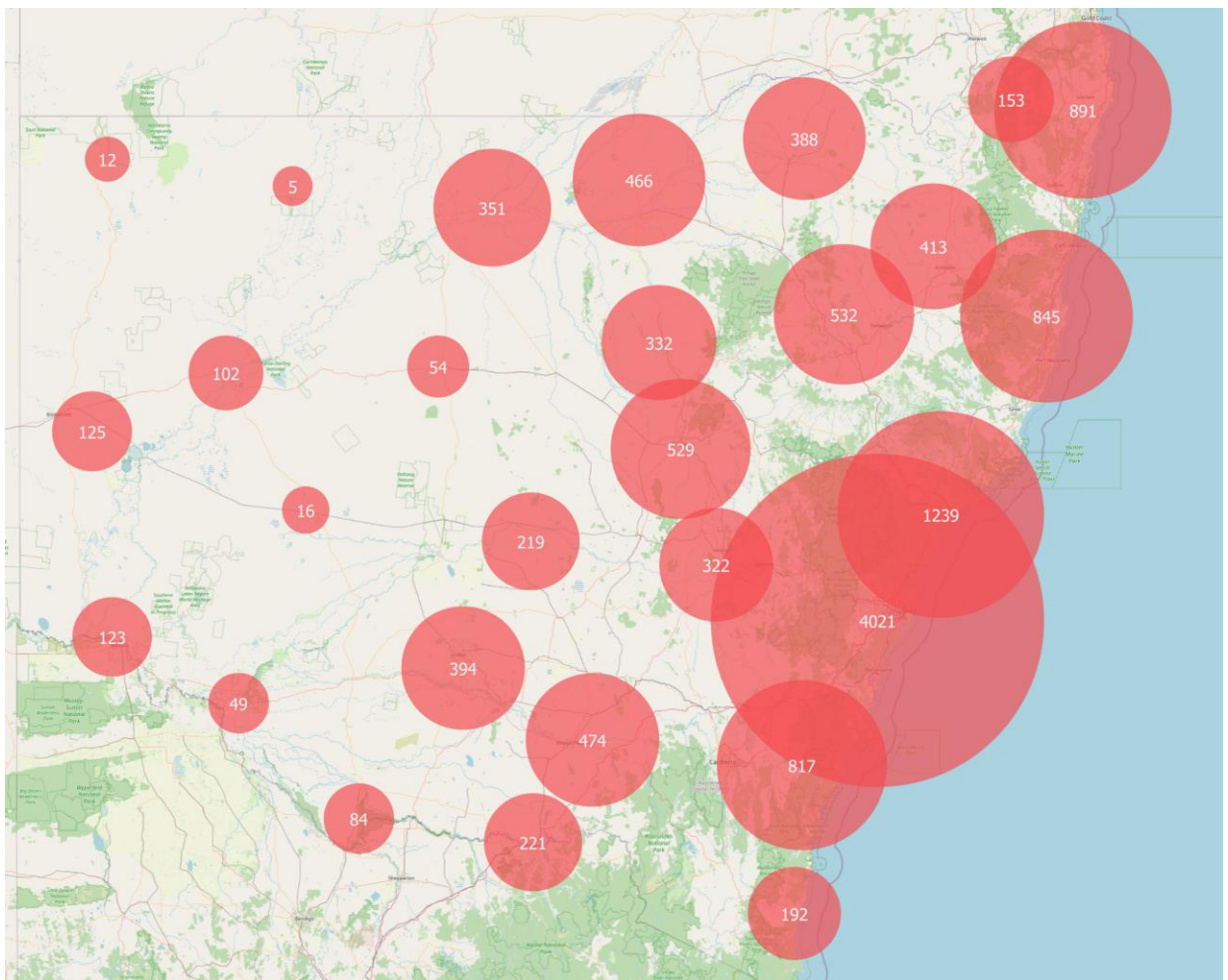
1. Introduction

Climate change is already reshaping the hazard landscape faced by housing providers in Australia. For public and First Nations housing portfolios, this is not only an issue of changing risk to assets, but also a question of continuity of housing, tenant safety, health, and connection to place.

The NSW Aboriginal Housing Office manages a large and geographically diverse portfolio, and many of its homes are in communities that are already vulnerable to flood, bushfire, storm and heat stress. The portfolio includes many long-term tenancies. With a high demand for increased services, driven by a high First Nations population growth rate in NSW and social and economic stressors, the AHO need to ensure it can continue to provide a safe and accountable service and meet its duty of care for its tenants through the amplification of natural disasters with climate change.

This paper presents the methodology and findings of a climate risk and resilience program undertaken for the AHO and Aboriginal Community Housing Provider (ACHP) portfolios by Finity. The assessment covers over 13,000 properties, with approximately one third in Greater Sydney and the remainder regionally based (Figure 1). Around 9,500 of the properties included in this assessment are owned by the AHO and 4,000 by the ACHP, providing housing to approximately 32,000 tenants.

Figure 1 – Distribution of properties AHO and ACHP properties in NSW



This study evaluated insured perils (flood, bushfire and storm) and uninsured hazard (heat stress) under current and low and high emissions scenarios to 2075. 2075 was chosen based on 50 years practical lifetime of the property. It further assesses resilience investments by estimating their costs, avoided future losses, and the wellbeing benefits to tenants, which can be

expected to translate into savings for the State Government in the form of reduced health care, social and rehousing costs. Finally, the study identifies properties that may be considered for disposal, including those at extreme risk, those exposed to coastal inundation, and those where resilience cannot be improved to an acceptable level.

2. Background and literature review

Climate risk in Australia and implications for housing

Australia is already experiencing a warmer climate with compounding extremes, and these risks are projected to intensify this century (Intergovernmental Panel on Climate Change, 2023). The National observational record shows Australia has warmed by ~1.5 °C since 1910, with more frequent extreme heat, longer fire seasons, heavier downpours, and rising seas - hazard trends that directly elevate stresses on dwellings and neighbourhood infrastructure (Bureau of Meteorology & CSIRO, 2024). The Commonwealth's National Climate Risk Assessment concludes that hazards worsen under all plausible futures, the difference between +2 °C and +3 °C warming is material for damage and disruption, and early adaptation lowers long-term social costs for people, infrastructure and the built environment (Australian Climate Services, 2025).

Economic and social costs of natural disasters

Independent inquiries over the past decade have consistently found that Australia underinvests in disaster mitigation relative to recovery, and that rebalancing funding toward prevention and resilience would improve economic efficiency, equity and incentives (Productivity Commission, 2015) (Colvin, 2024). Updated modelling for the Australian Business Roundtable projects that, even under a low-emissions scenario, annual disaster costs could reach the tens of billions of dollars by mid-century, with concentration in NSW and Queensland where housing exposure is high (Deloitte Access Economics, 2021). Financial system actors are also prioritising the affordability channel: APRA's Insurance Climate Vulnerability Assessment explores how physical risk and household incomes may drive future insurance affordability stress to 2050 (APRA, 2024), while the Insurance Council of Australia emphasises national, property-level risk data and targeted mitigation to sustain coverage (Insurance Council of Australia, 2022-2025). Disaster research also shows material mental-health burdens; a recent Australian longitudinal study using HILDA data finds repeat disaster exposure is associated with measurable declines in mental health scores (Mitchell, 2024), and national frameworks now embed mental health as a core stage of disaster preparedness and recovery (National Mental Health Commission, NEMA, 2023).

First Nations housing vulnerability and resilience

A growing amount of literature shows that First Nations households are disproportionately exposed to climate extremes and face elevated vulnerability due to housing conditions, location and structural disadvantages. While the AHO housing portfolio is considered above average for First Nations social housing with majority being "well maintained" or "maintained", a set design standard and active management of crowding, they are concerned about the exposure to climate.

Building performance simulations across tropical, arid and hot/mild zones show that even NCC-compliant improved designs may not maintain habitable conditions under plausible future heat, indicating the need for design reform and targeted retrofits tailored to occupancy and climate (Brambilla, 2022).

Why climate resilience in First Nations housing requires a broader lens

A conventional property risk assessment focuses mainly on the expected damage to the built asset. That perspective is necessary, but incomplete for considering the full benefits of resilience building in public and First Nations housing. The consequences of natural hazards in these settings extend well beyond repair costs. Disasters can interrupt tenancy continuity, worsen mental and physical health, exacerbate chronic disease, create distress and displacement, and weaken community and cultural connections (Rigaud, 2017) (Cunsolo, 2018). The wellbeing methods for this project were developed to reflect that broader set of consequences.

The tenant profile of the AHO portfolio underscores the importance of assessing social and wellbeing impacts alongside physical risk. Long average tenancies, a high proportion of women, and a significant prevalence of disability mean that housing is not simply a shelter but a central platform for health, care and community stability. When housing is impacted by natural disasters, sometimes repeatedly, or fails to provide protection from extreme heat, the consequences for tenants are therefore more persistent, cumulative and difficult to reverse than in more transient housing markets.

Figure 2 – AHO Property Portfolio Statistics



Historical experiences of First Nations people have had a considerable impact on housing situations and conditions (Australian Institute of Health and Welfare, 2025). These impacts include systemic barriers to accessing private housing, lower rates of home ownership, and reduced availability of safe, secure and culturally appropriate housing. First Nations households are significantly more likely to experience overcrowding, housing stress and homelessness, reflecting structural inequalities shaped by colonisation and institutional discrimination (Australian Institute of Health and Welfare, 2025).

For First Nations communities, housing also plays a broader cultural and social role, with instability or poor-quality housing contributing to disruption of community connections and overall wellbeing. As a result, both the availability and quality of housing are critical determinants of health outcomes (Australian Institute of Health and Welfare, 2025).

