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CLIMATE CHANGE RISK TO AUSTRALIA'S BUILT ENVIRONMENT

A SECOND PASS NATIONAL ASSESSMENT

OCTOBER 2019

ANALYSIS POWERED BY
Climate Risk Engines

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Climate Change Risk to Australia's Built Environment: A Second Pass National Assessment
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WELCOME

Australia as a country has built a solid reputation for being forward thinking and pragmatic. Significant shifts in extreme weather events are already underway and have caused unprecedented natural disasters. The severity and frequency of these events will only increase in the future. To be ready, these risks must be faced head on. Indeed, given the scale of changes underway policy makers are not moving nearly fast enough to prevent significant disruption to our economy and society.

Climate Change Risks to Australia's Coast - A First Pass National Risk Assessment was released by the Australian Government Office of Climate Change and Energy Efficiency in 2009. The national risk assessment focussed on the risks to settlements and infrastructure, natural ecosystems, and industries in the coastal zone. That report found that between AUD \$41-63 billion dollars worth of properties were at risk from coastal impacts.

In the ten years since that report, there have been improvements in the sophistication and detail of climate models as well as substantial increases in computing power. While XDI provides analysis to the public and private sector, the company is keen to ensure that stakeholders - communities, governments and business - are informed of the risks they face and are therefore equipped to plan for the current and future impacts of climate change. This XDI Second Pass Assessment considers a greater number of hazards, covers all municipal areas in Australia and seeks to provide a firm basis for continued awareness and policy development to secure Australia's resilience.

If governments and communities act on this information now, many of the projected losses can be averted. Acting in an orderly way with a strategic focus on those communities most at risk will ensure that adaptation is achieved at least cost. The analysis underpinning this report can be used to identify where action is necessary, what activities need to be undertaken and when.

We encourage all readers to consider the implications of the trends and results, and act to keep people safe from physical and financial harm.



A handwritten signature in black ink, appearing to read 'R Hamden', written in a cursive style.

ROHAN HAMDEN

CEO, XDI

TABLE OF CONTENTS

Executive Summary	4
1. Introduction	11
2. New Indicators for Climate Change Related Risk	13
2.1 Total Technical Insurance Premium (TTIP)	13
2.2 Percentage Value-at-Risk (VAR%)	14
2.3 Number of High-Risk Properties (HRP#)	14
2.4 High Risk Properties as Percentage of All Addresses (HRP%)	14
3. Methods	15
3.1 Stress-Test Approach	15
3.2 The Climate Risk Engines	16
3.3 A Representative Asset	16
3.4 Included Hazards	16
3.5 Mathematical Analysis	16
3.6 Hazard Exposure	17
3.7 Vulnerability Analysis; Damage and Failure Thresholds	17
3.8 Weather Data	17
3.9 Climate Change Modelling	18
3.10 Scenario Run Data	18
4. National Risk Maps and Distributions	19
4.1 Overview	20
4.2 National Risk Maps	21
4.2.1 All Hazards	21
4.2.2 Per Hazard	23
4.3 Distribution Graphs for All Hazards by Risk Indicator	26
5. New South Wales & Australian Capital Territory Risk Maps and Distributions	28
5.1 Risk Maps	28
5.2 Distribution	29
6. Northern Territory Risk Maps and Distributions	30
6.1 Risk Maps	30
6.2 Distribution	31
7. Queensland Risk Maps and Distributions	32
7.1 Risk Maps	32
7.2 Distribution	33

8. South Australia Risk Maps and Distributions	34
8.1 Risk Maps	34
8.2 Distribution	35
9. Tasmania Risk Maps and Distributions	36
9.1 Risk Maps	36
9.2 Distribution	37
10. Victoria Risk Maps and Distributions	38
10.1 Risk Maps	38
10.2 Distribution	39
11. Western Australia Risk Maps and Distributions	40
11.1 Risk Maps	40
11.2 Distribution	41
12. Benchmarking of Local Government Areas Nationally and Per State	42
12.1 Overview	43
12.2 LGA Results and Ranking Nationally and per State	45
13. Discussion	72
13.1 Accuracy, Uncertainty and Confidence	72
13.2 Compound Climate Models Instead of Ensemble	72
13.3 Which Addresses are Exposed to What Hazard	73
13.4 LGAs with a High Percentages of High-Risk Properties (HRP)	73
13.5 LGAs with Large Numbers of Addresses with Small Losses	74
13.6 LGAs with Large TTIP	74
13.7 LGAs with Large VAR	74
13.8 Large increases in TTIP	75
13.9. Other XDI Insights	75
14. Policy Recommendations	77
15. Appendices	78
15.1 Agencies used for Inputs to Climate Risk Engines	78
15.2 Recommendations from <i>Climate Change Risks to Australia's Coast</i> - a First National Pass Assessment	82



