ACIL ALLEN

22 February 2024

Report to Australian Building Codes Board

Waterproofing provisions in NCC 2025

Impact analysis of proposed changes

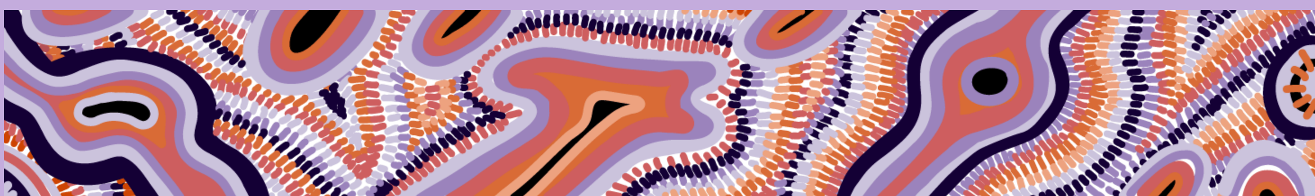
About ACIL Allen

ACIL Allen is a leading independent economics, policy and strategy advisory firm, dedicated to helping clients solve complex issues.

Our purpose is to help clients make informed decisions about complex economic and public policy issues.

Our vision is to be Australia's most trusted economics, policy and strategy advisory firm. We are committed and passionate about providing rigorous independent advice that contributes to a better world.

ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.



Goomup, by Jarni McGuire

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Executive summary

In 2020, Building Ministers approved the Australian Building Codes Board's (ABCB) work program for 2020-21. This program included a key project to develop weatherproofing and waterproofing provisions for the National Construction Code (NCC) — the Waterproofing and Water Shedding Project.

The **first stage of the Waterproofing and Water Shedding Project involved the development of Deemed-to-Satisfy (DtS) weatherproofing and waterproofing provisions for inclusion in NCC 2022**. These changes were included without conducting a Regulatory Impact Assessment (RIA) because they did not represent an increase in stringency.

The Waterproofing and Water Shedding Project is now in its **second stage**. This stage **involves further changes to both the Performance Requirements and DtS provisions** (including new provisions where relevant) **to address specific waterproofing failures in buildings**. These changes are the **focus of this report**.

In June 2022, the ABCB Board requested the ABCB Office establish a Technical Reference Group for the Waterproofing and Water Shedding project (TRG) to progress the second stage of the Waterproofing and Water Shedding Project. The broad objectives of the TRG have been to:

— clearly establish and identify the scope of the problem relating to waterproofing failures (including the types and quantum of waterproofing issues facing the building and development industry)
— establish if there is a need to make further changes to the NCC to address these failures.

The TRG comprises industry and professional body representatives and the NSW Building Administration.

The TRG met on 9 occasions since June 2022 and took a number of steps to meet its objectives and recommend changes to the DtS provisions and Performance Requirements in NCC to address waterproofing failures in buildings.

With the assistance of the TRG, the ABCB Office developed proposed changes to the Performance Requirements and DtS (including new and amended provisions) for inclusion in the NCC 2025. These have been written to mitigate and prevent waterproofing defects prevalent in the building and construction industry. The proposed provisions are outlined in Appendix D and the key changes are summarised Chapter 5.

As part of the NCC 2025 development process, the ABCB engaged ACIL Allen to undertake a Cost Benefit Analysis (CBA) of the proposed changes to NCC waterproofing Performance Requirements and DtS provisions.

What is the problem?

There is growing evidence about the high prevalence of waterproofing defects in Class 2 to Class 9 buildings in Australia (see additional discussion in the following sections).

While there is no systematic collection of information about the causes of waterproofing defects in buildings, an analysis of data provided by the ABCB from a sample of buildings with waterproofing defects shows that **sub-surface water is responsible for the majority of waterproofing defects in Class 2 to 9 buildings**. Furthermore, anecdotal evidence discussed in TRG meetings suggests that the percentage of defects caused by sub-surface water is higher than that shown in the sample of data provided by the ABCB. A range between 80% to 90% was nominated by some members who are experts in consultative remedial work.[1]

Feedback received by the ABCB Office through the Board's technical committees and working groups also indicates that **the absence of adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water to buildings is contributing to waterproofing defects**. The absence of adequate provisions in the NCC results in a reliance on performance solutions, but there is a hit-and-miss approach to these performance solutions, leading to poor design and documentation, and sub-standard construction outcomes.[2]

Waterproofing issues and their relationship to NCC provisions were discussed during several meetings of the TRG to clearly identify and articulate the problem related to waterproofing and establish if this could be addressed by making changes to the NCC. The agreed definition of the problem, at which the TRG arrived, is described in the following statement.

> While the NCC covers some issues relating to surface water, there is an absence of adequate Performance Requirements and DtS provisions responding to the ingress of sub-surface water to the building or elements of its fabric. Further, the NCC does not effectively provide for the collection, redirection, and drainage of sub-surface water and to a lesser extent surface water.
>
> ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 6

Size of the problem

The problem that the proposed waterproofing provisions are aiming to address is the absence of adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water, which is a leading cause of waterproofing defects in buildings.

Waterproofing defects impose significant costs on communities and the economy as a whole.

We reviewed existing studies on the prevalence and costs of waterproofing defects and, despite differences in methodologies, most studies in the literature place the **prevalence of waterproofing defects in Class 2 buildings between 20% and 40% of buildings**. Literature on the prevalence of waterproofing defects in **Class 3 to 9 buildings** is limited, but a survey of Class 3 to 9 building managers undertaken by CIE for their Building Confidence Report: a case for intervention[3] indicated that **waterproofing/weatherproofing defects are present in approximately 21% of buildings**, and **roof and rainwater disposal defects in around 16% of buildings**. These estimates should be treated with caution given the small number of

[1] ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 10.

[2] ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 3.

[3] Centre for International Economics 2021, *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

responses to this survey, but are the only estimates available in the literature of the prevalence of waterproofing defects in Australian Class 3 to 9 buildings.

The impacts of these defects on the economy and the community are wide ranging and include[4]:

— the costs to rectify the defects
— increased maintenance costs
— legal costs where there are disputes about the defects
— the costs associated with building evacuations and of alternative accommodation
— higher than necessary insurance premiums (or inability to obtain insurance) for some industry practitioners and affected building owners
— loss of value for affected buildings (which could be due to damage to the building or reputation even after the defects are fixed) or income where it is an investment
— reduced consumer confidence in the building and construction industry
— increased safety risks for people living in defective buildings
— increased anxiety, stress and emotional impacts for building occupants/owners.

Costs of defects' rectification

Rectification costs refer to the cost of the building work that needs to be undertaken to remedy the defect. To produce estimates of the costs of waterproofing defects we reviewed existing studies in the literature and analysed data on rectification costs from a sample of buildings with waterproofing defects provided by the ABCB (additional details of this data are provided in Section 3.1.1). The key findings from this analysis are summarised in the points below.

Notably, rectification costs in the literature are based on different methodologies (e.g. surveys, insurance claims, building records, consultations with experts, etc.), different circumstances/contexts, provided on different bases (e.g. per building, per apartment or per defect) and based in different years. While we have done our best to report these on the same basis, so they are comparable (e.g. converted all costs to the same dollars - $2023 and to the same basis – per apartment/building/etc.), in some instances there are still significant differences in the costs of rectification across studies.

— Rectification costs for Class 2 buildings:
  – vary considerably for roofs, from around $5,000 per building, to approximately $655,000 per building. On a per apartment basis, this is equivalent to between $550 and $6,900 per apartment
  – are broadly in line across sources for balconies/podiums/external enclosures, costing around $24,000 per defect/balcony
  – are significant for basements, estimated around $1.5 million per building (equivalent to around $8,300 per apartment).
— Rectification costs for Class 3 to 9 buildings:
  – are between $461,000 and $687,000 per building for waterproofing defects in roofs
  – are around $40,000 per balcony/podium defect
  – are between $50,000 and $225,000 per internal wet area defect.

Estimates about the prevalence and costs of building defects vary significantly across studies in the literature. They also vary across jurisdictions, with the prevalence and costs assumed to be lower in NSW with the introduction of the *Design and Building Practitioners Act 2020* and

[4] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

the *Residential Apartment Buildings (Compliance and Enforcement Powers) Act 2020,* which apply to Class 2, 3 and 9c buildings.[5] These 2 key pieces of NSW legislation place greater responsibility on building practitioners to ensure proper consideration and application is given to waterproofing design and construction.

Given the range of estimates, the rectification costs associated with waterproofing defects in balconies, podiums, roofs and basements has been estimated based on low, medium and high assumptions. The assumptions underpinning our estimates under each of these scenarios are summarised in Section 3.2.3. In general terms:

- For Class 2 buildings, the assumptions for the:
  - low scenario reflect the lowest estimates for the cost and prevalence of waterproofing defects found in the literature
  - mid scenario reflect the average of all the cost and prevalence estimates found in the literature
  - high scenario reflect the highest estimates for the cost and prevalence of waterproofing defects found in the literature.
- For Class 3-9 buildings, the assumptions for the:
  - prevalence of waterproofing defects is the same across all scenarios (as noted before, there is limited literature on the prevalence of defects in these building classes) and it is sourced from CIE's Building Confidence Report: a case for intervention[6]
  - the low, mid and mid-high estimate scenarios are based on CIE's low/mid/high estimates of overall prevalence of all defects, their low/mid/high estimates for overall costs of all defects and their estimates of prevalence of waterproofing defects
  - high scenario uses the cost of rectifying waterproofing defects estimated from the ABCB dataset.
- The assumptions about prevalence of different areas (balconies/podiums, roofs and basements) across different building classes were informed by stakeholder consultations.

For the purposes of estimating the impacts of the proposed changes to the NCC, we have used the mid estimate as the central case scenario for both Class 2 and 3 to 9 buildings.

Other costs of defects

In addition to the costs of rectifying the defect itself, waterproofing defects have a variety of impacts on the economy and the community. Based on our review of existing studies we found that:

- the costs incurred to obtain professional advice related to waterproofing defects seem to be between $33,000 and $56,600 per defective Class 2 building
- the costs incurred to resolve legal disputes arising from waterproofing defects in Class 2 buildings are broadly around $41,000 per building
- on average, apartment owners spend 46 hours on getting a defect repaired (per apartment).

Other costs mentioned above (e.g. evacuation costs, insurance costs, loss of property value and stress and anxiety) have not been quantified but are qualitatively discussed in Section 3.2.2 of the report.

[5] Details of the assumptions used to estimate the impact of the new NSW on defects and incorporate them in the baseline are provided in Appendix B.

[6] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

Overall size of the problem

Based on the above estimates of the prevalence and cost of defects, together with projections of new residential (Class 2) dwellings and commercial buildings (see Appendix C), we estimated the costs associated with waterproofing defects in balconies/podiums, roofs and basements in new Class 2 to 9 buildings.

As shown in Table ES 1 and Table ES 2, depending on the assumptions used under each scenario (discussed above), it is estimated that waterproofing failures:

— could affect between 1,790 and 15,960 apartments per annum across Australia and cost these buildings between $235 million and $610 million per annum

— could affect over a 1,000 Class 3 to 9 buildings per annum across Australia and cost these buildings between $829 million and $2.4 billion per annum.

Table ES 1 Estimated size of the problem related to waterproofing in new buildings

	Low estimate	Mid estimate	High estimate
Average annual number of new buildings over period 2025-2034			
NSW			
Class 2 residential buildings – single occupancy units (apartments)		18,071	
Class 3-9 (commercial use) buildings		1,538	
All other states			
Class 2 residential buildings – single occupancy units (apartments)		31,438	
Class 3-9 (commercial use) buildings		5,313	
Average annual number of new buildings with waterproofing defects over period 2025-2034			
Class 2 residential buildings			
NSW			
No. apartments with balcony / podium defects	1,325	3,138	4,733
No. apartments with roof defects	1,137	1,960	2,783
No. apartments with basement defects	530	2,385	2,385
All other states			
No. apartments with balcony / podium defects	3,144	7,445	11,228
No. apartments with roof defects	2,697	4,650	6,602
No. apartments with basement defects	1,258	5,659	5,659
Class 3-9 (commercial use) buildings			
NSW			
No. buildings with balcony / podium defects		315	
No. buildings with roof defects		236	
No. buildings with basement defects		315	
All other states			
No. buildings with balcony / podium defects		1,121	
No. buildings with roof defects		839	
No. buildings with basement defects		1,121	

Note: estimates exclude costs associated with internal wet areas and account for the impacts of the introduction of the DBP Act and the RAB Act in NSW (applicable to Class 2, Class 3 and Class 9c buildings).
Source: ACIL Allen estimates.

Table ES 2 Estimated cost of the problem related to waterproofing in new buildings, average cost per year, $M 2023

	Average cost per year, $M 2023
Class 2 residential buildings	
Rectification costs	
Low estimate	$113
Mid estimate	$315
High estimate	$487
Other costs	
Professional costs	$65
Legal costs	$49
Time costs [a]	$9
Subtotal other costs	$123
Total costs (rectification + other costs)	
Low estimate	$235
Mid estimate	$438
High estimate	$610
Class 3-9 (commercial use) buildings	
Rectification costs	
Low estimate	$502
Mid estimate	$753
Mid-high estimate	$1,484
High estimate	$2,064
Other costs	
Professional costs	$185
Legal costs	$139
Time costs [a]	$3
Subtotal other costs	$327
Total costs (rectification + other costs)	
Low estimate	$829
Mid estimate	$1,080
Mid-high estimate	$1,811
High estimate	$2,391

[a] Refers to the value of the time that building owners and occupants spend to rectify waterproofing defects.

Note: estimates exclude costs associated with internal wet areas and account for the impacts of the introduction of the DBP Act and the RAB Act in NSW (which apply to Class 2, 3 and 9c buildings).

Source: ACIL Allen estimates.

Is this problem relevant to the NCC?

As noted above, ingress of sub-surface water to buildings has been identified as the main cause of waterproofing defects in Class 2 to 9 buildings and feedback received by the ABCB Office through the Board's technical committees and technical reference groups indicates that the absence of adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water to buildings is contributing to waterproofing defects.

Waterproofing defects can be caused by a number of factors (e.g. poor maintenance by property owners or inappropriate materials) and can occur at different phases of a building's lifecycle (design, construction or operational phase). Waterproofing defects caused by poor design and construction practices can be minimised through the introduction of adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water to the building or elements of its fabric.

Minimising the probability that waterproofing defects will arise during the design and construction of buildings is the most efficient approach to reduce the costs associated with these defects. Indeed, various studies indicate that addressing waterproofing failures at the design/construction stage is more efficient (less costly) than after buildings have been completed.

Addressing the ingress of sub-surface water in buildings through the introduction of adequate Performance Requirements and DtS provisions in the NCC would be consistent with the goal of the NCC of achieving minimum health, safety and amenity standards efficiently.

While, to our knowledge, there is no systematic Australian data identifying the causes of building defects, we reviewed the findings in the literature (detailed in Section 3.3) and based on this evidence, we have assumed that the proportion of waterproofing defects that are caused by the design of buildings is 52% for Class 2 and 49% for Class 3-9 buildings (i.e. we have assumed that around 50% of waterproofing defects are relevant to the design and construction phases of buildings and could be potentially addressed through the NCC).

Using these estimates and the ranges of the size of the waterproofing defects problem outlined above, we estimate that the costs associated with waterproofing defects that could be potentially addressed through the NCC (i.e. that are relevant to the design and construction phases of buildings) are in the order of [7]:

- between $121 million and $314 million per year for Class 2 buildings
- between $403 million and $1.2 billion per year for Class 3 to Class 9 buildings.

Is there a case for more stringent waterproofing regulation?

The discussion in Chapters 2 and 4 suggests that, in principle, there is a case for more stringent waterproofing regulation on the basis that:

- There are existing market failures that justify government intervention in relation to waterproofing of new buildings. These include information asymmetries, split incentives and negative externalities.
- Asymmetric information and split incentives are major barriers to fostering design and construction practices that effectively deal with the ingress of sub-surface water to buildings because:
  - Asymmetric information results in property buyers being unable to determine the effectiveness of waterproofing solutions used/present in buildings and assess the full impact of these on building safety and amenity, and the lifecycle costs of the building. When buyers are unable to differentiate between properties with/without effective waterproofing solutions, higher-quality properties in the market are gradually reduced to the point where only lowest-cost 'lemons' remain.
  - Split incentives mean that people making decisions about waterproofing solutions during the design and construction phases of buildings are typically not responsible for the lifecycle costs of those buildings, and hence would not bear the rectification

[7] Note this includes avoidable costs for both concrete and non-concrete buildings.

costs of buildings with waterproofing failures nor the benefits of buildings using effective waterproofing solutions (however, they would incur the upfront cost and/or time associated with these solutions).

— The continuous high incidence of serious waterproofing defects in new buildings points to a systemic failure of existing regulatory frameworks to prevent these defects – a situation where the regulation that was intended to overcome market failures related to building construction and protect the public at large, has failed to achieve these same goals. Indeed, the absence of adequate provisions in the NCC addressing the ingress of sub-surface water to building elements (which has been identified as the root cause of the majority of waterproofing defects[8]) has contributed to the high prevalence of waterproofing defects in Class 2 to 9 buildings.
— The significant health, safety and financial impacts of waterproofing defects have led to a legitimate public outcry about this issue in several Australian jurisdictions.
— More stringent waterproofing regulation would contribute to achieving social objectives and equity objectives by meeting community expectations that all buildings in Australia provide a minimum level of performance and safety.
— There is a lack of non-regulatory alternatives that would be effective in correcting for the market failures related to waterproofing of buildings.
— Existing regulation needs to be updated to reflect changes to the regulatory environment, improved government and community understanding of risks, and changing business practices.

Objectives of government action

The broader objectives of the proposed changes to the waterproofing provisions in the NCC can be summarised as to[9]:

— drive a reduction in the incidences of waterproofing defects and reduce rectification costs
— improve confidence in the construction industry
— improve health and amenity in buildings.

There are also a number of secondary objectives of the proposed changes. These include:

— increased clarity of the water management requirements of the NCC (for instance, by recasting 5 Performance Requirements into one and removing ambiguity about the ability for water to penetrate a building element.
— providing a level platform for all sectors to operate within.

Policy options

The policy options considered in this CBA are:

1. **The Business as Usual (BAU) or status quo** — an option where there are no changes to the waterproofing requirements for Class 2 to 9 buildings in the NCC 2025. The BAU sets up a baseline against which the impacts of the alternative option discussed below is evaluated. The BAU portrays the ‘best’ representation of the foreseeable counterfactual and considers a range of factors, including:
   – existing policies/measures to aimed at reducing building defects. In particular, it considers the impact of the DBP Act and the RAB Act in NSW (which apply to Class 2, 3 and 9c buildings)

[8] See discussion in Chapter 3.

[9] ABCB 2023, *Waterproofing and Water Shedding Position Paper – September 2022- March 2023.*

- instances where buildings have a level of waterproofing that is above that required by the NCC (more details provided in Chapter 6)
- growth in building stock
- other relevant background variables.

2. **Amending the waterproofing requirements in NCC 2025 (NCC 2025 scenario)** — this scenario reflects a world where the stringency of the waterproofing provisions in the NCC is increased. A summary of the key regulatory changes related to waterproofing requirements proposed for NCC 2025 is provided in Table 5.1 and a draft of the proposed provisions is provided in Appendix D.

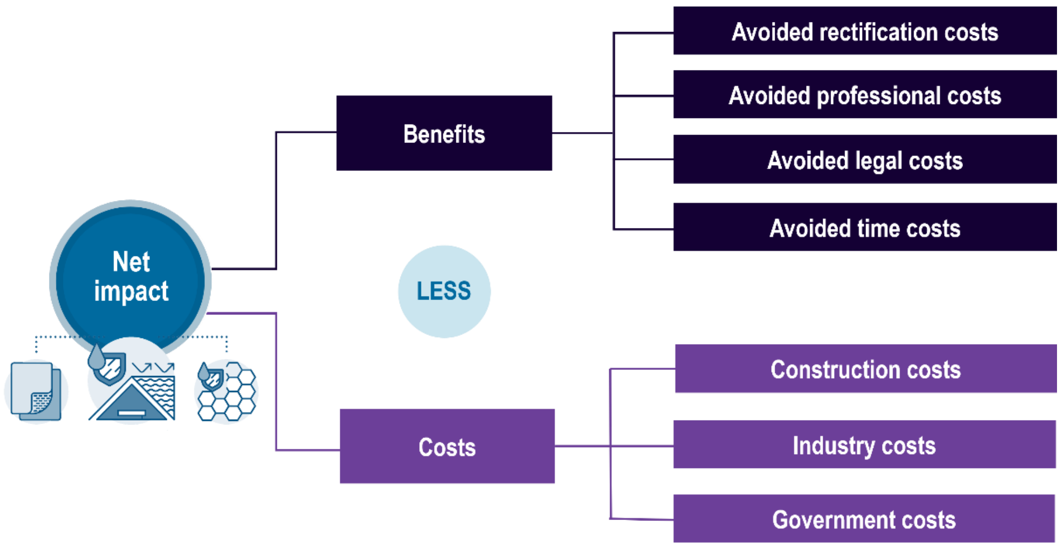
Estimated impacts

As is standard practice, the impact analysis of the proposed regulatory changes was undertaken from the perspective of the broader Australian community, with impacts that are transfers between stakeholders netted out.

Figure ES 1 identifies the costs and benefits that have been quantified in the CBA. The estimated impacts of the proposed regulatory changes are presented in the following sections. Costs and benefits have been expressed in both Net Present Value[10] (NPV) terms in 2023 dollars, and as Benefit Cost Ratios[11] (BCRs). Following guidance from the ABCB, the central discount rate used in the CBA is 5% (real) with sensitivity analysis conducted using a discount rate of 2% and 7%.

The impacts on Class 4 parts of buildings have not been estimated due to very low construction activity in this segment (the CSIRO Australian Housing Data portal shows that fewer than 400 of these buildings were built between 2016 and 2022).

Figure ES 1 Costs and benefits included in the analysis



Source: ACIL Allen.

[10] The NPV is the sum of the discounted stream of costs and benefits of the scenario.

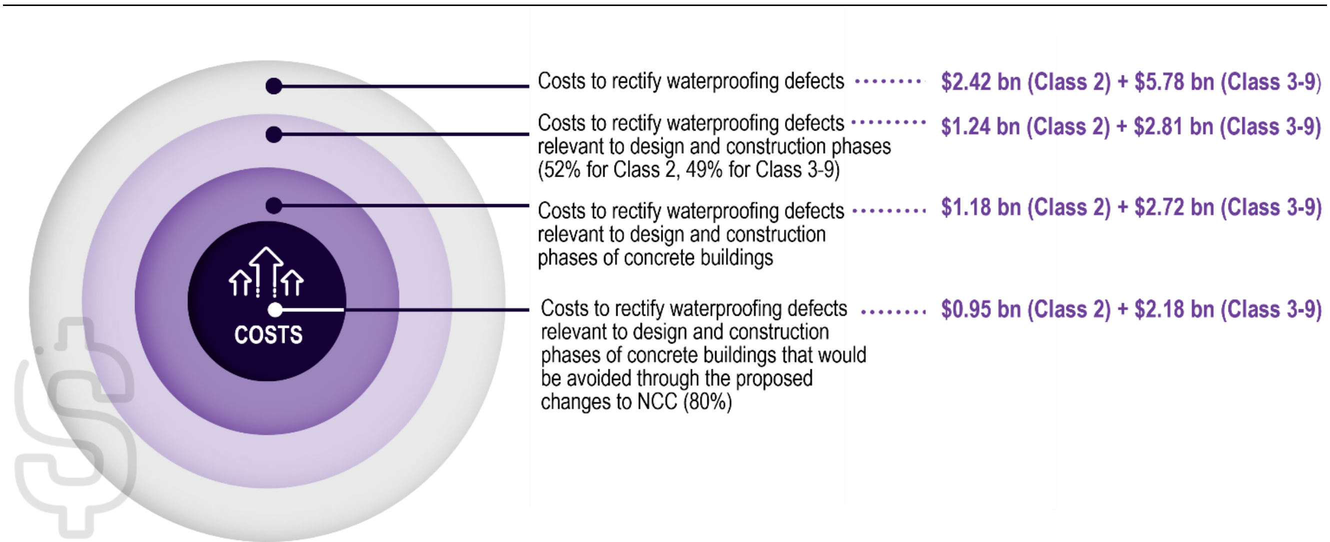
[11] The BCR is calculated by dividing the present value of benefits by the present value of costs and can be interpreted as every one dollar of costs delivers 'X' dollars of benefits.

The analysis considers 4 categories of benefits and 3 categories of costs associated with the proposed new waterproofing provisions:

— **Benefits** — the analysis uses the following measures of the potential benefits accruing to the proposed changes[12]:
  – **avoided rectification costs** — these are the costs that are incurred by the owners and occupants of Class 2 to 9 buildings under the current regulations to rectify waterproofing defects, which will be avoided under the proposed changes. An overview of how these benefits were estimates is provided in Figure ES 2
  – **avoided professional costs** – these are the costs incurred to obtain professional advice on waterproofing defects, which will be avoided under the proposed changes
  – **avoided legal costs** – these are the costs incurred to resolve disputes over waterproofing defects, which will be avoided under the proposed changes
  – **avoided time costs** – this is the value of the time that building owners and occupants spend to rectify waterproofing defects, which will be avoided under the proposed changes.

— **Costs** — the proposed changes entail costs to industry and government. There are 3 categories of costs that have been included in the analysis:
  – **construction costs**[13] — these are the additional costs that would be incurred by developers to meet the proposed new waterproofing requirements
  – **industry costs** — these are the costs that would be incurred by the industry to implement the proposed new waterproofing requirements
  – **government costs** — these are the costs that would be incurred by the government to transition to the proposed new waterproofing requirements.

Figure ES 2 Avoided building rectification costs due to the proposed NCC changes, present value



Notes: Based on the mid estimate in Table 6.12 as the central case scenario. Present values calculated using a 5% central discount rate. Totals may not add up due to rounding.
Source: ACIL Allen.

[12] All benefits are a 'one-off' benefit each the relevant building cohort.

[13] Construction costs are a 'one-off' cost for each relevant building cohort.

Table ES 3 provides estimates of the economy-wide costs and benefits of the proposed changes for Class 2 and Class 3 to 9 buildings. As shown in this table, at an economy-wide level it is estimated that the proposed waterproofing requirements would deliver:

— a net societal benefit for Class 2 buildings of $1.02 billion and a BCR of 4.3
— a net societal benefit of $2.5 billion for Class 3 to 9 buildings, and a BCR of 4.9.

Table ES 3 Estimated economy-wide costs and benefits of the proposed changes to NCC, Present value (in 2024) over 2025-2034, $M ($2023)

CLASS 2 BUILDINGS		
COSTS ($M)		
Households - capital costs		$306
Industry costs		$4
Government costs [a]		$0.04
	TOTAL COSTS	**$310**
BENEFITS ($M)		
Households		
Avoided rectification costs		$946
Avoided professional costs		$206
Avoided legal costs		$154
Avoided time costs		$27
	TOTAL BENEFITS	**$1,333**
NET PRESENT VALUE ($M)		**$1,023**
BCR (RATIO)		**4.3**
CLASS 3-9 BUILDINGS		
COSTS ($M)		
Owners/occupants - capital costs		$638
Industry costs		$4
Government costs [a]		$0.04
	TOTAL COSTS	**$642**
BENEFITS ($M)		
Owners/occupants		
Avoided rectification costs		$2,179
Avoided professional costs		$553
Avoided legal costs		$415
Avoided time costs		$9
	TOTAL BENEFITS	**$3,156**
NET PRESENT VALUE ($M)		**$2,514**
BCR (RATIO)		**4.9**

[a] In reality, government costs are not class-specific, but have nominally been split equally between Class 2 and Class 3 to 9 buildings.

Source: ACIL Allen.

Sensitivity and breakeven analysis

Given the uncertainty associated with many of the assumptions used in the CBA, sensitivity analysis was conducted to assess the sensitivity of the results to substantial changes in the following assumptions (a detailed discussion of the assumptions used in the analysis and their rationale is provided in Chapter 6): discount rate, industry training costs, government costs, construction costs to meet NCC 2025 and the proportion of defects caused by design that could be avoided with the proposed changes to the NCC.

The results of the sensitivity analysis are presented in Table ES 4. As shown in this table:

- the BCR and NPV for all Class 2 to 9 buildings increases with:
  - a reduction in the discount rate
  - a decrease in industry costs
  - a reduction in construction costs
  - an increase in the proportion of defects avoided with changes.
- the NPV for Class 2 to 9 buildings does not turn negative (i.e. the BCR does not drop below 1) when the construction costs of meeting NCC 2025 are increased by 25% or when the proportion of defects avoided with the changes is decreased to 60%
- increasing or decreasing government costs has no material effect in the overall results.

Table ES 4 Sensitivity analysis — impact of sensitivity tests on the NPV ($M, 2023)

	Class 2	Class 3-9
NPV under standard assumptions	**$1,023**	**$2,514**
Discount rate		
Decrease from 5% to 2%	$1,197	$2,934
Increase from 5% to 7%	$928	$2,281
Industry costs		
Decrease costs by 50%	$1,025	$2,516
Increase costs by 50%	$1,021	$2,512
Government costs		
Decrease costs by 50%	$1,023	$2,514
Increase costs by 50%	$1,023	$2,514
Costs of meeting NCC 2025		
Decrease costs by 25%	$1,100	$2,673
Increase costs by 25%	$947	$2,354
Proportion of defects avoided with changes		
Decrease from 80% to 60%	$690	$1,725
Increase from 80% to 100%	$1,357	$3,303

Note: All changes are modelled as changes from the central case scenario using a 5% discount rate.
Source: ACIL Allen.

Breakeven analysis was also undertaken (see Table ES 5), which indicates that:

- the proposed requirements for Class 2 and Class 3 to 9 buildings would still have a positive NPV and a BCR above 1 even if the costs to comply with the proposed provisions were 4.35 times higher and 4.94 times higher, respectively
- the proposed requirements would still have a positive NPV and a BCR above 1 even if the new provisions only avoid 19% of waterproofing defects in Class 2 concrete buildings and 16% of waterproofing defects in Class 3 to 9 concrete buildings.

Table ES 5 Breakeven analysis [a]

	Class 2	Class 3-9
Percentage change in capital costs to breakeven	335%	394%
Proportion of defects avoided with changes	19%	16%

[a] Breakeven point is where the benefits of the policy option minus its costs equal zero (in net present value terms), with a 5% discount rate.

Source: ACIL Allen.

Conclusions

The analysis of the more stringent waterproofing requirements for new Class 2 to 9 buildings proposed for inclusion in NCC 2025 indicates (based on the best information available at the time of the analysis and assumptions used where data was not available) that the proposed changes would deliver:

— a net societal benefit for Class 2 buildings of $1.02 billion and a BCR of 4.3

— a net societal benefit of $2.5 billion for Class 3 to 9 buildings and a BCR of 4.9.

The societal benefits that would largely be derived from avoided rectification costs are estimated to be well in excess of the construction costs associated with meeting the proposed waterproofing requirements for these buildings.

The breakeven analysis undertaken indicates that, for there to be an Australia-wide net societal benefit associated with the proposed changes, there would need to be:

— a very significant increase in the construction costs to meet the new proposed waterproofing requirements (between 4 and 5 times the current estimated costs)

— a very significant decrease in the proportion of waterproofing defects avoided through the proposed changes (to less than 16% of waterproofing defects avoided in Class 3 to 9 concrete buildings and to less than 19% of waterproofing defects avoided in Class 2 concrete buildings)

Notably, beyond the outcomes from the CBA, there are a number of other considerations that are important when making the decision about the waterproofing requirements for NCC 2025, including:

— achieving social and equity objectives by promoting public health and safety and reducing the risk of harm to building occupants

— meeting community expectations that all buildings in Australia provide a minimum level of performance and safety

— the value of unquantified benefits to households and commercial building owners/occupiers of less defective buildings, including improved amenity, health and wellbeing.

