A framework for assessing risk to life from flooding at the property level

Auckland Floods 2023

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R. Donnelly (Richard Donnelly Ltd)

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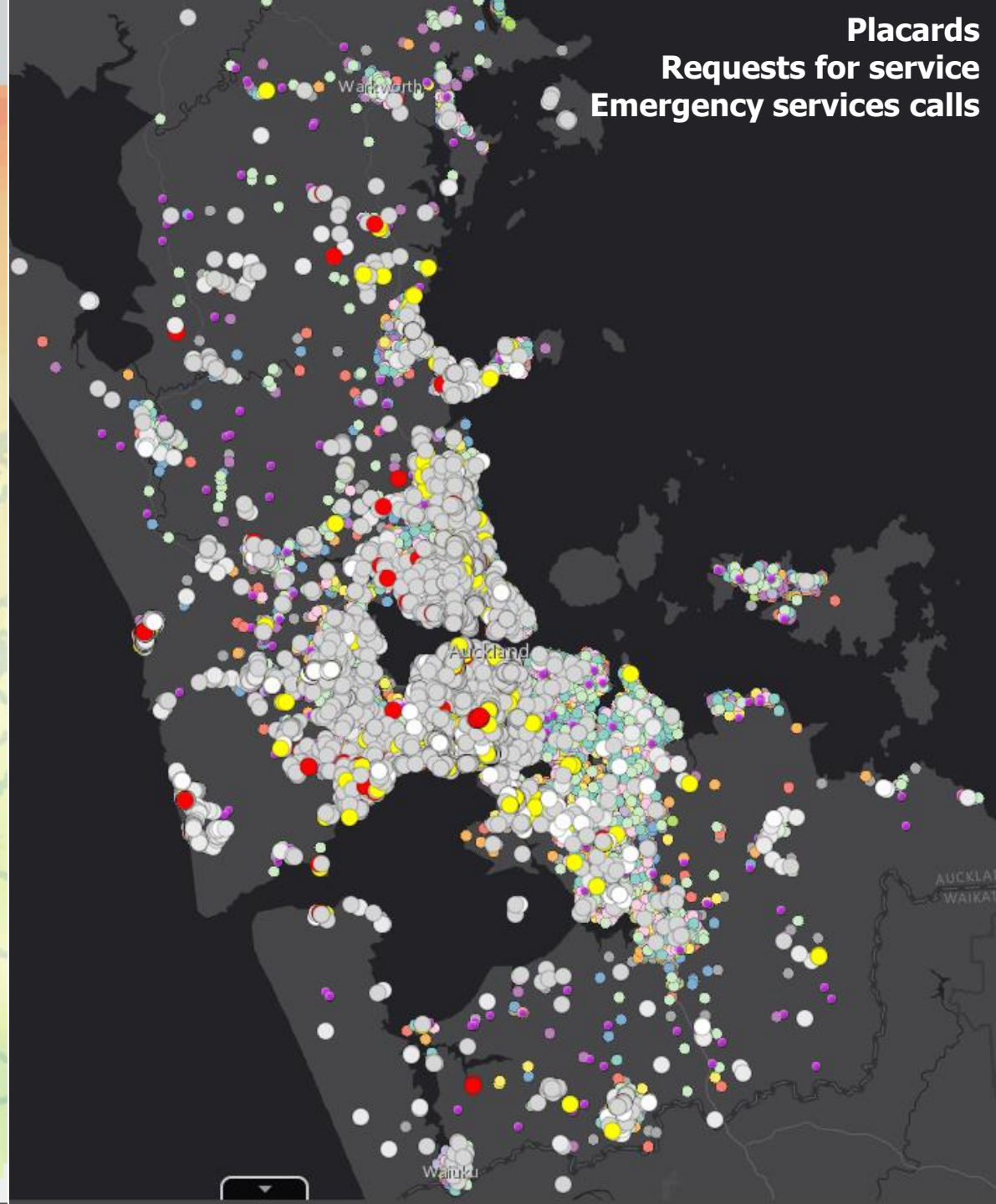
Rainfall

Dark shaded area shows areal extent of rainfall on 27 January 2023 which equalled or exceeded the TP108 100-year ARI (1% AEP) rainfall depth.