Poor thermal performance, energy insecurity and inadequate building envelopes have been directly linked to heat-related illness, sleep disruption and exacerbation of chronic disease in Indigenous communities (Quilty, 2022) (Bhatta, 2026). Importantly, these impacts occur regardless of whether a property sustains structural damage, meaning they are largely invisible if resilience is assessed only through insured losses.

There is also clear evidence that targeted, dwelling-level interventions outperform uniform portfolio approaches. Evaluations of First Nations housing programs highlight that place-based targeting, focusing on dwellings with both high hazard exposure and high potential for improvement, delivers stronger outcomes and greater community acceptance than blanket retrofits (Lea, 2021) (Moskos, 2025). Measures that improve building envelopes and reduce ingress (water, dust, air, smoke), such as door sealing and fabric upgrades, have been shown to deliver cross-hazard benefits, improving everyday comfort and indoor health while also reducing exposure during hazardous conditions (Lea, 2021).

To conclude, avoiding repeated displacement and maintaining habitable indoor conditions are strongly associated with improved health and wellbeing outcomes for First Nations people, highlighting that many benefits of housing resilience sit outside damage reduction to assets (Australian Institute of Health and Welfare, 2025) (ACOSS, 2025).

3. Methodology

The project was delivered in three main stages:

1. *Climate risk assessments* which translated hazard and climate change information into property-level risk metrics.
2. *Property resilience assessments* were developed considering property characteristics and conditions.
3. *Cost-benefit analysis* that translated the above into economic evidence, valuing not only avoided damage to buildings but also avoided social, mental and physical harms to tenants due to undertaking the recommended resilience building work.

The analysis was undertaken using a static portfolio assumption. This means the assessment assumed that, over time, new properties entering the portfolio would replace properties exiting it, rather than modelling major growth or contraction in the housing stock. This approach allows the focus to remain on the climate resilience of the portfolio as an asset base rather than on future portfolio expansion. The cost-benefit analysis was expressed over a 50-year horizon from 2025 to 2075, reflecting the asset planning horizon for the AHO and ACHP portfolios and allowing the project to capture the cumulative effects of climate change and adaptation over time. Benefits and costs were discounted using a 0.5% real discount rate, derived from a 5.5% nominal NSW Government borrowing cost less 5% inflation, applied consistently across building and wellbeing components.

Stage 1 – Climate Risk Assessment

The first stage was a property-level risk assessment for flood, bushfire, storm, and heat (Figure 3). For insured perils, property-level annual average losses were produced under low (RCP 2.6 (Representative Concentration Pathway)) and high (RCP 8.5) emissions scenarios. These scenarios were chosen to span a plausible range of future climate outcomes used in the Intergovernmental Panel on Climate Change (IPCC, 2014) aligned climate modelling. This establishes where the portfolio is most exposed today, how exposure varies with climate change, and which perils would likely dominate losses and how tenant impacts may vary over time.

Figure 3 - Risk and Resilience Assessment Framework

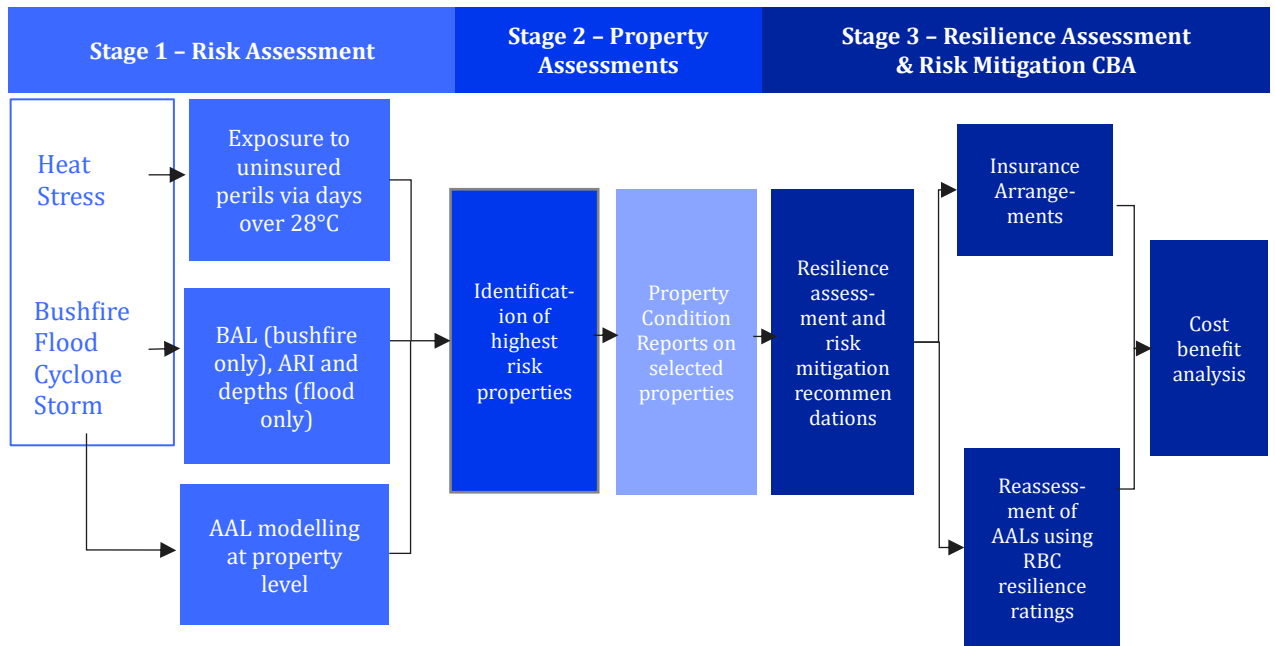


Figure 4 and Figure 5 provide an overview of our approach to assessing current and future climate physical risk for perils typically insured under property coverage (Storm, Cyclone, Bushfire, and Flood), and those that are not insured under property insurance (Heat Stress). The overall view of physical climate risk combines the two views from both uninsured and insured perils using a set of metrics and risk thresholds.

Figure 4 - Process for climate physical risk assessment: uninsured peril (heat stress)

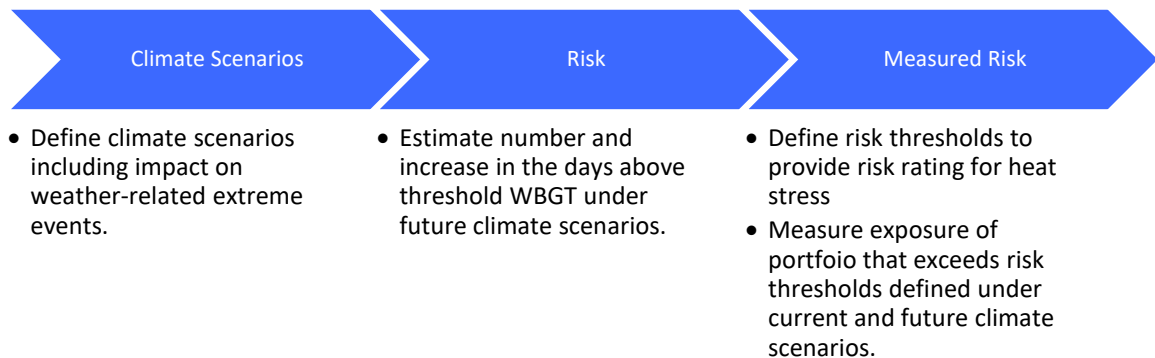
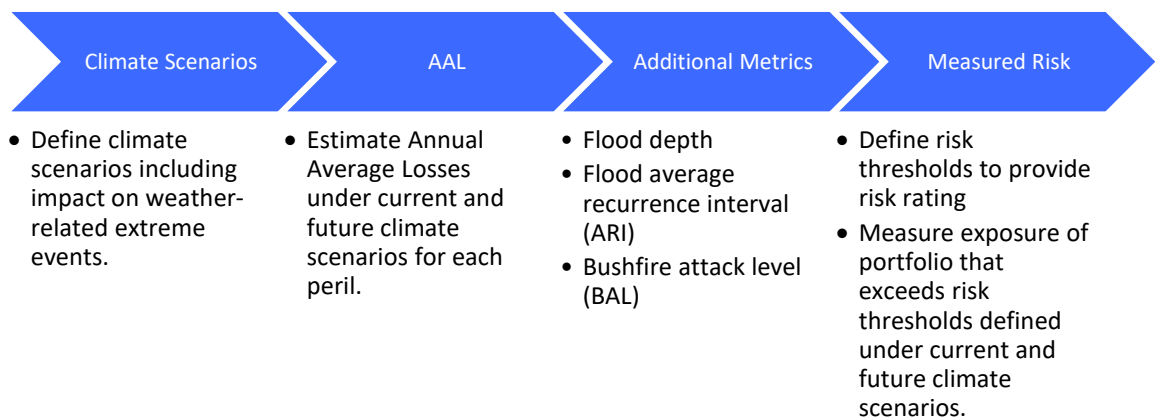


Figure 5 - Process for climate physical risk assessment: insured perils (storm, cyclone, bushfire and flood)



We have estimated the Average Annual Loss (AAL) under a low and a high emissions scenario. These two scenarios represent the highest and lowest Representative Concentration Pathways (RCPs) considered in the fifth assessment report of the IPCC (IPCC, 2014). However, they do not represent maximum or minimum outcomes, and it is possible that emissions may be higher or lower than the range we have considered, resulting in higher or lower risk than considered within this paper.