EXECUTIVE SUMMARY

Context

It has been ten years since the Australian Government's groundbreaking report *Climate Change Risk to Australia's Coast - A First National Pass Assessment* was released. In the time since that report, there have been major advances in science, data and computing. This XDI report, *Climate Change Risk to Australia's Built Environment - A Second Pass National Assessment* carries forward the same objective of informing governments, business and the public about the possible effects of climate change on the built environment, but with deeper analysis, across more hazards, and at a higher spatial resolution.

Scope

The analysis assesses climate risk to over 15 million addresses in 544 local government areas (LGAs) between 2020 and 2100, analysing data for five hazards across the entire nation. Asset vulnerability to hazards has also been assessed using a representative archetype to provide insights into failure modes and damage thresholds. This report summarises the findings and provides a first national benchmarking of extreme weather and climate risk across all LGAs, large and small.

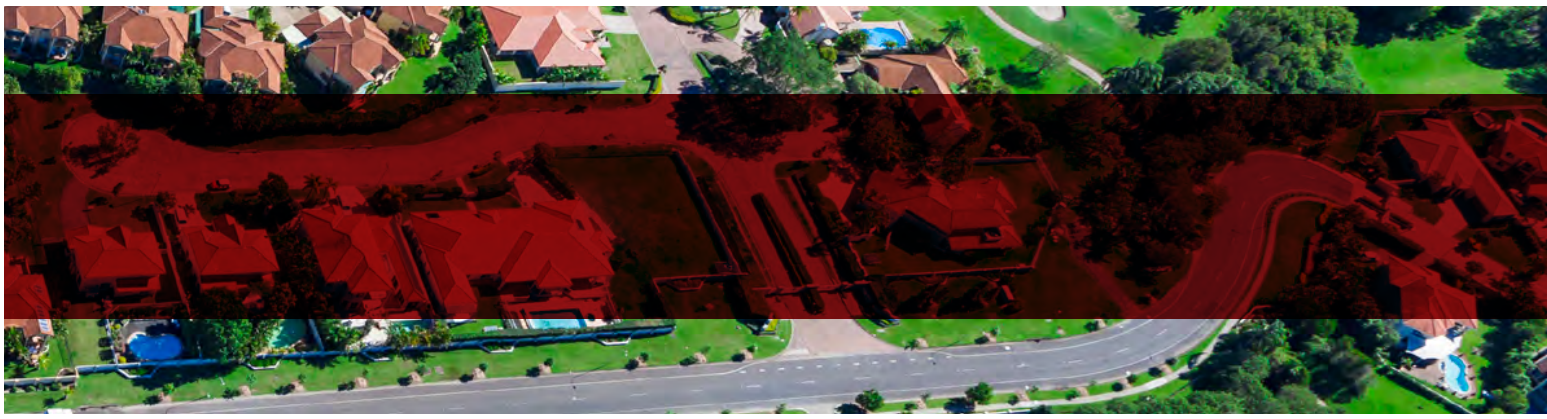
Approach

The underpinning data for this project has been generated by XDI's sister company, Climate Risk Pty Ltd, with a team that includes physicists, engineers, geologists, marine scientists and hydrologists. The team has used detailed mapping of floods, forests, elevations and soils to accurately pin-point at-risk properties, then applied local weather station data and down-scaled climate projections to consider how different climate change models indicate that heat, precipitation, wind and fire weather may change in future.

Key Risk Metrics

The reporting uses four key metrics for quantifying climate change impacts to the built environment in each local government area:

- **Total Technical Insurance Premium (TTIP)**, which is the total annual cost of damage and assumes all hazards are insured.
- **Percentage of Value-at-Risk (VAR%)**, which is the TTIP as a percentage of the replacement cost of the property.
- **Number of High Risk Properties (HRP#)**, which are those properties where the VAR is greater than 1%, consistent with US Federal Emergency Management Agency (FEMA) definitions.
- **Percentage of High-Risk Properties (HRP%)**, which is the HRP# expressed as a percentage of all properties in the LGA.



