Fluvial and Pluvial Flooding Research

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Flood risk overview

- Most frequent/damaging natural hazard
- Climate change increasing risk
- The costs of flood recovery are rapidly growing
- Built environment designed to outdated flood hazard assumptions

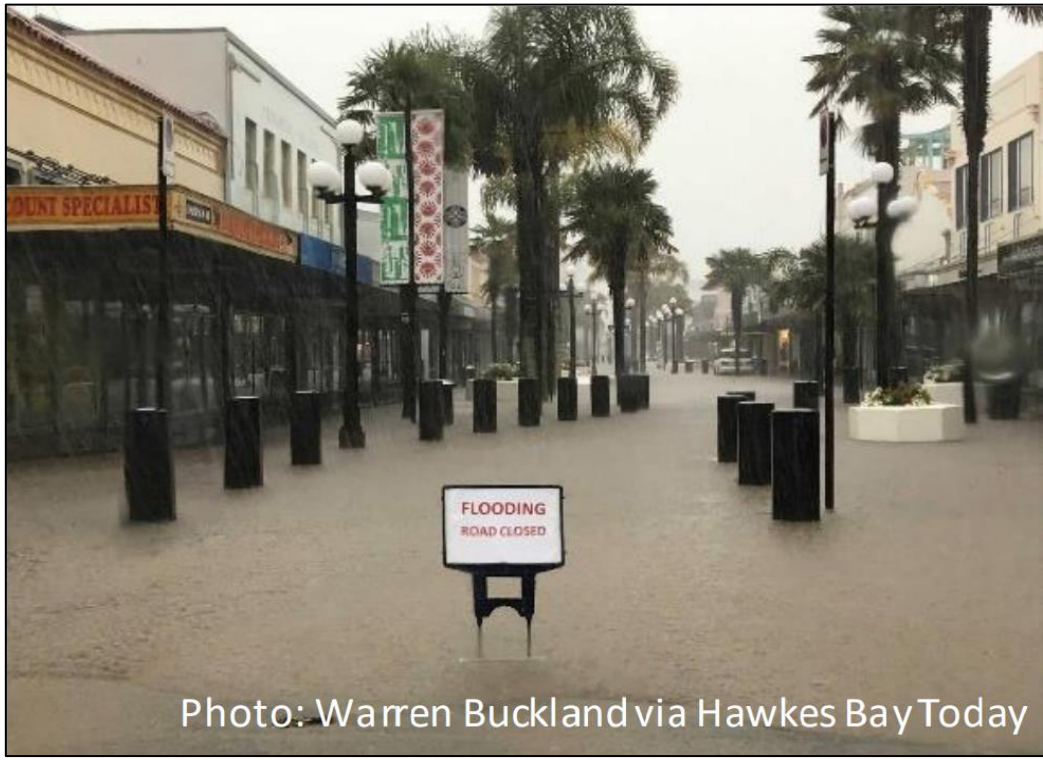


Photo: Warren Buckland via Hawkes Bay Today


Photo: Timaru District Council via RadioNZ

Flood Exposed Assets

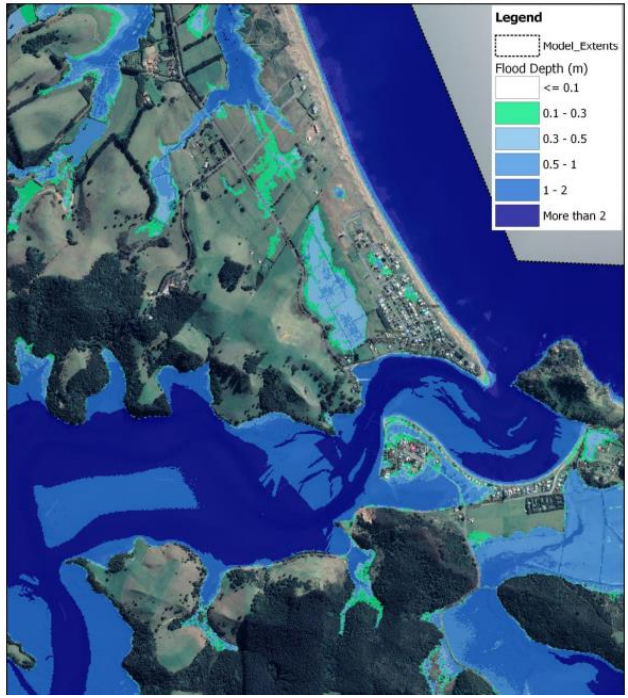
RNZ

Region*	Transport			Electricity (National Grid)			Three-Waters	
	Roads (km)	Railway (km)	Airports (#)	Transmission Lines (km)	Structures (#)	Sites (#)	Pipelines (km)	Nodes (#)
Northland	1,141	163	0	51	53	0	515	15,619
Auckland	1,259	196	3	214	243	4	4,409	146,165
Waikato	2,542	176	1	583	1,262	8	1,614	25,228
Bay of Plenty	667	36	2	57	119	0	1,269	37,034
Gisborne	371	18	1	0	0	0	417	8,663
Hawkes Bay	681	86	1	270	116	3	796	22,489
Taranaki	74	7	0	43	14	1	114	1,683
Manawatu-Whanganui	1,213	234	3	388	1,006	4	571	9,503
Wellington	1,515	37	0	93	138	6	3,453	73,053
Tasman	789	0	0	38	2	0	620	19,063
Nelson	130	0	1	3	85	1	895	24,336
Marlborough	387	25	1	205	160	1	8**	126**
West Coast	1,025	212	2	247	180	5	281	7,885
Canterbury	3,947	156	2	808	672	10	4,177	No Data
Otago	1,386	136	1	126	1,355	2	1,782	47,482
Southland	1,971	95	2	268	443	4	250	4,170
NZ Total	**19,098**	**1,577**	**20**	**3,397**	**8,848**	**49**	**21,173**	**442,499**

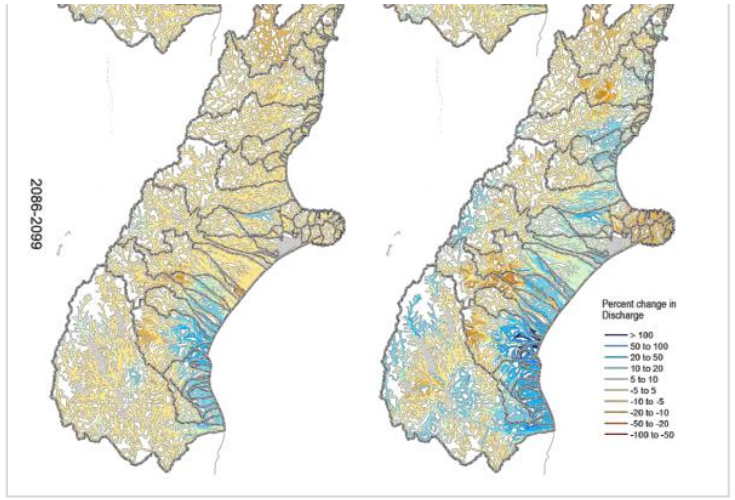
Paulik et al. (2019)

Recent research

- Flood Schemes, Flood **Hazards**, and Awareness in New Zealand - Walsh, Paulik, Robertson
- High Impact Weather infrastructure component **Fragility** models from NZ case histories - Wotherspoon
- Sea-Level Rise, Groundwater Dynamics and **Impacts** on Infrastructure Systems - Bosserelle, Hughes
- Technical **Resilience** of stormwater management systems to flooding - Valizideh, Shamseldin
- **Interdependent** System Resilience and **Adaptive** Planning in a Changing **Climate** - Brunner , Logan