Decision-makers are best placed to weigh up these factors against the costs imposed on the community.

1 Introduction

1.1 Policy landscape

1.1.1 The National Construction Code

The NCC provides nationally consistent, minimum technical standards for the design and construction of new buildings (and new building work in existing buildings) throughout Australia, covering building and plumbing, standards. The NCC includes provisions relating to the structure, fire protection, health, amenity, accessibility and energy efficiency.

Importantly, the NCC sets out how buildings must perform, rather than how they are to be constructed. That is, the NCC sets out performance requirements, which are the minimum levels of performance that buildings must meet to receive approval for use. This means that designers and builders can find alternative solutions to meet the set standards. The NCC also describes how buildings can meet performance requirements in a prescriptive way through DtS solutions.

A general summary of classifications of buildings and structures used in the NCC is provided in Table 1.1. The shaded rows in the table refer to the building classes that are considered in this project – that is, Class 2 to 9 buildings.

The NCC is maintained by the ABCB and is administered by state and territory governments. While the NCC is a national code, it is enacted by the individual states and territories who can also supplement the NCC with their own building regulations to reflect geographic, climatic, policy or technical differences. Local governments may also have their own development policies and controls accounting for local conditions.

Table 1.1 NCC building classifications

Class	Sub-class	Description
Class 1	Class 1a	A single dwelling being a detached house; or one of a group of attached dwellings being a town house, row house or the like.
	Class 1b	A boarding house, guest house or hostel that has a floor area less than 300 m^2 and ordinarily has less than 12 people living in it. It can also be 4 or more single dwellings located on one allotment which are used for short-term holiday accommodation.
Class 2		Apartment buildings. Typically, multi-unit residential buildings where people live above and below each other. The NCC describes the space considered as an apartment as a sole-occupancy unit (SOU).
Class 3		Residential buildings other than Class 1 or Class 2 buildings, or a Class 4 part of a building. Class 3 buildings are a common place of long term or transient living for a number of unrelated people (e.g., a boarding house, guest house, hostel or backpackers).
Class 4		A sole dwelling or residence within a building of a non-residential nature. An example of a Class 4 part of a building would be a caretaker's residence in a storage facility. A Class 4 part can only be located in a Class 5 to 9 building.
Class 5		Office buildings used for professional or commercial purposes.
Class 6		Typically shops, restaurants and cafés. They are a place for the sale of retail goods or the supply of services direct to the public.
Class 7	Class 7a	Carparks.
	Class 7b	Typically warehouses, storage buildings or buildings for the display of goods (or produce) for wholesale.
Class 8		A building in which a process (or handicraft) is carried out for trade, sale, or gain (e.g. a factory or a mechanic's workshop).
Class 9	Class 9a	Healthcare buildings (e.g. hospitals, day surgeries).
	Class 9b	Buildings in which people may gather for social, theatrical, political, religious or civil purposes (e.g. schools, universities, childcare centres, etc.).
	Class 9c	Residential care buildings that may contain residents who have various care level needs.
Class 10	Class 10a	Non-habitable buildings including sheds, carports, and private garages.
	Class 10b	A structure being a fence, mast, antenna, retaining wall, swimming pool, or the like.
	Class 10c	A private bushfire shelter. A private bushfire shelter is a structure associated with, but not attached to, a Class 1a building.

Source: ABCB n.d., Understanding the NCC: Building classifications, https://www.abcb.gov.au/sites/default/files/resources/2022/UTNCC-Building-classifications.PDF.

1.1.2 The Waterproofing and Water Shedding Project

In 2020, Building Ministers approved the ABCB's work program for 2020-21. This program included a key project regarding the weatherproofing and waterproofing provisions in the NCC — the Waterproofing and Water Shedding Project.

Stage 1

The first stage of the Waterproofing and Water Shedding Project developed DtS provisions for inclusion in NCC 2022 (Volume One Weatherproofing Performance Requirements in NCC 2019 was not supported by DtS provisions). These changes were included without conducting a Regulatory Impact Assessment (RIA) as they did not represent an increase in stringency. The major changes in NCC 2022 included[14]:

- **Waterproofing**:
  - New DtS Provisions in Volume Two for waterproofing of wet areas, not previously covered by an Acceptable Construction Practice (ACP). These prescriptive DtS Provisions can be adopted as an alternate compliance option to Australian Standard (AS) 3740.
  - Waterproofing in Volume One was restructured into 3 parts to enhance readability and accommodate future changes.
  - Volumes One and Two adopted the revised edition of AS 3740:2021. Key changes included[15]:
    - more extensive waterproofing requirements for shower walls
    - more choices for wet area waterproof and water-resistant substrates and surface materials
    - more contemporary design options
    - a range of editorial changes and other changes to make the provisions clearer and to overcome interpretation issues
    - a range of additional figures to assist with interpretation
    - provision for a polished concrete in situ shower base
    - a more comprehensive appendix which includes more design considerations and design solutions in wet-area waterproofing.
- **Weatherproofing:**
  - Clarifying when and where the external waterproofing provisions apply and when the external waterproofing standard applies.[16]
  - Volume One contains additional DtS Provisions, providing new solutions for weatherproofing external walls. These include references to weatherproofing provisions in Australian Standards for masonry, autoclaved aerated concrete and metal wall sheeting.

Stage 2

The Waterproofing and Water Shedding Project is now in its second stage. This stage recommends changes to Performance Requirements and DtS provisions (including new provisions where relevant) in NCC to address waterproofing failures in buildings. These changes are the focus of this report.

In June 2022, the ABCB Board requested the ABCB Office to establish a Technical Reference Group for the Waterproofing and Water Shedding project (TRG) to progress the second stage of the Waterproofing and Water Shedding Project. The broad objectives of the TRG are to:

- clearly establish and identify the scope of the problem relating to waterproofing failures (including the types and quantum of waterproofing issues facing the building and development industry)
- establish if there is a need to make further changes to the NCC to address these failures.

[14] ABCB 2022, *What's new about NCC 2022*, https://ncc.abcb.gov.au/news/2022/whats-new-about-ncc-2022.

[15] Housing Industry Association (HIA) 2022, *Alternate compliance options for waterproofing*, https://hia.com.au/resources-and-advice/building-it-right/building-codes/articles/alternate-compliance-options-for-waterproofing.

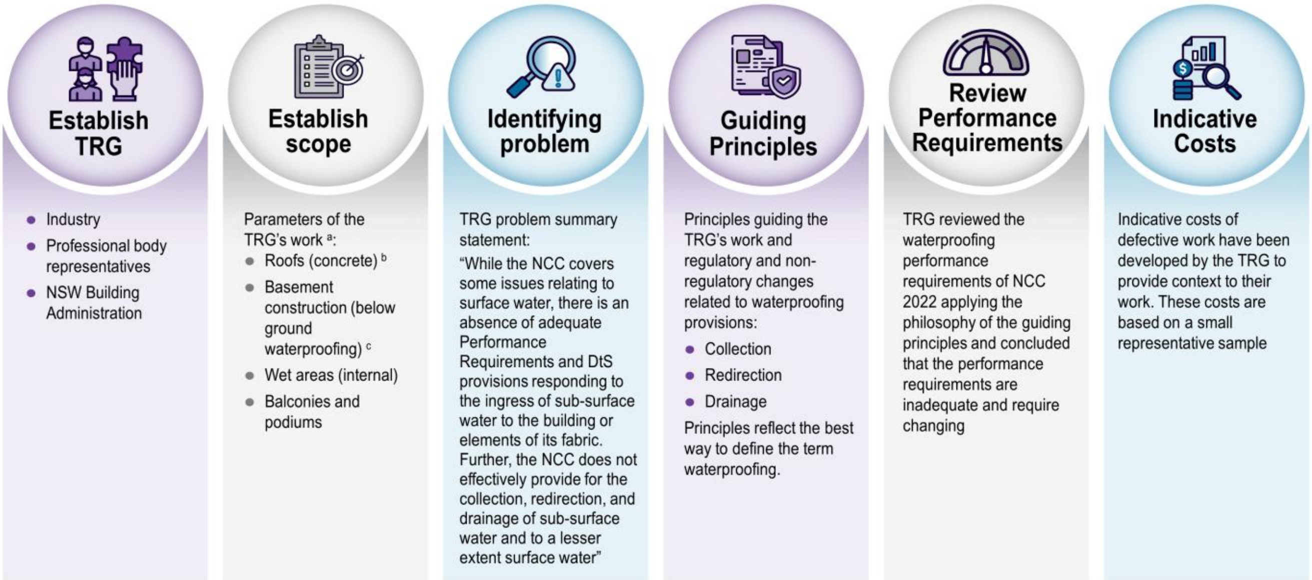
[16] Housing Industry Association 2023, *External waterproofing requirements explained*, https://hia.com.au/resources-and-advice/building-it-right/building-codes/articles/external-waterproofing-requirements-explained.

The TRG comprises industry and professional body representatives and also includes the NSW Building Administration.

The TRG met on 9 occasions since June 2022 and took a number of steps to meet its objectives and advise its position with respect to recommending changes to the DtS provisions and Performance Requirements in NCC to address waterproofing failures in buildings. These steps were outlined in the ABCB's Waterproofing and Water Shedding Position Paper (Position Paper) and are summarised in Figure 1.1.

With the assistance of the TRG, the ABCB Office developed changes to the Performance Requirements and DtS (including new and amended provisions) for inclusion in the NCC 2025. These have been written to mitigate and prevent waterproofing defects prevalent in the building and construction industry.

Figure 1.1 Key steps taken to date by the TRG – Waterproofing and Water Shedding



[a] These key areas of focus reflect building elements commonly suffering some form of waterproofing failure leading to defects. The impact of these defects ranges from a loss of visual amenity with respect to building finishes to the more serious issues of compromised structural integrity of the building and health of its occupants.

[b] Scope does not include roofs using sheet and tile systems.

[c] Basements have been established as areas of a building that contribute to a significant portion of waterproofing defects. The elements being considered in this scoped item include construction of both walls and slabs and the interaction with aspects of saturated and unsaturated zones of the water tables. Basement construction is also sensitive to design and documentation coordination. It has also been identified as an area of construction affected by unclear NCC provisions.

Source: ABCB 2023, Waterproofing and Water Shedding Position Paper, February.

1.2 This project

As discussed in the sections above, in the context of the Waterproofing and Water Shedding Project, the ABCB Office has developed new provisions to address the issue of sub-surface water for inclusion in the NCC 2025.

The ABCB engaged ACIL Allen to undertake an impact analysis of the proposed changes to NCC waterproofing provisions for Class 2-9 buildings[17]. The impact analysis complies with the *Regulatory Impact Analysis Guide For Ministers' Meetings And National Standard Setting*

[17] Notably, the impacts on Class 4 parts of buildings have not been separately estimated due to very low construction activity in this segment (the CSIRO Australian Housing Data portal shows that fewer than 400 of these buildings were built between 2016 and 2022).

Bodies (referred to as the RIA Guidelines or OIA Guidelines)[18] developed by the Office of Impact Assessment (OIA – formerly the Office of Best Practice Regulation or OBPR).

This report is structured as follows.

— Chapter 2 discusses the evolution of waterproofing issues in buildings
— Chapter 3 outlines the nature and extent of the problem that the proposed changes are seeking to address
— Chapter 4 establishes the need for a government response to the problems identified in Chapter 3
— Chapter 5 specifies the objectives of government action and the proposed changes to address the identified problem
— Chapter 6 assesses the impacts of the proposed changes to the NCC
— Chapter 7 sets out the conclusions of the analysis.

[18] Commonwealth of Australia, Department of the Prime Minister and Cabinet 2023, Regulatory Impact Analysis Guide for Ministers' Meetings and National Standard Setting Bodies, June.

2 The evolution of waterproofing issues in buildings

Buildings are a vital part of the Australian economy and community. Safe, accessible and sustainable buildings not only improve lives and communities, but the building industry and its broader ecosystem are significant contributors to the national economy in terms of output and employment. Yet, the quality and safety of buildings across Australia are lacking across several areas, the reforms recommended by the Building Confidence Report[19] are lagging behind, and building industry insolvencies are on track to break a decade-long record[20].

There is growing evidence about the rise in building defects in Australia over time (particularly for multi-owner and high-rise residential buildings)[21], and as noted in the Building Confidence Report, the extent and prevalence of these failures have led to diminishing public confidence that the building industry can deliver compliant, safe buildings which will perform to the expected standards over the long term[22].

Defects related to waterproofing are now amongst the most common defects reported in buildings. For instance, a survey on serious defects in recently completed strata buildings across NSW found that 42% of the buildings surveyed reported having serious waterproofing defects.[23] Although these findings focused on a sample of buildings in NSW, they support anecdotal evidence provided by other State and Territory governments who often state waterproofing defects occupy the top one or 2 spots on a top-ten defect list.[24] Indeed, the rise of waterproofing failures in Australian buildings has been compared to the ‘Leaky Building Syndrome’ crisis in New Zealand (which it is estimated to have cost the country between $11 billion and $23 billion) and Canada (where over $4 billion has been spent on remediation of leaks).[25]

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[19] The Building Confidence Report was prepared for the Building Ministers Forum (now the Building Ministers Meeting) by Professor Peter Shergold and lawyer Bronwyn Weir. The report made 24 recommendations to strengthen the effective implementation of the NCC and address systemic issues in the Australian building industry.

[20] Bleby, Michael 2023, Construction insolvencies march towards a decade high, Australian Financial Review, https://www.afr.com/property/commercial/construction-insolvencies-march-towards-a-decade-high-20230418-p5d1b7.

[21] Architects Registration Board of Victoria (ARBV) and NSW Architects Registration Board (NSW ARB) 2022, *Systemic Risks in the Australian Architecture Sector*, https://content.vic.gov.au/sites/default/files/2022-12/Report-on-Systemic-Risks-for-the-Architecture-Sector-in-Australia_0.pdf. Also see discussion in Chapter 3.

[22] Shergold, P. and Weir, B. 2018, *Building Confidence: Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia*, February.

[23] Office of the Building Commissioner and Strata Community Association NSW 2023, *2023 Strata Defects Survey Report*, November.

[24] ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 3.

[25] Lovegrove & Cotton Construction and Planning Lawyers 2022, *Leaky Building Syndrome – NZ, Canada and Australian Experiences*, September, https://lclawyers.com.au/leaky-building-syndrome-nz-canada-and-australian-experiences/#:~:text=Ill%2Dconceived%2C%20compromised%20design%20and,factors%20that%20compromised%20construction%20outcomes.

The causes behind the rise of building defects in Australia are many and multifaceted. Some of the frequently cited causes in relevant literature and by stakeholders consulted for this study including the following.

— The prevalence of serious **compliance failures** in recently constructed buildings, including non-compliant cladding, water ingress leading to mould and structural compromise, structurally unsound roof construction and poorly constructed fire resisting elements.[26] These failures are a result of several factors, including[27]:
  – large numbers of practitioners operating in the industry who either **lack competence, do not properly understand the NCC and/or have never had proper training on its implementation**
  – **poor design documentation** and **builders making improvised decisions** on matters which affect safety without independent oversight
  – **weak oversight** by licensing bodies, state and territory regulators and local governments (due to either to inadequate funding or a lack of skills and resources to undertake effective enforcement)
  – **ineffective regulatory oversight of the commercial building industry** by regulators. The Building Confidence Report noted that 'Those involved in high-rise construction have been left largely to their own devices'[28]
  – **inadequate compliance and enforcement systems.**

— A significant **change in construction practices** over the past 20-30 years. In particular, the **rise of Design and Construct (D&C) contract**s, which has become the dominant procurement approach in the Australian construction industry, particularly for large-scale residential and non-residential building projects[29]. Under this model, clients enter into a single contract with a construction company, which provides both the design and construction of the project based on the client's initial design requirements and project brief. The Building Confidence Report noted that:

  Although building approvals are required, the nature of a design-and-construct project means that many aspects of the design change after the initial approval is obtained. This often leads to just-in-time supply of documentation and squeezes the compliance checking processes.

  And that

  Whilst the developer might initially engage architects and engineers to prepare early designs to obtain planning approvals, these consultants then become subcontractors. It is the builder who is responsible for the delivery of a completed building at an agreed price. Once contracted, the builder will work to find efficiencies and cost savings in the development of the design and construction of the building.

  Shergold, P. and Weir, B. 2018, Building Confidence: Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia, p. 10

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[26] Shergold, P. and Weir, B. 2018, Building Confidence: Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia, p. 3.

[27] Ibid.

[28] Ibid., p. 4.

[29] Architects Registration Board of Victoria (ARBV) and NSW Architects Registration Board (NSW ARB) 2022, Systemic Risks in the Australian Architecture Sector, https://content.vic.gov.au/sites/default/files/2022-12/Report-on-Systemic-Risks-for-the-Architecture-Sector-in-Australia_0.pdf.

- Project-based construction processes which involve **scattered accountability** and a multitude of active entities in every project (e.g. several specialist companies, multiple subcontractors and sub-subcontractors, and myriad material suppliers). This results in:
  - a siloed ecosystem where **companies tend to manage their own risk**
  - **information asymmetry** between different entities in the construction process
  - **'piecemeal' rectification/remediation practices** (where, for instance, instead of rectifying a waterproofing issue at the design phase of a building, the problem is 'passed down' the supply chain and dealt by at later construction stages by adding membranes).
- **Low competency, accountability and integrity of many builders** (evidenced by the rates of disputes, alleged defects and reports of high levels of illegal phoenix activity in the industry[30]).
- **Changes in the materials used in buildings** – around 4 decades ago, construction practices changed with the increased use of plastics. At that time, the increased use of plastics was expected to deliver improvements in cost and time without any impact on quality. However, plastics did not live up to the hype and construction practices changed to address the quality issues that arose from their use. For example, rather than use one membrane, 2 membranes were used to minimise water leakage. Over time, the previous construction practice of relying on gravity has been forgotten.[31]

All of these issues have contributed to a collective industry mindset which seems willing to do things as quickly as possible and pass on responsibility for deficiencies to others without consideration of the lifetime cost of a building.

To date, the wider industry response has been to maintain the status quo, which is the root cause of many of the issues highlighted above. Furthermore, the NCC has failed to keep pace with modern construction practices. In particular, for waterproofing, the NCC has failed to provide adequate performance requirements and DtS provisions responding to the ingress of sub-surface water to the building elements (which has been identified as the root cause of the majority of waterproofing defects[32]).

The changes being proposed for NCC 2025 aim to address this regulatory failure through the principles of collection, redirection and drainage of water. Sufficient falls in appropriate finished surfaces and substrates (among other things) will achieve the philosophy of the guiding principles and drain both surface and sub-surface water.[33] This is effectively a return to the construction practices that were widely adopted before the industry increased its use of plastics.

While the proposed changes are not expected to result in significant additional construction costs[34], they would require a change in the mindset of those involved in building construction, a shift away from thinking about waterproofing near the end of construction to the design stage of a building, and guidance to industry to support the successful implementation of the proposed reforms.

The benefits of this change can be significant. Indeed, reduced waterproofing defects would not only reduce the lifetime costs of buildings, but would also decrease liability claims for industry, and increase consumer safety and confidence.

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[30] Shergold, P. and Weir, B. 2018, *Building Confidence:* Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia, p. 13.

[31] This issue was highlighted during stakeholder consultations.

[32] See discussion in Chapter 3.

[33] ABCB 2023, *Waterproofing and Water Shedding Position Paper*, February, p. 7.

[34] See Appendix E.

3 Is there a problem that needs to be addressed?

To analyse the costs and benefits of regulatory change, it is important to first understand the nature and magnitude of the problem being addressed by the proposed change in regulation. This chapter describes the nature of the problem and estimates the size of the problem.

3.1 What is the problem?

There is growing evidence about the high prevalence of waterproofing defects in Class 2 to Class 9 buildings in Australia (see additional discussion in Section 3.2).

While to our knowledge there is no systematic collection of information about the causes of waterproofing defects in buildings, an analysis of data provided by the ABCB from a sample of buildings with waterproofing defects shows that **sub-surface water is responsible for the majority of waterproofing defects in Class 2 to 9 buildings**. In particular, this data shows that sub-surface water is responsible for approximately (see additional analysis in Section 3.1.1):

— 63% of the incidences of waterproofing defects in Class 2 and Class 7 buildings

— 35% of the incidences of waterproofing defects in Class 5 and Class 9 buildings.

Furthermore, anecdotal evidence discussed in TRG meetings suggests that the percentage of defects caused by sub-surface water is higher than that shown in the sample of data provided by the ABCB. A range between 80% to 90% was nominated by some members who are experts in consultative remedial work.[35]

Feedback received by the ABCB Office through the Board’s technical committees and working groups also indicates that **the absence of adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water to buildings is contributing to waterproofing defects**. The absence of adequate provisions in the NCC results in a reliance on performance solutions, but there is a hit-and-miss approach to these performance solutions, leading to poor design and documentation, and sub-standard construction outcomes.[36]

Waterproofing issues and their relationship to NCC provisions were discussed during several meetings of the TRG to clearly identify and articulate the problem related to waterproofing and establish if this could be addressed by making changes to the NCC. The agreed definition of the problem at which the TRG arrived is described in the following statement.

[35] ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 10.

[36] ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 3.

> While the NCC covers some issues relating to surface water, there is an absence of adequate Performance Requirements and DtS provisions responding to the ingress of sub-surface water to the building or elements of its fabric. Further, the NCC does not effectively provide for the collection, redirection, and drainage of sub-surface water and to a lesser extent surface water.
>
> ABCB 2023, Waterproofing and Water Shedding Position Paper, February, p. 6

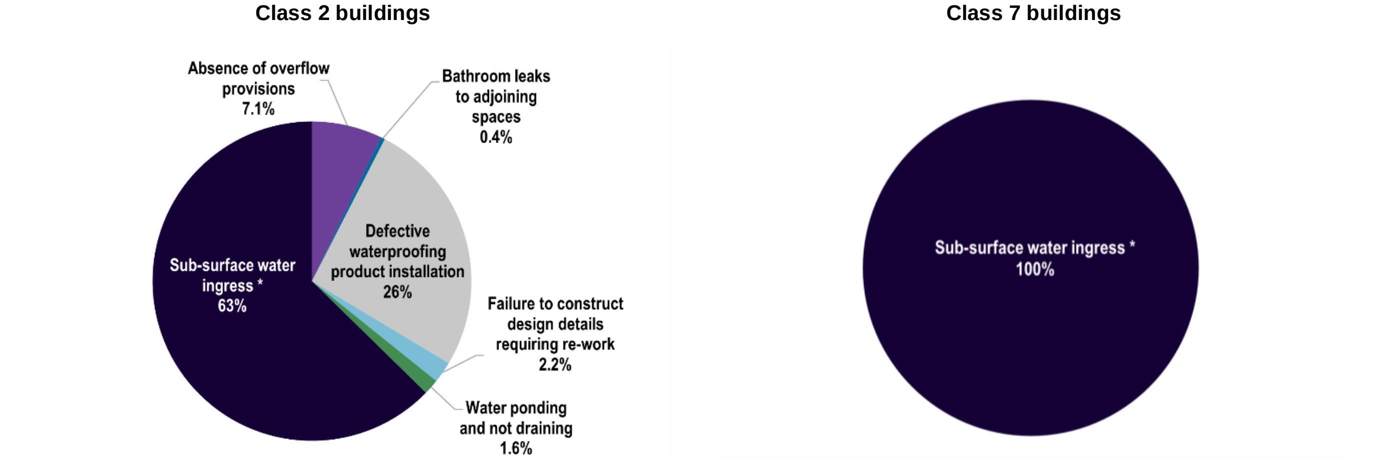
3.1.1 Waterproofing: evidence on the areas of failure

As mentioned above, to support the analysis in this report, the ABCB provided data from a sample of buildings with waterproofing failures (sourced confidentially). An overview of the findings from this data is provided in the sections below.

Class 2 and Class 7 buildings

The data provided by the ABCB for Class 2 (apartments) and Class 7 (carparks or warehouses) buildings included a total of 38 distinct buildings (cases). Amongst these buildings, a total of 1,854 waterproofing defects were recorded in Class 2 buildings and a total of 12 waterproofing defects were recorded in Class 7 buildings. As shown in Figure 3.1**,** sub-surface water is responsible for approximately 63% of the incidences of waterproofing defects in Class 2 buildings and 100% in Class 7 buildings in the sample.

Figure 3.1 Percentage of defects by description of defect/point of failure for Class 2 and Class 7 buildings in ABCB sample



* Defects relevant to sub-surface water ingress in Class 2 and 7 buildings include the following categories: inadequate substrate preparation; roof and podium leaking into levels adjacent and below; uncontrolled lateral and rising water entry; water entry from rooftop; water entry into habitable spaces; water entry via failed membrane; water entry into habitable spaces and basement carpark; and water entry via windows.

Source: ABCB data.

Most of the waterproofing defects in Class 2 and Class 7 buildings occurred in balconies/podiums and external enclosures (see Table 3.1). The average cost of rectification of these waterproofing defects (per building) was around $1.7 million, with the average cost of rectifying these defects being around $24,000 for a balcony or external enclosure, $19,300 for internal wet areas, $655,000 for a roof, and $1.5 million for a basement/carpark.

Table 3.1 Categories of defects and rectification costs for Class 2 (apartments) and Class 7 (carparks or warehouses) buildings in ABCB sample

	Location of defect					
Class	Balcony / Podium	Trafficable roof	External enclosure	Internal wet area	Basement	Total
Number of buildings where defect occurred [a]						
2	25	21	16	5	-	N/A
7	-	-	-	-	6	
Total	25	21	16	5	6	
Number of locations within buildings where defect occurred [b]						
2	760	75	675	344	-	1,854
7	-	-	-	-	12	12
Total	**760**	**75**	**675**	**344**	**12**	**1,866**
Total rectification costs across all buildings in sample ($2023)						
2	$18,160,000	$13,760,000	$15,975,000	$6,650,000	-	$54,545,000
7	-	-	-	-	$9,000,000	$9,000,000
Total	**$18,160,000**	**$13,760,000**	**$15,975,000**	**$6,650,000**	**$9,000,000**	**$63,545,000**
Rectification cost per defect (except for basement and roof which are per building), $2023						
2	$23,895	$655,238 (equivalent to an average cost per apartment of $6,907)	$23,667	$19,331	-	N/A
7	-	-	-	-	$1,500,000 (equivalent to an average cost per apartment of $8,333)	

[a] A building can have defects in more than one location, but the building is only counted once.
[b] The same building can have a number of different locations where defects have occurred.
Source: ACIL Allen based on ABCB data.

The dataset provided by the ABCB also included information about the identified cause of the defects. There were 3 main causes which could be selected for each defect: workmanship, design or 'combination' (i.e. a combination of workmanship and design). As shown in Table 3.2, most defects in this dataset were caused by a combination of faulty design and workmanship.

Table 3.2 Number of locations where defect occurred by cause of defect for Class 2 and Class 7 buildings in ABCB sample

Class	Combination	Workmanship	Design	Total
2	1,543	215	96	1,854
7	10	1	1	12
Total	**1,553**	**216**	**97**	**1,866**

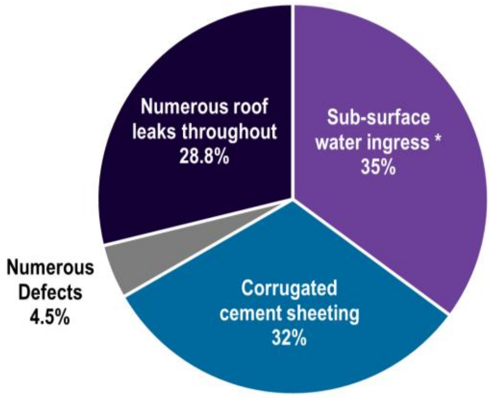
Source: ACIL Allen based on ABCB data.

Class 3 to Class 9 buildings

The data provided by the ABCB for non-residential buildings included a total of 74 distinct buildings (cases) across 2 classes – Class 5 and Class 9. Amongst these buildings, a total of 111 waterproofing defects were recorded.

As shown in Figure 3.2**,** sub-surface water is responsible for approximately 35% of the incidences of waterproofing defects in Class 5 and Class 9 buildings in the sample.

Figure 3.2 Percentage of defects by description of defect/point of failure for Class 5 and Class 9 buildings in ABCB sample



* Defects relevant to sub-surface water ingress in Class 5 and 9 buildings include the following categories: beneath the ceramic tiles; beneath the ceramic tiles & ceiling; beneath the ceramic tiles & flooring; beneath the ceramic tiles and floor; beneath the ceramic tiles and vinyl; beneath the ceramic tiles, vinyl floor & ceiling; beneath the wall tiles; upper-level balcony, floor covering adhesive.

Source: ABCB data.

As shown in Table 3.3, most of the waterproofing failures in Class 5 and Class 9 buildings occurred in roofs. The average cost of rectifying these waterproofing defects (per building) was around $427,000, with the average cost per building with the defect present being around $40,000 for buildings with balcony or podium defects, $661,000 for buildings with roof defects, and $221,000 for buildings with internal wet areas defects.

The ABCB data about the cause of the defects for commercial buildings was divided into only 2 categories for each type of defect: ‘combination’ or ‘hazmat material identified in wet area’. As shown in Table 3.4:

— all the defects in balconies/podiums and roofs are reported as caused by a combination of workmanship and design

— all the defects caused by hazmat materials relate to internal wet areas, which are not covered by the proposed changes to the NCC and outside the scope of this CBA. While data related to defects caused by hazmat material has not been used in the analysis in this report (and hence does not affect the CBA results), this data is reported in Table 3.4 for transparency.

Table 3.3 Categories of defects and rectification costs for Class 5 and Class 9 buildings in ABCB sample

	Location of defect			
Class	**Balcony / Podium**	**Trafficable roof**	**Internal wet area**	**Total**
Number of buildings where defect occurred [a]				
5	1	31	37	69
9	-	4	1	5
Total	**1**	**35**	**38**	**74**
Number of locations within buildings where defect occurred [b]				
5	1	52	37	90
9	-	20	1	21
Total	**1**	**72**	**38**	**111**
Total rectification costs across all buildings in sample ($2023)				
5	$40,000	$21,311,826	$8,350,000	$29,701,826
9	-	$1,845,000	$50,000	$1,895,000
Total	**$40,000**	**$23,156,826**	**$8,400,000**	**$31,596,826**
Rectification cost per building ($2023)				
5	$40,000	$687,478	$225,676	$430,461
9	-	$461,250	$50,000	$379,000
Average	**$40,000**	**$661,624**	**$221,053**	**$426,984**

[a] A building can have defects in more than one location, but the building is only counted once.
[b] The same building can have a number of different locations where defects have occurred.
Source: ACIL Allen based on ABCB data.

Table 3.4 Number of locations where defect occurred by cause of defect for Class 5 and Class 9 buildings in ABCB sample

Class	Combination	Hazmat material identified in wet area	Total
Class 5			
Balcony / Podium	1	-	1
Trafficable roof	31	-	31
Internal wet area	-	37	37
Total Class 5	32	37	69
Class 9			
Balcony / Podium	-	-	-
Trafficable roof	4	-	4
Internal wet area	-	1	1
Total Class 9	4	1	5

Source: ACIL Allen based on ABCB data.

3.2 Size of the problem

The cost of waterproofing defects is a function of:

— the prevalence (frequency) of waterproofing defects (i.e. the proportion of buildings with waterproofing defects)
— the impacts of those defects, including the impact on[37]:
  – rectification costs
  – safety risks
  – evacuation costs
  – loss of property value, rental income and revenue for commercial tenants
  – legal costs
  – increase in insurance premium, excess and exclusion clauses
  – emotional impacts such as stress, although they are difficult to quantify.