Scale of Risk

- The scale of extreme weather and climate change related risk (since 1990 baseline) is already significant. Across Australia, the results find that there are 383,300 addresses in 2020 which would be classified as High Risk Properties.
- This number is projected to increase to 735,654 in 2100 for existing development only. This figure does not account for new development occurring in high hazard areas, or continued use of inadequate building standards, which unabated will substantially increase this number.

Direction of Risk

Based on the selection of climate change models used (Representative Concentration Pathway 8.5 with sea level rise of 1.6m), the national TTIP is projected to increase by 55% between 2020 and 2100. In the same time period, the number of HRP are projected to increase by 92%.

Causes of Risk

- Riverine flooding is a major driver of both TTIP and HRP#. Though flooding effects a smaller number of properties it generally causes severe financial impacts. Between 2020 and 2100, the TTIP from flooding is projected to increase by 29%. One in five LGAs will have TTIP double due to flood. (Not including pluvial flooding.)
- Risk from Coastal Inundation commences at a relatively low level but increases exponentially over the course of the century. The TTIP from coastal inundation is projected to increase by 111% between 2020 and 2100. (Not including coastal erosion.)
- Forest fire effects a large number of properties but has a low probability of causing damage. Overall the pre-conditions for fires to occur will increase due to climate change. The TTIP for forest fire is projected to increase by 54% between 2020 and 2100. Furthermore, areas that are not generally considered at risk from bushfires may become vulnerable in the future. (Not including grass fires.)
- Subsidence risk (caused by drought conditions) affects a large number of properties which are in clay soils, though damage is not catastrophic. Between 2020 and 2100, the TTIP from subsidence risk is projected to increase by 36%.
- Wind risk occurs in all locations, but buildings are designed differently to cope with local conditions. The climate change trends identified are relatively small compared to uncertainties, so major conclusions are not made. (Not including cyclone risk.)

Concentration of Risk

The impacts are not shared equally across Australia, and some of the risks are highly concentrated. Whilst risk from subsidence and bushfire is broadly distributed, risk from flooding and coastal inundation is highly concentrated, thus presenting an acute social and economic risk for affected local government areas.

Conclusions

XDI has released this report as a national reference to help business, government and the public to understand the scale of extreme weather risks and the general impact climate change may have on these risks. This can be used to plan for climate resilience and adaptation - with more property specific information about climate change and extreme hazards for state and local governments than any other analysis in the world so far.

With this information now at hand, it's incumbent upon decision makers in business and government to enact systems that make visible the future impacts of climate change, and to continue to instigate the plans and actions to build social, economic, infrastructure and environmental resilience.

Responding to these challenges will bring far more benefit than just at the local scale. There are significant changes underway in global financial markets to ensure the resilience of the economy. Publicly listed companies are now required to disclose their material climate risks in shareholder statements, while ratings agencies are accounting for climate change impacts at municipal scale when calculating sovereign debt risk. Action to address climate impacts will therefore improve the corporate and economic outlook and ensure improved financial ratings for these areas.

The future set out in these results is not inevitable. Australian carbon emissions may have increased in the ten years since the first climate risk assessment report, but at the same time low emission technologies have become an indelible part of Australia's economy. Similarly, Australia can assure the safety of its people and economy with an orderly, prudent and timely investment in national resilience. These results signpost the way.

Recommendations

On the basis of the insights provided by this analysis, XDI makes the following recommendations

- 1. Establish Legal Requirements for Risk Disclosure:** Establish unambiguous legal requirements for purchasers, investors and tenants of built property and infrastructure to be advised of the full range of extreme weather and climate change risks that may affect the property over its full life time.
- 2. Require Fit-for-Purpose Construction in High Hazard areas:** Ensure design standards and planning requirements for infrastructure and development match location specific hazards. All tiers of government seek to achieve full insurability by ensuring projected VARs of less than 1% of the replacement cost of the property over its design lifetime under worst-case climate change projections.
- 3. Plan for Infrastructure System Resilience:** Federal and state governments require that all critical infrastructure - including water, power, transport and telecommunications - be assessed both at an asset level and at an interdependent system level. Establish an overarching standard risk tolerance (e.g. 1:500 year event tolerance) such that extreme weather event failures do not cause cascading failures across sectors.
- 4. Develop Risk Based Insurance Pricing:** Financial regulators require that insurance industry products fairly reflect both site specific hazard probabilities and asset specific vulnerability, thus providing lower premiums for more resilient designs and materials, and a clear market signal that investment in resilience will be fairly rewarded by lower premiums.
- 5. Adaptation for Highly Exposed Areas:** State and Federal governments implement support schemes to finance adaptation in areas at high risk. This can finance resilient construction, municipal works or relocation.