The physical climate risk exposure of the AHO's portfolio under different scenarios was assessed by considering the following four acute perils that are typically covered under property insurance:

- **Flood risk:** Reflects the exposure of the property to riverine flooding (water spilling out of riverbanks). Flood risk is influenced by climatic conditions (rainfall, temperature), surface hydrology, together with the distance and elevation of the property relative to a river.
- **Bushfire risk:** Reflects the exposure of the property to fires started in wild vegetation (grasslands, woodlands etc). Bushfire risk is influenced by climatic conditions (humidity, temperature, rainfall and wind) together with the distance and topographic features of the asset relative to vegetation.
- **Storm risk:** Sub-models for severe convective storm, hail and low-pressure systems were calibrated to insurance claims experience and adjusted for local factors such as topography, shielding and tree cover.
- **Cyclone risk:** Reflects the exposure of the asset to cyclones and includes the exposure to storm surge events driven by cyclones. Cyclone risk is influenced by regional cyclone risk, tree coverage, shielding from wind and the distance of the asset to the coastline.

The physical climate risk exposure of the AHO's portfolio under different scenarios has been assessed by considering the following peril, which is typically excluded under property insurance:

- **Heat stress:** Risk of extreme heat days caused by a combination of high dry-bulb temperatures and high relative humidity, which gives Wet Bulb Globe Temperatures (WBGT). Exposure to extreme heat causes discomfort and physiological strain in humans and causes mechanical stress due to change in temperature of materials in buildings or equipment.

Finity's suite of proprietary perils models were used to estimate the AALs paid out by an insurer under a typical home insurance policy in the event of a loss from the peril concerned. The sum insured represents the rebuild cost of the property and drives the AAL. The sum insured for each property in Australia was estimated using Finity's Rebuild product, which estimates the sum insured based on building characteristics such as floor area, number of floors, and other characteristics.

Using the risk scores developed in Stage 1, a representative sample of properties were prioritised for further resilience assessment. Importantly, for sample selection the project relied on risk scores rather than AAL, so that the sample would not be overly biased toward high-value properties that naturally attract higher loss estimates even when their underlying hazard risk is not proportionately higher.

Tenant Wellbeing Assessment

The wellbeing assessment was designed to complement the physical risk and resilience analysis by quantifying the indirect social and health benefits of more resilient housing. While the hazard and resilience modelling focused on changes in expected property damage, the wellbeing assessment recognised that natural disasters also impose substantial non-asset costs on tenants, including impacts on physical and mental health, chronic disease burden, and displacement. This was particularly important for the AHO and ACHP portfolios, where the Government has a duty of care to tenants and where, despite relatively modest direct building losses from hazards such as storms and heat, significant tenant harms may still occur.

The wellbeing methodology began with a literature review to identify wellbeing indicators that are either directly or indirectly impacted by natural disasters and can be mitigated with housing resilience. Publicly available Australian wellbeing and policy frameworks were reviewed, including Measuring What Matters (The Treasury, 2023), Closing the Gap in Partnership (Australian Government, Department of Prime Minister and Cabinet, 2020), the Victorian Government Statewide Wellbeing Plan 2023–27 (Department of Health, 2023), and the Municipal Public Health and Wellbeing Plan 2021–2025 (East Gippsland Shire Council, 2021). These sources use different terminology and measures, but they reveal common themes relevant to housing resilience and disaster impacts. Based on this review, wellbeing indicators were grouped into three categories (Table 1).

Table 1 - List of wellbeing indicators identified in research

Directly impacted by natural disasters and housing resilience can mitigate its effects	Not directly impacted by natural disasters and housing resilience may contribute to mitigating its effects	Do not relate to natural disasters and housing resilience	
<ul style="list-style-type: none"> Life expectancy Injuries Mental health Prevalence to chronic conditions Experience of violence Community and belonging (proxied with displacement) Homelessness* Culture and identity* 	<ul style="list-style-type: none"> Liveability Housing serviceability Making ends meet 	<ul style="list-style-type: none"> Access to justice Childhood experience of abuse Feeling of safety National safety Online safety 	<ul style="list-style-type: none"> Childhood health Digital inclusion Access to care and support services Access to health services

* no data to support quantitative analysis this time, but identified as future improvement should more data become available

The first group indicators are directly affected by natural disasters and potentially mitigated by more resilient housing, and these formed the basis of our quantitative analysis. The second group comprised of indicators not directly caused by disasters, but potentially influenced by housing resilience, such as liveability. These were considered qualitatively rather than quantified. The third group comprised of broader wellbeing domains outside the scope of the quantitative model. This structure ensured that the quantitative model focused on outcomes that could be robustly linked to hazard exposure and resilience improvements, while still acknowledging broader social effects that are important but not readily monetised.

Quantitative valuation approach

The quantitative wellbeing valuation used a losses avoided framework. Under this approach, the benefits of resilience measures were estimated as the reduction in expected wellbeing costs that would occur when a property becomes more resilient to natural hazards. This method was also

used in (Deloitte Access Economics, 2016) and is conceptually consistent with the treatment of broader social impacts in the 2023 Intergenerational Report (Commonwealth of Australia, 2023).

The quantified wellbeing model developed for this project grouped losses avoided into three broad categories:

- *Physical health losses avoided*, including deaths, major and minor injuries, and the exacerbation of chronic diseases;
- *Mental health losses avoided*, including mental health issues, alcohol and drug misuse, and family violence; and
- *Social losses avoided*, represented primarily through displacement due to disasters.

This structure enabled the analysis to move beyond direct property damage and capture the wider consequences of disasters for tenants over time.

Wellbeing costs make up a significant proportion of disaster costs. In 2016, the Actuaries Institute's Natural Disaster Working Group estimated that of a total of \$11 billion in annual disaster costs, \$3.7 billion was insured, \$2.5 billion was uninsured tangible costs, and \$4.8 billion related to intangible and indirect costs (Andrews, et al., 2016). Like overall natural disaster costs, these wellbeing costs are volatile and difficult to estimate accurately. In this paper we have brought together existing data, research and analysis to estimate wellbeing benefits. These are discussed below.

We recognise that there are several areas where further research is required in improving wellbeing estimates, and in particular there are aspects of wellbeing that have not been captured in our analysis, such as cultural connections to place. Consequently, our wellbeing estimates are likely to be conservative and under-estimate the potential benefits of resilience work. Nonetheless, we were able to demonstrate that for many programs the benefits of resilience far outweighed the costs.

Data sources for wellbeing analysis

The model drew on AHO and ACHP primary data and supplemented this with published Australian evidence. Primary inputs included age, gender, household size, disability status, tenancy length, and survey-based measures from the AHO Tenant Satisfaction, Experience and Wellbeing Survey. These data helped tailor the assumptions to the actual tenant population and supported the interpretation of certain indicators. For example, tenancy length was treated as an important contextual measure for community and belonging: tenants had, on average, spent around 10.8 years in their current home, far longer than the broader NSW rental market median, indicating that disruption to housing continuity may carry substantial social and emotional consequences. Hence, it is important to quantify the cost of displacement as a proxy for the economic losses due to natural disaster impacts on community and belonging and culture, homelessness, and culture and identity. This method captures the cost of displacement from the tenants' current home due to increased natural disasters but does not amplify the loss if they are living on country now and must move. The cost of displacement is an indicator of cultural loss, and this would presume a certain amount of choice as to where they want to and are living currently.

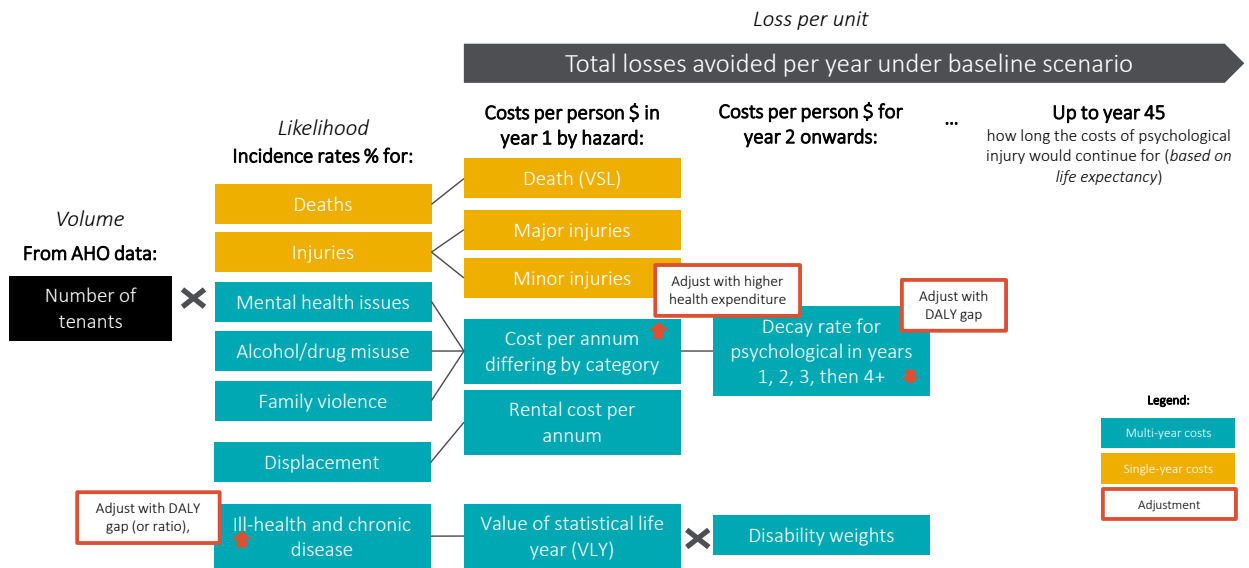
These sources provided the incidence rates and unit costs used to value deaths, injuries, chronic disease exacerbation, mental health impacts, alcohol misuse, family violence, and displacement.