These are discussed in more detail in the sections below.

3.2.1 Prevalence of waterproofing defects[38]

As mentioned above, estimating the prevalence of waterproofing defects is important to establish the size of the problem that the proposed changes to the NCC are aiming to address, and to estimate the impact that the proposed changes would have. Ideally, this would be done through a survey of building owners across different building classes and jurisdictions and/or audits of buildings. However, this is outside the scope and timeframe for this project, and as such, we rely on existing studies to produce estimates of the prevalence and costs of waterproofing defects.

All the studies reviewed for this project are summarised in Table A.1 in Appendix A, with a summary of the estimates of the prevalence of waterproofing defects in the literature provided in Table 3.5.

As shown in Table 3.5, despite differences in methodologies, most studies in the literature place the prevalence of waterproofing defects in Class 2 buildings between 20% and 40% of buildings. Literature on the prevalence of waterproofing defects in Class 3 to Class 9 buildings is limited, but a survey of a number of Class 3 to Class 9 building managers (undertaken by CIE for their Building Confidence Report: a case for intervention[39]) showed that waterproofing/weatherproofing defects are present in approximately 21% of buildings, and roof and rainwater disposal defects in around 16% of buildings.

[37] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

[38] In the context of this report, prevalence of waterproofing defects refers to the proportion of (all) buildings which have waterproofing defects.

[39] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

Table 3.5 Summary of estimates of prevalence of waterproofing defects in the literature

Study	Prevalence of defects	Comments
Class 2 buildings		
Studies without specific areas of defect identified ('just' waterproofing defects identified)		
Survey of building defects in NSW (2023)[40]	42%	Study did not identify specific areas of defect (i.e. may include internal wet areas).
Survey of building defects in NSW (2021)	23%	Study did not identify specific areas of defect (i.e. may include internal wet areas) and did not provide a definition of serious defects at the time of the survey.
Australian Institute of Architects (cited in Equity Economics, 2019[41])	4%	Major water problem (includes internal leaks).
Australian Institute of Architects (cited in Equity Economics, 2019[42])	34%	Minor water problem (includes internal leaks).
Studies identifying specific areas of waterproofing defect		
Roofs		
Building Confidence Report: a case for intervention (CIE, 2021[43])	21%	Refers to 'Roof and rainwater disposal defects' (examples given in the survey for these types of defects were: loose roof sheeting, inadequate gutters, leaking concrete roof).
Johnston & Reid, 2019[44]	8.6%	Defects related to roof and rainwater disposal. Compared to all other studies, prevalence estimate seems on the low side.
Balconies and/or podiums		
Johnston & Reid, 2019[45]	5.3%	Defects related to balconies and podiums. Compared to all other studies, prevalence estimate seems on the low side.
Building Confidence Report: a case for intervention (CIE, 2021[46])	30%	Refers to 'Waterproofing/weatherproofing defects' (examples given in the survey for these types of defects were: water leaking in from balcony or wall, water leaking through shower floor).
Cladding Safety Victoria, 2023[47]	36%	Percentage of balconies with defects unrelated to cladding that have water ingress/waterproofing issues.
Water penetration from the outside		
Cracks in the Compact City (Crommelin et al., 2021) [48]	29%	Includes the following defects: – Water leak / Water penetration / Water seepage / Water ingress – Wall, Slab

[40] Office of the Building Commissioner and Strata Community Association NSW (2023), *2023 Strata Defects Survey Report*, November.

[41] Equity Economics (2019), *The Cost of Apartment Building Defects*.

[42] Equity Economics (2019), *The Cost of Apartment Building Defects*.

[43] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

[44] Johnston, N. and Reid, S. (2019), *An examination of building defects in residential multi-owned properties*, Deakin University, Melbourne, June.

[45] Ibid.

[46] Centre for International Economics 2021, *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

[47] Cladding Safety Victoria 2023, *Research analysis on issues and risks associated with balcony defects*, January.

[48] Crommelin, L., Thompson, S., Easthope, H., Loosemore, M., Yang, H., Buckle, C., and Randolph, B. 2021, *Cracks in the Compact City: Tackling defects in multi-unit strata housing*, Final Project Report, City Futures Research Centre, October.

Study	Prevalence of defects	Comments
		– Water pond / Water flooding Drainage defects – Inadequate fall, Insufficient drainage etc.
Australian Apartment Advocacy 2021 (cited in Law et. al., 2021[49])	35%	Referred to as 'water penetration from outside (e.g. water coming in through the window, door, ceiling or balcony)'.
Australian Apartment Advocacy 2020 (cited in Law et. al., 2021[50])	32%	Referred to as 'water penetration from outside (e.g. water coming in through the window, door, ceiling or balcony)'.
Mozo, 2019[51]	30%	Referred to as 'water penetration from the outside'.
Easthope et al., 2012[52]	40%	Referred to as 'water penetration from outside'.
Class 3 to 9 buildings		
Roofs		
Building Confidence Report: a case for intervention (CIE, 2021[53])	15.8%	Refers to 'Roof and rainwater disposal defects' (examples given in the survey for these types of defects were: loose roof sheeting, inadequate gutters, leaking concrete roof).
Balconies and/or podiums		
Building Confidence Report: a case for intervention (CIE, 2021[54])	21.1%	Refers to 'Waterproofing/weatherproofing defects' (examples given in the survey for these types of defects were: water leaking in from balcony or wall, water leaking through shower floor). May include internal wet areas.

Source: ACIL Allen based on noted sources.

3.2.2 The impact of waterproofing defects

The impacts of waterproofing defects on the economy and the community are wide ranging and include[55]:

— the costs to rectify the defects

— increased maintenance costs

— legal costs where there are disputes about the defects

— the costs associated with building evacuations and of alternative accommodation

— higher than necessary insurance premiums (or inability to obtain insurance) for some industry practitioners and affected building owners

— loss of value for affected buildings (which could be due to damages to the building or reputation even after the defects are fixed) or income where it is an investment

— reduced consumer confidence in the building and construction industry

— increased safety risks for people living in defective buildings

[49] Law, T., Sorrentino, G., Barry, R. and Ronngard, P. (2021), *Scoping study on the nature and extent of moisture damage in houses & apartments in Victoria*, December.

[50] Ibid.

[51] Mozo (2019), *Property Pain: Building Defects Report 2019*, August, https://mozo.com.au/home-loans/articles/property-pain-building-defects-report-2019#:~:text=Leaks%20and%20cracks%20causing%20stress%20for%20buyers&text=For%20houses%2C%20cracking%20to%20internal,%25)%20were%20also%20major%20problems.

[52] Easthope, H., Randolph, B. & Judd, S. 2012, *Governing the Compact City: The role and effectiveness of strata management*, City Futures Research Centre, UNSW.

[53] Centre for International Economics 2021, *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

[54] Ibid.

[55] Ibid.

— increased anxiety, stress and emotional impacts for building occupants/owners.

Some of these costs are explored in more detail below.

Rectification costs

Rectification costs refer to the cost of the building work that needs to be undertaken to remedy the defect. Existing studies containing estimates of waterproofing defects are reviewed in Table A.1 in Appendix A, with a summary of the estimates of costs to rectify waterproofing defects found in the literature provided in Table 3.6. In addition to studies found in the literature, Table 3.6 contains estimates of rectification costs from a sample of buildings with waterproofing defects provided by the ABCB (additional details of this data were provided in Section 3.1.1).

As shown in Table 3.6, rectification costs for:

- Class 2 buildings:
  - vary considerably for roofs, from around $5,000 per building, to approximately $655,000 per building. On a per apartment basis this is equivalent to between $550 and $6,900 per apartment
  - are broadly in line across sources for balconies/podiums/external enclosures, costing around $24,000 per defect/balcony
  - are significant for basements, estimated around $1.5 million per building (equivalent to around $8,300 per apartment.
- Class 3 – Class 9 buildings:
  - are between $461,000 and $687,000 per building for waterproofing defects in roofs
  - are around $40,000 per balcony/podium defect
  - are between $50,000 and $225,000 per internal wet area defect.

Table 3.6 Summary of estimates of the cost of waterproofing defects in the literature

Study	Unit of measure	Rectification cost	Comments
Class 2 buildings			
Studies providing cost of overall defects (i.e. not waterproofing specific)			
Survey of building defects in NSW (2023)	$/building ($2023)	$161,310	Not waterproofing specific. Study did not identify specific areas of defect (i.e. may include internal wet areas). Reflects only rectification costs (study separately identifies professional costs, legal costs and other costs).
Survey of building defects in NSW (2021)	$/building ($2023)	$293,845	Study did not identify specific areas of defect (i.e. may include internal wet areas) and did not provide a definition of serious defects at the time of the survey. Reflects only rectification costs (study separately identifies professional costs, legal costs and other costs).
Studies identifying cost of overall waterproofing effects (but without specific areas of defect identified)			
ABCB data (2023 – Section 3.1.1)	$/building ($2023)	$1,497,237	Includes waterproofing defects in balconies/podiums, roof, basement and external enclosures. Excludes internal wet areas.
Law et al.[56]	$/defect ($2023)	$5,765	Water penetration from outside (e.g. water coming in through the window, door, ceiling or balcony).

[56] Law, T., Sorrentino, G., Barry, R. and Ronngard, P. (2021), *Scoping study on the nature and extent of moisture damage in houses & apartments in Victoria*, December.

Study	Unit of measure	Rectification cost	Comments
Australian Institute of Architects (cited in Equity Economics, 2019)	$/apartment ($2023)	$29,070	Major water problem (includes internal leaks).
	$/apartment ($2023)	$5,814	Minor water problem (includes internal leaks).
Studies identifying specific areas of waterproofing defect			
Roofs			
ABCB data (2023)	$/building ($2023) $/apartment ($2023)	$655,238 $6,907	The per apartment figure was estimated using the number of apartments per building in the ABCB dataset.
Building Confidence Report: a case for intervention (CIE, 2021)	$/defect ($2023) $/apartment ($2023)	$14,211 $1,651 (estimated)	Refers to 'Roof and rainwater disposal defects' (examples given in the survey for these types of defect: loose roof sheeting, inadequate gutters, leaking concrete roof). It has been assumed that the original cost presented in this report is per building (there is typically one roof per building). For comparative purposes, this estimate was converted into a per apartment basis assuming that each building has approximately 8.6 apartments[57].
Mills, Anthony & Williams, Peter., 2009[58]	$/defect ($2023) $/apartment ($2023)	$4,736 $550 (estimated)	Refers to leaking roof, external water penetration, flashings. It has been assumed that the original cost presented in this report is per building. For comparative purposes, this estimate was converted into a per apartment basis assuming that each building has approximately 8.6 apartments.
Balconies and/or podiums			
ABCB data (2023)	$/defect ($2023)	$23,895	For the purposes of this analysis, it is assumed that each defect refers to one balcony. That is, it is assumed that each balcony with a waterproofing defect cost $23,895 to rectify.
Building Confidence Report: a case for intervention (CIE, 2021)	$/defect ($2023)	$22,847	Refers to 'Waterproofing/weatherproofing defects' (examples given in the survey for these defects: water leaking in from balcony or wall, water leaking through shower floor). May include internal wet areas. For the purposes of this analysis, it is assumed that each defect refers to one balcony. That is, it is assumed that each balcony with a waterproofing defect cost $22, 847 to rectify.
External enclosure			
ABCB data (2023)	$/defect ($2023)	$23,667	
Basement			

[57] The 2022 Australasian Strata Insights Report estimates that the average number of lots per strata scheme in Australia is 8.6 (City Futures Research Centre's 2022 Australasian Strata Insights Report (https://cityfutures.ada.unsw.edu.au/2022-australasian-strata-insights/).

[58] Mills, Anthony & Williams, Peter. (2009), *Defect Costs in Residential Construction*. Journal of Construction Engineering and Management. 135. 10.1061/(ASCE)0733-9364(2009)135:1(12)

Study	Unit of measure	Rectification cost	Comments
ABCB data (2023)	$/building ($2023)	$1,500,000	Refers to NCC Class 7.
	$/apartment ($2023)	$8,333	The per apartment figure was estimated using the number of apartments per building in the ABCB dataset.
Class 3 to Class 9 buildings			
Studies providing cost of overall defects (i.e. not waterproofing specific)			
Building Confidence Report: a case for intervention (CIE, 2021) – Low estimate	$/defect/building ($2023)	$302,416	Not waterproofing or class specific, estimates provided for all defect types across Class 3-9 buildings.
Building Confidence Report: a case for intervention (CIE, 2021) – Mid estimate	$/defect/building ($2023)	$405,569	
Building Confidence Report: a case for intervention (CIE, 2021) – High estimate	$/defect/building ($2023)	$508,722	
Studies identifying specific areas of waterproofing defect			
Roofs			
ABCB data (2023) – Class 5	$/building ($2023)	$687,478	
ABCB data (2023) – Class 9	$/building ($2023)	$461,250	
Balconies and/or podiums			
ABCB data (2023) – Class 5	$/defect ($2023)	$40,000	
Internal wet areas			
ABCB data (2023) – Class 5	$/defect ($2023)	$225,676	
ABCB data (2023) – Class 9	$/defect ($2023)	$50,000	

Note: estimates for years other than 2023 were converted into 2023 dollars using data on the Consumer Price Index (CPI) from the ABS.
Source: ACIL Allen based on noted sources

Other quantified costs

As noted before, waterproofing defects have a variety of impacts on the economy and the community in addition to the costs of rectifying the defect itself. Some of these costs have been quantified in previous studies. A summary of the estimates found in the literature is provided in Table 3.7. Notably, the costs included in this table do not relate to waterproofing defects in particular, but to building defects in general.

Table 3.7 Quantifiable non-rectification impacts of defects

<table>
<tr><th>Study</th><th>Scope</th><th>Findings</th></tr>
<tr><td>Office of the Building Commissioner and Strata Community Association NSW, 2023</td><td>Estimates for Class 2 buildings related to:
– professional costs
– legal costs
– other costs.</td><td>– Report estimates that, on average, for the buildings that had access to accumulated costs accrued due to serious defects, the following non-rectification costs per building were associated with these defects:
  – around $57,000 for professional costs
  – around $42,000 in legal costs
  – around $23,000 in other costs (such as strata management charges).
– This report also includes information about the impact of defects on the buildings' insurance and notes that for 75% of buildings with serious defects, these have impacted the insurance for the building. In particular:
  – 2 thirds (67%) of buildings with serious defects faced higher insurance premiums as a result
  – 44% had a smaller choice of insurers
  – 35% were offered less coverage or added exclusions were enforced.
Notably, the impact of defects on insurance costs is not included in the estimates of the overall size of the problem to avoid double counting.[59]</td></tr>
<tr><td>Office of the Building Commissioner and Strata Community Association NSW, 2021</td><td>Estimates for Class 2 buildings related to:
– professional costs
– legal costs
– other costs.</td><td>– Report estimates that, on average, the following non-rectification costs per building were associated with serious defects (in $2021):
  – around $30,000 for professional costs
  – around $37,000 in legal costs
  – around $3,000 in other costs (such as strata management charges).</td></tr>
<tr><td>Building Confidence Report: a case for intervention (CIE, 2021)</td><td>Estimates for Class 2 buildings related to:
– time costs
– other costs.</td><td>In addition to rectification costs, this report estimated the time costs and 'other' costs of defects.
– Time costs refer to the value of time that building owners use to rectify the defect (e.g. chasing up repairers, investigating problems, speaking with practitioners, attending body corporate meetings, etc.). Based on survey responses, the study estimates that, on average, apartment owners spend 46 hours on getting a defect repaired. It then values this time at half the average hourly earnings for all employees in Australia in 2019 ($19.55) and estimates that the time cost per defect for apartments is $904.
– Other costs include lost rental income, temporary accommodation costs, extra travel/transport, technical/engineering reports, legal costs, extra health care costs, and other costs. Using survey responses, the study estimates that other costs associated with defects are $1,985 per defect for apartments.</td></tr>
<tr><td>Easthope et al., 2012</td><td>Estimates for Class 2 buildings related to legal costs.</td><td>This study refers to a document published by Teys Lawyers, which provided the following breakdown of time and legal costs for a hypothetical 20-unit scheme with 2 or 3 major defects in NSW.
<table><tr><th>Stage</th><th>Timeframe</th><th>Cost ($2010)</th><th>Approx cost in $2023</th></tr><tr><td>Assessment of the nature and extent of defects</td><td>4-6 months</td><td>$30,000-$50,000</td><td>$42,000-$70,000</td></tr></table></td></tr>
</table>

[59] Increases in insurance premiums are a consequence of high incidence of defects, higher perceptions of risk and therefore higher premiums so insurer can cover their risks/costs.

Study	Scope	Findings			
		Negotiations regarding settlement	Up to 6 months	$20,000-$50,000	$28,000-$70,000
		Application for rectification	9-12 months	$10,000-$50,000	$14,000-$70,000
		Court case for damages	2-3 years	$150,000-$250,000	$209,000-$348,000
		Source: Table 8.2, UNSW (2012) Governing the compact city: the role and effectiveness of strata management			

Source: ACIL Allen based on noted sources.

Non-quantified impacts

There are a number of additional impacts from waterproofing defects beyond the costs quantified in the CBA (discussed above). These include evacuation costs, insurance costs, loss of property value and stress and anxiety. These costs have not been quantified, but are discussed qualitatively below.

Evacuation costs

When damage to the property or the activities required for repair render the property unliveable, alternative accommodation must be found for the occupants. For Class 2 buildings, this requires the provision of alternative rental properties or hotel stays for those affected. The costs for evacuation scale with the severity of the defect, as a longer repair will necessitate a longer evacuation. The cost will also vary depending on the location and the availability of alternative accommodation.

There are no substantive data on the extent to which residents need to evacuate a building for a given defect. However, CIE's Building Confidence Report: a case for intervention detailed several high-profile evacuations following structural and cladding defects, including Opal Tower, Mascot Tower and the Lacrosse building. These evacuations lasted from as little as one night to over a year.[60]

Insurance costs

Insurance fees are charged on the basis of risk. As such, when there are higher incidences of defects in construction projects, the costs of insurance for construction firms and owners corporations will increase. Insurance costs do not represent a new cost, they represent a transfer of costs from insurance companies to the businesses that they insure.

CIE's Building Confidence Report: a case for intervention identifies 4 categories of construction professionals who require insurance:

— building surveyors, required to have indemnity insurance

— some states require professional engineers to have professional indemnity insurance (e.g. NSW and Victoria)

— architects, required to hold indemnity insurance everywhere except Queensland

— builders, required to participate in state mandatory warranty schemes, provided by government or by private providers.[61]

[60] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July. Table 2.31.

[61] Ibid, Table 2.32

Firms that are not able to signal to insurers that they follow good practice and minimise the risk of defects will be particularly liable for high costs. This may represent a moral hazard for insurers and construction firms.

Owners' corporations also hold insurance to cover defect costs, and premiums may rise where buildings are identified as defect prone. Evidence collected from the NSW 2023 Strata Defects Survey identified that insurance was an issue for 75% of strata managers dealing with serious defects, and that 67% faced higher premiums. Forty-four per cent reported that there were fewer insurers willing to cover them.[62]

Loss of property value

Where buildings have defects that require a costly repair, the value of that property will go down as prospective buyers factor in the cost and time to repair the defect. In this sense, the decrease in property value is not a new cost, but is a manifestation of the expected cost of rectification.

Stress and anxiety

The purchase of real estate is a significant investment for businesses, but is more so for individuals buying homes. In some cases, it is their biggest expense investment. As such, defects with the fabric of the building are typically high stakes for the owner, particularly where there is uncertainty or the cost to repair is high.

The CIE's Building Confidence Report: a case for intervention highlighted examples where there were cladding defects, including a UK study which showed that 90% of respondents had worse mental health after cladding defects were identified.

This is supported by the NSW 2023 Strata Defects Survey, which show that 50% of responding strata managers identified emotional stress as an impact of dealing with major defects. The Construct NSW Improving Consumer Confidence Report also identified that the stress and time required to deal with defects caused some owners to sell their apartment.

3.2.3 Overall size of the problem

The projected annual number of new buildings with waterproofing defects over period 2025-2034 is shown in Table 3.10 and the costs associated with these defects are summarised in Table 3.11.

The estimates of the size of the problem in Table 3.10 and Table 3.11 are based on:

— projections of new residential (Class 2) dwellings and commercial buildings (see Appendix C)

— estimates of the prevalence and costs of waterproofing defects.

As discussed in the previous sections, estimates about the prevalence and costs of building defects vary significantly across studies in the literature. They also vary across jurisdictions, with the prevalence and costs assumed to be lower in NSW with the introduction of the *Design and Building Practitioners Act 2020* and the *Residential Apartment Buildings (Compliance and Enforcement Powers) Act 2020,* which apply to Class 2, Class 3 and Class 9c buildings.[63]

Given the range of existing estimates, the size of the problem associated with waterproofing defects has been estimated based on low, medium and high assumptions. The assumptions

[62] Section 1.1.4.

[63] Details of the assumptions used to estimate the impact of the new NSW on defects and incorporate them in the baseline are provided in Appendix B.

underpinning our estimates under each of these scenarios are summarised in Table 3.8 for Class 2 buildings and Table 3.9 for Class 3-9 buildings. In general terms:

- For Class 2 buildings, the assumptions for the:
  - low scenario reflect the lowest estimates for the cost and prevalence of waterproofing defects found in the literature (and outlined in Table 3.5, Table 3.6 and Appendix A)
  - medium scenario reflect the average of all the cost and prevalence estimates found in the literature
  - high scenario reflect the highest estimates for the cost and prevalence of waterproofing defects found in the literature.
- For Class 3-9 buildings, the assumptions for the:
  - prevalence of waterproofing defects is the same across all scenarios (as noted before, there is limited literature on the prevalence of defects in these building classes) and it is sourced from CIE's Building Confidence Report: a case for intervention[64]
  - the low, mid and mid-high estimate scenarios are based on CIE's low/mid/high estimates of overall prevalence of all defects, their low/mid/high estimates for overall costs of all defects and their estimates of prevalence of waterproofing defects outlined in Table 3.5 and Appendix A
  - high scenario uses the cost of rectifying waterproofing defects estimated from the ABCB dataset.
- The assumptions about prevalence of different areas (balconies/podiums, roofs and basements) across different building classes were informed by stakeholder consultations.

Table 3.8 Assumptions underpinning the estimated size of the problem related to waterproofing defects in Class 2 buildings under various scenarios

		Assumptions used under each scenario		
	Basis of estimate	**Low estimate**	**Mid estimate**	**High estimate**
Prevalence assumptions				
NSW				
Balcony / Podium	% of buildings with defect	7%	17%	26%
Roof	% of buildings with defect	6%	11%	15%
Basement	% of buildings with defect	3%	13%	13%
All other jurisdictions				
Balcony / Podium	% of buildings with defect	10%	24%	36%
Roof	% of buildings with defect	9%	15%	21%
Basement	% of buildings with defect	4%	18%	18%
Rectification costs assumptions (all jurisdictions)				
Balcony / Podium	$/balcony ($2023)	$22,847	$23,371	$23,895
Roof	$/apartment ($2023)	$550	$3,036	$6,907
Basement	$/apartment ($2023)	$8,333	$8,333	$8,333
Assumed prevalence of different areas in Class 2 buildings				
Balcony/ Podium	% of buildings with balconies/podiums		95%	

[64] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

	Basis of estimate	Assumptions used under each scenario Low estimate	Mid estimate	High estimate
Roof	% of buildings with roof		100%	
Basement	% of buildings with basements		90%	

Note: assumptions for NSW account for the impacts of the introduction of the Design and Building Practitioners Act 2020 (DBP Act) and the Residential Apartment Buildings (Compliance and Enforcement Powers) Act 2020 (RAB Act) in NSW (which apply to Class 2, 3 and 9c buildings).

Source: ACIL Allen based on sources in Appendix A, WTP advice and stakeholder consultations.

Table 3.9 Assumptions underpinning the estimated size of the problem related to waterproofing defects in Class 3-9 buildings under various scenarios

<table>
<tr><th rowspan="2"></th><th rowspan="2">Basis of estimate</th><th colspan="6">Assumptions used under each scenario</th></tr>
<tr><th>Low estimate</th><th>Mid estimate</th><th colspan="2">Mid-high estimate</th><th colspan="2">High estimate</th></tr>
<tr><td colspan="8">Prevalence assumptions</td></tr>
<tr><td colspan="8">NSW Class 3</td></tr>
<tr><td>Balcony / Podium</td><td>% of buildings with defect</td><td colspan="6">15%</td></tr>
<tr><td>Roof</td><td>% of buildings with defect</td><td colspan="6">12%</td></tr>
<tr><td>Basement</td><td>% of buildings with defect</td><td colspan="6">15%</td></tr>
<tr><td colspan="8">NSW Class 9</td></tr>
<tr><td>Balcony / Podium</td><td>% of buildings with defect</td><td colspan="6">20%</td></tr>
<tr><td>Roof</td><td>% of buildings with defect</td><td colspan="6">15%</td></tr>
<tr><td>Basement</td><td>% of buildings with defect</td><td colspan="6">20%</td></tr>
<tr><td colspan="8">All classes in all other jurisdictions and Class 4 to Class 8 in NSW</td></tr>
<tr><td>Balcony / Podium</td><td>% of buildings with defect</td><td colspan="6">21%</td></tr>
<tr><td>Roof</td><td>% of buildings with defect</td><td colspan="6">16%</td></tr>
<tr><td>Basement</td><td>% of buildings with defect</td><td colspan="6">21%</td></tr>
<tr><td colspan="8">Rectification costs assumptions (all jurisdictions)</td></tr>
<tr><td>Balcony / Podium</td><td>$/building ($2023)</td><td>26,162</td><td>$41,932</td><td colspan="2">$56,890</td><td colspan="2">$40,000</td></tr>
<tr><td>Roof</td><td>$/building ($2023)</td><td>$19,591</td><td>$31,399</td><td colspan="2">$42,600</td><td colspan="2">$574,364</td></tr>
<tr><td>Basement</td><td>$/building ($2023)</td><td>$500,000</td><td>$750,000</td><td colspan="2">$1,500,000</td><td colspan="2">$1,500,000</td></tr>
<tr><td colspan="8">Assumed prevalence of different areas across building classes</td></tr>
<tr><td rowspan="2">Balcony / Podium</td><td rowspan="2">% of buildings that have balconies/podiums</td><td>Class 3</td><td>Class 5</td><td>Class 6</td><td>Class 7</td><td>Class 8</td><td>Class 9</td></tr>
<tr><td>15%</td><td>5%</td><td>5%</td><td>0%</td><td>0%</td><td>51%</td></tr>
<tr><td rowspan="2">Roof</td><td rowspan="2">% of buildings with roofs</td><td>Class 3</td><td>Class 5</td><td>Class 6</td><td>Class 7</td><td>Class 8</td><td>Class 9</td></tr>
<tr><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr>
<tr><td rowspan="2">Basement</td><td rowspan="2">% of buildings that have basements</td><td>Class 3</td><td>Class 5</td><td>Class 6</td><td>Class 7</td><td>Class 8</td><td>Class 9</td></tr>
<tr><td>90%</td><td>90%</td><td>50%</td><td>100%</td><td>0%</td><td>54%</td></tr>
</table>

Note: assumptions for NSW account for the impacts of the introduction of the Design and Building Practitioners Act 2020 (DBP Act) and the Residential Apartment Buildings (Compliance and Enforcement Powers) Act 2020 (RAB Act) in NSW (which apply to Class 2, 3 and 9c buildings).

Source: ACIL Allen based on sources in Appendix A, WTP advice and stakeholder consultations.

As shown in Table 3.10 and Table 3.11, depending on the assumptions used under each scenario (discussed above), it is estimated that waterproofing failures:

— could affect between 1,790 and 15,960 new apartments per annum across Australia and cost these buildings between $235 million and $610 million per annum

— could affect over 1,000 Class 3 to 9 buildings per annum across Australia and cost these buildings between $829 and $2.4 billion per annum.

Table 3.10 Estimated size of the problem related to waterproofing in new buildings

	Low estimate	Mid estimate	High estimate
Average annual number of new buildings over period 2025-2034			
NSW			
Class 2 residential buildings (SOUs)		18,071	
Class 3-9 (commercial use) buildings		1,538	
All other states			
Class 2 residential buildings (SOUs)		31,438	
Class 3-9 (commercial use) buildings		5,313	
Average annual number of new buildings with waterproofing defects over period 2025-2034			
Class 2 residential buildings			
NSW			
No. apartments with balcony / podium defects	1,325	3,138	4,733
No. apartments with roof defects	1,137	1,960	2,783
No. apartments with basement defects	530	2,385	2,385
All other states			
No. apartments with balcony / podium defects	3,144	7,445	11,228
No. apartments with roof defects	2,697	4,650	6,602
No. apartments with basement defects	1,258	5,659	5,659
Class 3-9 (commercial use) buildings			
NSW			
No. buildings with balcony / podium defects		315	
No. buildings with roof defects		236	
No. buildings with basement defects		315	
All other states			
No. buildings with balcony / podium defects		1,121	
No. buildings with roof defects		839	
No. buildings with basement defects		1,121	

Note: estimates exclude costs associated with internal wet areas and account for the impacts of the introduction of the DBP Act and the RAB Act in NSW (which apply to Class 2, Class 3 and Class 9c buildings). SOU stands for Single Occupancy Unit.
Source: ACIL Allen estimates.

Table 3.11 Estimated cost of the problem related to waterproofing in new buildings, average cost per year, $M 2023

	Average cost per year, $M 2023
Class 2 residential buildings	
Rectification costs	
Low estimate	$113
Mid estimate	$315
High estimate	$487

	Average cost per year, $M 2023
Other costs	
Professional costs	$65
Legal costs	$49
Time costs	$9
Subtotal other costs	$123
Total costs (rectification + other costs)	
Low estimate	$235
Mid estimate	$438
High estimate	$610
Class 3-9 (commercial use) buildings	
Rectification costs	
Low estimate	$502
Mid estimate	$753
Mid-high estimate	$1,484
High estimate	$2,064
Other costs	
Professional costs	$185
Legal costs	$139
Time costs	$3
Subtotal other costs	$327
Total costs (rectification + other costs)	
Low estimate	$829
Mid estimate	$1,080
Mid-high estimate	$1,811
High estimate	$2,391

Note: estimates exclude costs associated with internal wet areas and account for the impacts of the introduction of the DBP Act and the RAB Act in NSW (which apply to Class 2, 3 and 9c buildings).
Source: ACIL Allen estimates.

3.3 Is this problem relevant to the NCC?

The goal of the NCC is to:

> enable the achievement of nationally consistent, minimum necessary standards of relevant safety (including structural safety and safety from fire), health, amenity, and sustainability objectives efficiently.
>
> https://ncc.abcb.gov.au/editions/2016/ncc-2016-volume-one/introduction/introduction, accessed 14 February 2024

As discussed in Section 3.1, feedback received by the ABCB Office through the Board's technical committees and working groups indicates that the absence of adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water to the building or elements of its fabric is contributing to waterproofing defects. As illustrated in Table 3.11, these waterproofing defects are imposing costs on building owners of between $1 and $3 billion per annum (in $2023). In addition, these defects are having adverse impacts on the mental wellbeing of building occupants and the amenity of buildings.

Waterproofing defects can be caused by a number of factors (e.g. poor maintenance by property owners or inappropriate materials) and can occur at different phases of a building's lifecycle (design, construction or operational phase). If there were adequate Performance Requirements and DtS provisions in the NCC relating to the ingress of sub-surface water to the building or elements of its fabric, waterproofing defects caused by poor design and construction practices could be minimised.

As noted by the CIE, '[a]necdotally, the earlier a defect is detected, the less costly it is to rectify. For example, if non-compliant designs are identified prior to construction, the rectification costs incurred may be minimal. By contrast, if non-compliant designs or construction practices are not identified until after a building has been completed, the rectification costs could be very large.'[65] Another study that illustrates this point (albeit for Class 1 buildings – there is a lack of sources to draw from for Class 2-9 buildings) is summarised in Box 3.1.