- Quantification of urban flooding **resilience** and assessment of **Mitigation** strategies - Al Riyami, Shamseldin
- Marae infrastructure **Adaptations** and **Resilience** planning- (Vercoe, Fa'aui
- Integrated built environment assessment of **Resilience** and **Recovery** strategies - Lan, Zorn
- Embankment systems for flood detention and routing: Management strategies and **Impacts** - Wallace, Crawford-Flett
- Zealand Fluvial and Pluvial Flood **Exposure** – Paulik, Craig, Collins
- Integrated telecommunications and electricity **Resilience** assessments - Nair
- Characterisation of failure modes for New Zealand stopbank construction (**Impacts**) - Ting , Melville, Shamseldin, Whittaker
- Assessing the **Impact** of undocumented stopbanks - Wallace, Crawford-Flett, Wilson, Shamseldin
- Engineering **Impacts** of 2021 Canterbury floods - Lee , Zorn, Wotherspoon.
- Multi-hazard **Impact** and operability of flood defence network components - Essuman, Wotherspoon, Crawford-Flett
- Regional Policy Statement Modelling for Selwyn District Council (**Hazard**) - District Plan –DHI
- Selwyn River/ Waikirikiri floodplain investigation (**Hazard**) – Ecan
- Calibration Report NRC Region-wide River Flood Model (**Hazard**) – Water Technology, NRC
- Westport - flood forecasting roadmap for **Evacuation** warnings – NIWA, WCRC
- Hydraulic Modelling and Flood **Hazard** Mapping - Gardener
- Mā te Haumaru ō nga puna wai ō Rākaihautū ka ora mo ake tonu: Increasing flood **resilience** across Aotearoa
- National Flood **Hazard** model, current conditions and **Climate** change scenarios – Lane et al.
- Expert elicited flood **Vulnerability** models for Aotearoa infrastructure components – Williams, Zorn, Wotherspoon, Paulik
- Flooding **Impact** and **Loss** assessment framework for Aotearoa infrastructure - Williams, Zorn, Wotherspoon, Paulik, Foster
- Infrastructure network analysis from flooding **Impacts** in Aotearoa – Zorn, Wotherspoon, Paulik