Bottom-up estimation of wellbeing benefits

In line with the built assessment, for the wellbeing indicators directly impacted by natural disasters, we estimated the wellbeing costs relating to physical, mental, and social costs over 50 years from 2025 to 2075 before allowance for any resilience measures. This estimate has been

applied to the average profile of the portfolio in terms of age, gender, proportion of metropolitan to regional properties, number of tenants per household (Figure 6).

Figure 6 - Estimating the total losses avoided per year for AHO and ACHP tenants



The model distinguished between single-year losses and multi-year losses. Deaths and injuries were treated as immediate losses in the year of the disaster, whereas chronic disease exacerbation, psychological harms, and displacement were assumed to persist over multiple years. The longest-lasting impacts were assumed to arise from psychological harms, which were modelled with a decay structure over time: the effect is highest in the first year after the event, then gradually reduces, but persists at a lower level over the remainder of the affected person’s life. Chronic disease exacerbation was assumed to persist for several years, while displacement was assumed to last for four years. Average tenant ages and life expectancy assumptions were used to determine the duration over which some losses would continue, with lifetime effects modelled over approximately 45 years.

A key feature of the methodology was the treatment of displacement. Displacement was considered one of the major hidden costs of natural disasters and was used as the principal proxy for broader social impacts that are difficult to monetise directly. In this context, displacement captured not only the immediate cost of temporary relocation but also part of the associated loss of community and belonging, housing continuity, homelessness risk, and cultural disruption. This was particularly important for First Nations tenants, for whom wellbeing may also include the preservation of culture and place-based connection. At the same time, the model recognised that displacement cost is an imperfect proxy: it captures the loss associated with leaving the current home, but it does not fully reflect the added significance of being displaced from Country or culturally important places.

To calculate post-resilience wellbeing costs, we apply a damage reduction factor based on the average reduction in building damage from the built assessment, which reflects the adjustments for rebuild cost discussed in the prior section.

The wellbeing benefits due to reduced wellbeing costs under climate scenario s is:

$$Wellbeing\ benefit_{s,x,h} = \sum_{t=x+1}^{x+50} \frac{Wellbeing\ costs_{s,t,h} - Wellbeing\ costs'_{s,t,h}}{(1+i)^{t-x}}$$

where x is the base year 2025, $Wellbeing\ costs$ represent costs pre-resilience, $Wellbeing\ costs'$ represent costs post-resilience measures, h is the peril (flood, bushfire, storm, or heat), and the real discount rate i is 0.5%, derived from a 5.5% nominal discount rate less 5% inflation, which

accounts for the rise in health costs over time. The 5.5% estimates long-term borrowing costs of the NSW Government based on spreads of T-Corp issued bonds over Australian Government Securities.

Hazard occurrence and exposure assumptions in the wellbeing analysis

To translate unit costs and incidence rates into expected losses, the model required estimates of the proportion of properties likely to be materially impacted by each peril (Table 2). For bushfire, cyclone, flood and storm, these estimates were derived using COMBUS catastrophe modelling outputs combined with Insurance Council of Australia catastrophe data. This provided an estimate of the proportion of properties exposed to non-trivial peril risk and therefore the likelihood that tenants would experience associated harms.

Table 2 - Proportion of NSW properties exposed to each peril that are AHO & ACHP (Source: Finity)

Peril	AHO & ACHP properties impacted as a proportion of all NSW properties
Bushfire	0.017%
Cyclone	0.025%
Flood	0.210%
Storm	0.414%
Heat	0.511%

For heat stress, the occurrence assumption was derived differently. Heat exposure was measured using the Wet Bulb Globe Temperature (WBGT), a common metric of heat stress that reflects thermal conditions more closely than dry-bulb temperature alone. The proportion of properties impacted by heat was estimated by comparing the number of days above 28°C WBGT in 2025 for AHO properties with the corresponding measure for NSW more broadly. Heat was modelled using the same general health and psychological assumptions as other perils, except that temporary displacement was not assumed for heat stress events.

Adjustments for First Nations population

Where possible, national assumptions were adjusted to better reflect First Nations population health burdens and service-use patterns. This included:

- applying Indigenous-to-non-Indigenous adjustment to disability-adjusted life years (DALY) to adjust chronic disease prevalence assumptions; and
- applying Indigenous-to-non-Indigenous ratios in average health expenditure per person to adjust the cost of health-related impacts.

These adjustments were intended to recognise that the baseline burden of disease and the consequences of disaster-related exacerbation are not well represented by general-population averages alone.

Qualitative assessment

The quantitative model deliberately focused on the subset of wellbeing impacts that could be estimated through a losses-avoided framework. However, not all benefits of resilient housing are directly quantifiable. For this reason, the wellbeing assessment also included a qualitative component to identify and interpret broader wellbeing effects and feedback loops that sit outside the linear CBA model.

This qualitative work drew on a systematic review of post-disaster literature and metadata, including broader research on social vulnerability and interacting climate risks. It was used to

identify pathways through which disasters may reinforce existing disadvantage over time, such as repeated-event effects, increased exposure to family violence, strain on economic capital, barriers to recovery, and the compounding vulnerability experienced by women, First Nations communities, and other marginalised groups. In particular, the qualitative assessment recognised that natural disasters could intensify social vulnerability in a way that increases future risk, creating reinforcing cycles that are not fully captured in standard actuarial or economic models.

Accordingly, the qualitative assessment served two purposes: first, to highlight important wellbeing effects not monetised in the quantitative analysis; and second, to support interpretation of the quantified results by showing how resilient housing may deliver broader social value through reduced vulnerability, improved stability, and stronger community resilience.

Figure 7 - High-level process for qualitative assessment



The approach was similar to that described in (Paddam, Yong, & Elliot, 2024).

Stage 2 – Property Resilience Assessments

To develop an understanding of a dwellings resilience to perils, the AHO engaged independent assessors to complete a sample of 502 property condition assessments (PCAs). The assessments were spread across 34 LGAs, with each assessment completing a structured questionnaire and gathering photographic evidence. The assessment method was developed by Finity in collaboration with RBC experts and the AHO to balance the need to be efficient yet detailed enough to provide adequate data for the analysis of property level resilience.

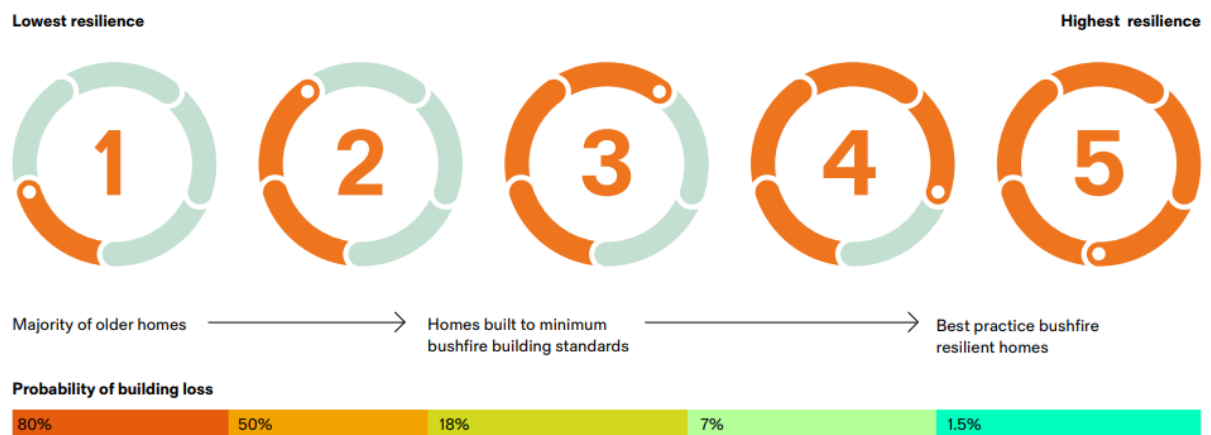
The sample was deliberately designed to cover a range of hazard exposures and geographies. Broadly, 50% of the sample was drawn from properties with the highest flood risk, 25% from those with the highest heat exposure, 12.5% from the highest bushfire risk, and the remaining 12.5% from properties with material cyclone or storm scores. ACHP properties were excluded from inspection for access reasons but were included later in portfolio extrapolation.

The PCA process collected detailed information relevant to resilience assessment, including building form, age band, roof type and condition, external wall construction, windows and doors, seals, shielding, attached structures, vegetation and landscaping, and a range of peril-specific vulnerability indicators. For flood, the PCAs were particularly valuable because they captured actual floor heights and physical characteristics that materially affect inundation damage. These were then used to recalculate flood AALs, incorporating more accurate first-floor height data.

The RBC then used the PCA information and photographs to assign hazard-specific resilience ratings to the sample homes. These ratings were produced for flood, bushfire, storm (including cyclone) and heat. The RBC system rates a dwelling from 1 to 5 stars according to the residual risk of building loss once both site exposure and building performance are considered. A key feature of the system is that it measures passive protection—that is, the inherent capacity of the building to withstand a hazard event—rather than assuming the presence of active systems (e.g. water sprinklers or air conditioning) or human intervention (e.g. firefighting) during an emergency. In Australia, standard code-compliant construction typically corresponds to a rating between 2 and 3 stars, while older homes commonly sit at 1 to 2 stars, and higher quality builds

that are substantially more capable of withstanding natural disasters reach 4- or 5-star ratings. Example of a resilience rating system for bushfire can be found in the Figure 8 below.