These studies indicate that the most efficient approach to reduce the costs associated with building defects (including waterproofing defects) is to ensure that the design and construction of buildings minimises the probability that defects will arise. This could be achieved if the NCC is amended to include adequate Performance Requirements and DtS provisions relating to the ingress of sub-surface water to the building or elements of its fabric, and this is consistent with the goal of the NCC.

Box 3.1 Indicative costs of rectifying damages at critical stages of construction in single dwellings

Case studies included in Western Australia's Consultation Regulatory Impact Statement analysing full private certification of building approvals for single (Class 1) residential buildings in WA indicate that rectifying defects identified at an early stage of construction is significantly less costly than after completion. For example, as shown in the table below, rectifying waterproofing in one bathroom of 6 m2 in a single dwelling would cost 44% more 5 years after completion (compared to rectifying it at construction).

While indicative, these estimates show that addressing defects at the design/construction stage is more efficient than after buildings have been completed.

Inspection stage	Rectification cost		Increase in cost if defect rectified at completion (compared to rectification at construction)
	At construction	At completion (5+ years)	
	$ 2019	**$ 2019**	**%**
Footing inspection	1,360	5,875	332%
Roof framing inspection	250	6,250	2400%
Completion/final			
Bushfire construction requirement	1,100	1,500	36%
Plasterboard installation	315	3,700	1075%
Waterproofing (bathroom)	10,400	15,000	44%

Source: WA Department of Mines, Industry Regulation and Safety 2019, Reforms to the building approval process for single residential buildings in Western Australia Consultation Regulatory Impact Statement, September.

[65] Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July, p.20.

While, to our knowledge, there is no systematic Australian dataset identifying the causes of building defects, relevant findings in the literature and existing data are outlined in the points below.

— As noted in Section 3.1.1, data provided by the ABCB suggest that:
  – In **Class 2** buildings, 5% of waterproofing defects are caused by design, 12% by workmanship and 83% are due to a combination of design and workmanship issues.
  – In **Class 3-9 buildings**, the main cause of waterproofing defects in balconies/podiums and roofs is a combination of workmanship and design.

— Based on a survey, the Building Confidence Report: a case for intervention[66] estimates that 52% of all defects in **apartments** are caused by the initial build[67] (that is, defects that are relevant to NCC compliance) and 48% by maintenance and other factors.

— A study of 18,704 defects in 74 buildings (across **various classes**) in Singapore found that:
  – 60% of these defects were preventable with better design
  – 33% were preventable with better workmanship
  – 24% were preventable with better materials
  – 4% were preventable with better maintenance.

— Johnston and Reid notes that ‘[s]tudies have shown 50 to 60% of building defects are attributed to design issues or would have been preventable with better design. Therefore, 40 to 50% of defects arise in the construction phase. Josephson and Hammarlund examined defect costs and found 32% originated in the earlier phases of development (including design), approximately 45% originated on site and approximately 20% related to materials and machines.’ [68] However we note that the authors caution about extrapolating these results.

— Chew and De Silva[69] studied defects related to internal water leakage in wet areas of 1,500 **high-rise residential** building blocks in Singapore between 0–35 years of age. The authors found that the primary sources of water leakage defects were construction (38% of defects) and design (37% of defects), with the remaining 25% attributed to the material used. The study also found that 50% of buildings had internal water leakage problems within the first-year post construction. The water leakage related defects were located around pipe penetrations (the most prevalent), construction joints, internal walls and slabs. More specifically, the water penetration related to the waterproof membranes.

Based on the above evidence, we have assumed that the proportion of waterproofing defects that are caused by the design of buildings is 52% for Class 2 and 49% for Class 3-9 buildings. These assumptions are based on:

— the Building Confidence Report: a case for intervention’s estimates of defects caused by the initial build of Class 2 buildings (52%)

— the estimates of defects caused by design and workmanship in Class 3-9 buildings from the ABCB data (49%).

Using these estimates and the ranges of the size of the waterproofing defects problem in Section 3.2, we estimate that the costs associated with waterproofing defects that could be

[66] Ibid, p. 30.

[67] The study defines defects caused by the initial build as those related to design, engineering, approval and construction.

[68] Johnston, N. and Reid, S. (2019), *An examination of building defects in residential multi-owned properties*, Deakin University, Melbourne, June, p. 11.

[69] M. Y.L. Chew & Nayanthara De Silva (2002) Factors Affecting Water-Tightness in Wet Areas of High-Rise Residential Buildings, Architectural Science Review, 45:4, 375-383, DOI: 10.1080/00038628.2002.9696953.

potentially addressed through the NCC (i.e. that are relevant to the design and construction phases of buildings) are in the order of (see Table 3.12)[70]:

— between $121 million and $314 million per year for Class 2 buildings

— between $403 million and $1.2 billion per year for Class 3 to Class 9 buildings.

Table 3.12 Annual costs associated with waterproofing defects that could be potentially addressed through the NCC, $M 2023

Class 2 residential buildings	
Low estimate	$121
Mid estimate	$226
High estimate	$314
Class 3-9 (commercial use) buildings	
Low estimate	$403
Mid estimate	$525
Mid-high estimate	$881
High estimate	$1,163

Note: estimates include avoidable costs for both concrete and non-concrete buildings and account for the impacts of the introduction of the DBP Act and the RAB Act in NSW (which apply to Class 2, 3 and 9c buildings).

Source: ACIL Allen estimates.

[70] Note this includes avoidable costs for both concrete and non-concrete buildings.

4 The case for government intervention

Establishing that a problem exists is not sufficient to justify government intervention. Rather, the case for action must be established on the basis of market failure, regulatory failure, or in order to achieve societal or environmental outcomes that would not be delivered by the market alone. Further, in building the case for government action, it is important to demonstrate that the problem could not be solved by the market itself or through alternative quasi or non-regulatory responses.[71]

This chapter explores the various types of failures that are related to waterproofing defects and whether there are non-legislative means for addressing them to determine whether the proposed changes to the waterproofing requirements are justified.

4.1 Market failure

A competitive market is generally the most efficient means of allocating resources across a society, ensuring that the goods and services demanded by consumers are produced efficiently and promoting innovation as well as consumer choice. A situation when a market fails to perform these functions is commonly known as market failure. Types of market failure include, for instance, public goods, externalities, information asymmetries, split incentives, bounded rationality and natural monopolies.

The presence of market failure implies that there is a potential for the government to improve outcomes for consumers, businesses, the economy and society as a whole.

The market failures that are related to waterproofing defects in buildings are discussed in the following sections.

4.1.1 Information asymmetries

Information asymmetry can manifest when consumers purchase or consume a good or service without fully being aware of the consequences of their decisions/actions. In the case of waterproofing in buildings, this relates to the difficulty some buyers and users of buildings have to determine and understand:

— the effectiveness of waterproofing solutions used/present in buildings to respond to the ingress of sub-surface water

— the potential impact of waterproofing failures on structural integrity of the building, the health of its occupants and the lifecycle cost of the building (amongst other things).

Property purchasers, who are infrequent buyers (particularly buyers of residential buildings), are not easily able to ensure that a building meets the qualities they think they are paying for and are often not even aware of what could go wrong. Building users (e.g. tenants and workers) are also often not able to fully assess building performance, as once a building is completed some aspects are concealed within the building fabric and impossible to inspect thoroughly.

[71] For example, refer NSW Treasury 2019, *NSW Guide to Better Regulation*, TPP 19-01, January.

This means building sellers (often property developers) have far more information than buyers about the underlying quality of the buildings for sale, and there is no way for buyers to be confident about the quality of the building they are considering buying into. This asymmetry of information puts buyers at risk of buying a property with defects, which they will then be responsible for fixing. While consumers in the residential market are often the most affected by this market failure, the less sophisticated consumers in the commercial market (e.g. small business owners) suffer from the same vulnerability.

While information imbalances do not necessarily require government intervention, from an efficiency perspective, these asymmetries are an issue because it is often not easy for building owners and occupiers to:

- determine what decisions regarding waterproofing solutions have been made on their behalf
- assess the full impact of waterproofing decisions made during construction on the building safety, amenity and its operational costs
- seek redress through the legal system for waterproofing defects (given the significant transaction costs related to this).

4.1.2 Split incentives

Split incentives refer to a situation where the benefits of a transaction do not accrue to the party who pays for the transaction. In the context of waterproofing defects, split incentives relate to the fact that people making decisions about waterproofing solutions during the design and construction phases may not be the owner/occupier of the building when completed. For instance, those deciding to save on building costs by increasing maintenance costs may not be the ones who bear the costs of maintenance.[72]

If the party who invests in developing the building (i.e. the actor in charge of capital expenses) is not the same as the party who benefits from its use of (i.e. the actor in charge of operational expenses), split incentives can arise – i.e. incentives are misplaced between the party selecting the design, materials, equipment or technologies for waterproofing a building and the party who pays the ongoing operational costs. This imbalance of decision-making powers can create inefficient/adverse outcomes in the market.

In the case of waterproofing, the developer or builder may have an incentive to reduce the upfront costs and/or time associated with waterproofing, with the costs associated with waterproofing defects paid for by others. Furthermore, as discussed in Chapter 2, contemporary project-based construction processes which involve scattered accountability and a multitude of active entities in every project have also lead to split incentives and resulted in siloed ecosystems where companies tend to manage their own risk and transfer the risk/costs of poor waterproofing practices to the building owners/occupiers.

Asymmetric information and split incentives are major barriers to fostering design and construction practices that effectively deal with the ingress of sub-surface water to buildings because:

- Asymmetric information results in property buyers being unable to determine the effectiveness of waterproofing solutions used/present in buildings and assess the full impact of these on building safety and amenity, and the lifecycle costs of the building. When buyers are unable to differentiate between properties with/without effective waterproofing solutions, higher-quality properties in the market are gradually reduced to the point where only lowest-cost ‘lemons’ remain.

[72] Productivity Commission 2004, *Reform of building regulation*, p. 31.

— Split incentives mean that people making decisions about waterproofing solutions during the design and construction phases of buildings are typically not responsible for the lifecycle costs of those buildings, and hence would not bear the rectification costs of buildings with waterproofing failures nor the benefits of buildings using effective waterproofing solutions (however, they would incur the upfront cost and/or time associated with these solutions).

4.1.3 Externalities

Externalities are defined as costs and benefits of an activity that are experienced by people or organisations other than those directly involved in the activity. They exist when the welfare of some agent, or group of agents, is affected by the actions of another and this is not reflected in market prices. When the effects of one agent on another are not taken into account, market prices will not reflect the true marginal cost/benefit of the good or service traded.

Negative externalities related to waterproofing in buildings include the negative impacts of defective buildings on:

— the buildings' occupiers
— the surrounding community (e.g. negative impacts on the value of neighbouring properties)
— the industry overall (in particular, the loss of confidence in the building sector).

4.1.4 Achieving social or environmental objectives

Government intervention may be justified in the pursuit of social and equity objectives. Such objectives include:

— the redistribution of income to achieve equity goals
— establishing law and order
— preserving and protecting environmental resources
— human rights
— protecting the vulnerable and disadvantaged
— relieving geographic and social isolation.

A particular form of social regulation relates to requirements that seek to reduce or manage the risk of harm to health, safety or welfare of individuals or the community. Examples include[73]:

— measures to promote public health and safety
— reducing the risk of harm to vulnerable sections of the community
— restrictions on the practice of certain occupations and professions.

In the context of buildings, there are widespread community expectations that all buildings will provide a minimum level of performance and safety.[74] Building defects across all building types increase costs to building owners/occupants/insurers to remediate defects, including waterproofing defects, and are an increased risk to the health and safety of people living in or occupying defective buildings.

[73] Victorian Department of Treasury and Finance (DTF) 2014, *Victorian Guide to Regulation, Toolkit 1: Purposes and types of regulation*, July, p. 2-3.

[74] Productivity Commission 2004, *Reform of building regulation*, p. 30.

4.2 Regulatory failure

While the OIA does not formally define regulatory failure in the RIA Guidelines, they provide a series of questions to assess whether government intervention could be justified on the basis of regulatory failure.[75] The sections below consider these questions.

4.2.1 Has a previous attempt to regulate failed?

Since its introduction as a national set of consistent technical building requirements in 1988, the NCC (previously the Building Code of Australia) has included provisions (i.e. minimum performance standards) related to the waterproofing of buildings. Despite this, as noted in Section 3.2.1, there is evidence that a very high proportion of buildings (particularly Class 2) experience waterproofing (and other) defects.

4.2.2 Have old regulations failed to keep up with new circumstances?

As discussed in Chapter 2, while the causes behind the rise of waterproofing (and other) defects in Australian buildings are many and multifaceted, there is evidence that the current regulatory framework has failed to keep up with new circumstances.

The NCC has failed to keep pace with modern construction practices, the rise of D&C contracts and changes/innovations in the materials used for waterproofing. In particular, for waterproofing, the code has failed to provide adequate performance requirements and DtS provisions responding to the ingress of sub-surface water to the building elements (which has been identified as the root cause of the majority of waterproofing defects[76]).

These issues have contributed to an increased number of buildings with waterproofing failures and have resulted in diminished public confidence that the building industry can deliver safe and compliant buildings, and public outcry (as discussed in the following section).

4.2.3 Is there a legitimate public outcry about an issue of public importance?

Waterproofing defects in newly constructed buildings (particularly multi-storey residential buildings) have recently been in the spotlight and have caused a legitimate public outcry about this issue. Some high-profile recent examples of major waterproofing defects are outlined in the points below.

- In 2017 the ABC published an article titled Leaking Buildings, mould, and court battles; The dark side of the apartment boom. [77] The article reported that:
  - according to a survey of strata owners conducted by the City Futures Research Centre at the University of New South Wales around 70% of new strata buildings leak
  - the problem was not limited to NSW and that the Victorian Building Authority has labelled waterproofing as 'possible systemic issue'.

[75] Commonwealth of Australia, Department of the Prime Minister and Cabinet 2023, *Regulatory Impact Analysis Guide for Ministers' Meetings and National Standard Setting Bodies*, June, p. 13.

[76] See discussion in Chapter 3.

[77] Roxburgh Tim 2017, *Leaking Buildings, Mould and Court Battles: The Dark Side of the Apartment Boom,* Australian Broadcasting Corporation, https://www.abc.net.au/news/2017-03-31/leaking-buildings-mould-court-battles-dark-side-apartment-boom/8403744.

— Various media articles have warned about Victoria facing a 'crisis of leaky buildings', with water damage topping the list of defects encountered in inspections and complaints to the Victorian Building Authority[78].

— Severe water damage, mould and rotten timber frames have been found in several poorly constructed apartment buildings in Victoria when replacing cladding as part of a $600 million Victorian Government scheme to reduce the risk associated with combustible cladding on residential apartment buildings and publicly owned buildings.[79]

— The Elara Apartment complex built in Canberra suffered from severe water penetration issues in roofs, walls, balconies and basement, as well as other structural issues. Owners faced more than $19 million in repairs.[80]

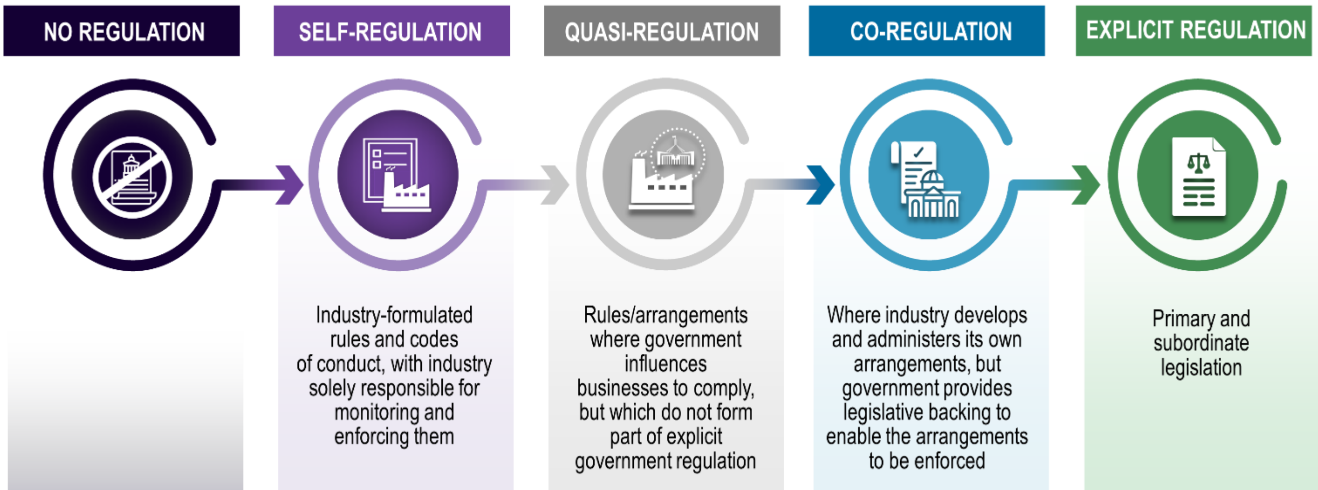
4.3 Can the problem be addressed by non-legislative means?

Having established a justification for government intervention arising from market and/or regulatory failure, it is necessary to consider whether there are non-regulatory or quasi-regulatory responses the government could pursue, or whether the market may self-correct through its normal functioning.

4.3.1 Is there scope for self-regulation, quasi-regulation or co-regulation?

In a broad sense, regulation can be considered as a spectrum ranging from self-regulation (where there is little or no government involvement), through quasi-regulation and co-regulation (which refers to a range of rules, instruments or standards that government expects businesses to comply with), to explicit government regulation (see Figure 4.1).

Figure 4.1 Continuum of government intervention



Source: ACIL Allen based on Commonwealth of Australia 2007, Best Practice Regulation Handbook.

[78] See for instance: Topsfield, Jewel 2023, *Rot and toxic mould: Leaky homes could be Victoria's next building crisis*, The Age, https://www.theage.com.au/national/victoria/rot-and-toxic-mould-leaky-homes-could-be-victoria-s-next-building-crisis-20230707-p5dmm1.html; Dow, Aisha 2016, Melbourne's faulty building crisis, The Age, https://www.theage.com.au/national/victoria/melbournes-faulty-building-crisis-20161217-gtdbb0.html.

[79] Cladding Safety Victoria (2023), *Research analysis on issues and risks associated with balcony defects*, January.

[80] See: https://www.abc.net.au/news/2019-02-14/elara-apartment-owners-lose-federal-court-compensation-bid/10810628.

According to the *Australian Government Best Practice Regulation Handbook*[81], **self-regulation** is typically characterised by the industry formulating rules and codes of conduct. As noted by the Australian Treasury's Taskforce on Industry Self-regulation, self-regulation should be considered where:

— *there is no strong public interest concern, in particular, no major public health and safety concern;*

— *the problem is a low risk event, of low impact/significance, in other words the consequences of self-regulation failing to resolve a specific problem are small; and*

— *the problem can be fixed by the market itself, in other words there is an incentive for individuals and groups to develop and comply with self-regulatory arrangements (e.g. for industry survival, or to gain a market advantage).*[82]

Quasi-regulation includes a wide range of rules and/or arrangements where governments influence businesses/industry to comply, but which do not form part of explicit government regulation.[83] Examples of quasi-regulation include accreditation schemes and codes of conduct/practice developed with government involvement. Box 4.1 outlines the circumstances in which self or quasi-regulation may be appropriate.

Quasi-regulation is likely to be successful when government is not convinced of the need to develop or mandate a code for the whole industry. Flexible, tailor-made solutions and less formal mechanisms bring cost advantages, and the industry is capable of engaging in a cohesive response.

Box 4.1 Checklists for assessment of self and quasi-regulation

Self-regulation should be considered where:

— there is no strong public interest concern, in particular, no major public health and safety concern

— the problem is a low-risk event, of low impact or significance

— the problem can be fixed by the market itself.

Quasi-regulation should be considered where:

— there is a public interest in some government involvement in addressing a community concern and the issue is unlikely to be addressed by self-regulation

— there is a need for an urgent, interim response to a problem in the short term, while a long-term regulatory solution is being developed

— government is not convinced of the need to develop or mandate a code for the whole industry

— there are cost advantages from flexible, tailor-made solutions and less formal mechanisms

— there are advantages in the government engaging in a collaborative approach with industry, with industry having substantial ownership of the scheme. For this to be successful, there needs to be:

  – a specific industry solution rather than regulation of general application
  – a cohesive industry with like-minded participants, motivated to achieve the goals
  – a viable industry association with the resources necessary to develop and/or enforce the scheme
  – effective sanctions or incentives to achieve the required level of compliance, with low scope for benefits being shared by non-participants
  – effective external pressure from industry itself (survival factors), or threat of consumer or government action.

As in the case of self-regulation, proposed approaches should not restrict competition.

Source: Commonwealth of Australia 2007, Best Practice Regulation Handbook.

[81] Commonwealth of Australia 2007, *Best Practice Regulation Handbook*.

[82] Taskforce on Industry Self-regulation 2020, *Industry Self-Regulation in Consumer Markets*, p. 43.

[83] Commonwealth of Australia 2007, Best Practice Regulation Handbook.

Co-regulation typically refers to situations where industry develops and administers its own arrangements, but government provides legislative backing to enable the arrangements to be enforced.[84]

It is clear that, in the case of waterproofing of new buildings, several of the conditions for relying on self-regulation, quasi-regulation, or co-regulation are not met:

— the problems caused by waterproofing failures in buildings are of high impact/significance as they can affect the structural integrity of a building and the health of occupants
— there is a strong public interest concern, in particular the significant concerns regarding the impact of mould and dampness in buildings on human health and community safety
— there are no market incentives for industry to develop and comply with self-regulatory arrangements to address the issues related to the ingress of sub-surface water to the building elements
— there is no cohesive industry with like-minded participants motivated to achieve the same goals. The number of stakeholders involved in the construction industry is large, with diverse interests.

4.3.2 Provision of information

A possible non-regulatory response by government to problems arising from information asymmetry could be to provide more information to consumers so that they are more informed (e.g. governments could undertake education campaigns or facilitate access to relevant information regarding what to look for in relation to poor building works). However, this approach (in its own) is unlikely to be effective in relation to risks related to defective building work due to a number of factors, for instance[85]:

— information programs may not reach everyone
— some individuals may be unable to absorb or act on information provided
— a significant number of people ‘do not know what they don’t know’
— the cause of waterproofing defects may not be visible to those not involved with the design or construction of the building.

In light of this, while an education campaign (both for consumers and industry) would be an important part of a regulatory response, information provision by government on its own is not sufficient to address the problem.

[84] Australian Law Reform Commission 2012, *Classification—Content Regulation and Convergent Media*, Final Report, February, https://www.alrc.gov.au/wp-content/uploads/2019/08/final_report_118_for_web.pdf, accessed 8 December 2022.

[85] Productivity Commission 2004, *Reform of building regulation*, p. XXIV.

4.4 Summing up

The discussion in this and the previous chapter suggests that, in principle, there is a case for more stringent waterproofing regulation on the basis that:

— There are existing market failures that justify government intervention in relation to waterproofing of new buildings. These include information asymmetries, split incentives and negative externalities.

— Asymmetric information and split incentives are major barriers to fostering design and construction practices that effectively deal with the ingress of sub-surface water to buildings because:

  – Asymmetric information results in property buyers being unable to determine the effectiveness of waterproofing solutions used/present in buildings and assess the full impact of these on building safety and amenity, and the lifecycle costs of the building. When buyers are unable to differentiate between properties with/without effective waterproofing solutions, higher-quality properties in the market are gradually reduced to the point where only lowest-cost 'lemons' remain.

  – Split incentives mean that people making decisions about waterproofing solutions during the design and construction phases of buildings are typically not responsible for the lifecycle costs of those buildings, and hence would not bear the rectification costs of buildings with waterproofing failures nor the benefits of buildings using effective waterproofing solutions (however, they would incur the upfront cost and/or time associated with these solutions).

— The continuous high incidence of serious waterproofing defects in new buildings points to a systemic failure of existing regulatory frameworks to prevent these defects – a situation where the regulation that was intended to overcome market failures related to building construction and protect the public at large, has failed to achieve these same goals. Indeed, the absence of adequate provisions in the NCC addressing the ingress of sub-surface water to building elements (which has been identified as the root cause of the majority of waterproofing defects[86]) has contributed to the high prevalence of waterproofing defects in Class 2 to 9 buildings.

— The significant health, safety and financial impacts of waterproofing defects have led to a legitimate public outcry about this issue in several Australian jurisdictions.

— More stringent waterproofing regulation would contribute to achieving social objectives and equity objectives by meeting community expectations that all buildings in Australia provide a minimum level of performance and safety.

— There is a lack of non-regulatory alternatives that would be effective in correcting for the market failures related to waterproofing of buildings.

— Existing regulation needs to be updated to reflect changes to the regulatory environment, improved government and community understanding of risks, and changing business practices.

The case for more stringent waterproofing regulation through the NCC is assessed in the following chapters.

[86] See discussion in Chapter 3.

5 Objectives of government intervention and proposed changes

5.1 Objectives of government action

The broader objectives of the proposed changes to the waterproofing provisions in the NCC can be summarised as to[87]:

— drive a reduction in the incidences of waterproofing defects and reduce rectification costs
— improve confidence in the construction industry
— improve health and amenity in buildings.

There are also a number of secondary objectives of the proposed changes. These include:

— increased clarity of the water management requirements of the NCC (for instance, by recasting 5 Performance Requirements into one and removing ambiguity about the ability for water to penetrate a building element).
— providing a level platform for all sectors to operate within.

5.2 Policy options

The policy options considered in this CBA are:

— the Business as Usual (BAU) or status quo
— amending the waterproofing requirements in NCC 2025 (NCC 2025 scenario).

Each of these options are discussed in more detail in the sections below.

5.2.1 Business as Usual (Status Quo)

The Business as Usual (BAU) or status quo is an option where there are no changes to the waterproofing requirements for Class 2 to 9 buildings in the NCC 2025. The BAU sets up a baseline against which the impacts of the alternative option discussed below is evaluated.

While the BAU benchmark assumes there are no changes to the waterproofing requirements in the NCC, this does not imply that the baseline is static. There may exist, for example, a background level of voluntary adoption of additional/improved waterproofing measures in new buildings that occurs without changes in the NCC.

Essentially, the BAU portrays the ‘best’ representation of the foreseeable counterfactual and considers a range of factors, including:

— existing policies/measures to aimed at reducing building defects. In particular, it considers the impact of the DBP Act and the RAB Act in NSW (which apply to Class 2, 3 and 9c buildings)

[87] ABCB 2023, *Waterproofing and Water Shedding Position Paper – September 2022- March 2023.*

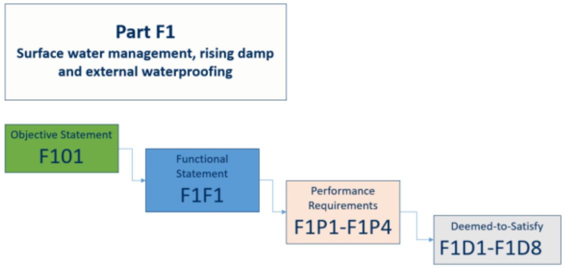
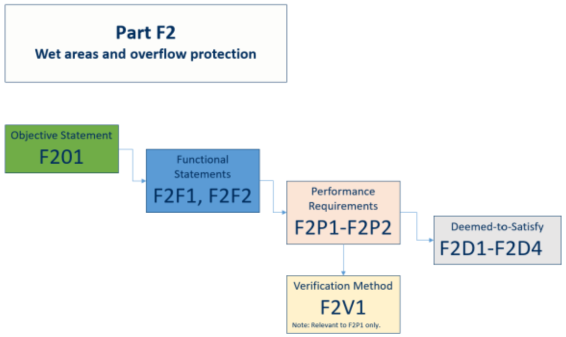
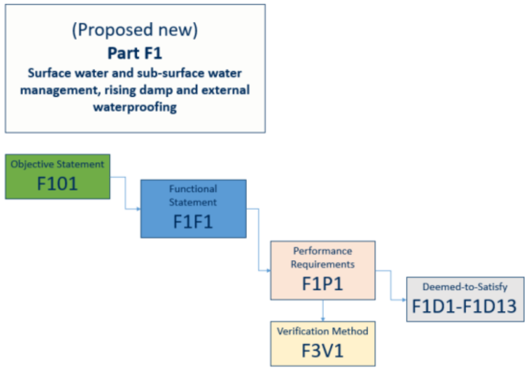
- instances where buildings have a level of waterproofing that is above that required by the NCC (more details provided in Chapter 6)
- growth in building stock
- other relevant background variables.

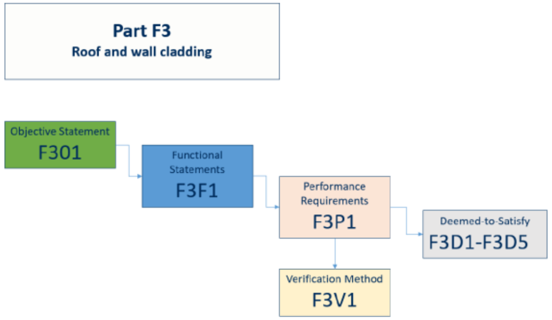
More details about the factors accounted for in the BAU for the cost benefit analysis modelling are provided in Chapter 6.

5.2.2 NCC 2025 Scenario

The NCC 2025 Scenario reflects a world where the stringency of the waterproofing provisions in the NCC is increased. A summary of the key regulatory changes related to waterproofing requirements proposed for NCC 2025 is provided in Table 5.1 and a draft of the proposed provisions is provided in Appendix D.

Table 5.1 Summary of key regulatory changes contained in NCC 2025

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
Section F Health and Amenity			
Performance Map	Provisions for waterproofing in NCC 2022 are set out in Section F – Health and amenity. Parts F1, F2 and F3 under this section contain all the provisions related to waterproofing. The figures below are maps showing relevant Objectives, Functional Statements, Performance Requirements and Deemed-to-Satisfy (DtS) provisions for Parts F1, F2 and F3.  	The proposed changes for NCC 2025 include merging Part F1 and Part F3 of NCC 2022 into a single Part. Part F2 of NCC 2022 will remain unchanged. The figure below shows the proposed merging of Part F1 and F3 (NCC 2022). 	The reason for merging Part F1 and Part F3 of NCC 2022 is due to the rewording of the Performance Requirements. Performance Requirements F1P1 to F1P4 and F3P1 have been condensed into a single proposed new Performance Requirement. The proposed new single Performance Requirement embraces the guiding principles of collection, redirection, and drainage. Recasting 5 Performance Requirements into one also provides clarity to the interpretation of the NCC in relation to water management. It helps to remove ambiguity about the ability for water to penetrate a building element.

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
			
Section F (Health and Amenity), Part F1 Surface water management, rising damp and external waterproofing			

Objective	The current Objective of Part F1 is to:
	– safeguard occupants from illness or injury and protect the building from damage caused by:
	  – surface water; and
	  – external moisture entering a building; and
	  – the accumulation of internal moisture in a building; and
	– protect other property from damage caused by redirected surface water.
		It is proposed that the objective in NCC 2025 is changed to:
		– Safeguard occupants from illness or injury and protect the building from damage caused by **water** (which is then defined in the Performance Requirement F1P1 – see below). The new definition of water is broader and encompasses a range of terms previously used to in the NCC to refer to water.
		– Protect other property from damage caused by **water.**
			The objective and functional statements are the guidance level within the NCC. Performance Requirements form the compliance level and DtS provisions provide compliance solutions.
			The proposal includes changing both the Performance Requirements and DtS provisions. Given this, there was also a need to change the objective and functional statements.
			Drainage of sub-surface water is not currently included in the NCC (i.e., there is no regulatory provision to deal with sub-surface water, yet available evidence suggests that sub-surface water is the primary cause of waterproofing failures).