TOP TEN LOCAL GOVERNMENT AREAS (LGAs) BY HAZARD RISK

The tables below rank the top ten LGAs at risk from a cohort of all 266 LGAs in Australia with over 10,000 addresses. Areas with very low density show bias in results and therefore are not represented here but can be found in the benchmarking table in the body of the report, which covers all 544 LGAs.

ALL HAZARDS

Top 10 LGAs at Risk All Hazards - 2020				
RANK	TTIP\$	VAR%	HRP#	HRP%
1	Gold Coast, Qld	Greater Shepparton, Vic	Gold Coast, Qld	Greater Shepparton, Vic
2	Brisbane, Qld	Wangaratta , Vic	Brisbane, Qld	Wangaratta , Vic
3	Sunshine Coast, Qld	Mid Murray, SA	Greater Shepparton, Vic	Murray, WA
4	Greater Shepparton, Vic	Murray, WA	Sunshine Coast, Qld	Maranoa, Qld
5	Central Coast, NSW	Gold Coast, Qld	Fraser Coast, Qld	Mid Murray, SA
6	Fraser Coast, Qld	Fraser Coast, Qld	Wangaratta , Vic	Federation , NSW
7	Moreton Bay, Qld	Tweed , NSW	Mandurah, WA	Horsham , Vic
8	Wangaratta , Vic	Maranoa, Qld	Bundaberg, Qld	Mandurah, WA
9	Tweed , NSW	Noosa, Qld	Tweed , NSW	Fraser Coast, Qld
10	Mackay, Qld	Douglas, Qld	Moreton Bay, Qld	Hinchinbrook, Qld

Top 10 LGAs at Risk All Hazards - 2100				
RANK	TTIP\$	VAR%	HRP#	HRP%
1	Gold Coast, Qld	Greater Shepparton, Vic	Gold Coast, Qld	Greater Shepparton, Vic
2	Brisbane, Qld	Wangaratta, Vic	Brisbane, Qld	Murray, WA
3	Sunshine Coast, Qld	Mid Murray, SA	Sunshine Coast, Qld	Adelaide Hills, SA
4	Greater Shepparton, Vic	Murray, WA	Central Coast, NSW	Wangaratta , Vic
5	Central Coast, NSW	Gold Coast, Qld	Newcastle, NSW	Mundaring, WA
6	Moreton Bay, Qld	Tweed, NSW	Greater Shepparton, Vic	Mid Murray, SA
7	Fraser Coast, Qld	Fraser Coast, Qld	Fraser Coast, Qld	Maranoa, Qld
8	Tweed, NSW	Mandurah, WA	Moreton Bay, Qld	Noosa, Qld
9	Mackay, Qld	Douglas, Qld	Mandurah, WA	Narrabri, NSW
10	Mandurah, WA	Noosa, Qld	Tweed , NSW	Western Downs, Qld

RIVERINE FLOODING



FOREST FIRE



**Top 10 LGAs at Risk
Riverine Flooding - 2020**

RANK	TTIP\$	VAR%
1	Greater Shepparton , Vic	Greater Shepparton , Vic
2	Gold Coast , Qld	Wangaratta , Vic
3	Brisbane, Qld	Mid Murray , SA
4	Wangaratta , Vic	Maranoa , Qld
5	Port Phillip, Vic	Horsham , Vic
6	Mid Murray, SA	Federation , NSW
7	Sunshine Coast, Qld	Esperance , WA
8	Loga , Qld	Western Downs , Qld
9	Albury, NSW	Albury , NSW
10	Western Downs, Qld	Port Phillip, Vic

**Top 10 LGAs at Risk
Forest Fire - 2020**

RANK	TTIP\$	VAR%
1	Central Coast, NSW	Adelaide Hills, SA
2	Lake Macquarie, NSW	Mundaring, WA
3	Blue Mountains, NSW	Blue Mountains, NSW
4	Adelaide Hills, SA	Mitcham, SA
5	Gold Coast, Qld	Central Coast, NSW
6	Sunshine Coast, Qld	Byron , NSW
7	Shoalhaven, NSW	Hepburn, Vic
8	Yarra Ranges, Vic	Port Stephens , NSW
9	Mundaring, WA	Lake Macquarie, NSW
10	Logan, Qld	Burnside, SA