Figure 8 - RBC resilience ratings for bushfire (example)



The RBC also provided tailored retrofit recommendations and estimated retrofit costs for each assessed property. These costings represent the “cost” part of the CBA that was later conducted. Retrofit recommendations were hazard-specific but often had cross-peril benefits:

- *Flood* - drainage improvements, wet-area materials, raised services and water-resistant wall linings.
- *Bushfire* - non-combustible cladding, fire-rated doors and seals, ember screening, roof sealing and vegetation management.
- *Storm* - roof, gutter, window and door upgrades.
- *Heat* - shading, insulation, glazing, roof colour changes and passive ventilation improvements.

The RBC also provided advice on the expected reduction in future damage costs (Average Annual Loss (AAL)) if the works are undertaken (Table 3):

Table 3 – Expected disaster cost reduction passed onto consumers from the RBC for flood, bushfire and storm

Resilience Rating (Stars)	Resilience Range (Decimal)	Damage Ratio Band (%)	Reduction in AAL (%)
1	0.0 - 1.4	57 - 72	0
2	1.5 - 2.4	32 - 56	10
3	2.5 - 3.4	13 - 31	20
4	3.5 - 4.4	1.6 - 12	40
5	4.5 - 5.5	0.8 - 1.5	60

To assess resilience to Heat, the project applied the RBC heatwave resilience model, developed in association with the University of Wollongong’s Sustainable Buildings Research Centre. This model evaluated passive building performance under an extreme heatwave and blackout scenario using simulated building physics across Australia’s heatwave climate zones. Recommended interventions focused on improving passive thermal performance, including shading, insulation, glazing, ventilation pathways, and reflective or lighter roof colours. This is particularly important in public housing because passive resilience continues to provide value

during blackouts and does not depend on tenants being able to afford or operate air-conditioning.

Because only 502 homes were physically assessed in the sample, a statistical modelling approach was used to extend the resilience results to the broader portfolio. A SHapley Additive exPlanations (SHAP) model was used to decompose how selected property, peril risk and geographic features contributed to a modelled resilience score. These SHAP-based profiles were then used to identify assessed properties with similar model-driven characteristics, enabling retrofit recommendations and associated resilience attributes to be mapped more consistently to unassessed homes. This was undertaken separately for each peril. Performance was stronger for those perils with larger training samples, such as heat and storm which every property was at risk from.

This extrapolation step was central to the project's practical use. It enabled the AHO to move from a physically assessed sample to a portfolio-wide view, estimating not only resilience ratings for the broader stock but also the cost and benefit implications of different resilience-building programs.

Stage 3 – Cost Benefit Analysis

The third stage of the project was a cost-benefit analysis that considered direct savings to the AHO from reduction in future damage costs and benefits to tenant wellbeing. The CBA produced benefit-cost ratios (BCRs), net present values, total retrofit costs, and total benefits by hazard and program. This allowed the AHO to compare resilience options not only by engineering feasibility, but also by economic efficiency and tenant outcomes.

Five standard programs were modelled for each peril:

- *Program 1:* Improve resilience for all properties with risk
- *Program 2:* Improve resilience so that all properties are at least 3-star rated - new homes built to the minimum National Construction Code (NCC) standard typically achieve between 2 and 3 stars for resilience. In contrast, older buildings constructed before relevant building standards were introduced average around 1.5 stars. This includes homes built before the 1980s for cyclone risk, before the 2010s for bushfire, and before 2012 for flood. Given this, the AHO could consider upgrading all properties to achieve at least a 3-star resilience rating, aligning with modern construction standards.
- *Program 3:* Properties with benefit due to damage reduction resulting in BCR greater than 1. This program ignores any wellbeing benefit and includes property on a property damage reduction basis only.
- *Program 4:* Properties with damage reduction BCR less than 1 but with wellbeing improvements resulting in BCR greater than 1. This program considers properties that only have a BCR greater than 1 if wellbeing benefits are also considered. Wellbeing benefits per property here is estimated using the average reduction in damage across all properties with risk (Program 1).
- *Program 5:* Properties that contribute to a portfolio BCR greater than 1 due to combined benefits from damage reduction and wellbeing improvements across the portfolio (rather than necessarily on an individual property level). Properties are sorted by largest combined benefits first and then selected for the program until portfolio BCR is 1. This program effectively subsidises some properties with less than 1 BCR with properties with much higher than 1 BCR to give an overall portfolio level BCR that is greater than 1. Like Program 4, wellbeing benefits per property here is estimated using the average reduction in damage across all properties with risk (Program 1).

- For flood, one additional program, raising the property habitable floor height, has also been considered.

4. Results and Insights

Results showed that a positive business case exists for resilience investment into a housing portfolio, consisting of a range of residential property types, by retrofitting or upgrading the property to make it more resilient to natural disasters. The benefits were largest when considering the amplification of risk in a high emissions scenario however there was still a positive case for investment, in some programs, based on a low emissions scenario.

For example, when considering undertaking works for all perils at all properties with risk, the total benefits fall approximately by \$215 million in a low emissions scenario. With retrofit costs remaining the same, the overall benefit-cost ratio decreases from 1 to 0.8. Focusing on certain perils, and doing selective work programs, becomes more important to ensure a higher BCR for resilience investment under a low emissions scenario.

Summary of results for all programs under the high emissions scenario

The overall benefits from undertaking works were substantially higher when wellbeing benefits were also considered (Table 4) with a maximum benefit of \$1.2b able to be realised by investing in all recommended works, across all properties with disaster risk under a high emission scenario (note that this would include preparing some properties for future risk now). While this option, to invest in as much as possible, may be unlikely due to the cost, it is worth noting that the BCR was 1 (neutral) when considering reduced future costs of disasters and wellbeing benefits. This business case could be strengthened further for this kind of program by considering wider community and economic benefits, reduced future emergency response costs etc.

Table 4 – Summary of key metrics from CBA for five programs for all resilience under the high emissions scenario

Program	Whole Portfolio	
1 – Improve resilience for all properties with risk	Retrofit cost:	\$ 1,242m
	Damage reduction:	\$66m
	Wellbeing benefit:	\$1,115m
	BCR:	1.0
	# properties:	13,371
2 – Improve resilience so that all properties are at least 3-star rated	Retrofit cost:	\$ 662m
	Damage reduction:	\$40m
	Wellbeing benefit:	\$579m
	BCR:	0.9
	# properties:	11,937
3 – Properties with benefit due to damage reduction resulting in BCR greater than 1	Retrofit cost:	\$ 1m
	Damage reduction:	\$2m
	Wellbeing benefit:	\$1m
	BCR:	2.1
	# properties:	42
4 – Properties with damage reduction BCR less than 1 but with wellbeing improvements resulting in BCR greater than 1	Retrofit cost:	\$ 622m
	Damage reduction:	\$22m
	Wellbeing benefit:	\$841m
	BCR:	1.4
	# properties:	13,362
5 – Properties that contribute to a portfolio BCR greater than 1 due to combined benefits from damage reduction and wellbeing improvements across the portfolio	Retrofit cost:	\$ 652m
	Damage reduction:	\$26m
	Wellbeing benefit:	\$921m
	BCR:	1.5
	# properties:	13,175

When focusing exclusively on the lowest resilience properties (Program 2), an investment of \$662M into resilience across nearly 12,000 properties could provide confidence that the resilience standard of properties is being uplifted where it is most needed, despite the BCR being 0.9 due to the disaster cost reductions being realised more. This reflects the fact that most disaster cost reductions only materialise when properties achieve higher resilience ratings. For example, a move to a 3-star rating delivers an average reduction in annual average loss (AAL) of around 20 per cent, compared to reductions of approximately 40 per cent at 4 stars and 60 per cent at 5 stars.

Only a small number of properties (42) had a positive BCR when only considering damage reduction benefits. Investing in these 42 homes resulted in the best BCR when considering all perils (BCR 2.1). This shows that investing in properties with positive benefit from a damage reduction perspective alone, provides a favourable approach for resilience investment, however, only addresses a very small number of properties.

Property portfolio managers may see substantial cost savings if looking to build resilience to multiple perils as activities such as installing bushfire rated shutters can provide protection from flood and heat stress. This has not been accounted for in this assessment.

4.2 Results by Peril

Risk

Flood impacts 12% of properties currently (1,524), with this expected to increase to 30% (3,989) under a high emissions scenario by 2050. While this extension of flood risk is important to plan for, the properties with current extreme flood risk, and 20 which move into the extreme flood risk band, are the most important properties to focus on for resilience building or disposal considerations.

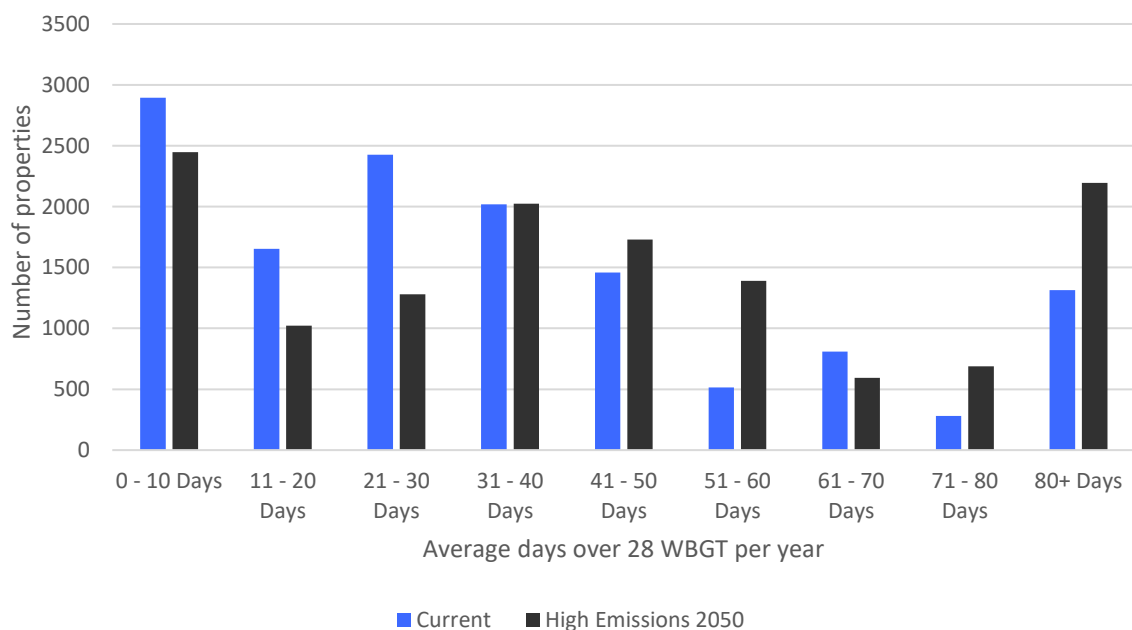
70% of the properties (9,380) assessed are at risk from bushfire currently. Most alarmingly, by 2050 the 865 properties that currently have very low risk to bushfire move to having a higher risk level. 251 more properties have high risk and 48 more have very high risk in a high emissions scenario.