Functional statements	The current functional statement F1F1 refers to protection from redirected surface water. In particular, it reads as follows: A building, including any associated sitework, is to be constructed in a way that protects people and other property from the adverse effects of redirected surface water.	Similar to the change proposed for the objective, it is proposed that this functional statement is changed in NCC 2025 to refer to protection from redirected ***water***. It also includes a new statement about protection from the adverse effects of water that may enter the building and cause damage. The new proposed functional statements reads as follows: A building, including any associated sitework, is to be constructed in a way that protects people and other property from the adverse effects of **water including water that may enter the building and cause damage**.	

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
Performance Requirements	Performance Requirement **F1P1** currently refers to managing the **impact of rainwater on adjoining properties**. It refers only to surface water collected or concentrated by a building or sitework and requires that this water is disposed to avoid the likelihood of damage or nuisance to any other property. Performance Requirement **F1P2** currently refers to **preventing rainwater from entering buildings**. It refers only to surface water resulting from a storm having an annual exceedance probability of 1% and requires that this water 'must not enter the building'. Importantly, Class 7[88] and 8[89] buildings are exempt from these requirements where it is deemed that there is no necessity for compliance. Performance Requirement **F1P3** currently refers to **rainwater drainage systems**. Similar to F1P1 and F1P2, it only refers to surface water and requires that a drainage system for the disposal of surface water resulting from a storm having an annual exceedance probability of: – 5% must convey surface water to an appropriate outfall and avoid surface water damaging the building – 1% must avoid the entry of surface water into a building. Performance Requirement **F1P4** currently refers to **rising damp**. It requires that moisture from the ground must be prevented from causing:	As noted above, the proposed amendments merge Performance Requirements F1P1 to F1P4 and F3P1 into a single proposed new Performance Requirement F1P1. The main changes contained in the new proposed F1P1 are outlined in the points below. **Guiding principles** The proposed new single Performance Requirement incorporates the guiding principles of collection, redirection, and drainage. In particular, it states that water must be collected, redirected, and drained from the building, associated sitework and allotment to prevent: a) unhealthy or dangerous conditions, loss of amenity for occupants within the building; and b) undue damage to the building or building elements; and c) undue damage or nuisance to other buildings and any other property. The philosophy behind the guiding principles is simple and relies on the naturally occurring force that is gravity. Sufficient falls in appropriate finished surfaces and substrates among other things will achieve the philosophy of the guiding principles of collection, redirection, and drainage. This will drain both surface and sub-surface water. **Definition of water** As noted before, the current NCC uses a range of terms to refer to water. The new F1P1 defines water as including, but not being limited to: – surface water; and – sub-surface water; and	The primary reason for the proposed change is the identified lack of NCC provisions responding to sub-surface water. Analysis of the data shows defects arise because of sub-surface water entering building elements or the internal parts of a building. It follows that most rectification costs relate to this problem. The next reason for change is based on the need to apply guiding principles to the NCC provisions. The principles of collection, redirection, and drainage will be a constant factor of design, documentation and construction or installation. This is important as it will mean all sectors of industry have a consistent set of provisions for the elements of construction requiring waterproofing. The principles will apply to construction elements in vertical and horizontal planes such as walls and slabs, roofs, or balconies. They will also be applicable to internal and external areas of buildings requiring a waterproofing response. The importance of these changes is to drive a reduction in the incidences of waterproofing defects. It will also help to reduce rectification costs. Other benefits will include positive social outcomes, confidence in the construction industry, improved health and amenity in buildings, and a level platform for all sectors to operate within.

[88] Class 7a buildings are carparks. Class 7b buildings are typically warehouses, storage buildings or buildings for the display of goods (or produce) for wholesale.

[89] A Class 8 building is one in which a process (or handicraft) is carried out for trade, sale, or gain (e.g. a factory or a mechanic's workshop).

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
	– undue dampness or deterioration of building elements; and – unhealthy or dangerous conditions, or loss of amenity for occupants. Importantly, Class 7 and 8 buildings are exempt from these requirements where it is deemed that there is no necessity for compliance.	– rainwater; and – stormwater; and – rising damp; and – water services overflow; and – irrigation water; and – groundwater; and – surface water seepage. **Managing rainwater impact on adjoining properties** NCC 2025 would require that, to comply with the new Performance Requirement, water resulting from a rain event is drained in a way that avoids the likelihood of damage to the building or nuisance to any other property. This means any water that enters the fabric of the building is intercepted and directed to a satisfactory system or outfall and drained. The introduction of falls in building elements will mean the force of gravity acting upon water will not allow it to remain in place and pond or build up to a point where it ingress the building and cause damage. **Preventing rainwater from entering buildings** NCC 2025 would require that, to comply with the new Performance Requirement, water from a storm collected or concentrated by building elements (including roofs, balconies, podiums, attached awnings with box gutters and stormwater overflow systems) does not enter the building and is drained to an appropriate outfall. The effect of this change will be the introduction of mandatory falls in structural substrates. In addition, membranes will be required to be directly fixed to structural substrates. In the event the substrate fails, the inherent fall in the structural substrate will prevent ponding by removing water by gravity.	

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
		There is also a new requirement to consider the impact of water from a rain event that may be subject to wind action. This change will require design consideration to be given in cases where wind, with an annual exceedance probability of 4%, impacts a building. A separate Performance Requirement has been preserved for rising damp and has been expanded to include ground water. The addition of ground water results from the detailed definition of the term *water*. Rising damp and ground water are separate because they are not directly included in rain events under F1P1. **Removal of exemptions for Class 7 and 8 buildings** Currently Class 7 and 8 buildings are exempt from the waterproofing requirements in NCC 2022 where it is deemed that there is no necessity for compliance. NCC 2025 would remove this exemption and require that Class 7 and 8 buildings to comply with the new Performance Requirement.	
Performance Requirements	F3V1 Weatherproofing outlines the verification methods for weatherproofing	The weatherproofing verification methods have been renumbered F1V1 and the following minor changes have been made: – (1) (b) (ii) has been deleted – in clause (3) it has been clarified that 'the test specimen must be a minimum of 2.4 m high and 2.4 m wide' – clause (5) (d) (iv) now reads 'With the internal lining removed, apply a final static pressure test at 50 Pa for a period of 15 minutes **and check for compliance with (6)**.'	The changes made to this verification method have been made to add clarity and give a quantified metric to the test specimen.
Deemed-to-Satisfy Provisions	The current DtS provisions in NCC 2022 are outlined in the table below.	A number of new DtS provisions are being proposed based on the new Performance Requirement F1P1 and the guiding principles. The new provisions are summarised in the table below and discussed in more detail in the following sections.	DtS provisions need to be revised to reflect the proposed changes in Performance Requirements

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment

Number	Provision in NCC 2022
F1D1	Deemed-to-Satisfy Provisions
F1D2	Application of Part
F1D3	Stormwater drainage
F1D4	Exposed joints
F1D5	External waterproofing membranes
F1D6	Damp-proofing
F1D7	Damp-proofing of floors on the ground
F1D8	Subfloor ventilation
B1D3	Determination of individual actions (page 48-49)

Number	Provision in NCC 2022	Provision in NCC 2025
F1D1	Deemed-to-Satisfy Provision	Deemed-to-Satisfy Provisions
F1D2	Application of Part	Application of Part
F1D3	Stormwater drainage	Stormwater drainage
F1D4	Exposed joints	**[New]** Provision of drainage and grading to external areas
F1D5	External waterproofing membranes	**[New]** Substrate materials
F1D6	Damp-proofing	**[Renumbered]** Exposed joints **[New]** location requirements
F1D7	Damp-proofing of floors on the ground	**[Renumbered]** External waterproofing membranes **[New]** installation requirements
F1D8	Subfloor ventilation	**[Renumbered]** Damp-proofing **[New]** Possible Class 7 and 8 exemption removed
F1D9		**[Renumbered]** Damp-proofing on the ground
F1D10		**[New]** Surface finishes
F1D11		**[Renumbered]** Subfloor ventilation
F1D12		**[Renumbered]** Roof coverings
F1D13		**[Renumbered]** Sarking

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
		<table><tr><td>F1D14</td><td>**[Renumbered]** Glazed assemblies **[New]** Possible Class 7 and 8 exemption removed</td></tr><tr><td>F1D15</td><td>**[Renumbered]** Wall cladding **[New]** Possible Class 7 and 8 exemption removed</td></tr><tr><td>B1D3</td><td>**[New]** expected 10-year deflection for structural-substrates in Part F1</td></tr></table> **F1D1 Deemed-to-Satisfy Provisions** Reference to F1P2 has been included. **F1D2 Application of Part** Reference to F1D5 has been added to subclause (1) and F1D5 and F1D10 to (2). **F1D3 Stormwater drainage** No change **F1D4 Provision of drainage and grading to external areas** F1D4 relates specifically to "concrete" roofs, balconies, podiums, and similar parts. It has been expanded to require a 1:80 fall to structural substrates. A requirement has been included for 70 mm step downs from inside a building to the outside and integral hobs are required around the perimeter of the building elements. **F1D5 Substrate materials**	

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
		F1D5 removes reference to autoclaved aerated concrete as a substrate material. **F1D6 Exposed joints** F1D6 has been expanded to include requirements for a hob located at a ridge or highest point if a construction joint is formed. **F1D7 External waterproofing membranes** A sub-clause has been added to establish specific compliance with relevant clause if a membrane is installed directly on a structural substrate. **F1D8 Damp-proofing** The possible exemption for Class 7 and 8 buildings has been removed from F1D8. **F1D9 Damp-proofing on the ground** No change. **F1D10 Surface finishes** F1D10 provides a requirement for surfaces to be either self-draining or have a membrane directly fixed to a structural substrate. This is to ensure the management of sub-surface water. **F1D11 Subfloor ventilation** No change. **F1D12 Roof coverings** No change. **F1D13 Sarking** No change. **F1D14 Glazed assemblies**	

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
		The possible exemption for Class 7 and 8 buildings has been removed from F1D8. **F1D15 Wall cladding** The possible exemption for Class 7 and 8 buildings has been removed from F1D8.	
Section B (Structure), Part B1 Structural provisions			
Deemed-to-Satisfy Provisions	Part B1 of the NCC focuses on safeguarding people from injury caused by structural failure, loss of amenity caused by structural behaviour (deflections, creep, vibration, settlement and the like), protection of other property from physical damage caused by structural failure and safeguarding people from injury that may be caused by failure of, or impact with, glazing DtS provision B1D3 (Determination of individual actions) outlines how individual actions must be determined. B1D3 (e) requires that the following actions are considered during construction of buildings: i) liquid pressure action; and ii) ground water action; and iii) rainwater action (including ponding action); and iv) earth pressure action; and v) differential movement; and vi) time dependent effects (including creep and shrinkage); and vii) thermal effects; and viii) ground movement caused by— A. swelling, shrinkage or freezing of the subsoil; and B. landslip or subsidence; and	A new action is proposed to be included in B1D3 (e) for NCC2025. This action is as follows: x) expected 10-year deflection for structural substrates in Part F1. The intention of including design for ten-year deflection is to ensure concrete building elements relied on to accommodate falls for drainage maintain sufficient grades over time. Concrete building elements will inevitably deflect and consideration must be given to the design to ensure falls are able to be maintained.	The reason for requiring the consideration of 10-year deflection is to ensure the continuity of falls or grades in drainage substrates (concrete elements). Concrete structures, across large spans, can deflect to the point where falls that existing at the time of construction can flatten out or reverse. Designing to accommodate this over a 10-year period will allow the building to settle to a state where excessive movement becomes proportionately minimal.

Area of change	Current situation (NCC 2022)	Proposed change (NCC 2025)	Purpose/rationale of the proposed amendment
	C. siteworks associated with the building or structure; and ix) construction activity actions.		

Source: ACIL Allen and ABCB.

6 Impacts of the proposed provisions

This chapter assesses the indicative impacts of the proposed changes to waterproofing provisions in NCC 2025 on Class 2 to 9 buildings[90], compared with the ‘base case’ option of no change to the current situation, and it is structured as follows.

— Section 6.1 provides an overview of the Cost-Benefit Analysis (CBA) framework that has been used to assess the impacts of the proposed changes of the waterproofing provisions and outlines our approach to some general parameters used in the CBA.

— Section 6.1.4 provides an overview of the costs and benefits that have been quantified in the analysis. A detailed of the methodology used to measure these costs and benefits is provided in Section 6.3 and Section 6.4, respectively.

— Section 6.3 provides estimates of the costs associated with the proposed changes.

— Section 6.4 assesses the benefits associated with more stringent waterproofing requirements for new buildings.

— Section 6.5 estimates the net impacts of the new regulatory requirements on the Australian economy, and presents the results of undertaking sensitivity analysis of key assumptions.

In line with the proposed provisions, the impact analysis focuses on roofs, basements, balconies/podiums in concrete framed buildings. That is, the analysis assumes that no changes are made to internal (or other) wet areas of concrete buildings or to buildings framed using materials other than concrete.

6.1 CBA framework

Consistent with best regulatory practice, the analysis of the impacts of the new proposed waterproofing provisions was undertaken using a CBA framework.

CBA is an analytical tool that can be used to assess the benefits and costs of new programs and regulatory proposals. Costs and benefits are examined from the perspective of the community as a whole to identify the proposal with the highest net benefit. This approach applies a with/without comparative metric that allows the analysis to specifically isolate the impacts of the introduction of new waterproofing requirements for buildings from the ever-changing policy landscape.

The following sections outline our approach to some general parameters used in the CBA.

[90] For the purposes of the impact analysis, Class 4 parts of buildings have been excluded due to very low construction activity in this segment (the CSIRO Australian Housing Data portal shows that fewer than 400 of these buildings were built between 2016 and 2022).

6.1.1 Timeframe for analysis

Consistent with best practice, it is assumed that compliance and enforcement actions begin the year that the amendments take effect (2025) and are modelled to extend for a period of 10 years (that is, compliance costs are modelled for 10 years). After this period, it is assumed that in a normal cyclical policy review, a new cost benefit analysis results in either the regulations being superseded, revised or extended.

While the economic analysis in this RIS has been undertaken assuming that the proposed changes to the NCC start in 2025, in practice, the regulations may start at different time and may have a transition period.

6.1.2 Discount rate

Following guidance from the ABCB, the discount rate used in the CBA to discount the stream of costs and benefits of changes related to waterproofing is 5% (real) with sensitivity analysis conducted using a discount rate of 2% and 7%.

6.1.3 Cost benefit summary measures

The CBA model includes 2 summary measures that distil the results of the analysis, as listed in Table 6.1.

Table 6.1 Summary of measures included in the CBA

Summary measure	Description	Success measurement	Comparative ability
Net present value (NPV)	Sum of discounted annual net benefits (benefits minus costs)	Scheme is beneficial to society if NPV is greater than zero	Provides the ability to compare scenarios according to the total economic return of each, where the option with the largest NPV should be favoured
Benefit-cost ratio (BCR)	Ratio of the present value of total costs to the present value of total benefits	Scheme is beneficial to society if BCR is greater than one	Provides the ability to compare scenarios according to the degree to which benefits outweigh costs for each, where the option with the largest BCR should be favoured

Source: ACIL Allen.

6.1.4 Compliance

The analysis assumes full compliance with the new waterproofing requirements. While in reality not all new constructions are likely to comply with the requirements fully, this is a standard assumption in regulatory analysis.

6.1.5 Cost pass-through

Consistent with previous analyses, for this CBA, we assumed that the additional compliance costs associated with the construction of a new dwelling or a new commercial building are passed through in full to the consumer (owners/occupiers).

6.1.6 Interactions with state and territory legislation

While the NCC is a national code, states and territories can choose which provisions of the code are 'called up' within their legislative frameworks, and can also vary these provisions. As such, the waterproofing provisions in the NCC could be applied with variations in some states and territories.

Consistent with previous RIS analyses, this CBA does not address the interaction between the proposed amendments to the NCC and the existing and planned state and territory regulations. The analysis assumes that each of the states and territories will apply the NCC in its jurisdiction and compares the current NCC requirements to the proposed new requirements.

Given this, the results of the analysis in this CBA should be interpreted as to represent the costs and benefits associated with increasing the stringency of waterproofing requirements of new buildings from the baseline set by NCC 2022, compared to NCC 2025.

The analysis does take into account new regulation in NSW aimed at decreasing the prevalence of defects (the DBP Act and the RAB Act, which apply to Class 2, 3 and 9c buildings). No state or territory variation is included in the baseline.

This approach allows for a like with like comparison between jurisdictions and avoids having to make assumptions about the likely policy responses of different states and territories.

6.1.7 Treatment of refurbishments

There are several difficulties related to the analysis of the impacts of the proposed increased waterproofing requirements on the refurbishment of existing buildings.

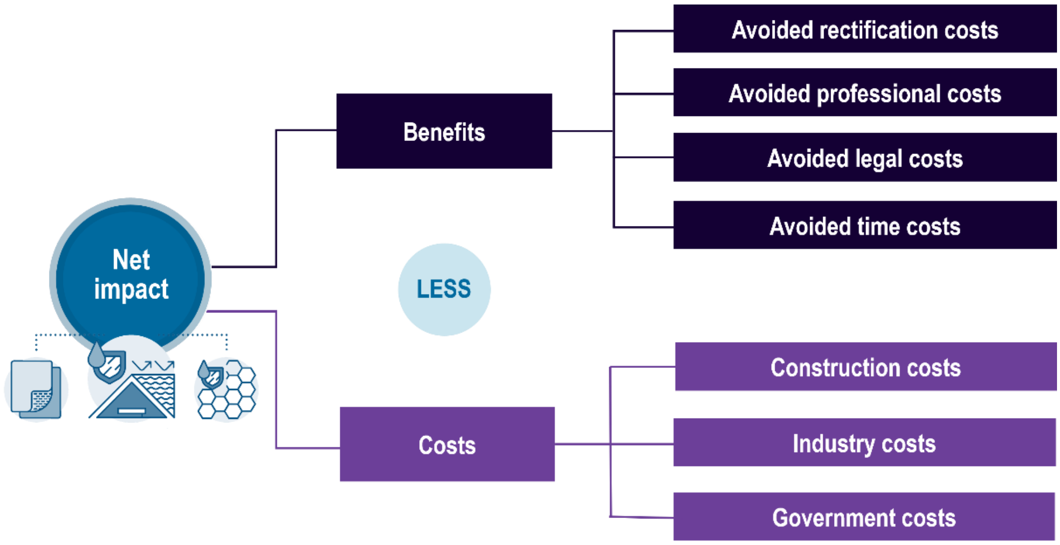
— The application of the NCC to refurbishments is covered in state/territory legislation, so individual jurisdictions can apply the NCC to refurbishments as rigorously as they see fit.
— The extent to which refurbishments comply with the NCC will vary by project (i.e. it is unknown what proportion of refurbishments will need to comply with the new NCC requirements and to what extent).
— Many existing buildings may be unable to comply with the NCC provisions.
— The costs of complying with the new waterproofing requirements in existing buildings may differ to new builds given the inherent variability of refurbishments.

Given this, refurbishments are excluded from the CBA.

6.2 Overview of impacts included in the analysis

The costs and benefits associated with the new waterproofing requirements that have been quantified and included in the analysis are illustrated in Figure 6.1, and are described in the points below. There are additional benefits associated with the proposed changes that have not been quantified for the analysis. These were discussed in Section 3.2.2.

Figure 6.1 Costs and benefits included in the analysis



Source: ACIL Allen.

The analysis considers 4 categories of benefits and 3 categories of costs associated with the proposed new waterproofing provisions:

— Benefits – the analysis uses the following measures of the potential benefits accruing to the proposed changes:
  – avoided rectification costs – these are the costs that are incurred by the owners and occupants of Class 2 to 9 buildings under the current regulations to rectify waterproofing defects, which will be avoided under the proposed changes
  – avoided professional costs – these are the costs incurred to obtain professional advice on waterproofing defects, which will be avoided under the proposed changes
  – avoided legal costs – these are the costs incurred to resolve disputes over waterproofing defects, which will be avoided under the proposed changes
  – avoided time costs – this is the value of the time that building owners and occupants spend to rectify waterproofing defects, which will be avoided under the proposed changes
— Costs – the proposed changes entail costs to industry and government. There are 3 categories of costs that have been included in the analysis:
  – Construction costs – these are the additional costs that would be incurred by developers to meet the proposed new waterproofing requirements
  – Industry costs – these are the costs that would be incurred by the industry to implement the proposed new waterproofing requirements
  – Government costs – these are the costs that would be incurred by the government to transition to the proposed new waterproofing requirements.

6.3 Cost of the proposed changes

The proposed changes to the waterproofing requirements in the NCC would involve some costs for the Australian economy. Costs at the economy-wide level include:

— additional costs incurred in the construction of new buildings to meet the proposed new requirements
— costs incurred by industry that cannot be directly passed on to the consumer (such as training costs)
— costs incurred by government to administer the policy and communicate the policy changes.

These are discussed in more detail in the sections below.

6.3.1 Change in construction costs

The proposed changes to the NCC would impose additional costs on developers to construct new buildings that meet the proposed new waterproofing requirements. The nature of the required investments has been assessed by Quantity Surveyors, WT Partnership (WTP), based on:

— the proposed provisions (see Appendix D)

— consultations with waterproofing experts to determine how a building's design and specifications would change to meet the new requirements

— average costs for 'typical' building designs within each class (see Appendix E).

The cost estimates provided by WTP consider the additional costs of labour and materials associated with the new requirements across the planning, design, construction and verification phases of building development. Estimates of cost increases (as a percentage of current costs) were provided on a square metre (m2) basis for each development phase for each of the areas of analysis (i.e. balconies, roofs, podiums and basements) – see Table 6.2 (estimated increases per area are the same across building classes).

As shown in this table, WTP estimates that the proposed provisions would result in an increase of:

— around 3% in the costs of balcony areas

— approximately 0.4% in the costs of podiums and roof areas

— no increase in the costs of basements.

Table 6.2 Indicative percentage increase in construction costs of different building areas to meet the proposed waterproofing requirements

	Planning phase	Design Phase	Construction phase	Verification of design	Weighted increase in cost across phases
Proportion of total building development cost by area					
% of total building cost	5.0%	5.0%	85.0%	5.0%	N/A
Increase in cost per m2 due to the new waterproofing requirements					
Balcony area	-	-	3.6%	-	3.1%
Roof	-	-	0.5%	-	0.4%
Podium area	-	-	0.5%	-	0.4%
Basement	-	-	-	-	-
Rest of building areas	-	-	-	-	-

Source: WTP and ACIL Allen.

The cost increases in Table 6.2 were then applied to the average 'typical' costs of construction (on a m2 basis) for each area in each building class under the Business as Usual (BAU, see Table 6.3) to estimate the overall cost increase for each area in each building class (see Table 6.5).

Notably, the cost increases in Table 6.5 were adjusted to reflect:

— Instances where buildings have a level of waterproofing that is above that required by the NCC. That is, to recognise that some buildings are currently being built using waterproofing standards that are higher than those required in the NCC and hence, would not incur additional costs if the new provisions are implemented. Given the evidence of high incidence of waterproofing defects, the percentage of buildings assumed to be 'over compliant' is very small (5%).

— The proportion of buildings built using a concrete frame – that is, only those buildings built using a concrete frame will be affected by the proposed increased stringency in waterproofing requirements in the NCC (see Table 6.4).

Table 6.3 Average costs of construction by area by building class under the BAU (per m2), $2023

	Class 2	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
Balcony area	$1,875	$1,875	$1,875	$1,875			$1,875
Roof	$700	$700	$700	$700	$563	$375	$700
Podium area	$1,563	$1,563	$1,563	$1,563			$1,563
Basement (excluding bulk excavation)	$2,000	$2,000	$2,000	$2,000			$2,000
Building overall (GFA)[a]	$4,000	$4,500	$4,000	$3,000	$1,500	$1,500	$7,000

[a] GFA= Gross Floor Area, which is defined as the sum of the 'Fully Enclosed Covered Area' and 'Unenclosed Covered Area'. Fully Enclosed Covered Area is defined as the sum of all such areas at all building floor levels, including basements (except unexcavated portions), floored roof spaces and attics, garages, penthouses, enclosed porches and attached enclosed covered ways alongside building, equipment rooms, lift shafts vertical ducts, staircases and any other fully enclosed spaces and useable areas of the building, computed by measuring from the normal inside face of exterior walls but ignoring any projections such as plinths, columns, piers and the like which project from the normal inside face of exterior walls. It shall not include open courts, light wells, connecting or isolated covered ways and net open areas of upper portions of rooms, lobbies, halls interstitial spaces and the like which extend through the storey being computed. Unenclosed Covered Area is defined as the sum of all such areas at all building floor levels, including roofed balconies, open verandas, porches and porticos, attached open covered ways alongside buildings, undercrofts and useable space under buildings, unenclosed access galleries (including ground floor) and any other trafficable covered areas of the building which are not totally enclosed by full height walls, computed by measuring the area between the enclosing walls or balustrade (i.e.., from the inside face of the UCA excluding the wall or balustrade thickness). When the covering element (i.e.., roof or upper floor) is supported by columns, is cantilevered or is suspended, or any combination of these, the measurements shall be taken to the edge of the paving or to the edge of the cover, whichever is the lesser. UCA shall not include eaves overhangs, sun shading, awnings and the like where these do not relate to clearly defined trafficable covered areas, nor shall it include connecting or isolated covered ways.

Source: WTP.

Table 6.4 Factors used to adjust estimated increases in construction costs by class

Class	Assumed proportion of buildings built at higher standard than NCC requires	Assumed proportion of buildings built using a concrete frame
Class 3	5%	95%
Class 5	5%	95%
Class 6	5%	95%
Class 7	5%	100%
Class 8	5%	-
Class 9	5%	95%

Source: WTP, industry stakeholders and ACIL Allen.

Table 6.5 Estimated increase in construction costs by area by building class as a result of the proposed waterproofing provisions (per m2), $2023

	Class 2	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
Balcony area	$55	$55	$55	$55	-	-	$55
Roof	$3	$3	$3	$3	$2	$1	$3
Podium area	$6	$6	$6	$6	-	-	$6
Basement	-	-	-	-	-	-	-

Source: WTP and ACIL Allen.

The increases in construction costs that were estimated on a per m2 basis (in Table 6.5) were converted to a per building basis using assumptions about (see Table 6.6):

— the overall size of buildings, and of each of the areas that would be covered by the new waterproofing requirements

— the prevalence of different areas across building classes (e.g. the percentage of buildings with balconies, podiums, etc.).

Table 6.6 Assumed building size (GFA) by area by class

	Class 2	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
Assumed building size (GFA) by area by class, m2 per building							
Whole building	11,000 [a]	4,616 [b]	11,000 [c]	43,000 [d]	14,000 [a]	-	11,178 [a]
Balcony area	15 (per apartment)[a]	118	240	752	-	-	326
Roof area	1,320 (per building)[a]	577	550	8,600	3,500	-	3,960
Podium area	1,305 (per building)[a]	56	114	358	-	-	155
Basement area	5,250 (per building)[a]	523	2,200	8,600	-	-	1,446
Assumed prevalence of different areas across building classes (% of buildings with relevant area) [e]							
Balcony/ Podium	95%	15%	5%	5%	-	-	51%
Roof	100%	100%	100%	100%	100%	100%	100%
Basement	90%	90%	90%	50%	100%	-	54%

Notes:

[a] Based on information provided by WTP.

[b] Weighted average of hotels with 100, 200 and 400 rooms. Assumes hotels with 100 rooms have a GFA of 2,000m2 and represent 33% of the total number of hotels; hotels with 200 rooms have a GFA of 4,400m2 and represent 46% of the total number of hotels; and hotels with 400 rooms have a GFA of 9,200 m2 and represent 21% of the number of hotels.

[c] Weighted average of office buildings with a GFA of 5,000m2 (assumed to be 58% of total), 15,000m2 (30% of total) and 30,000m2 (12% of total).

[d] Weighted average of shopping centres with a GFA of 10,000m2 (assumed to be 10% of total), 40,000m2 (80% of total) and 100,000m2 (10% of total).

[e] No dataset/information available to inform these prevalence assumptions. In the absence of data, these assumptions were based on consultations with WTP and industry stakeholders.

Source: ACIL Allen estimates based on information from WTP and industry stakeholders.

The estimated indicative costs of meeting the proposed waterproofing requirements on a per building basis are shown in Table 6.7. It has been estimated that the indicative costs of meeting the proposed waterproofing requirements are:

— around $900 per apartment (Class 2)

— around $2,200 per office building (Class 5)

— approximately $2,600 for Class 3 buildings, $27,600 for Class 6 buildings, $7,700 for Class 7 buildings and $20,700 for Class 9 buildings.

Table 6.7 Estimated marginal construction costs to meet new waterproofing requirements, $2023 per building (except Class 2 buildings for which costs are provided per apartment)

	Class 2 [a]	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
Balcony	$781	$968	$659	$2,061	-	-	$9,175
Roof	$36	$1,579	$1,505	$23,528	$7,695	-	$10,834
Podium	$76	$51	$70	$2,075	-	-	$760
Basement	-	-	-	-	-	-	-
Whole building	**$893 (per apartment)**	**$2,598**	**$2,234**	**$27,664**	**$7,695**	**-**	**$20,769**

[a] Costs relate to SOUs, not whole Class 2 buildings.
Source: ACIL Allen.

The estimated costs of meeting the proposed waterproofing requirements on a per building basis were aggregated to a national level using:

— projections of new residential building stock we generated for the NCC 2022 Decision Regulation Impact Statement for increased residential building energy efficiency

— projections of new commercial stock from the Commercial Building Baseline Study 2022.[91]

More details of these stock projections are provided in Appendix C and the aggregate construction costs associated with the proposed policy changes are summarised in Table 6.8.

As set out in Table 6.8, it is estimated that the proposed waterproofing changes to the NCC would impose Australia-wide costs of $944 million over the life of the policy.

[91] Department of Climate Change, Energy, the Environment and Water 2022, *Commercial Building Baseline Study 2022 Final Report*, prepared by Strategy. Policy. Research, August.

Table 6.8 Present value (in 2024) of construction costs to meet the NCC 2025 over 2025-2034, $M ($2023)

	Class 2	Class 3-9	Total
NSW	$91	$152	$243
VIC	$98	$185	$283
QLD	$61	$117	$178
SA	$9	$42	$51
WA	$26	$102	$128
TAS	$1	$18	$19
NT	$3	$11	$14
ACT	$17	$11	$28
Australia	**$306**	**$638**	**$944**

Notes: Present values calculated using a 5% central discount rate. Estimates exclude costs associated with internal wet areas and account for the impacts of the introduction of the DBP Act and the RAB Act in NSW (which apply to Class 2, 3 and 9c buildings). Totals may not add up due to rounding.
Source: ACIL Allen.

6.3.2 Implementation costs for industry

The CBA includes the following one-off costs for industry as a result of the proposed changes to NCC.

— the time invested by industry in familiarising themselves with the relevant new requirements

— any fees associated with attending professional development courses (for instance, the Waterproofing Design Principles course offered by the NSW Government to prevent water leaks and leaching in buildings[92]).

To calculate the training cost associated with the proposed changes to the NCC, we estimated:

— the number of industry stakeholders in the construction industry directly affected by the proposed changes

— the training costs projected to be incurred by each stakeholder.

Stakeholders directly affected by the proposed changes

The main stakeholder groups that are likely to be directly affected by the proposed changes to the NCC and would need to undertake training to understand the proposed changes are:

— civil and structural engineers

— architects and architectural draftspersons

— quantity surveyors and construction estimators

— building inspectors.