**Top 10 LGAs at Risk
Riverine Flooding - 2100**

RANK	TTIP\$	VAR%
1	Greater Shepparton, Vic	Greater Shepparton, Vic
2	Gold Coast, Qld	Wangaratta, Vic
3	Brisbane , Qld	Mid Murray, SA
4	Wangaratta, Vic	Horsham, Vic
5	Port Phillip, Vic	Murray, WA
6	Central Coast, NSW	Maranoa, Qld
7	Mid Murray, SA	Federation, NSW
8	Melbourne, Vic	Western Downs, Qld
9	Sunshine Coast, Qld	Port Phillip, Vic
10	Newcastle, NSW	Inverell, NSW

**Top 10 LGAs at Risk
Forest Fire - 2100**

RANK	TTIP\$	VAR%
1	Central Coast, NSW	Adelaide Hills, SA
2	Lake Macquarie, NSW	Mundaring, WA
3	Blue Mountains, NSW	Blue Mountains, NSW
4	Adelaide Hills, SA	Mitcham, SA
5	Sunshine Coast, Qld	Hepburn, Vic
6	Yarra Ranges, Vic	Port Stephens , NSW
7	Shoalhaven, NSW	Central Coast, NSW
8	Gold Coast, Qld	Lake Macquarie, NSW
9	Mid-Coast, NSW	Byron, NSW
10	Port Stephens, NSW	Yarra Ranges, Vic

COASTAL INUNDATION



SUBSIDENCE



**Top 10 LGAs at Risk
Coastal Indundation - 2020**

RANK	TTIP\$	VAR%
1	Gold Coast, Qld	Gold Coast, Qld
2	Sunshine Coast, Qld	Fraser Coast, Qld
3	Brisbane, Qld	Tweed , NSW
4	Fraser Coast, Qld	Murray, WA
5	Tweed , NSW	Mandurah, WA
6	Moreton Bay, Qld	Noosa, Qld
7	Mackay, Qld	Sunshine Coast, Qld
8	Mandurah, WA	Douglas, Qld
9	Redland, Qld	Mackay, Qld
10	Central Coast, NSW	Byron , NSW

**Top 10 LGAs at Risk
Subsidence - 2020**

RANK	TTIP\$	VAR%
1	Brisbane, Qld	Ku-ring-gai , NSW
2	Sydney, NSW	Willoughby, NSW
3	Central Coast, NSW	Lane Cove , NSW
4	Canterbury-Bankstown, NSW	Ryde, NSW
5	Northern Beaches , NSW	Mosman , NSW
6	Inner West , NSW	North Sydney , NSW
7	Unincorporated ACT, ACT	Hornsby , NSW
8	Melbourne, Vic	Burwood , NSW
9	Sutherland Shire, NSW	Strathfield , NSW
10	Parramatta, NSW	Inner West , NSW

**Top 10 LGAs at Risk
Coastal Indundation - 2100**

RANK	TTIP\$	VAR%
1	Gold Coast, Qld	Murray, WA
2	Sunshine Coast, Qld	Tweed , NSW
3	Brisbane, Qld	Gold Coast, Qld
4	Moreton Bay, Qld	Fraser Coast, Qld
5	Tweed , NSW	Douglas, Qld
6	Fraser Coast, Qld	Mandurah, WA
7	Central Coast, NSW	Noosa, Qld
8	Mackay, Qld	Sunshine Coast, Qld
9	Mandurah, WA	Mackay, Qld
10	Redland, Qld	Byron , NSW

**Top 10 LGAs at Risk
Subsidence - 2100**

RANK	TTIP\$	VAR%
1	Brisbane, Qld	Tamworth Regional, NSW
2	Sydney, NSW	Tablelands, Qld
3	Unincorporated ACT, ACT	Campaspe, Vic
4	Moreton Bay, Qld	Perth, WA
5	Central Coast, NSW	Greater Shepparton, Vic
6	Stirling, WA	Barossa, SA
7	Northern Beaches , NSW	Mount Barker, SA
8	Canterbury-Bankstown , NSW	Isaac, Qld
9	Gold Coast, Qld	Hinchinbrook, Qld
10	Inner West , NSW	Vincent, WA