Storm and extreme heat effected all properties. Storm is a high-frequency, lower-severity peril with very broad reach across both the asset base and tenant population. Storm risk did not increase in a high emissions scenario at 2050 like the other perils. Although all properties remain exposed, the distribution of risk shifts, with fewer homes in the extreme, very high and very low categories and more in the high, medium and low risk bands. Around 250 homes decreased in risk while similar number increased from very low band.

Heat exposure was measured using Wet Bulb Globe Temperature (WBGT) above 28°C. Under the high emissions scenario, aggregate heat stress increases sharply over time, with the total number of days above this threshold more than doubling by 2090.

Figure 9 below illustrates how the number of extreme heat days experienced by properties changes between current day and under the high emissions scenario in 2050. When we focus on those properties that are already experiencing extreme heat conditions, with more than 50 days of extreme heat per year, there is an increase of 67% between present day and the high emissions future (number of properties rising from 2921 to 4868). This represents a significant intensification of heat stress across the portfolio.

Figure 9 - Number of days for properties experience WBGTs above 28 degrees Celsius



Cost-benefit analysis for resilience

Results by peril can be considered by looking at the programs with the highest BCR or the ability to raise resilience of the portfolio.

BCR

Table 5 on the next page shows the perils and programs that achieved the highest BCRs. The top BCR was achieved in flood (BCR 8.8) for the 86 properties that could be raised above flood height (raising floor height to less than 2.7m, or one standard flood level, would take the property outside of the flood event and lower risk to zero). This strong result reflects the very large reduction in expected flood impacts where habitable floor levels can be lifted above severe events, although implementation would still require property-by-property confirmation of site feasibility and planning constraints, and tenants would need to be able to safely evacuate during an event.

Raising resilience to storm provided the next highest BCRs when considering investing in the one property with a positive BCR due to damage reduction benefits alone. Investing \$7,500 into this home, sees \$30,000 of benefit due to damage cost reduction and wellbeing, and a BCR of 4. While this is an interesting case study, it only provides risk reduction to one home. The next best BCR is 3 which is realised when looking at 2,446 properties with have a positive BCR when considering both damage reduction and wellbeing benefits (Programs 4 & 5).

Flood Program 3, which focused on raising the resilience of 17 properties that had a positive BCR when considering damage reduction alone, achieved a BCR of 2.1 and flood Program 2 which looked at raising the resilience of all properties with a resilience rating less than three achieved the next best BCR of 2. Figure 11 shows the BCR, retrofit cost, and number of properties affected for flood under the high emission scenario for the six programs.

The highest BCR programs for bushfire were realised when focusing on the 24 properties with positive results from disaster damage reduction alone (Program 3) or those with positive results including wellbeing benefits (Program 4). These results suggest that bushfire resilience is best pursued through focused interventions in the highest-risk clusters, rather than through portfolio-wide retrofit. The business case may also be strengthened where bushfire upgrades can be coordinated with planned maintenance cycles or where the same works deliver cross-peril benefits, such as roofing improvements, sealing, or upgrades to external materials.

Heat is the only major peril in the study for which the quantified benefits are driven entirely by wellbeing rather than insured loss. The quantitative results for heat were particularly strong under every program. The most targeted program that lifted all sub-3-star homes to at least 3 stars covered approximately 6,100 dwellings, required around \$237 million, and achieved a slightly stronger BCR of 1.5 compared to retrofitting the entire portfolio (Program 1) which required an estimated \$530 million on investment and produced a BCR of 1.4 under the high emissions scenario, with an average reduction in thermal exceedance of roughly one quarter and estimated wellbeing benefits of \$743 million.

In contrast to bushfire and flood, the results for heat show that even broad portfolio-level heat programs can be justified on wellbeing grounds alone. They also suggest a strong strategic case for embedding heat resilience into planned maintenance and refurbishment cycles, particularly given the additional co-benefits for energy affordability and thermal comfort, which were not fully captured in the CBA.

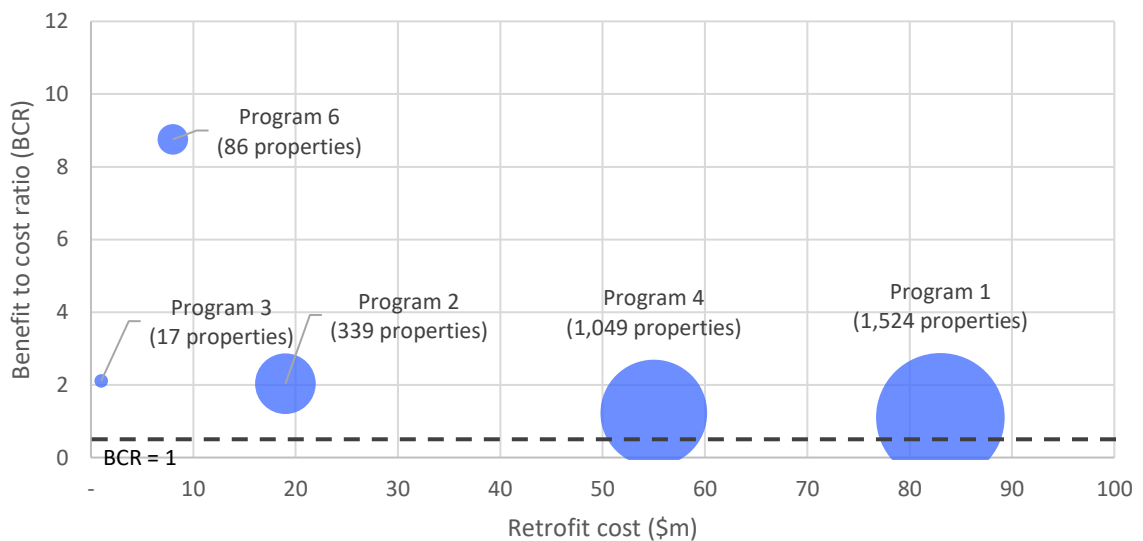
As in heat stress, the results for storm resilience lie far more in avoided tenant harms than in reduced insured losses alone. For storm, the ratio of wellbeing benefits to avoided disaster costs was approximately 9:2, substantially higher than for flood or bushfire. This is a significant finding, as it demonstrates that for frequent hazards with broad exposure, most of the value comes from reducing psychological distress, health impacts and disruption to housing stability,

rather than from building loss alone. In turn, this highlights why public sector resilience decisions can differ markedly from decisions based only on insured-loss logic.

Table 5 - Summary of perils and programs that achieved the highest BCR's under the high emissions scenario

Peril & Program	Results	
Flood Program 6 – Raise property habitable floor height	Retrofit cost:	\$8m
	BCR:	8.8
	# properties:	86
Storm Program 3 - Properties with benefit due to damage reduction resulting in BCR greater than 1	Retrofit cost:	\$0.01m
	BCR:	4.0
	# properties:	1
Storm Program 4 & 5 - Properties with damage reduction BCR less than 1 but with wellbeing improvements resulting in BCR greater than 1	Retrofit cost:	\$36m
	BCR:	3
	# properties:	2,446
Flood Program 3 – Properties with benefit due to damage reduction resulting in BCR greater than 1	Retrofit cost:	\$1m
	BCR:	2.1
	# properties:	17
Flood Program 2 – Improve resilience so that all properties are at least 3-star rated	Retrofit cost:	\$19m
	BCR:	2.0
	# properties:	339
Bushfire Program 3 - Properties with benefit due to damage reduction resulting in BCR greater than 1	Retrofit cost:	\$0.4m
	BCR:	1.9
	# properties:	24
Heat Program 2 – Improve resilience so that all properties are at least 3-star rated	Retrofit cost:	\$237m
	BCR:	1.5
	# properties:	6,094
Bushfire Program 4 - Properties with damage reduction BCR less than 1 but with wellbeing improvements resulting in BCR greater than 1	Retrofit cost:	\$0.7m
	BCR:	1.5
	# properties:	47

Figure 10 - BCR, retrofit cost, and number of properties affected for flood under the high emission scenario (larger size of circle indicates more properties)