The estimated number of these stakeholders that are employed in the construction of Class 2 to 9 buildings is outlined in Table 6.9. These figures were derived using data on the number of people in each relevant occupation employed in the construction sector Australia-wide from

[92] See: https://store.training.tafensw.edu.au/product/waterproofing-design-principles/.

the Australia Bureau of Statistics (ABS)[93], escalating these numbers to 2023 using ABS estimates of employment growth in the Australian construction industry, and splitting them by construction sector using assumptions about the share of residential and commercial construction employment. In particular, it was assumed that, of people employed in the construction industry (across all the above occupations)[94]:

— 51% of people are employed in residential building construction. As no data is available on the split of Class 1 and Class 2 employment, it was assumed that employment is split equally between these 2 classes
— 25% are employed in non-residential building construction
— 24% are employed in heavy and civil engineering construction.

Table 6.9 Estimated number of industry stakeholders directly affected by the proposed changes to the NCC, 2023

Occupation	Class 2	Class 3 to 9	All buildings
Civil Engineer	2,357	2,286	4,642
Architect	308	298	606
Structural Engineer	209	203	412
Quantity Surveyor	317	307	624
Architectural Draftsperson	987	957	1,944
Construction Estimator	1,164	1,129	2,292
Building Inspector	334	324	658
Total	**5,675**	**5,504**	**11,179**

Source: ACIL Allen estimates based on ABS data.

Training costs incurred by each stakeholder

As noted above, the training costs incurred by affected stakeholders include:

— the time required for training
— the fees associated with attending formal training (e.g. for professional development courses/seminars).

It has been assumed that each person who requires retraining would require a total of 7 hours of training, including:

— 2 hours to attend a seminar/webcast to explain the proposed changes
— 2.5 hours of formal training (this is the time that it takes to complete the Waterproofing Design Principles course offered by the NSW Government[95]
— 2.5 hours of self-paced learning.

[93] This data was sourced from the Australian Government Australia's Labour Market Insights (LMI) website (https://labourmarketinsights.gov.au/) and is based on the 2016 Census.

[94] Assumptions about the share of residential, commercial and engineering construction are based employment data by each of these sectors derived from Input-Output (IO) tables.

[95] See: https://store.training.tafensw.edu.au/product/waterproofing-design-principles/.

The opportunity cost of this time has been valued using estimates of hourly earnings for each of the affected occupations adjusted to exclude tax[96] and to include an on-cost multiplier of 1.75 to account for non-wage labour on-costs.[97]

The most recent earnings data was sourced from the LMI website[98], which provides up-to-date information about the Australian jobs market based on ABS data. This data represents the median pay for full-time employees in 2021 paid at the adult rate, before tax, including amounts salary sacrificed. These earnings were adjusted to 2023 using ABS data on weekly average earnings. The updated indicative hourly earnings used to value the time invested in training for occupations undertaking retraining are outlined in Table 6.10.

Table 6.10 Indicative hourly earnings for occupations requiring retraining

Occupation	Median hourly earnings before tax, $2021	Median hourly earnings excluding tax, $2021	Median hourly earnings excluding tax $2023	Median hourly earnings excluding tax, including on-costs $2023
Civil Engineer	$57.00	$45.60	$48.84	$85.47
Architect	$48.00	$38.40	$41.13	$71.97
Structural Engineer	$57.00	$45.60	$48.84	$85.47
Quantity Surveyor	$57.00	$45.60	$48.84	$85.47
Architectural Draftsperson	$48.00	$38.40	$41.13	$71.97
Construction Estimator	$48.00	$38.40	$41.13	$71.97
Building Inspector	$48.00	$38.40	$41.13	$71.97

Note: assumes 230 working days per year and 7.5 hours per working day.
Source: ACIL Allen based on information from the Australian Government Australia's Labour Market Insights website.

In addition to the time costs, industry stakeholders would incur formal training fees. It has been assumed that the cost of this training is $175 ($159 excluding GST) for a 2.5 hours waterproofing course. This assumption is based on the costs of the Waterproofing Design Principles course offered by the NSW Government.

The total estimated training costs for industry stakeholders are presented in Table 6.11.

Table 6.11 Estimated total retraining costs for industry (including training time and training fees), $M ($2023)

	Class 2	Class 3 to 9	All buildings
Training time	3.13	3.04	6.17
Training fees	0.90	0.88	1.78
Total	**4.03**	**3.91**	**7.95**

Source: ACIL Allen.

[96] Taxation is excluded from the analysis as it is a transfer to government (not a cost). The earnings data is multiplied by 0.8, which is equivalent to assuming each of these individuals has an average tax rate of 20%.

[97] The Commonwealth Regulatory Burden Measurement Framework Guidance Note by the OIA (p.11) states that average weekly earnings need to be 'scaled up using a multiplier of 1.75 (or 75 per cent as it is input into the Regulatory Burden Measure) to account for the non-wage labour on-costs (for example, payroll tax and superannuation) and overhead costs (for example, rent, telephone, electricity and information technology equipment expenses).'

[98] https://labourmarketinsights.gov.au/

6.3.3 Government costs

Costs to government are estimated by the ABCB to be $80,000. These are the costs to be incurred by the ABCB to assist with the transition to the new code. These costs include preparation of a range of guidance material (e.g. fact sheets, design solutions, case studies) and presentations on the changes in all capital cities.

These costs are assumed to be incurred as a once-off in 2025.

6.4 Benefits of change

There are benefits associated with the proposed changes to the waterproofing requirements in the NCC. Benefits at the economy-wide level include costs that are avoided in:

— rectifying waterproofing defects
— obtaining professional advice on waterproofing defects
— obtaining legal advice to resolve disputes related to waterproofing defects
— spending time by building owners to rectify waterproofing defects.

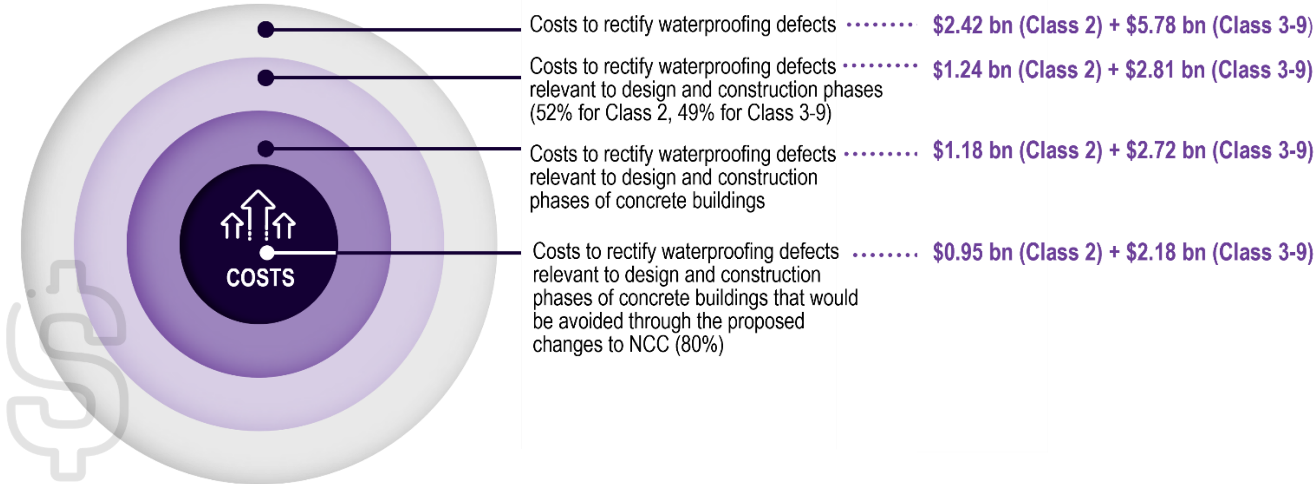
These are discussed in more detail in the sections below.

6.4.1 Avoided costs to rectify defects

The proposed changes to the NCC would avoid the costs that are currently incurred to rectify waterproofing defects. To estimate the savings in rectification costs stemming from the proposed changes to the NCC, we have used the estimated costs to rectify waterproofing defects and determine the proportion of these costs that would be reduced through the NCC changes (this is illustrated in Figure 6.2). This in accounts for the following factors:

— the estimated cost to rectify waterproofing defects on a per unit or per building basis, aggregated to a national basis using projections of new building stock
— the estimated proportion of waterproofing defects that are relevant to the design and construction phases of buildings and hence could be potentially addressed through the NCC
— the proportion of buildings built using a concrete frame
— the estimated proportion of these waterproofing defects that would be avoided through the proposed changes to the NCC.

Figure 6.2 Avoided building rectification costs due to the proposed NCC changes, present value



Notes: Based on the mid estimate in Table 6.12 as the central case scenario. Present values calculated using a 5% central discount rate. Totals may not add up due to rounding.
Source: ACIL Allen.

Estimated cost to rectify waterproofing defects

The cost to rectify waterproofing defects was estimated on a per apartment or per building basis based on:

- the cost to rectify a defect, by building area (balcony, roof, podium and basement) across different scenarios (low, medium, medium-high, high), as set out in Table 3.8 for Class 2 buildings and Table 3.9 for Class 3-9 buildings
- the assumed prevalence of different areas across building classes (percentage of buildings with relevant area), as set out in Table 6.6
- the prevalence of a defect, as set out in Table 3.8 for Class 2 buildings and Table 3.9 for Class 3-9 buildings.

The average estimated cost to rectify waterproofing defects on a per apartment basis (Class 2 buildings) or on a per building basis (Class 3-9 buildings) is set out in Table 6.12.

For the purposes of the CBA of the proposed changes to the NCC we use the mid estimate in Table 6.12 as the central case scenario.

Table 6.12 Average estimated cost to rectify waterproofing defects, per apartment (Class 2 buildings) or per building (Class 3-9) buildings, $2023

Class	Jurisdiction	Low estimate	Mid estimate	Mid-high estimate	High estimate
Class 2	All except NSW	$2,518	$7,057	N/A	$10,908
	NSW	$1,846	$5,175	N/A	$7,999
Class 3	All except NSW	$98,045	$147,386	$291,581	$376,866
	NSW	$72,507	$108,083	$213,826	$276,368
Class 5	All	$98,045	$147,386	$291,581	$376,022
Class 6	All	$55,845	$84,086	$164,981	$249,422

Class	Jurisdiction	Low estimate	Mid estimate	Mid-high estimate	High estimate
Class 7	All	$108,595	$163,211	$323,231	$407,250
Class 8	All	$3,095	$4,961	$6,731	$90,750
Class 9	All except NSW	$60,204	$90,625	$178,058	$266,413
	NSW	$60,723	$87,293	$171,512	$256,620

Note: The description of, and assumptions underpinning the low, medium and high estimates are outlined in Section 3.2.3.

Source: ACIL Allen.

Cost of waterproofing defects at a national level

The estimated costs of rectifying waterproofing defects on a per apartment or per building basis were aggregated to a national level using:

— projections of new residential building stock we generated for the NCC 2022 Decision Regulation Impact Statement for increased residential building energy efficiency

— projections of new commercial stock from the Commercial Building Baseline Study 2022.[99]

More details of these stock projections are provided in Appendix C.

Estimated proportion of waterproofing defects that are relevant to the NCC

As discussed in Section 3.3, the evidence on the cause of waterproofing defects indicates that they may be caused by design, workmanship, materials or a combination of other factors. Based on the evidence discussed in Section 3.3, we have assumed that the proportion of waterproofing defects that are caused by the design of buildings is 52% for Class 2 and 49% for Class 3-9 buildings.

Buildings built using a concrete frame

The proposed NCC provisions are aimed mainly at concrete buildings (i.e. they would only reduce defects in concrete buildings). As discussed in Section 6.3.1, we have assumed that most buildings across Classes 3 to 9 buildings (other than Class 8), are built using a concrete frame. Accordingly, there are no avoided rectification costs associated with Class 8.

Estimated proportion of waterproofing defects that would be avoided through the proposed changes to the NCC

We could not find any evidence in the literature on the proportion of waterproofing defects that would be avoided through the proposed changes to the NCC. Stakeholders consulted indicated that around 80% of waterproofing defects caused during the design and construction phases of buildings could be avoided through the proposed changes to NCC provisions, with some defects continuing to occur due to workmanship and maintenance.

The aggregate rectification costs that could be avoided with the proposed policy changes are summarised in Table 6.13 (as noted above, these are based on the mid estimate in Table 6.12 as the central case scenario). As set out in Table 6.13, it is estimated that the proposed waterproofing changes to the NCC could decrease rectification costs Australia-wide by around $3.1 billion over the life of the policy.

[99] Department of Climate Change, Energy, the Environment and Water 2022, Commercial Building Baseline Study 2022 Final Report, prepared by Strategy. Policy. Research, August.

Table 6.13 Present value (in 2024) of avoided rectification costs with proposed changes to the NCC over 2025-2034, $M ($2023)

	Class 2	Class 3-9	Total
NSW	$281	$461	$742
VIC	$303	$682	$985
QLD	$190	$392	$582
SA	$27	$153	$180
WA	$80	$352	$432
TAS	$3	$66	$69
NT	$9	$40	$49
ACT	$54	$32	$86
Australia	**$946**	**$2,179**	**$3,125**

Notes: Based on the mid estimate in Table 6.12 as the central case scenario. Present values calculated using a 5% central discount rate. Totals may not add up due to rounding.
Source: ACIL Allen.

6.4.2 Avoided professional costs

The proposed changes to the NCC would avoid the costs that are currently incurred to obtain professional advice related to waterproofing defects. The avoided professional costs have been estimated for Class 2 buildings on a per apartment basis based on the:

- estimated cost of the professional advice
- proportion of buildings for which professional advice is likely to be sought
- estimated proportion of waterproofing defects that are assumed to be caused by the design of buildings, as discussed in Section 3.3
- estimated proportion of these waterproofing defects that would be avoided through the proposed changes to the NCC, as discussed in section 6.4.1
- the projected new building stock, as discussed in section 6.4.1.

As outlined in Table 3.7, we found 2 estimates in the literature of the cost of the professional advice related to building defects, as summarised in Table 6.14. On the basis of this evidence, we have assumed that the cost of professional advice is $56,600 (in $2023) per building.

Table 6.14 Summary of estimates of the cost of professional advice, per defective building

Source	Estimated cost ($2023)	Comments
Office of the Building Commissioner and Strata Community Association NSW, 2023	$56,600	Not specific to waterproofing defects.
Office of the Building Commissioner and Strata Community Association NSW, 2021	$33,276	Not specific to waterproofing defects.

Source: ACIL Allen based on sources noted.

We have assumed that professional advice is sought on waterproofing defects for 20% of Class 2 buildings, and that there are, on average, 8.6 apartments per Class 2 building[100].

Given the lack of specific estimates for Class 3-9 buildings, we have estimated the cost of professional advice sought on waterproofing defects for these buildings by scaling the cost for Class 2 buildings based on the rectification costs.

As shown in Table 6.15, it is estimated that the proposed waterproofing changes to the NCC could decrease professional costs Australia-wide by around $759 million over the life of the policy.

Table 6.15 Present value (in 2024) of avoided professional costs with proposed changes to the NCC over 2025-2034, $M ($2023)

	Class 2	Class 3-9	Total
NSW	$75	$124	$199
VIC	$59	$166	$225
QLD	$37	$101	$138
SA	$5	$40	$45
WA	$16	$88	$104
TAS	$1	$17	$18
NT	$2	$10	$11
ACT	$11	$8	$19
Australia	**$206**	**$553**	**$759**

Notes: Present values calculated using a 5% central discount rate. Totals may not add up due to rounding.
Source: ACIL Allen.

6.4.3 Avoided legal costs

The proposed changes to the NCC would avoid the costs that are currently incurred to resolve legal disputes arising from waterproofing defects. The avoided legal costs have been estimated for Class 2 buildings on a per apartment basis based on the:

— estimated cost of the legal advice

— proportion of buildings for which professional advice is likely to be sought, as discussed in section 6.4.2

— estimated proportion of waterproofing defects that are assumed to be caused by the design of buildings, as discussed in Section 3.3

— estimated proportion of these waterproofing defects that would be avoided through the proposed changes to the NCC, as discussed in section 6.4.1

— the projected new building stock, as discussed in section 6.4.1.

As outlined in Table 3.7, we found 2 estimates in the literature of the cost of legal advice related to building defects, as summarised in Table 6.16. On the basis of this evidence, we have assumed that the cost of legal advice is $42,450 (in $2023) per building[101].

[100] This is the average number of lots per strata scheme in Australia sourced from the City Futures Research Centre's 2022 Australasian Strata Insights Report (https://cityfutures.ada.unsw.edu.au/2022-australasian-strata-insights/).

[101] The estimate in Easthope et al., 2012 is not included as it was a hypothetical example.

Table 6.16 Summary of estimates of the cost of legal advice, per defective building

Source	Estimated cost ($2023)	Comments
Office of the Building Commissioner and Strata Community Association NSW, 2023	$42,450	Not specific to waterproofing defects.
Office of the Building Commissioner and Strata Community Association NSW, 2021	$40,915	Not specific to waterproofing defects.
Easthope et al., 2012	$293,000	Time and legal costs for a hypothetical 20-unit scheme with 2 or 3 major defects in NSW

Source: ACIL Allen based on sources noted.

Given the lack of specific estimates for Class 3-9 buildings, we have estimated the cost of legal advice sought on waterproofing defects for these buildings by scaling the cost for Class 2 buildings based on the rectification costs.

As shown in Table 6.17, it is estimated that the proposed waterproofing changes to the NCC could decrease legal costs related to waterproofing defects Australia-wide by around $569 million over the life of the policy.

Table 6.17 Present value (in 2024) of avoided legal costs with proposed changes to the NCC over 2025-2034, $M ($2023)

	Class 2	Class 3-9	Total
NSW	$56	$93	$150
VIC	$45	$124	$169
QLD	$28	$76	$104
SA	$4	$30	$34
WA	$12	$66	$78
TAS	$0	$13	$13
NT	$1	$7	$9
ACT	$8	$6	$14
Australia	**$154**	**$415**	**$569**

Notes: Present values calculated using a 5% central discount rate. Totals may not add up due to rounding.
Source: ACIL Allen.

6.4.4 Avoided time costs

Time costs refer to the value of time that building owners use to rectify the defect (e.g. chasing up repairers, investigating problems, speaking with practitioners, attending body corporate meetings, etc.). The proposed changes to the NCC would avoid the time costs that are currently incurred to resolve waterproofing defects.

The time costs have been estimated for Class 2 buildings on a per apartment basis based on the:

— estimated time that apartment owners spend on getting a defect repaired and then value of this time
— proportion of buildings for which owners need to spend time to get a defect rectified, as discussed in section 6.4.2
— estimated proportion of waterproofing defects that are assumed to be caused by the design of buildings, as discussed in Section 3.3
— estimated proportion of these waterproofing defects that would be avoided through the proposed changes to the NCC, as discussed in section 6.4.1
— the projected new building stock, as discussed in section 6.4.1.

The estimated time that apartment owners spend on getting a defect repaired has been sourced from the Building Confidence Report: a case for intervention which estimates that, on average, apartment owners spend 46 hours on getting a defect repaired. This time is valued at half the average hourly earnings for all employees in Australia in 2023 ($39.50 per hour) sourced from the ABS. This results in time costs per defective apartment of $909.

Given the lack of specific estimates for Class 3-9 buildings, we have estimated the cost of time spent dealing with waterproofing defects for these buildings by scaling the cost for Class 2 buildings based on the rectification costs.

As shown in Table 6.18, it is estimated that the proposed waterproofing changes to the NCC could decrease time costs related to waterproofing defects Australia-wide by around $36 million over the life of the policy.

Table 6.18 Present value (in 2024) of avoided time costs with proposed changes to the NCC over 2025-2034, $M ($2023)

	Class 2	Class 3-9	Total
NSW	$10.4	$2.0	$12.4
VIC	$8.2	$2.7	$10.9
QLD	$5.2	$1.6	$6.8
SA	$0.7	$0.6	$1.4
WA	$2.2	$1.4	$3.6
TAS	$0.1	$0.3	$0.3
NT	$0.2	$0.15	$0.4
ACT	$0.2	$0.13	$0.37
Australia	**$27.2**	**$8.9**	**$36.1**

Notes: Present values calculated using a 5% central discount rate. Totals may not add up due to rounding.
Source: ACIL Allen.

6.5 Net impacts on the economy

A summary of the quantified direct costs and benefits and the estimated net impact of the proposed changes to the NCC waterproofing requirements on the Australian economy is provided in Table 6.19.

Table 6.19 indicates that, at an economy-wide level the proposed waterproofing requirements appear to result in a net benefit to society when applied to Class 2 to 9 buildings.

Table 6.19 Estimated economy-wide costs and benefits of the proposed changes to NCC, Present value (in 2024) over 2025-2034, $M ($2023)

CLASS 2 BUILDINGS		
COSTS ($M)		
Households - capital costs		$306
Industry costs		$4
Government costs [a]		$0.04
	TOTAL COSTS	**$310**
BENEFITS ($M)		
Households		
Avoided rectification costs		$946
Avoided professional costs		$206
Avoided legal costs		$154
Avoided time costs		$27
	TOTAL BENEFITS	**$1,333**
NET PRESENT VALUE ($M)		**$1,023**
BCR (RATIO)		**4.3**
CLASS 3-9 BUILDINGS		
COSTS ($M)		
Owners/occupants - capital costs		$638
Industry costs		$4
Government costs [a]		$0.04
	TOTAL COSTS	**$642**
BENEFITS ($M)		
Owners/occupants		
Avoided rectification costs		$2,179
Avoided professional costs		$553
Avoided legal costs		$415
Avoided time costs		$9
	TOTAL BENEFITS	**$3,156**
NET PRESENT VALUE ($M)		**$2,514**
BCR (RATIO)		**4.9**

[a] In reality, government costs are not class-specific, but have nominally been split equally between Class 2 and Class 3 to 9 buildings.

Source: ACIL Allen.

6.5.1 Regulatory burden

The OIA's Guide to Regulatory Impact Analysis discusses the importance of avoiding imposing unnecessary regulatory burden on businesses, individuals and community organisations. Under OIA's requirements, the regulatory burden of a policy proposal on businesses should be measured using the Regulatory Burden Measure (RBM) framework.

The framework includes consideration of the following regulatory costs[102]:

- compliance costs, including:
  - administrative costs
  - substantive compliance costs
- delay costs.

The costs associated with the proposed changes to the NCC that fall under the RBM framework are:

- the incremental costs associated with meeting the new waterproofing requirements incurred by private building owners (the costs imposed on governments are excluded under the RBM framework, hence the additional construction costs incurred by government-owned buildings must be excluded from these costs)
- retraining costs incurred by industry.

To estimate the additional construction costs to be incurred by government-owned buildings (office, education and healthcare buildings) and exclude them from the regulatory burden estimates, we have used the same assumptions about the share of non-government owned buildings used in the Decision Regulation Impact Statement (DRIS) for the NCC 2019 energy efficiency requirements for non-residential buildings[103] (see Table 6.20).

Table 6.20 Share of government and non-government owned buildings, Australia

	Privately owned buildings	Government owned buildings
Office	77.36%	22.64%
Education	34.47%	65.53%
Health	34.81%	65.19%

Source: Centre for International Economics (CIE) 2018, Decision Regulation Impact Statement, Energy Efficiency of Commercial Buildings, prepared for the Australian Building Codes Board, 13 November, p. 110.

Table 6.21 provides the regulatory burden estimate for the proposed waterproofing changes. As required by the OIA, these costs are presented as average annual impacts (undiscounted) costed over the 10-year default duration of the regulation. As shown in this table, the average additional regulatory burden from the proposed changes to the NCC is around $1.7 billion per year. The Commonwealth's share of this regulatory burden is $185 million or 1/9th of the regulatory burden.

[102] Commonwealth of Australia, Department of the Prime Minister and Cabinet 2022, *Regulatory Burden Measurement Framework*, May.

[103] Centre for International Economics (CIE) 2018, *Decision Regulation Impact Statement, Energy Efficiency of Commercial Buildings*, prepared for the Australian Building Codes Board, 13 November, p. 110.

Table 6.21 Regulatory burden estimate — average annual regulatory costs (from business as usual), $M 2023

	$ million
Compliance costs	
Class 2	$40
Classes 3 to 9	$75
Industry training costs	
Class 2	$0.4
Classes 3 to 9	$0.4
Total change in costs	**$116**
Commonwealth share	**$12.9**

Source: ACIL Allen.

6.6 Sensitivity and breakeven analysis

6.6.1 Sensitivity analysis

Sensitivity analysis was conducted in key areas of uncertainty. For each of these areas, the analysis was conducted as follows:

— discount rate — a low discount rate of 2% and a high discount rate of 7% were tested

— industry training costs — an increase in industry training costs of 50% and a decrease in industry costs of 50% were tested

— government costs— an increase in government costs of 50% and a decrease in government costs of 50% were tested

— construction costs to meet NCC 2025 — an increase in the construction costs incurred to meet the new requirement of 25% and a decrease in construction costs of 25% were tested

— proportion of defects caused by design that could be avoided with the proposed changes to the NCC — an increase in the proportion of design defects avoided by the proposed changes to 100% and a decrease to 60% were tested.

The results of the sensitivity analysis are provided in Table 6.22. This table shows that:

— higher discount rates produce a more negative result (that is, a lower net benefit to society) and lower discount rates produce a higher net benefit to society

— increasing or decreasing industry costs by 50% has an insignificant effect in the NPV of the proposed changes

— increasing or decreasing government costs by 50% has no material effect in the overall results

— if construction costs to meet NCC 2025 are decreased or increased by 25%, the NPV for the new waterproofing requirements changes:

  – from $1.02 billion under the initial ‘standard’ assumptions for Class 2, to $1.1 billion (when costs are decreased by 25%) or $947 million (when costs are increased by 25%)

  – from $2.5 billion under the central case for Class 3 to 9, to $2.7 billion (when costs are decreased by 25%) or $2.4 billion (when costs are increased by 25%)

— if the proportion of defects that is avoided with the proposed changes is:

  – decreased from 80% to 60%, the NPV for the new waterproofing requirements changes from $1.02 billion to $690 million for Class 2, and from $2.5 billion to $1.7 billion for Class 3 to 9

– increased from 80% to 100%, the NPV for the proposed provisions changes from $1.02 billion to $1.4 billion for Class 2, and from $2.5 billion to $3.3 billion for Class 3 to 9.

Table 6.22 Sensitivity analysis — impact of sensitivity tests on the NPV ($M, 2023)

	Class 2	Class 3-9
NPV under standard assumptions	**$1,023**	**$2,514**
Discount rate		
Decrease from 5% to 2%	$1,197	$2,934
Increase from 5% to 7%	$928	$2,281
Industry costs		
Decrease costs by 50%	$1,025	$2,516
Increase costs by 50%	$1,021	$2,512
Government costs		
Decrease costs by 50%	$1,023	$2,514
Increase costs by 50%	$1,023	$2,514
Costs of meeting NCC 2025		
Decrease costs by 25%	$1,100	$2,673
Increase costs by 25%	$947	$2,354
Proportion of defects avoided with changes		
Decrease from 80% to 60%	$690	$1,725
Increase from 80% to 100%	$1,357	$3,303

Note: All changes are modelled as changes from the central case scenario using a 5% discount rate.
Source: ACIL Allen.

6.6.2 Breakeven analysis

Breakeven analyses are common practice in situations where the degree of benefit associated with a proposal is uncertain. It involves a simulation process where key parameters of the model – in this case, the construction costs to meet the new requirements in NCC 2025 and the proportion of defects caused by design that could be avoided with the proposed changes– are varied until the net impacts calculated through the model equal zero. In other words, it answers the questions:

— how much would construction costs to meet the new requirements in NCC 2025 have to increase for the proposed policy to break even to society in cost-benefit terms?

— how much would the proportion of waterproofing defects avoided have to decrease for the proposed policy to break even to society in cost-benefit terms?

This breakeven analysis is similar to the sensitivity analysis outlined above only the parameters are varied to achieve a particular outcome. In this case, the parameters are varied until the national NPV is equal to zero and the BCR is one.

The results of the breakeven analysis are provided in Table 6.23. As shown in this table, the new proposed waterproofing requirements in the NCC 2025 would:

— Breakeven nationally if construction costs for Class 2 were 4.4 times higher and 4.9 times higher for Class 3 to 9 buildings than currently estimated. This means that the proposed requirements for Class 2 and Class 3 to 9 buildings would still have a positive NPV and a BCR above 1 even if the costs to comply with the proposed provisions were to increase by 300% and 390%, respectively.

— The proposed requirements would still have a positive NPV and a BCR above 1 even if the new provisions only avoid 19% of waterproofing defects in Class 2 concrete buildings and 16% of waterproofing defects in Class 3 to 9 concrete buildings.

Table 6.23 Breakeven analysis [a]

	Class 2	Class 3-9
Percentage change in capital costs to breakeven	335%	394%
Proportion of defects avoided with changes	19%	16%

[a] Breakeven point is where the benefits of the policy option minus its costs equal zero (in net present value terms), with a 5% discount rate.

Source: ACIL Allen.

7 Conclusion

The analysis of the more stringent waterproofing requirements for new Class 2 to 9 buildings proposed for inclusion in NCC 2025 indicates (based on the best information available at the time of the analysis and assumptions used where data was not available) that the proposed changes would deliver:

— a net societal benefit for Class 2 buildings of $1.02 billion and a BCR of 4.3
— a net societal benefit of $2.5 billion for Class 3 to 9 buildings, and a BCR of 4.9.

The societal benefits that would largely be derived from avoided rectification costs are estimated to be well in excess of the construction costs associated with meeting the proposed waterproofing requirements for these buildings.

The breakeven analysis undertaken indicates that, for there to be an Australia-wide net societal benefit associated with the proposed changes, there would need to be:

— a very significant increase in the construction costs to meet the new proposed waterproofing requirements (between 4 and 5 times the current estimated costs)
— a very significant decrease in the proportion of waterproofing defects avoided through the proposed changes (to less than 16% of waterproofing defects avoided in Class 3 to 9 concrete buildings and to less than 19% of waterproofing defects avoided in Class 2 concrete buildings).

Notably, beyond the outcomes from the CBA, there are a number of other considerations that are important when making the decision about the waterproofing requirements for NCC 2025, including:

— achieving social and equity objectives by promoting public health and safety and reducing the risk of harm to building occupants
— meeting community expectations that all buildings in Australia provide a minimum level of performance and safety
— the value of unquantified benefits to households and commercial building owners/occupiers of less defective buildings, including improved amenity, health and wellbeing.

Decision-makers are best placed to weigh up these factors against the costs imposed on certain members of the community.

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Appendices

A Existing studies of prevalence and cost of building defects

All the studies of prevalence and costs of building defects reviewed for this project are summarised in Table A.1

Table A.1 Existing studies of prevalence and cost of building defects

Study	Scope	Findings

Office of the Building Commissioner and Strata Community Association NSW, 2023[104]	<u>Class 2 buildings, NSW</u>
	– NSW Class 2 building strata schemes (4+ floors above ground level) registered between July 2016 – June 2022 (to align with the statutory warranty period of 6 years for major defects under the *Home Building Act 1989*, and these types of buildings are not covered under the Home Building Compensation Scheme).
	– Serious defects which are defined by legislation as those which relate to 5 key building elements:
	  – waterproofing
	  – fire safety systems
	  – structure
	  – key services
	  – enclosure (and non-compliant cladding).
		– Of the 642 strata buildings that were the subject of the research, 53% of the buildings have had serious defects in common property in the 6 years following their construction.
		– Waterproofing was the most common serious defect, with 42% of buildings reporting waterproofing defects.
		– The incidence of waterproofing defects has decreased in newer buildings since the introduction in 2020 of the NSW *Residential Apartment Buildings (Compliance and Enforcement Powers) Act 2020* (RAB Act) and the *Design and Building Practitioners Act 2020* (DBP Act).
		– For the buildings that had access to accumulated costs accrued due to serious defects, $79 million was reported to have been spent by owners' corporations as a result of serious defects in common property, and the average was $283,000 per building.
		  – $45 million (57% of the costs) was associated with the rectification of the defect(s), including temporary and long-term rectification of the defect(s)
		  – professional costs (such as technical statements) represented around 20% of the costs (around $15.6 million)
		  – legal costs were around $11.6 million (15%)
		  – other costs (such as strata management charges) amounted to around $6.7 million.
		– Only 9% of the buildings where costs were confirmed had recovered any of the costs. For these buildings, $13.1 million of $24.1 million of costs was recovered, equating to just over half (55%) of the total costs incurred. The average amount recovered was $1.05 million per building. Some 40% reported recovering over 75% of their expenditure, 20% recovered 50-75%, 24% recovered 25–50% and 16% recovered 25% or less.