Regional flood models- NRC 2021



Climate forecasts - Macara et al, 2020

Where things are moving

- Full **hazard coverage**
- **Vulnerability** models
- **Indirect impacts**
- Direct and economic **Loss ($)**
- Climate **adaption**
- Dynamic, **iterative** tools

Image: John Bisset (Stuff)

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Mā te haumaru ō nga puna wai ō Rākaihautū ka ora mo ake tonu:
5-year MBIE Endeavour Research Programme: Increasing flood resilience in Aotearoa

Image: RNZA

National screening tool:

- **Updateable, nationally-consistent** flood hazard and risk assessment
- Identify where flood hazard/risk may increase with **climate change**
- Work with local and **central government, iwi, stake-holders** to determine how to use this information to increase **resilience**

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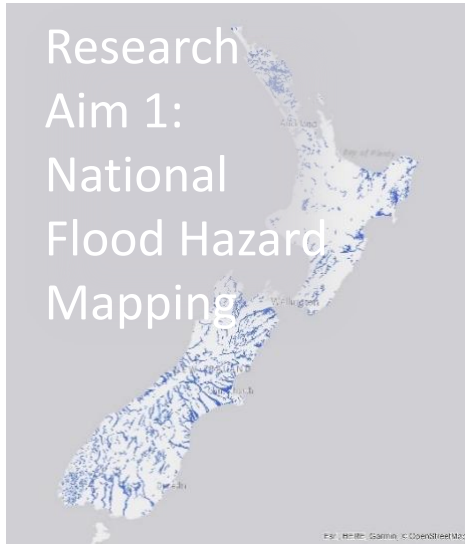
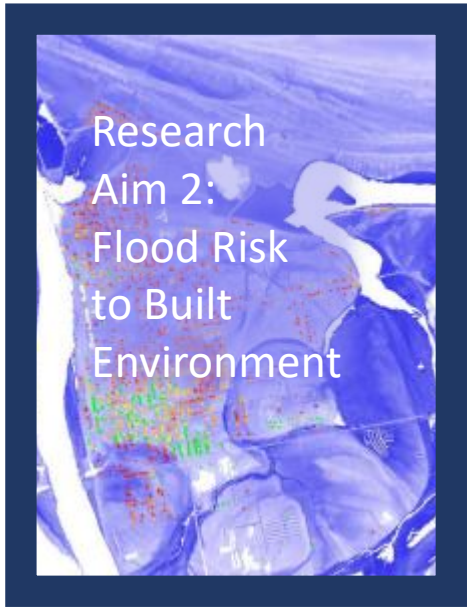
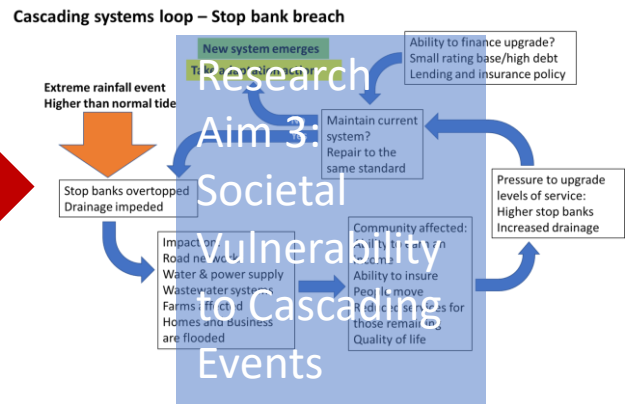
Mātauranga Māori Theme







Uncertainty Theme

Mā te haumaru ō nga puna wai ō Rākaihautū ka ora mo ake tonu:
Increasing flood resilience across Aotearoa

Implementation Workflow

Flood Hazard Maps (RA1)

Built-Environment Exposure Maps (CS2.2)

Buildings
- Residential
- Non-Residential

Agriculture
- Production Assets
- Capital Assets

Infrastructure Networks
- Components
- Service Flows

Vulnerability Models (CS2.3)

Exposure
- Binary Function

Physical Damage
- Damage model

Direct Economic Loss
- Damage-to-loss model

Risk Analysis (CS2.4|2.5|2.6)
- Exposure
- Event Loss ($)
- Expected Annual Loss($)
- National Risk Assessment

Risk Evaluation (CS2.4|2.6|2.7)
- Cost-Benefit Analysis
- Multi-Criteria Analysis
- Case Studies