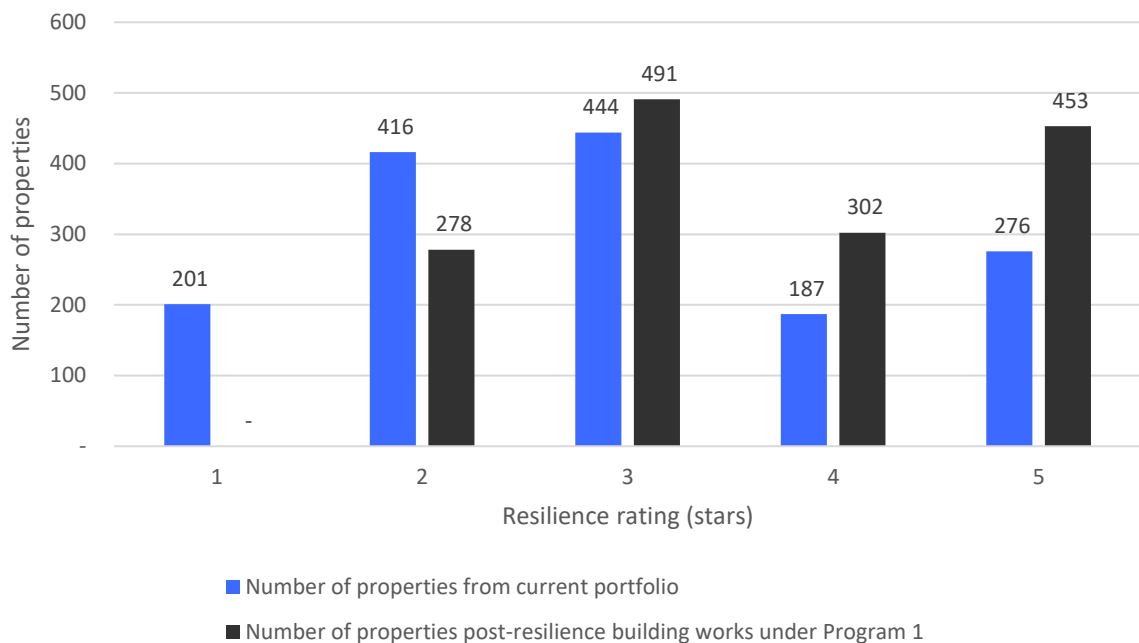


Resilience rating

Resilience ratings can be considered on their own as a driver for resilience investment and as a proactive management approach. Property portfolio managers could focus on building resilience across the portfolios in all properties with risk (Program 1) or focus on the lowest resilience rated homes (Program 2 focuses on building resilience in all properties with a rating less than 3).

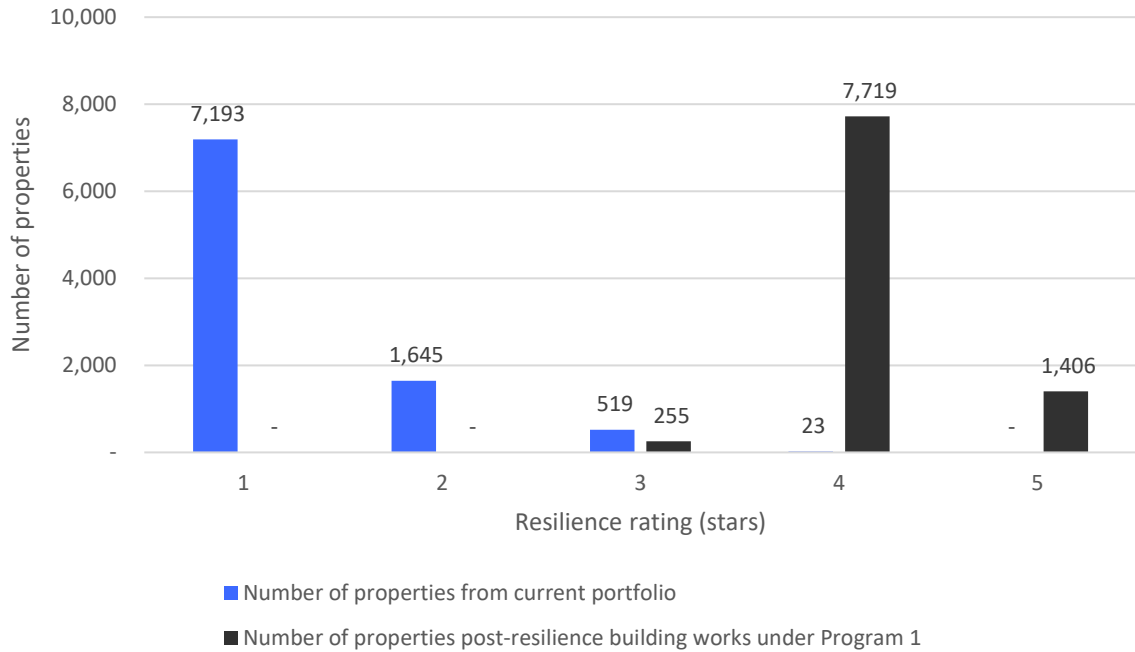
For flood, investing in all at-risk properties (BCR 1.1) shifts resilience ratings upwards, however, around 50% remain at a 2 and 3 star rating (Figure 11). A more selective program that focuses only on the 340 homes below 3 stars, achieving a BCR close to 2 under the high emissions scenario, still achieved resilience rating uplift. In some instances, raising the property can provide a greater uplift in resilience rating for flood.

Figure 11 - Property portfolio flood resilience ratings from current portfolio and after undertaking resilience work under Program 1



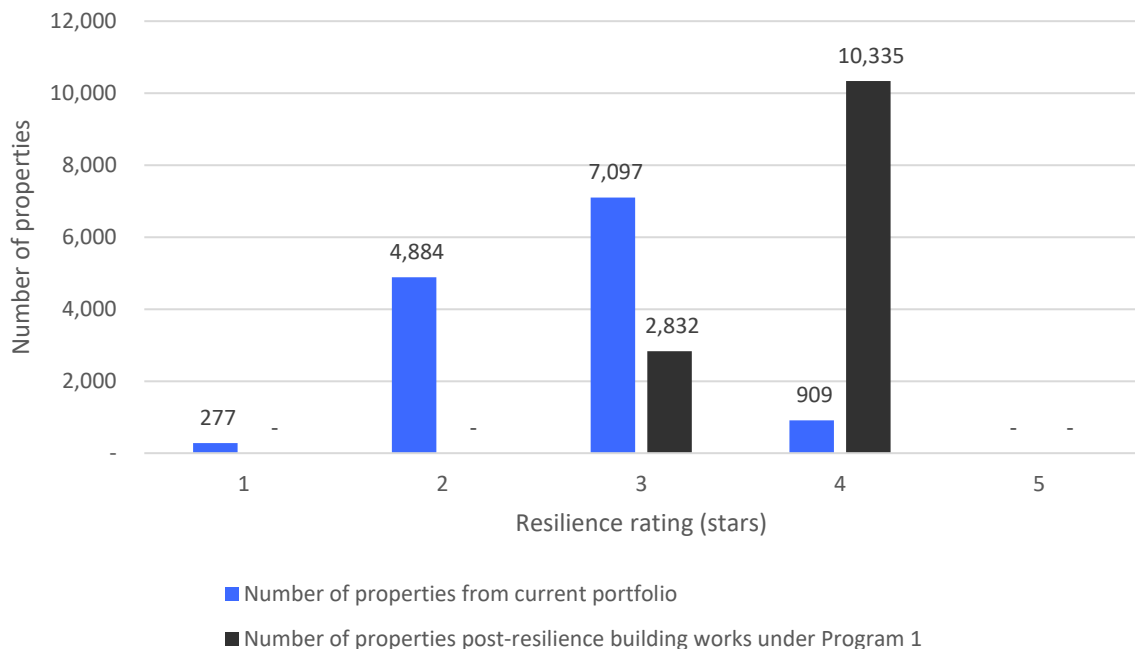
For bushfire risk, there is clear evidence that targeted resilience investment can substantially improve outcomes for both people and property. As shown in Figure 12, investment across all at-risk properties under Program 1 drives a marked upward shift in resilience ratings, with the portfolio moving from predominantly 1-star properties to mostly 4-star or higher. Only a small number of properties remain rated at 3 stars, and none remain below this level.

Figure 12 - Property portfolio bushfire resilience ratings from current portfolio and after undertaking resilience work under Program 1



Possible shifts in storm resilience ratings were equally as evident as for bushfire. Retrofitting the full portfolio, sees all properties become rated 3 or 4 stars (Figure 13). A targeted program covering 5,161 properties with resilience ratings less than 3, achieved a slightly improved BCR that program 1 (BCR 0.9) while ensuring that all properties were a 3 star or higher post investment.

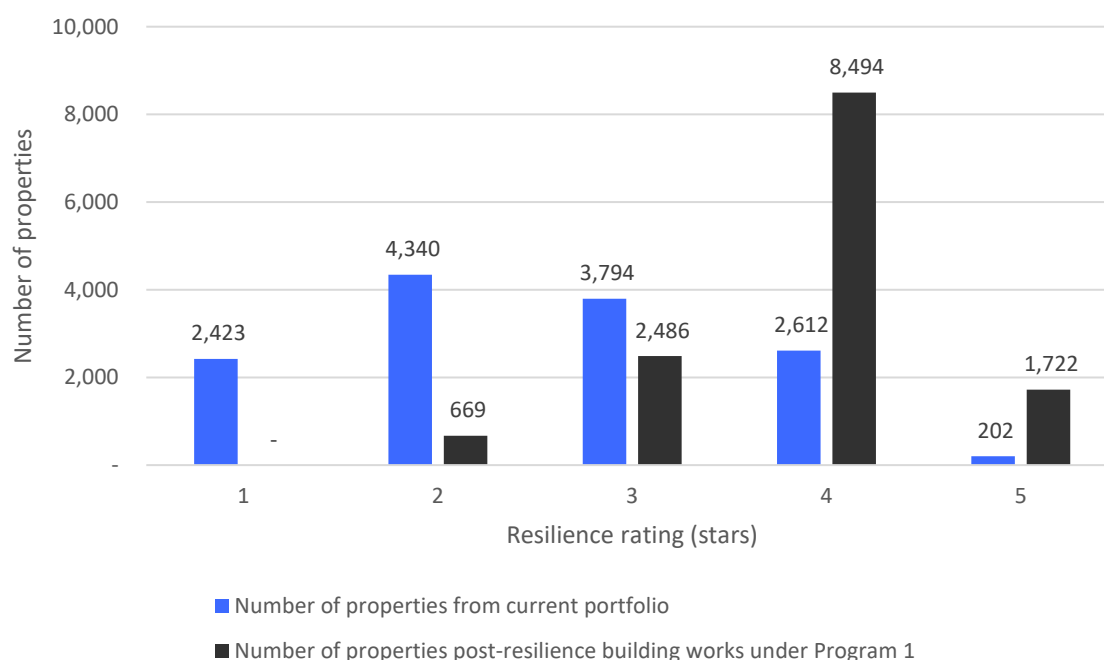
Figure 13 - Property portfolio storm resilience ratings from current portfolio and after undertaking resilience work under Program 1



For heat stress, completing works on the full portfolio to build resilience to heat sees a large shift in housing resilience, with most properties becoming 4-star rated and none remaining at 1-star (Figure 14).