[104] Office of the Building Commissioner and Strata Community Association NSW (2023), *2023 Strata Defects Survey Report*, November.

Study	Scope	Findings

Office of the Building Commissioner and Strata Community Association NSW, 2021[105]	<u>Class 2 buildings, NSW</u>
	– NSW Class 2 building strata schemes (4+ floors above ground level).
	– Study focused on producing baseline data on the prevalence and impact of serious defects in recently completed residential strata buildings in NSW.
	  – Serious defects not defined so results are not comparable with most recent (2023) survey (see row above).
		– 39% of strata buildings in the sample had experienced serious defects in the common property.
		– Majority of serious defects related to waterproofing, affecting 23% of all buildings surveyed.
		– Other serious defects related to fire safety systems (14%), structure (9%), enclosure (9%), key services (5%) and non-compliant cladding (6%).
		– Across the buildings affected by serious defects, around $69 million was reported to have been spent by owners' corporations, representing an average cost of approximately $331,829 per building.
		  – 79% of these costs were associated with the rectification of the defect(s)
		  – professional costs (such as technical statements) represented around 9% of the costs
		  – legal costs were around 11%
		  – other costs represented the remaining 1%.

Cladding Safety Victoria, 2023[106]	<u>Class 2 buildings, Victoria</u> – Focuses on the prevalence of balcony defects in high rise residential apartments in Victoria as part of the Victorian Government's Cladding Rectification Program (CRP). – Includes some details on the prevalence of waterproofing defects.	Of the 339 buildings that have received rectification funding under the CRP program: – 168 buildings (50%) of the total funded buildings were identified to have defects unrelated to cladding. – Of these, 84 buildings (25% of the total funded buildings to date) have been identified with leaking balconies, balustrades and terraces causing structural damage. – In total, more than 550 defective balconies have been identified with problems that have been left unaddressed by the owners. – 52% have defective balconies caused by water ingress issues. – 19% have waterproofing issues due to lack or insufficient waterproofing. – 64% of impacted buildings were constructed more than 10 years ago. – The costs of defective balconies over total construction contracts (initiated for cladding works) comprises approximately 38%.

Law, T., Sorrentino, G., Barry, R. and Ronngard, P., 2021[107]	<u>Class 2 buildings, Victoria</u>
	– Study focuses on obtaining baseline data on the causes of moisture damage and indoor mould in residential buildings in Victoria based on Victoria Managed
		– Of the 2,178 accepted claims, 92% (1,995 claims) had at least one water-related defect.
		– The researchers took a representative sample of 54 claims to examine the causes for each claim:
		  – 28 (61%) had parapet roofs, which pose significant waterproofing challenges
		  – 17 (31%) had defects associated with waterproofing of balconies

[105] Office of the Building Commissioner and Strata Community Association NSW (2021), *Research report on serious defects in recently completed strata buildings across New South Wales*, September.

[106] Cladding Safety Victoria (2023), *Research analysis on issues and risks associated with balcony defects*, January.

[107] Law, T., Sorrentino, G., Barry, R. and Ronngard, P. (2021), *Scoping study on the nature and extent of moisture damage in houses & apartments in Victoria*, December.

Study	Scope	Findings
	Insurance Authority (VMIA) accepted domestic building insurance (DBI) claims between July 2018 and November 2020. – Limited to residential buildings up to 3 storeys in height.	– 11 (20%) of claims were for incomplete construction where water had damaged the incomplete home. – The study also refers to a survey by the Australian Apartment Advocacy (AAA, 2021), where out of 1,044 survey respondents from Victoria, 52% had experienced defects, with the most commonly reported defect being water penetration from outside (being reported by 35% of respondents). Other defects reported (arranged by most commonly reported) are outlined in the table below.

Defects experienced	Percentage (Victoria)
Water penetration from outside (e.g. water coming in through the window, door, ceiling or balcony)	35%
Structural cracking i.e. cracks appearing in the wall	30%
Poor waterproofing within the apartment (e.g. in bathroom, kitchen, etc.)	28%
Defective plumbing	26%
Tiling problems i.e. cracks, uneven surface, grout	25%
Too much noise coming in from outside	24%
Other	23%
Problems with the lifts / elevators	20%
Problems with doors such as warping, locks not working, doors not hung properly, etc.	19%
External cladding is not fireproof	15%
Windows/sliding doors not closing properly	15%
Faulty guttering	12%
Air conditioning systems – not installed properly	12%
Problems with electrical works / connections	12%
Defective roofing	11%
Defective balustrades on the balcony	9%
Concrete cancer	8%
Wooden flooring warping	5%
Defective fire protection system	4%
Asphalt / car park floor lifting	4%
Lack of fire safety system	3%
Brick growth – no plan to allow for expansion	1%

Source: Australian Apartment Advocacy 2021, 2021 Apartment Survey Research Results for Victoria, p.35.

Study	Scope	Findings
		– The percentage of defects related to water penetration from outside in 2021 is similar to the 2020 result, which showed that waterproofing was the most common issue out of those that had defects, indicating that 32% of all respondents had experienced a waterproofing issue nationwide.[108]

Crommelin, L., Thompson, S., Easthope, H., Loosemore, M., Yang, H., Buckle, C., and Randolph, B., 2021[109]	<u>Class 2 buildings, NSW</u>
	– Study focuses on defects in multi-unit strata titled developments in Sydney.
		– 51% of the schemes have evidence of at least one defect, and 12% have evidence of at least ten types of defects.
		– The most prevalent types of defects are water defects (42%), cracking (26%) and fire safety issues (17%).
		– The proportion of schemes with water related defects by defect type are as follows:
		  – Water leak / Water penetration / Water seepage / Water ingress – Wall, Slab: 18%
		  – Moisture / Mould / Humidity / Dampness: 6%
		  – Water pond / Water flooding: 6%
		  – Waterproofing defect: 5%
		  – Drainage defects – Inadequate fall, Insufficient drainage etc.: 5%
		  – Water leak / Water penetration / Water seepage / Water ingress – Pipe: 4%
		  – Blocked weephole: 2%
		  – Water leak / Water penetration / Water seepage / Water ingress – Shower booth, Basin etc.: 1%
		  – Water leak / Water penetration / Water seepage / Water ingress – Tap: 1%.

CIE, 2019[110]	<u>Class 1 to 9 buildings, across Australia</u>
	– Class 2 buildings:
	  – Estimates the rate of defects caused by the initial build across states and territories (including and excluding defects related to flammable cladding) based on existing data and a survey of residential building owners.
	– Classes 3-9 buildings:
		– Class 2 buildings:
		  – For apartments, the prevalence rate for defects (excluding flammable cladding) is 1.62 defects per apartment.
		  – 30% of Class 2 buildings had waterproofing/weatherproofing defects (e.g. water leaking in from balcony or wall, water leaking through shower floor), while 21% had roof and rainwater disposal defects (e.g. loose roof sheeting, inadequate gutters, leaking concrete roof).
		  – The estimated rectification cost per Class 2 dwelling was $12,221 per defect for roof and rainwater disposal and a further $19,648 per defect for waterproofing and weatherproofing. Together, gives a combined rectification cost of $31,869.

108 60% of respondents had a defect, of which 54% had waterproofing defects. 54% of 605 is 32.4%

109 Crommelin, L., Thompson, S., Easthope, H., Loosemore, M., Yang, H., Buckle, C., and Randolph, B. (2021), *Cracks in the Compact City: Tackling defects in multi-unit strata housing*, Final Project Report, City Futures Research Centre, October.

110 Centre for International Economics (2021), *Building Confidence Report: a case for intervention*, prepared for the ABCB, July.

Study	Scope	Findings
	– Estimates the rate of defects based on existing data and a survey of commercial building managers/owners.	– Classes 3-9 buildings: – While the number of survey responses received for Class 3 to 9 buildings was limited[111], this study estimated that defects are present in between 41% and 53% of buildings (with a central estimate of 49% used in the analysis). – Defects create costs ranging from $260,000 to $437,000 per defect per building, with a central estimate of $348,788. – The most common types of defects reported by survey respondents are waterproofing/weatherproofing (21.1%), roof and rainwater disposal (15.8%).
Johnston & Reid, 2019[112]	<u>Class 2 buildings, NSW, Queensland and Victoria</u> – Report focuses on understanding the types of defects common in multi-owned residential buildings as well as their impacts. It is based on 11 interviews with industry stakeholders and building professionals and a comprehensive analysis of 212 defect audit reports of buildings in NSW, Queensland and Victoria provided by 3 consulting and auditing companies.	– Authors concluded that the extent of defects is significant and causes great distress and harm (financial, physical and psychological) to building occupiers and owners. – 85% of all buildings in the sample had at least one defect (NSW 97%, Queensland 71%, Victoria 74%), with an average number of defects per building at 14 (NSW 16, Queensland 12, Victoria 11). – The most impacted construction systems were building fabric and cladding (40% of defects identified), fire protection (13%), waterproofing (11.5%), roof and rainwater disposal (8.5%) and structural (7%). – Of the roof and rainwater disposal defects, 32% were related to roof cladding, 20% were related to gutters, 17% were related to concrete roofs, 10% to downpipes, 8% to spitters, 6% to sumps, and 4% to roof penetration seals and 3% to other. – Of the waterproofing defects, 28% were related to balconies, 19% were related to internal wet areas, 10.5% to podiums, 8.6% to windows and doors, 7% to caulking seals, 5% to planter boxes, 19% to paint failures and 3% to other. – Regarding the causes/effects of defects, water ingress/moisture was the most common, with 29% of defects relating to this.

[111] 11 responses were received from commercial use (Classes 3 to 9) building managers/owners. These respondents own or manage 291 buildings in total.

[112] Johnston, N. and Reid, S. (2019), *An examination of building defects in residential multi-owned properties*, Deakin University, Melbourne, June.

Study	Scope	Findings
Equity Economics, 2019[113]	Class 2 buildings, Australia (by state/territory) – Estimates the total costs likely to result from building defects in apartments built over ten years based on assumptions in a range of published national and international estimates and media reports.	– Total cost of defect rectification estimated to be $6.6 billion, Australia wide, over 10 years. – Assumed that: – 4% of buildings had a major water problem and a further 34% had a minor water problem (the definition of water problem includes internal leaks). – The cost to rectify water problems was $25,000 per major problem per apartment and $5,000 per minor problem per apartment (this was based on data from the Canadian leaky condo crisis, where 45% of condominiums and 57% of school buildings built between 1985 and 2000 had significant leaks. The average repair cost was CAD 25,000 per apartment). – The paper refers to an estimate by the Australian Institute of Architects that 'found that 4% of buildings inspected between 2010 and 2015 in Australia (9% in NSW) had a major water problem and a further 34% had a minor water problem'. [114]
Mozo, 2019[115]	Class 1 & 2 buildings, Australia – Study estimates the prevalence and cost of building defects based on a nationally representative survey of 1,222 Australians, of which 506 had purchased a property in the last 10 years.	– Most apartment and house owners who purchased a new property in the past 10 years have experienced building defects. – Most common defects for apartments: – Internal water leaks (48%) – Cracking to internal or external structures (39%) – Water penetration from the outside (30%) – Tiling problems (27%) – Defective plumbing (21%) – Guttering faults (19%) – Inappropriately installed items (19%). – Most common defects for houses: – Cracking to internal or external structures (42%) – Guttering faults (33%) – Defective plumbing (28%) – Internal water leaks (25%) – Water penetration from the outside (24%)

[113] Equity Economics (2019), *The Cost of Apartment Building Defects*.

[114] A minor defect is defined as a defect that costs less than $10,000 while a major defect is one that costs more than $10,000.

[115] Mozo (2019), *Property Pain: Building Defects Report 2019*, August, https://mozo.com.au/home-loans/articles/property-pain-building-defects-report-2019#:~:text=Leaks%20and%20cracks%20causing%20stress%20for%20buyers&text=For%20houses%2C%20cracking%20to%20internal,%25)%20were%20also%20major%20problems.

Study	Scope	Findings
		– Tiling problems (25%). – Estimates repairing building defects has cost Australians a total of $10.5 billion over the past decade. – In apartments, 4% of new owners had to pay above $50,000 to have repairs done, 23% paid $5,000 to $50,000 and 74% paid up to $5,000. – For houses, 5% had to pay more than $20,000 for repairs, 68% paid up to $5,000 and 27% had to pay $5,000 to $20,000.
ACIL Allen, 2016[116]	Class 1 & 2 buildings, NSW – Report estimates the cost of building defects based on claims to the Home Building Compensation Fund (HBCF). – Rectification costs are measured based on claims from Home Warranty Insurance.	– Rectification costs estimated at $65 million per year on average.

[116] ACIL Allen Consulting (2015), I*ndependent Review of the Building Professionals Act 2005: Cost Benefit Analysis of Proposed Recommendations*, Report to Building Professionals Board, December.

<table>
<tr><th>Study</th><th>Scope</th><th>Findings</th></tr>
<tr>
<td>Easthope et al., 2012[117]</td>
<td><u>Class 2 buildings, NSW</u>
– Project focused on residential strata properties with 3 or more lots in NSW.
– Research was conducted between 2009 and 2012 and included surveys and interviews with strata owners, executive committee members and strata managing agents, as well as analysis of the NSW strata database and NSW strata schemes management legislation and interviews with peak body representatives around Australia.</td>
<td>– 72% of all schemes had had one or more defects at some stage, rising to 85% for schemes built since 2000.
– A breakdown of the types of defects found is provided in the table below. Internal water leaks are the most common defect (42%), followed by cracking (42%) and water penetration from outside (40%).
<table>
<tr><th>Defects experienced</th><th>Percentage</th></tr>
<tr><td>Internal water leaks</td><td>42%</td></tr>
<tr><td>Cracking to internal or external structures</td><td>42%</td></tr>
<tr><td>Water penetration from outside</td><td>40%</td></tr>
<tr><td>Guttering faults</td><td>25%</td></tr>
<tr><td>Defective roof coverings</td><td>23%</td></tr>
<tr><td>Defective plumbing</td><td>22%</td></tr>
<tr><td>Tiling problems</td><td>20%</td></tr>
<tr><td>Building movement</td><td>17%</td></tr>
<tr><td>Noise break through</td><td>17%</td></tr>
<tr><td>Defective balcony balustrades</td><td>15%</td></tr>
<tr><td>Lack of or defective fire safety measures</td><td>15%</td></tr>
<tr><td>Electrical faults</td><td>14%</td></tr>
<tr><td>Inappropriate or incorrectly installed materials</td><td>12%</td></tr>
<tr><td>Defective machinery</td><td>12%</td></tr>
<tr><td>Other</td><td>5%</td></tr>
<tr><td>No problems to my knowledge</td><td>17%</td></tr>
<tr><td>Don't know / Not defects</td><td>11%</td></tr>
</table>
</td>
</tr>
<tr>
<td>CIE, 2013[118]</td>
<td><u>Class 1 & 2 buildings, NSW</u>
– Study estimates the total cost of building defects for NSW by extrapolating from a UNSW survey.</td>
<td>– Total cost of defects in NSW was estimated at around $100-$200 million per year.</td>
</tr>
</table>

[117] Easthope, H., Randolph, B. & Judd, S. (2012), *Governing the Compact City: The role and effectiveness of strata management*, City Futures Research Centre, UNSW.

[118] Centre for International Economics (CIE) 2013, *Local Government Compliance and Enforcement: Quantifying the impacts of IPART's recommendations*, prepared for the Independent Pricing and Regulatory Tribunal of NSW, June.

Study	Scope	Findings
Mills, Anthony & Williams, Peter., 2009[119]	Class 1 & 2 buildings, Victoria – Study aims to quantify the degree of defects being experienced in new residential construction by analysing defects that were recorded by a government-owned housing insurance organisation, the Housing Guarantee Fund (HGF) between 1982 and 1997 in Victoria, the majority of which were in detached houses.	– One in 8 dwellings reported defects, with water ingress (because of cost and frequency) and footings (because of severity) the most concerning. – Where existing, defect rectification was 4% of the original contract price (of the new dwelling or renovation). This included both the direct cost of rectification and the associated cost borne by the HGF to examine the claim. The total defect cost accounted for an average of AUD 4,245 for each dwelling where a claim occurred (in 2006 prices). – The analysis provided the average cost of water ingress defects (cost below is per defect, in $2006): – Leaking roof - $775 – Leaking shower base - $864 – External water penetration - $1,344 – Plumbing - $753 – Leaking shower cubicle - $963 – Drainage - $1,049 – Leaking windows - $1,755 – Leaking spouting - $502 – Flashings - $921 – Water hammer - $374.

Source: ACIL Allen based on noted sources.

[119] Mills, Anthony & Williams, Peter. (2009), *Defect Costs in Residential Construction*. Journal of Construction Engineering and Management. 135. 10.1061/(ASCE)0733-9364(2009)135:1(12)

B Impacts of recent building reforms in NSW

In response to community concerns about compliance and enforcement issues in the Australian building and construction industry, in mid-2017 the Australian Building Ministers commissioned Professor Peter Shergold AC and Ms Bronwyn Weir to examine compliance and enforcement systems and identify ways to enhance the confidence of all those who own, work, live, or conduct their business in Australian buildings.

The Building Confidence Report was published in 2018 and made 24 recommendations to Building Ministers to address systemic issues in the building industry and enhance regulatory frameworks to ensure compliance and enforcement of building standards. Building Ministers supported the report's findings, and in March 2019 agreed to an Implementation Plan.

In response to the Building Confidence Report's recommendations, the NSW Government introduced 2 laws to regulate the building and construction industry:

— the *Design and Building Practitioners Act 2020* (DBP Act) which introduced new obligations and mandatory requirements for industry practitioners to ensure designs and building work are compliant with the NCC

— the *Residential Apartment Buildings (Compliance and Enforcement Powers) Act 2020* (RAB Act) which granted sweeping powers for the NSW Building Commissioner and authorised officers to take action against defective building work.

Initially, these laws only applied to class 2 residential apartment buildings. From July 2023, these laws also apply to class 3 and 9c buildings.

Additional details about these 2 key pieces of legislation are outlined in the following sections.

B.1 DBP Act

Most provisions in the DBP Act commenced on 1 July 2021 (except the duty of care which commenced on 10 June 2020) [120]. The DBP Act imposed new obligations on design practitioners, building practitioners and professional engineers (Practitioners) working on Class 2, 3 or 9c buildings to foster better quality design documentation and compliance with the NCC. The DBP Act sets up a general framework for checks and balances in building and design work through regulated designs and compliance declarations from designers and builders.[121] Key provisions of the legislative framework include the following: [122]

— Imposes statutory duty of care on every person who carries out construction work to exercise reasonable care to avoid economic loss caused by defects (1) in or related to a building for which work is done, and (2) arising from construction work. The statutory duty is owed to each owner of the land in relation to which the construction work is conducted (including all subsequent owners) and the statutory duty of care applies retrospectively where the economic loss suffered first became apparent within the 10 years prior to 10 June 2020.

— Imposes requirement for Practitioners to be registered and a declaration scheme (1) for submission of regulated designs by registered designers, and (2) in respect of building work by registered builders, prior to applying for an occupation certificate (Declaration Scheme).

— Imposes requirements for Practitioners to be adequately insured.

— Provides investigation and enforcement powers to authorised officers and the Secretary of the Department of Customer Service (including the power to issue stop work orders).

B.2 RAB Act

The DBP Act operates in conjunction with the RAB Act which commenced on 1 September 2020, with the transitional period ending 1 March 2021. The RAB Act by is designed to ‘better regulate the construction of residential apartment buildings through proactive investigation and rectification of serious defects before occupation’[123]. It does this by imposing notification requirements on developers and granting the Department of Customer Service extensive powers to investigate and intervene in the construction of residential apartment buildings, stop work, and order the rectification of serious defects. Non-compliance with such orders or directions carries severe penalties and, for offending body corporates, personal liability for managers and directors.[124]

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[120] Clayton UTZ 2021, *NSW residential building sector reforms commence on 1 July 2021: Are you ready?,* April, https://www.claytonutz.com/insights/2021/april/nsw-residential-building-sector-reforms-commence-on-1-july-2021-are-you-ready.

[121] Clayton UTZ 2020, *Draft Design and Building Practitioners Regulation: are you ready to declare?*, December, https://www.claytonutz.com/insights/2020/december/draft-design-and-building-practitioners-regulation-are-you-ready-to-declare.

[122] Clayton UTZ 2021, *NSW residential building sector reforms commence on 1 July 2021: Are you ready?,* April, https://www.claytonutz.com/insights/2021/april/nsw-residential-building-sector-reforms-commence-on-1-july-2021-are-you-ready.

[123] Moray&Agnew 2021, *The Residential Apartment Buildings Act (NSW): A Year In Operation*, https://www.moray.com.au/insights-media-events/publications/commercial-directions/november-2021/the-residential-apartment-buildings-act-nsw-a-year-in-operation.

[124] Ibid.

B.3 Impact of the DBP Act and the RAB Act

In the most recent survey of strata defects in NSW, the NSW Builder Commissioner noted that[125]:

— Since the commencement of the RAB Act, developers and builders associated with the construction of apartment buildings with serious defects are increasingly held accountable to fix them. As of 1 November 2023, 465 RAB-Act-related audits have been conducted involving more than 29,000 apartments. Development financiers are now paying attention to how they can lower these risks.

— Since the DBP Act commenced, 94 DBP Act audits have been conducted, involving over 10,000 apartments. Across NSW, apartments are now commencing with a much higher resolution of design before construction starts on site. This shift of approach is being reported by builders as leading to less rework, less waste and improved construction times.

The 2023 strata survey added questions about the DBP Act and the RAB Act and the report noted that:

— There is high awareness of the DBP Act and RAB Act amongst strata managers (with 96% of strata managers aware of the DBP Act and 86% aware of the RAB Act).

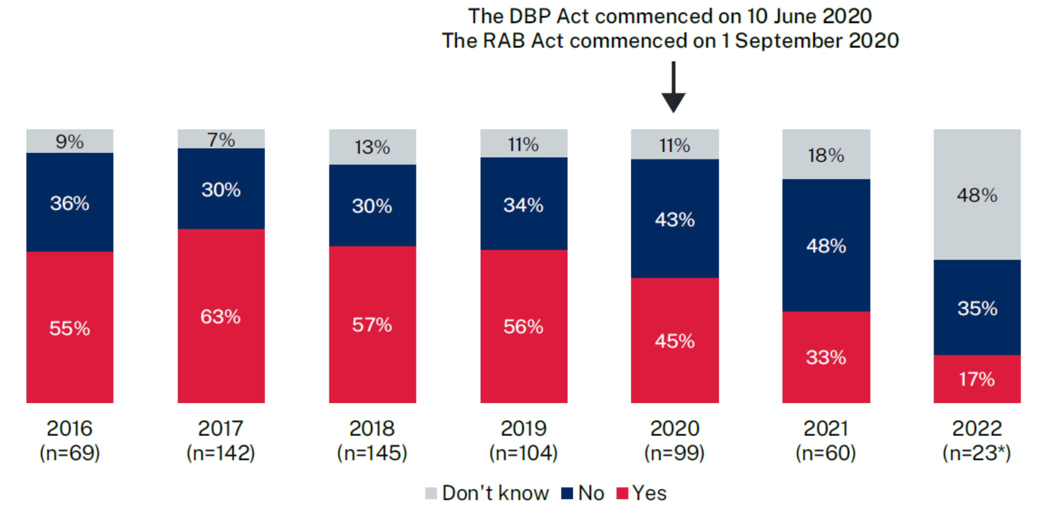
— Most strata managers (76%) agreed that the introduction of the Acts had improved the way they deal with serious defects. Only 24% of strata managers believed that the introduction of reforms had not improved the way they deal with serious defects.

The 2023 survey also recorded the registration year of buildings and found that there is a reduction in the incidence of serious defects by building registration date, trending downward since the introduction of the RAB and DBP Acts in 2020 and 2021 (see Figure B.1).

Based on the findings in Figure B.1, we have assumed that the recent changes to the regulatory framework of buildings in NSW have decreased serious defects in Class 2 buildings by 27% (i.e. the percentage change in the incidence of serious defects from 2020 to 2021). Given the recent extension of the regulations to Class 3 and 9c, we have also assumed that, going forward, serious defects in these buildings will also reduce by the same percentage.

[125] Office of the Building Commissioner and Strata Community Association NSW (2023), *2023 Strata Defects Survey Report*, November, p. iii.

Figure B.1 Incidence of serious defects (by building registration year) among all buildings



Q19A By serious defect(s) we mean defect(s) in: structural integrity (including foundations and footings, floors, walls, roofs, columns and beams); fire safety systems (passive and active); waterproofing; building enclosures (including façade, doors, windows); key services (including mechanical, plumbing and electrical services, acoustics and lifts); non-compliant cladding. Has the building had serious defect(s)? Base: All buildings registered that year

* Caution: -small base size for 2022 registered buildings (n=23). Indicative result only.

Source: Office of the Building Commissioner and Strata Community Association NSW (2023), 2023 Strata Defects Survey Report, November, p.12.

C Projections of new building stock

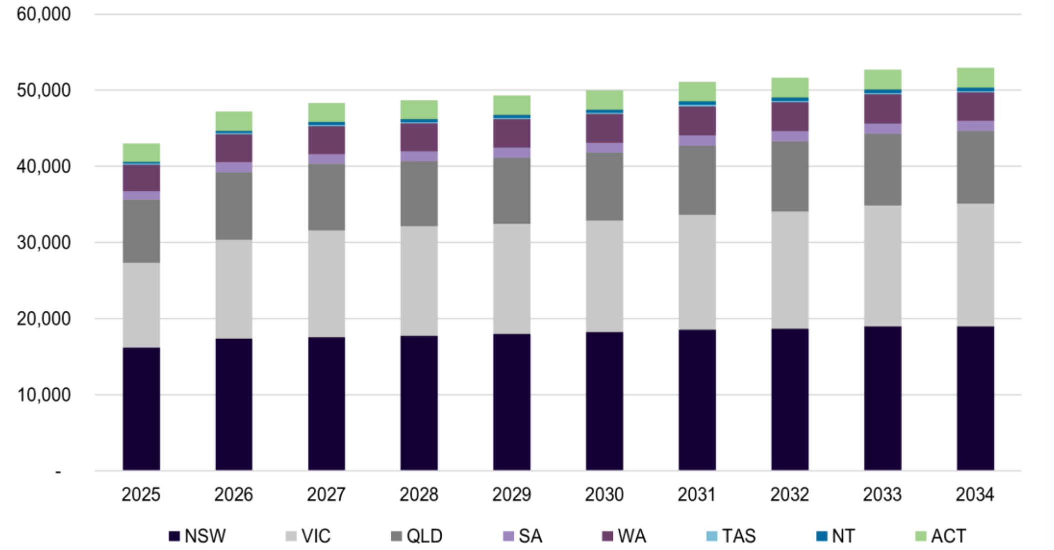
The projections of new residential (Class 2) dwellings and commercial buildings used in this analysis are outlined in the following sections.

C.1 New Class 2 stock

The projections of new apartment stock were sourced from the analysis underpinning the NCC 2022 Decision Regulation Impact Statement for increased residential building energy efficiency.[126]

These projections are primarily based on historical ABS approvals data and ABS forecasts of the Australian housing stock. The analysis for the NCC 2022 RIS also used Housing Industry Association (HIA) information on projected dwelling commencements to inform adjustments to the projections in the short term due to COVID-19. These projections see the number of new dwellings increase from just above 43,000 apartments in 2025 to around 53,000 units by 2034 (see Figure C.1).

Figure C.1 Projected number of new apartments by jurisdiction 2025 to 2034



Source ACIL Allen 2022, National Construction Code 2022: Decision Regulation Impact Statement for a proposal to increase residential building energy efficiency requirements, August.

[126] ACIL Allen 2022, National Construction Code 2022: Decision Regulation Impact Statement for a proposal to increase residential building energy efficiency requirements, August.

C.2 New Class 3 to 9 stock

Estimates of the current and future stock of Class 3 to 9 buildings was sourced from the Commercial Building Baseline Study 2022[127] (the Baseline Study), which provides information about:

— the number (and floor area) of commercial buildings by type by jurisdiction

— net projected growth in commercial building stock by type.

Notably, the building types used in the Baseline Study do not directly correspond to the NCC classification of buildings. However, the Baseline Study's contains a discussion about how these estimates compare to studies organised by NCC class. We have used this information to develop a concordance between building types/classes (see Table C.1). Where a building type in the Baseline Study refers to buildings in more than one NCC class, we have spread the number of buildings equally amongst these classes. Buildings classified as 'Non-residential buildings nec' have been excluded from the estimates.

The estimated number of new buildings under each NCC class from 2025 to 2034 is show in Figure C.2. As shown in this figure, these projections see the number of Class 3 to 9 buildings increase from just above 6,400 buildings in 2025 to around 7,300 buildings by 2034.

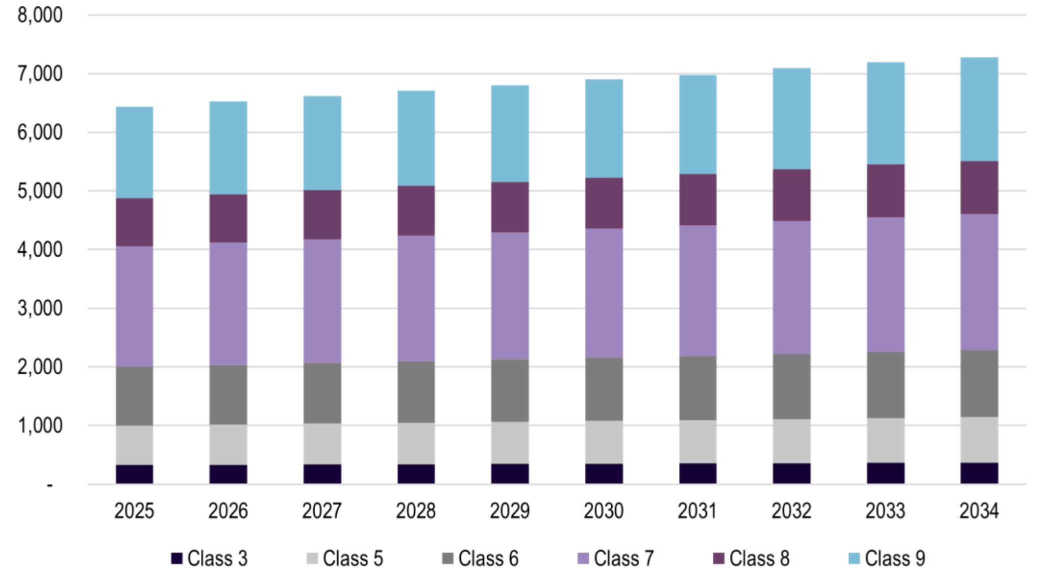
Table C.1 Concordance of building type in Baseline Study and NCC class

Building Type (Primary Purpose) in Baseline Study	Concordance with NCC class
Retail and wholesale trade buildings	6
Offices	5
Factories and other secondary production buildings	8
Warehouses	7b
Education buildings	9b
Religion buildings	9b
Aged care facilities (including nursing homes)	9c
Health facilities	9a
Entertainment and recreation buildings	9b
Short term accommodation buildings	3
Transport buildings	9b,7a
Commercial buildings nec	6, 7b, 8
Agricultural and aquacultural buildings	10a, 7b, 8
Other industrial buildings nec	8, 10a, 7b
Non-residential buildings nec	Diverse

Source: Strategy. Policy. Research. (SPR) 2022, Commercial Building Baseline Study 2022 Final Report, prepared for the Department of Climate Change, Energy, the Environment and Water, August.