Infrastructure Network Analysis (CS2.4|2.6)
- Network Model
- Interdependency Model
- Case Studies

Flood Risk Analysis Model (CS2.1|2.5)

Model Extension/Plugin (CS2.7)

External Model (CS2.4|2.6)

RiskScape Software: https://riskscape.org.nz/

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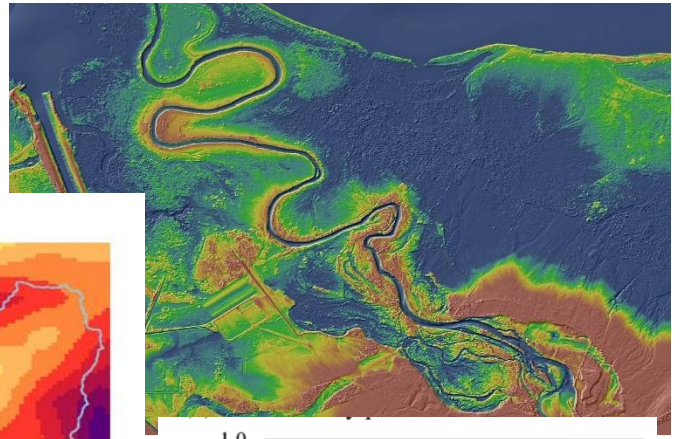
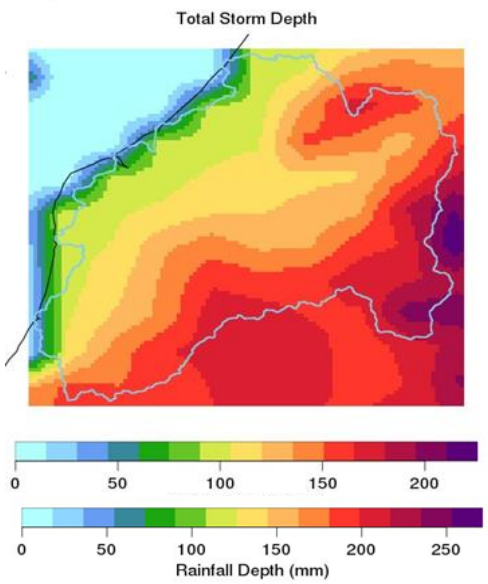
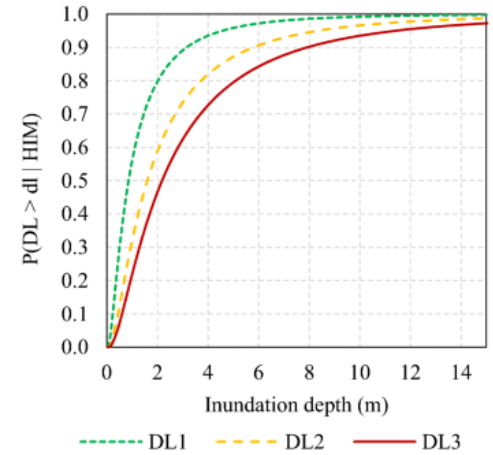
Increasing flood resilience across Aotearoa

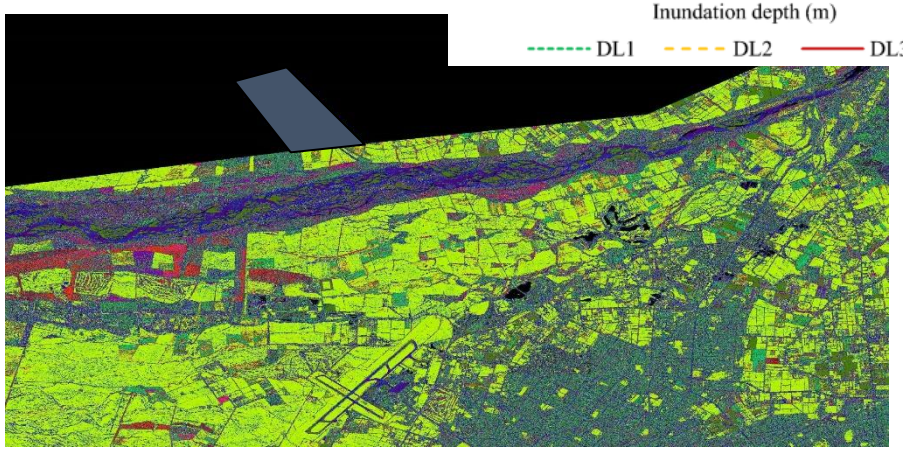
Open Source Outputs:

- Flood hazard and risk layers
- Vulnerability model suite
- National scale risk assessments
- Tools to support adaptation decision-making
- Consistent regionally-appropriate design for all Aotearoa









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