A more targeted program that lifted all sub-3-star homes to at least 3 stars covered approximately 6,100 dwellings, required around \$237 million investment, and achieved a slightly stronger BCR of 1.5. In contrast to bushfire and storm, these results show that even broad portfolio-level heat programs can be justified on wellbeing grounds alone. They also suggest a strong strategic case for embedding heat resilience into planned maintenance and refurbishment cycles, particularly given the additional co-benefits for energy affordability and thermal comfort, which were not fully captured in the CBA.

Figure 14 - Property portfolio heat resilience ratings from the current portfolio and after undertaking resilience work under Program 1



A focus on uplift of resilience ratings could enable setting of minimum standards, or targets, to foster pro-active management of resilience ratings across portfolios. This could further be accompanied by a certification program that may see insurance savings such as in the RBC’s bushfire resilience certification program, where discounts are provided by insurers on the bushfire peril component of their insurance policy for any properties with a certified Bushfire Resilience Rating of 3 stars or above¹.

Wellbeing benefit ratios

Research shows that most costs from natural disasters are not captured by insured losses alone, and there are more costs associated with non-building related items (Andrews, et al., 2016). Table 6 shows the ratio of wellbeing benefits to disaster costs from our analysis.

Table 6 – Ratio of wellbeing benefits to disaster costs under high emissions scenario

Hazard / peril	Reduction in disaster costs (\$m)	Wellbeing benefits (\$m)	Ratio	Number of properties with non-zero risk	Proportion of properties impacted from events in NSW
Flood	20	72	3.6	1,524	0.210%
Storm	28	258	9.2	13,167	0.414%
Bushfire	17	42	2.4	9,380	0.017%

¹ <https://rbccouncil.org/certify-my-rating/#:~:text=Certification%20is%20valid%20for%203,need%20for%20your%20expert%20review>

Storm had the highest ratio of wellbeing benefits to reduction in disaster costs (9.2) given the frequency of storms is highest among the three perils, and so the number of properties that are impacted are the highest. Average claim sizes or building damage for storms tend to be smaller compared to other perils, hence even with all properties exposed to storm risk, the reduction in disaster costs of \$28m is not much larger than the other perils like bushfire (\$17m) and flood (\$20m). Furthermore, storm risk is projected to remain roughly the same under high emissions scenario and so the potential benefit of reducing these costs is less compared to the other perils. However, since the size of wellbeing benefits correlate to the number of tenants impacted, the wellbeing benefits are the largest compared to other perils.

Flood has the next highest ratio of 3.6. The proportion of properties affected by flood is less than that for storm, and the number of properties with non-zero flood risk is much less than every other peril. Floods do not have the same widespread effect as storms and only impact much fewer number of properties. The average claim size or building damage for floods is higher than storm but less than bushfire. Flood risk is also projected to increase under the high emissions scenario, which increases the potential benefits for both building damage reduction and wellbeing benefits.

Although almost 10,000 properties in the assessed portfolio had some level of bushfire risk, only 0.017% are expected to be impacted over a year. Hence the reduction in disaster costs and wellbeing benefits are the lowest in bushfire compared to other perils.

5. Key messages and next steps

The core analytics used through this assessment are the combination of the property-level resilience rating framework developed by the RBC for flood, bushfire, storm and heat stress and a cost-benefit analysis that combines direct building loss reduction with quantified wellbeing benefits. In parallel with physical risk, the study therefore places explicit value on wellbeing (which is typically not taken into consideration for similar analyses). This produces a practical framework that converts hazard risk into credible business cases for targeted resilience programs. Findings show that targeted programs can achieve strong benefit-cost ratios (BCRs) for direct benefits due to disaster loss reduction, while the addition of wellbeing considerations enables further resilience building activities to be undertaken while still maintaining an investment-neutral or better business case. This framework therefore offers a structured way for public asset owners to prioritise resilience upgrades by peril, region and feasibility, while focusing on tangible improvements to housing outcomes and community resilience.

This project demonstrates the value of applying an integrated resilience lens to public housing. It shows that credible climate adaptation assessments can, and should, incorporate tenant wellbeing, producing a materially different investment frontier than one based on insured losses alone. By using simple, transparent program archetypes and a common resilience rating scale, the framework gives decision-makers a practical language to design, sequence and prioritise upgrades, while setting targets that are meaningful to communities and measurable by delivery teams. The framework is designed to support strategic choices beyond any single cost-benefit ratio, combining hazard risk, resilience ratings, wellbeing impacts and feasibility to guide what to do first, where and how.

The project provides three major lessons for resilience planning in public housing:

First - Wellbeing should be incorporated into adaptation business cases.

If the assessment had focused only on direct property damage reduction, many storm and heat resilience programs would appear unjustifiable. Yet once avoided psychological harms, chronic disease burdens and other social impacts are included, several of those same programs become economically viable. This matters because public housing providers and government do

not experience climate impacts only through claims and repairs; they also bear costs through health systems, social services, tenant disruption and diminished housing outcomes.

Second, program design matters.

Flood illustrates that broad retrofits can have marginal investment benefit, but targeted programs, particularly house raising, can deliver very high returns. For bushfire, portfolio-wide treatment is often uneconomic, but carefully selected clusters of properties remain worthwhile. Storm resilience shows that portfolio-level programs can be justified by aggregated wellbeing benefits even where property-level benefits are modest. Heat resilience, by contrast, is well suited to gradual, maintenance-led uplift across a broad share of the housing stock.

Third, resilience ratings provide a practical decision language.

The RBC framework turns technical hazard and building-vulnerability information into a standardised scale that can be used by asset managers, insurers, funders and communities to proactively build resilience. Rather than asking only whether homes are “at risk”, decision-makers can set clear targets; for example, lifting the portfolio from 1–2 stars to a minimum 3-star standard, or identifying where 4–5-star performance is required for severe hazards such as extreme flood. This enables transparent prioritisation, sequencing of works and measurable progress over time.

Applicability and extension

There is a significant opportunity for resilience funding to support defined programs of work aimed at strengthening resilience in First Nations social housing. The modelling methods and analytical approach used in this assessment could be applied broadly to any residential property portfolio.

The resilience investment business case could be further extended by considering:

- Reduced state emergency costs,
- Medical cost savings from avoided injury
- Improved productivity because of reduced disruption
- Reductions in emissions costs
- Improved property and land values
- Reduced energy costs/costs of running the property

A key next step for extension of this work is investment in developing methods to assess community buildings and critical infrastructure, enabling proactive resilience investment business cases that protect not only housing assets but also communities and regional economies.

Housing providers with responsibility for tenant safety, insurers seeking to reduce risk concentrations within their portfolios, and financial institutions aiming to limit default risk can all use resilience ratings to drive proactive uplift in building resilience. In this way, resilience ratings can act as a common decision-making tool across the housing, insurance and finance sectors.

6. Limitations

Housing providers with a responsibility for the safety of their tenants, insurers wanting to reduce risk in their portfolios, or banks wanting to reduce risk of defaults, can use resilience ratings of properties to drive proactive uplifts of resilience.

Housing providers with a responsibility for the safety of their tenants, insurers wanting to reduce risk in their portfolios, or banks wanting to reduce risk of defaults, can use resilience ratings of properties to drive proactive uplifts of resilience.

This analysis is subject to data, modelling and scope limitations typical of portfolio-scale studies.

The property resilience assessment was reduced compared to the RBCs full assessment methodology and only 502 properties were physically assessed, with resilience ratings for the broader portfolio inferred statistically.

The modelling focuses on a subset of climate hazards (bushfire, cyclone, flood, storm and heat). Other risks including drought, air pollution, transition risks, and compound or cascading events, were not considered.

Climate projections are based on ensemble averages across scenarios, and actual outcomes will depend on future emissions and local variability. Property-level vulnerability was approximated using average characteristics due to limited data on construction and resilience features. During stage 2, the PCAs provided individual property vulnerability data for a sample of properties that was then extrapolated to the remaining portfolio.

Cost estimates are indicative and designed for strategic planning rather than procurement. The economic assessment focuses on direct resilience benefits and does not capture broader system impacts or co-benefits, such as other health outcomes, social cohesion, energy savings, or regional economic effects.

Finally, the wellbeing model reflects average tenant characteristics and does not capture the full diversity of household circumstances or the broader social and cultural impacts of displacement.

These caveats point to next steps: deepen the property dataset through additional condition assessments; run pilots that test installation methods, unit costs and realised rating uplift; and integrate post-event evidence to refine analysis.

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