[127] Strategy. Policy. Research. (SPR) 2022, *Commercial Building Baseline Study 2022 Final Report*, prepared for the Department of Climate Change, Energy, the Environment and Water, August.

Figure C.2 Projected number of new Class 3 to 9 buildings 2025 to 2034



Source: ACIL Allen based on Strategy. Policy. Research. (SPR) 2022, Commercial Building Baseline Study 2022 Final Report, prepared for the Department of Climate Change, Energy, the Environment and Water, August.

D Proposed NCC provisions

Part F1 Water management

Introduction to this part

This Part is intended to minimise the risk of water leaking into or accumulating within a building and causing unhealthy conditions or damaging building elements by corrosion or rot. It is also intended to prevent water redirected away from the building damaging nearby properties.

Objectives

F1O1 The Objective of this Part is to—

(a) safeguard occupants from illness or injury and protect the building and its internal surfaces from damage caused by the entry of water; and

(b) protect other property from damage caused by redirected ~~surface water or sub-surface~~ *water*.

Functional statements

F1F1 Protection from ~~redirected~~ water

A building, including any *associated sitework*, is to be constructed in a way that protects people and *other property* from the adverse effects of *water* including water that may enter the building and cause damage to internal surfaces.

F1F2 Resistance to rising damp and ground water

A building is to be constructed to provide resistance to moisture from the ground.

Performance requirements

F1P1 Managing water impact on the building and adjoining properties

(1) Water collected or concentrated by a building, *associated sitework* or the *allotment*, must be redirected to a *drainage system* to prevent—

(a) unhealthy or dangerous conditions, loss of amenity for occupants within the building; and

(b) undue damage to internal surfaces and other building elements; and

(c) undue damage or nuisance to other buildings and any other property.

(2) *Water in* (1) includes ~~but is not limited to~~—

i. surface water; and

ii. sub-surface water; and

iii. rainwater; and

iv. stormwater; and

v. rising damp; and

vi. water services overflow; and

vii. irrigation water; and

viii. groundwater; and

ix. surface water seepage.

(3) Water resulting from a rain event with an *annual exceedance probability*, with a five-minute duration period, up to and including 5% collected or concentrated by a building, sitework or an *allotment* satisfies (1) if it is—

(a) disposed of in a way that avoids the likelihood of damage to the building; and

(b) conveyed through a drainage system to an appropriate outfall.

(4) Water resulting from a rain event having an *annual exceedance probability*, with a five-minute duration period, up to and including 1% collected or concentrated by building elements satisfies (1) if it does not enter the building.

(5) Water resulting from a rain event in F1P1 (3) and (4), subject to wind action with an *annual exceedance probability*, up to and including 4% collected or concentrated by a building satisfies (1) if it is disposed of in a way that prevents—

(a) unhealthy or dangerous conditions, loss of amenity for occupants within the building; and

(b) undue damage to internal surfaces and other building elements.

Notes:

For the purposes of F1P1(4)—

(a) building elements include roofs, balconies, podiums, attached awnings with box gutters and stormwater overflow systems; and

(b) an annual exceedance probability of 5% can be applied to awnings and roofs with eaves gutters.

Exemption:

F1P1 does not apply to—

(a) *condensation;* or

(b) a *private garage*, tool shed, sanitary *compartment* or the like separate from, or forming part of, a building used for other purposes; or

(c) parts of a building below the ground surface where an *appropriate authority* determines drainage is not permitted.

F1P2 Rising damp and ground water

Rising damp and *ground water* must be prevented from causing—

(a) undue dampness or deterioration of building elements; and

(b) unhealthy or dangerous conditions, or loss of amenity for occupants

Exemption:

F1P2 does not apply to—

(a) *condensation*; or

(b) a *private garage*, tool shed, *sanitary compartment* or the like separate from, or forming part of, a building used for other purposes; or

(c) parts of a building below the ground surface where an *appropriate authority* determines drainage is not permitted.

F1V1 Weatherproofing

(1) Compliance with F1P1 for weatherproofing of an *external wall* is verified when—

(a) a prototype passes the procedure described in (2); and

(b) the *external wall*—

i. has a risk score of 20 or less, when the sum of all risk factor scores is determined in accordance with Table F1V1a; and

~~ii. is not subjected to an ultimate limit state wind pressure of more than 2.5kPa; and~~

iii. includes only *windows* that comply with AS 2047.

(2) The test procedure referred to in (1)(a) must be as follows:

(a) The test specimen is in accordance with the requirements of (3).

(b) The test procedure is in accordance with the requirements of (4) or (5) as applicable.

(c) The test specimen does not fail the criteria in (6).

(d) The test is recorded in accordance with the requirements of (7).

(3) Test specimen: The test specimen must be a minimum of 2.4 m high and 2.4 m wide and incorporate—

(a) representative samples of openings and joints, including—

i. vertical and horizontal control joints; and

ii. wall junctions; and

iii. windows or doors; and

iv. electrical boxes; and

v. balcony drainage and parapet flashings; and

vi. footer and header termination systems; and

(b) for a *cavity wall*—

i. a transparent material for a proportion of the internal wall lining (to provide an unobstructed view of the *external wall* cladding) with sufficient structural capability and similar air tightness to resist the applied wind pressures; and

ii. a 15 mm diameter hole in the internal wall lining below a window.

(4) The test procedure for a *direct fix cladding or unique wall* must be as follows:

(a) Apply 100% positive and negative serviceability wind pressures to the external face of the test specimen for a period of not less than 1 minute each.

(b) Apply static pressure of either 300 Pa or 30% serviceability wind pressure, whichever is higher, in accordance with the water penetration test procedure at clause 8.5.2 of AS/NZS 4284.

(c) Apply cyclic pressure in accordance with—

i. the three stages of Table F1V1b; and

ii. the water penetration test procedure at clause 8.6.2 of AS/NZS 4284.

(5) The test procedure for a cavity wall must be as follows:

(a) Apply 100% positive and negative serviceability wind pressures to the external face of the test specimen for a period of not less than 1 minute each.

(b) Apply static pressure of either 300 Pa or 30% serviceability wind pressure, whichever is higher, in accordance with the water penetration test procedure at clause 8.5.2 of AS/NZS 4248.

(c) Apply cyclic pressure in accordance with—

i. stage 3 of Table F1V1b; and

ii. the water penetration test procedure at clause 8.6.2 of AS/NZS 4284.

(d) To simulate the failure of the primary weather-defence or sealing, the following procedure must be applied to the specimen:

i. Insert 6 mm diameter holes through the external face of the cavity wall in all places specified below:

A. Wall/window or wall/door junctions at 0.75 height.

B. Immediately above the head flashing.

C. Through external sealing of the horizontal and vertical joints.

D. Above any other penetration detail not covered by (A) to (C).

ii. Repeat the static and cyclic pressure tests of (b) and (c).

iii. Within 30 minutes of the completion of (ii), remove the internal lining of the cavity wall and check for compliance with (6).

iv. With the internal lining removed, apply a final static pressure test at 50 Pa for a period of 15 minutes and **check for compliance with (6).**

(6) Compliance is determined as follows:

(a) A *direct fix cladding* wall and unique wall are verified for compliance with F1P1 if there is no presence of water on the inside surface of the façade.

(b) A *cavity wall* is verified for compliance with F1P1 if there is no presence of water on the removed surface of the *cavity*, except that during the simulation of the failure of the primary weather-defense or sealing, water may—

i. Transfer to the removed surface of the cavity due to the introduced defects (6 mm holes); and

ii. Contact, but not pool on, battens and other cavity surfaces.

(7) The test report must include the following information:

(a) Name and address of the person supervising the test.

(b) Test report number.

(c) Date of the test.

(d) Cladding manufacturer's name and address.

(e) Construction details of the test specimen, including a description, and drawings and details of the components, showing modifications, if any.

(f) Test sequence with the pressures used in all tests.

(g) For each of the static and cyclic pressure tests, full details of all leakages, including position, extent, and timing.

Deemed-to-Satisfy Provisions

F1D1 Deemed-to-Satisfy Provisions

(1) Where a *Deemed-to-Satisfy Solution* is proposed, *Performance Requirements* F1P1 and F1P2 is satisfied by complying with F1D2 to F1D15.

(2) Where a *Performance Solution* is proposed, the relevant *Performance Requirements* must be determined in accordance with A2G2(3) and A2G4(3) as applicable.

F1D2 Application of Part

(1) F1D5, F1D6 and F1D7 do not apply to a roof with a covering complying with F1D12(a) to (d).

(2) F1D3, F1D5, F1D6, F1D7, and F1D10 do not apply to a balcony, podium, or similar horizontal surface part of a building–

(a) where the flooring is of timber decking or other perforated flooring; or

(b) which is located directly above ground.

F1D3 Stormwater drainage

Stormwater drainage must be designed and constructed in accordance with AS/NZS 3500.3.

Explanatory information

Where stormwater drainage does not comply with F1D3, a Performance Solution is to be used to demonstrate compliance with the relevant Performance Requirements.

F1D4 Provision of drainage and grading to external areas

(1) A concrete roof, balcony or similar part of a building must have—

(a) the structural substrate graded with a minimum fall of 1:80 to the floor drain, rainwater outlet or other drainage outlet; and

(b) a floor drainage system, rainwater outlet or other drainage outlet that is connected to a stormwater drainage system complying with F1D3.

(2) A concrete roof, balcony, podium, or similar part must have a minimum—

a. 70 mm step down from the internal floor level to the external structural substrate; and

b. 70 mm high integral hob around its perimeter; and

c. F1D4(2)(b) does not apply where the external structural substrate abuts an external wall or door.

Limitation:

F1D4(b) does not apply to the floor of planter boxes.

Notes:

For the purposes of this Part, a tile bed, screed, topping, or similar component is not considered a structural substrate except within planter boxes where it can be used to achieve the minimum fall of 1:80.

F1D5 Substrate materials

(1) In a building or part of a building, a roof, balcony, podium, or similar part of a building must have a *structural substrate* consisting of—

(a) concrete complying with AS 3600; or

(b) fibre cement sheeting manufactured in accordance with AS 2908.2; or

~~(c) autoclaved aerated concrete in accordance with AS 5146~~.

(2) The surface of structural substrates in (1) must be free of any material or variation in finish that will affect the performance of a membrane.

F1D6 Exposed joints

Exposed joints in the drainage surface on a roof, balcony, podium, or similar horizontal surface part of a building must—

(a) be located on the ridge line or highest point of the structural substrate; and

(b) have a hob with a minimum height of 50 mm formed within the structural substrate for the full length of both sides of the exposed joint; and

(c) be protected in accordance with Section 2.9 of AS 4654.2; and

(d) not be located beneath or run through a planter box, water feature or similar part of the building.

Notes

For the purposes of F1D6, an exposed joint is a construction joint, control joint, expansion joint, contraction joint or movement joint and includes an exposed joint which is directly below a drainage surface.

~~**Explanatory Information: Location of exposed joints**~~

~~To minimise the potential of water ingress, the exposed joint should be located at a ridge or high point of the structural substrate, where possible.~~

~~**Explanatory Information: Exposed joints subject to excessive movement**~~

~~Where an exposed joint is subject to excessive movement, such as more than 10 mm, additional measures should be considered to ensure protection of the exposed joint. These additional measures may include use of a hob with a minimum height of 50 mm formed within the structural substrate for the full length of both sides of the exposed joint, and the exposed joint protected by a discontinuous membrane in accordance with Section 2.9 of AS 4654.2.~~

F1D7 External waterproofing membranes

(1) A roof, balcony, podium, or similar horizontal surface part of a building must be provided with a waterproofing membrane—

(a) consisting of materials complying with AS 4654.1; and

(b) designed and installed in accordance with AS 4654.2.

(2) A membrane required by (1) must be installed directly on the structural substrate complying with F1D4(1)(b) and F1D5.

F1D8 Damp-proofing

(1) Except for a building covered by (3), moisture from the ground must be prevented from reaching—

(a) the lowest floor timbers and the walls above the lowest floor joists; and

(b) the walls above the *damp-proof course*; and

(c) the underside of a suspended floor constructed of a material other than timber, and the supporting beams and girders.

(2) Where a *damp-proof course* is provided, it must consist of—

(a) a material that complies with AS/NZS 2904; or

(b) impervious sheet material in accordance with AS 3600.1.

(3) The following buildings need not comply with (1):

~~(a) A Class 7 or Class 8 building where in the particular case there is no necessity for compliance.~~

(b) A *private garage*, tool shed, *sanitary compartment*, or the like, separate from or forming part of a building used for other purposes.

(c) An *open spectator stand or open-deck carpark*.

F1D9 Damp-proofing on the ground

(1) If a floor of a room is laid on the ground or on fill, moisture from the ground must be prevented from reaching the upper surface of the floor and adjacent walls by the insertion of a vapour barrier in accordance with AS 2870.

(2) The requirements of (1) do not apply where—

- (a) weatherproofing is not *required*; or
- (b) the floor is the base of a stair, lift or similar *shaft* which is adequately drained by gravitation or mechanical means.

F1D10 Surface finishes

In a building or part of a building, the flooring or surface finish of a roof, balcony, terrace, podium, or similar part of a building must be—

- (a) *self-draining*; or
- (b) directly fixed to a membrane complying with F1D7.

Limitation:

F1D10(a) does not apply to areas subject to vehicular traffic.

F1D11 Subfloor ventilation

(1) Subfloor spaces must—

- (a) be provided with opening in *external walls* and internal subfloor walls in accordance with Table F1D11 for the climate zones given in figure F1D11; and
- (b) have clearance between the ground surface and underside of the lowest horizontal member in the subfloor in accordance with Table F1D11.

(2) In addition to (1), a subfloor space must—

- (a) be cleared of all building debris and vegetation; and
- (b) have the ground beneath the suspended floor graded to prevent *water* ponding under the building; and
- (c) contain no dead air spaces; and
- (d) have openings evenly spaced as far as practicable; and
- (e) have openings placed not more than 600 mm in from corners.

(3) In double leaf masonry walls, openings specified in (1) must be provided in both leaves of the masonry, with openings being aligned to allow an unobstructed flow of air.

(4) Openings in internal subfloor walls specified in (1) must have an unobstructed area equivalent to that required for the adjacent external openings.

(5) Where the ground or subfloor space is excessively damp or subject to frequent flooding, in addition to the requirements of (1) to (4)—

(a) the subfloor ventilation *required* in (1) must be increased by 50%; or

(b) the ground within the subfloor space must be sealed with an impervious *membrane;* or

(c) Subfloor framing must be—

i. where above ground, above-ground durability Class 1 or 2 timbers or H3 preservative treated timbers in accordance with AS 1684.2, AS 1684.3 or AS 1684.4; or

ii. where in ground, in-ground durability Class 1 or 2 timbers or H5 preservative treated timbers in accordance with AS 1684.2, AS 1684.3 or AS 1684.4; or

iii. steel in accordance with NASH Standard 'Residential and Low-Rise Steel Framing' Part 2.

F1D12 Roof coverings

A roof must be covered with—

(a) roof tiles complying with AS 2049, fixed in accordance with AS 2050; or

(b) metal sheet roofing complying with AS 1562.1; or

(c) plastic sheet roofing designed and installed in accordance with AS 1562.3; or

(d) terracotta, fibre-cement and timber slats and shingles designed and installed in accordance with AS 4597, except in cyclonic areas; or

(e) an external waterproofing membrane complying with F1D7.

F1D13 Sarking

Sarking-type material used for weatherproofing of roofs and walls must comply with AS 4200.1 and AS 4200.2.

F1D14 Glazed assemblies

(1) Subject to (2) and (3), the following glazed assemblies in an *external wall,* must comply with AS 2047 requirements for resistance to water penetration:

(a) Windows.

(b) Sliding and swinging glazed doors with a frame, including French and bi-fold doors with a frame.

(c) Adjustable louvres.

(d) Shopfronts.

(e) Window walls with one piece framing.

(2) The following buildings need not comply with (1):

(a) ~~A Class 7 or 8 building where in the particular case there is no necessity for compliance.~~

(b) A *private garage*, tool shed*, sanitary compartment*, or the like, separate from or forming part of a building used for other purposes, except where the construction of the garage, tool shed, *sanitary compartment*, or the like contributes to the weatherproofing of the other part of the building.

(c) An *open spectator stand* or *open-deck carpark*.

(3) The following glazed assemblies need not comply with (1):

(a) All glazed assemblies not in an external wall.

(b) Revolving doors.

(c) Fixed louvres.

(d) Skylights, roof lights and windows in other than the vertical plane.

(e) Sliding and swinging glazed doors without a frame.

(f) Windows constructed on site and architectural one-off windows, which are not design tested in accordance with AS 2047.

(g) Second-hand windows, re-used windows, and recycled windows.

(h) Heritage windows.

F1D15 Wall cladding

(1) External wall cladding must comply with one or a combination of the following:

(a) Masonry, including masonry veneer, unreinforced and reinforced masonry: AS 3700.

(b) Autoclaved aerated concrete: AS 5146.3.

(c) Metal wall cladding: AS 1562.1.

(2) The following buildings need not comply with (1):

~~(a) A Class 7 or 8 building where in the particular case there is no necessity for compliance.~~

(b) A *private garage*, tool shed, *sanitary compartment*, or the like, forming part of a building used for other purposes, except where the construction of the garage, tool shed, *sanitary compartment* or the like contributes to the weatherproofing of another part of the building that is *required* to be weatherproofed.

(c) An open spectator stand or open deck carpark.

Part B1 Structural provisions

(Extract only – Clause B1D3)

B1D3 Determination of individual actions

The magnitude of individual actions must be determined in accordance with the following:

(a) ……………….

(e) For the purposes of (d) the actions include but are not limited to—

i. liquid pressure action; and…..

x. expected 10-year deflection for structural substrates in Part F1 ~~and F2~~.

Schedule 1 Definitions

Glossary

(extract only)

Allotment

An area of land shown on an approved plan of subdivision for which a separate title is held or issued.

Collected

For the purposes of Section F, the interception of *water*—

(a) on the surface or *sub-surface* of a building element; or

(b) on an *allotment*; or

(c) on a *site*; or

(d) resulting from *sitework,*

that is required to be redirected to a *drainage system.*

Redirected

For the purposes of Section F, the changing of direction of collected water to a *drainage system.*

Drained

For the purposes of Section F, the removal to a *drainage system*, water that has been collected and redirected.

Drainage system

A system that—

(a) conveys *water* by gravity, mechanical means, or evaporation to a point of discharge or evaporative surface; or

(b) channels water by pipes, overflows, and overland flow paths to a point of discharge.

Water

For the purposes of Section F, includes—

(a) *surface water*, and

(b) *sub-surface water*, and

(c) *rainwater*, and

(d) *stormwater,* and

(e) *rising damp,* and

(f) *water services overflow,* and

(g) *irrigation water*, and

(h) *groundwater,* and

(i) *surface water seepage.*

Surface Water

All naturally occurring water, other than *sub-surface water*, which results from rainfall on or around the *site* or *water* flowing onto the *site*, including *water* that results from rainfall on the external *fabric* of the building, including any other *water* that falls or flows onto the *fabric* from other sources.

Sub-surface Water

Includes—

(a) all naturally occurring water, other than *surface water*, which is either *groundwater* or *water* which results from rainfall infiltration on the site or other infiltration from another water source; or

(b) *water* beneath the surface of a building element, other structure, or the ground.

Rainwater

Naturally occurring *water* generated by a rain or storm event.

Self-draining

A *surface finish* allowing water to be conveyed by gravity from the finished surface level to the membrane on the top surface of a *structural substrate.*

Surface finish

For the purposes of Section F, is a material or flooring system directly fixed to or supported above a *structural substrate.*

Structural substrate

The surface of a structural member to be waterproofed as *required* by Part F1 or Part F2D2(2)(a).

Stormwater

Water accumulated or discharged as a result of a rain event.

Rising damp

Water absorbed from the ground into a building element.

Irrigation water

Water distributed in controlled amounts for the maintenance of vegetation.

Water services overflow

Water discharged from water service referred to in the Plumbing Code of Australia not primarily drained by a sanitary drainage system or sanitary plumbing system.

Groundwater

Water underground in saturated zones beneath the land surface.

Surface water seepage

Water escaping through the surface of the ground or a building element.

E Methodology and assumptions underpinning WTP's cost modelling

The impact of the new waterproofing provisions proposed for inclusion in NCC 2025 on development costs was assessed by Quantity Surveyors, WT Partnership (WTP), based on:

— the proposed provisions

— consultations with waterproofing experts to determine how a building's design and specifications would change to meet the new requirements

— average costs for 'typical' building designs within each class.

E.1 Limitations

The costs estimated by WTP provide valuable evidence of the potential magnitude of the change in construction costs to meet the new proposed waterproofing requirements. Nonetheless, as with any modelling exercise, there are some limitations in this analysis. The key limitations of the cost estimates produced by WTP are outlined below.

— Different building types, qualities and locations will involve different development costs. The estimates provided to ACIL Allen for this CBA are for a series of 'typical' illustrative buildings of certain characteristics (outlined in the sections below) within each class based upon construction within the Sydney metropolitan area and are not meant to reflect the 'average' (or a representative) apartment/office/etc.

— The costs should be adjusted to take into account site specific issues deemed as being abnormal together with being adjusted to reflect location relative to the Sydney metropolitan area.

E.2 Specifications and assumptions

The following sections outline the specifications and assumptions used by WTP to estimate the cost impacts of the proposed changes to the NCC.

E.2.1 Building characteristics

As mentioned above, the WTP's cost opinion is based on a series of illustrative buildings of certain characteristics. The characteristics of the illustrative 'typical' development for each asset type are outlined in the points below — each building can be assumed to be of efficient design, relative to its class as follows:

— **Class 2** — multi unit, multi storey generally of reinforced concrete frame construction with typical external façade system and aluminium glazing systems. Internally, walls are constructed of solid to stairs and cores with lightweight partitioning systems to apartments. Finishes generally assume ceramic tiling to walls and floors, as appropriate, carpets to bedrooms and timber flooring to living areas. Plasterboard walls and ceilings to receive paint finish. Typical kitchen and sanitary fittings and typical services installations. External services including associated connections for power, water, communications, stormwater and sewer.

— **Class 3** — multi storey student accommodation generally of reinforced concrete frame construction with typical external façade system and aluminium glazing systems. Internally, walls are constructed of solid to stairs and cores with lightweight partitioning systems to accommodation. Finishes generally hard wearing. Plasterboard walls and ceilings to receive paint finish. Fittings to rooms and communal areas to be durable. External services including associated connections for power, water, communications, stormwater and sewer.
— **Class 5** — PCA A grade multi storey commercial generally of reinforced concrete frame construction with typical external curtain wall glazed façade system. Internally, walls are constructed of solid to stairs and cores with lightweight partitioning systems to ancillary accommodation. Finishes generally commensurate with a warm shell finish with carpets to floors and suspended lay in grid systems to ceilings. Kitchen points at each level together with amenities. External services including associated connections for power, water, communications, stormwater and sewer.
— **Class 6** — multi storey retail centre generally of reinforced concrete frame construction with typical external façade system. Internally, walls are constructed of solid to stairs, cores, tenancies and back of house with lightweight partitioning systems to ancillary accommodation. Finishes generally hard wearing commensurate with mall areas and cold shell to tenancies suitable for tenant fit out. External services including associated connections for power, water, communications, stormwater and sewer.
— **Class 7** — multi storey carpark generally of reinforced concrete frame construction with external cladding system. Internally, walls are constructed of solid to stairs, cores and back of house. Finishes generally hard wearing. External services including associated connections for power, water, communications, stormwater and sewer.
— **Class 8** — single level industrial unit generally of steel frame construction with external cladding system to walls and roof. Internally, walls are constructed of solid to ancillary accommodation. Finishes generally hard wearing. External services including associated connections for power, water, communications, stormwater and sewer.
— **Class 9** — multi storey hospital generally of reinforced concrete frame construction with typical external façade system and aluminium glazing systems. Internally, walls are constructed of a mix of solid and lightweight partitioning systems. Finishes generally hard wearing. Plasterboard walls and ceilings to receive paint finish. Fittings to rooms and communal areas to be durable. External services including associated connections for power, water, communications, stormwater and sewer.

E.2.2 Key assumptions underpinning change estimates

The cost estimates provided by WTP consider the impacts on costs of labour and materials associated with the new proposed requirements across the planning, design, construction and verification phases of building development. Importantly, WTP considers that the proposed waterproofing provisions would:

— impact costs during the construction phase of a building
— not impact the costs incurred during the planning, design and verification phases of building development.

The indicative share of each of these phases to total building development cost is outlined in the table below.

Table E.1 Indicative share of development costs by phase

	Planning phase	Design Phase	Construction phase	Verification of design
Proportion of total building development cost	5.0%	5.0%	85.0%	5.0%

Source: WTP.

The following sections outline the key assumptions used by WTP to estimate the change in costs during the construction phase for different building areas covered by the proposed provisions.

Roof

- 1:80 falls allow for some deflection over first 10 years to end up with at least minimum 1:100 falls across full roof area. The assumption is that the best form of protection from water ingress is effective falls to suitably placed outlets.
- Max slab thickness increased to 250mm for integral falls to allow minimum 220mm thickness to be maintained at outlets.
- Most waterproofing membrane manufacturers require membrane to be placed on a surface with falls. Warranty void if ponding of water on membrane. Therefore, if slab is placed flat it requires a topping to falls prior to membrane.
- Concrete in both scenarios (the BAU and NCC 2025 scenario) should be poured with crack prevention strategies in place such as:
  - shrinkage cracking steel to restraint cracking zones
  - proper curing practices
  - concrete mix design in terms of aggregate selection and micro-strain to be optimised for crack minimisation.

  These provisions are cost neutral since they should be applied to any concrete affected by water in both scenarios.
- With either a topping to falls or structural slab to falls, both scenarios require a perimeter curb or hob. This allows a conforming upward termination for the membrane and a suitable architectural fascia finish.
- Hobs to both sides of movement joint through roof is cost neutral since this is required for both scenarios under Building Code of Australia (BCA) Vol 1 2022 F1D4.

Using the above assumptions, WTP estimated that the overall change in cost per m2 of roof construction is +0.5%.

Podiums

Podiums are essentially roofs at ground level - they share all the same design characteristics related to management of water.

One major difference is that planter boxes are common in podiums but uncommon on roofs. The proposed NCC changes are exempt from planter boxes due to the difficulty of geometry in providing integral falls to boxes which do not often follow the direction of the falls to the main slab. Given this exemption, planter boxes in podiums do not have a cost impact.

Given this, the change in construction costs for podiums are assumed to be the same as for roofs (refer section above).

Balconies

- New provisions provide for 70mm step down from the internal floor level to the external substrate and 70mm hob around perimeter.
- In flat plate scenario a hob still needs to be placed under the sliding door arrangement to allow compliant upward membrane termination height.
- In flat plate scenario there also should be a perimeter curb or hob for attachment of balustrade out of a water saturation zone and for termination of the sand /cement mortar bed to falls.
- Double membrane to balconies in flat plate scenario allowed for since common practice is as follows:
  - A liquid membrane is placed first to the structural flat plate and under the door frame.
  - The sand cement screed is placed to falls. Since historically there has been so much problem in the industry with efflorescence coming up from sand cement screed to the tile surface, another liquid membrane is applied to the top of the screed as a barrier before gluing the tiles.

Using the above assumptions, WTP estimated that the overall change in cost per m2 of balcony construction is +3.6%.

Basements

Currently Class 7 and 8 buildings are exempt from the waterproofing requirements in NCC 2022 where it is deemed that there is no necessity for compliance.

Exemptions from specific requirements of wall cladding, damp-proofing, and glazed assemblies have existed in the BCA since its inception and formal introduction in 1992. These exemptions expanded into the BCA when it became a performance-based code in 1996. They exempted Class 7 and 8 buildings from the performance requirements entirely, for prevention of rainwater entering buildings and rising damp *if there was no necessity for compliance*. However, these exemptions pre-date the first edition of the BCA (1992) and existed in NSW's Local Government Ordinance 70 and were for above ground open sided carparks in home units and simple standalone car park buildings.

The exemptions in their current form require a level of decision making that takes a different form to that enshrined in the NCC's governing requirements in Part A2. Effectively, decisions based on these exemptions are not held to account with respect to any formal process of evidence, documentation, comparison to current technical requirements or analysis.

The intent behind removing these exemptions is to align the decision-making process with that contained within the governing requirements. That is, decisions made based on "where in a particular case there is no necessity for compliance" will be elevated to the requirements underpinning performance solutions. This will ensure there is a proper, robust, and accountable decision-making process followed as there is for all other performance-based decisions under the NCC.

Most of the construction industry understands that water entry must be managed to prevent damage to finishes or to cars and prevent unhealthy conditions such as slip hazards. The proposed change confirms that poor practices of allowing uncontrolled water entry that is unsafe or damaging, are not permitted. The proposed changes are therefore deemed to be cost neutral.

E.2.3 Baseline construction costs

The cost change estimates discussed in Section E.2.2 were then applied to the average 'typical' costs of construction (on a m2 basis) for each area in each building class under the BAU (see table below) to estimate the overall cost increase for each area in each building class during the construction phase.

Table E.2 Average costs of construction by area by building class under the BAU (per m2), $2023

	Class 2	Class 3	Class 5	Class 6	Class 7	Class 8	Class 9
Balcony area	$1,875	$1,875	$1,875	$1,875			$1,875
Roof	$700	$700	$700	$700	$563	$375	$700
Podium area	$1,563	$1,563	$1,563	$1,563			$1,563
Basement (excluding bulk excavation)	$2,000	$2,000	$2,000	$2,000			$2,000
Building overall (GFA)[a]	$4,000	$4,500	$4,000	$3,000	$1,500	$1,500	$7,000

[a] GFA= Gross Floor Area, which is defined as the sum of the 'Fully Enclosed Covered Area' and 'Unenclosed Covered Area'. Fully Enclosed Covered Area is defined as the sum of all such areas at all building floor levels, including basements (except unexcavated portions), floored roof spaces and attics, garages, penthouses, enclosed porches and attached enclosed covered ways alongside building, equipment rooms, lift shafts vertical ducts, staircases and any other fully enclosed spaces and useable areas of the building, computed by measuring from the normal inside face of exterior walls but ignoring any projections such as plinths, columns, piers and the like which project from the normal inside face of exterior walls. It shall not include open courts, light wells, connecting or isolated covered ways and net open areas of upper portions of rooms, lobbies, halls interstitial spaces and the like which extend through the storey being computed. Unenclosed Covered Area is defined as the sum of all such areas at all building floor levels, including roofed balconies, open verandas, porches and porticos, attached open covered ways alongside buildings, undercrofts and useable space under buildings, unenclosed access galleries (including ground floor) and any other trafficable covered areas of the building which are not totally enclosed by full height walls, computed by measuring the area between the enclosing walls or balustrade (i.e.., from the inside face of the UCA excluding the wall or balustrade thickness). When the covering element (i.e.., roof or upper floor) is supported by columns, is cantilevered or is suspended, or any combination of these, the measurements shall be taken to the edge of the paving or to the edge of the cover, whichever is the lesser. UCA shall not include eaves overhangs, sun shading, awnings and the like where these do not relate to clearly defined trafficable covered areas, nor shall it include connecting or isolated covered ways.

Source: WTP.

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