Placards
Requests for service
Emergency services calls



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1 JUNE 2023

Govt to support councils with buyout and better protection of cyclone and flood affected properties

HON GRANT ROBERTSON

HON MICHAEL WOOD

Cyclone Recovery | Finance

The Government will enter into a funding arrangement with councils in cyclone and flood affected regions to support them to offer a voluntary buyout for owners of Category 3 designated residential properties. It will also co-fund work needed to protect Category 2 designated properties.

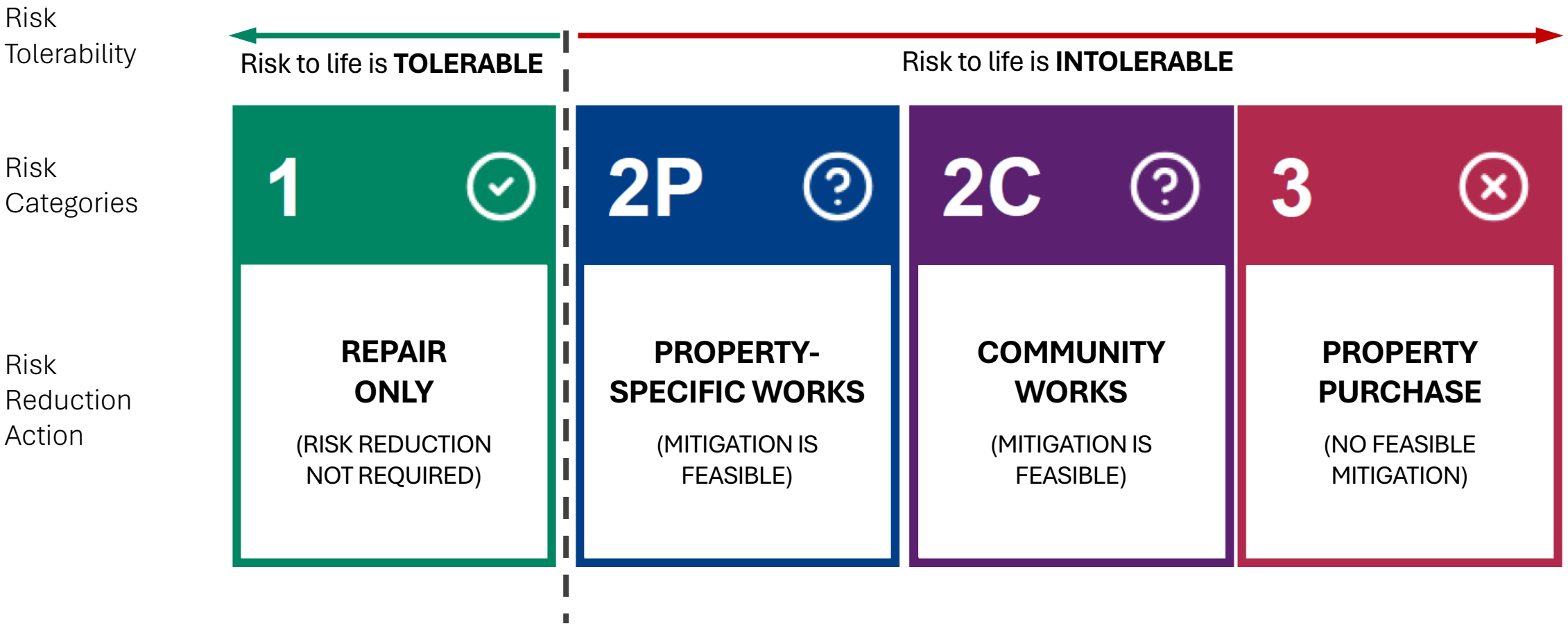
"From the beginning of this process the Government has supported a locally-led response to the North Island weather events, as requested by councils and communities in affected regions," Grant Robertson said.

"The facilitation work that the cyclone taskforce has been engaged in to undertake risk assessments has been completed. From here the councils will lead engagement with their affected property-owners.

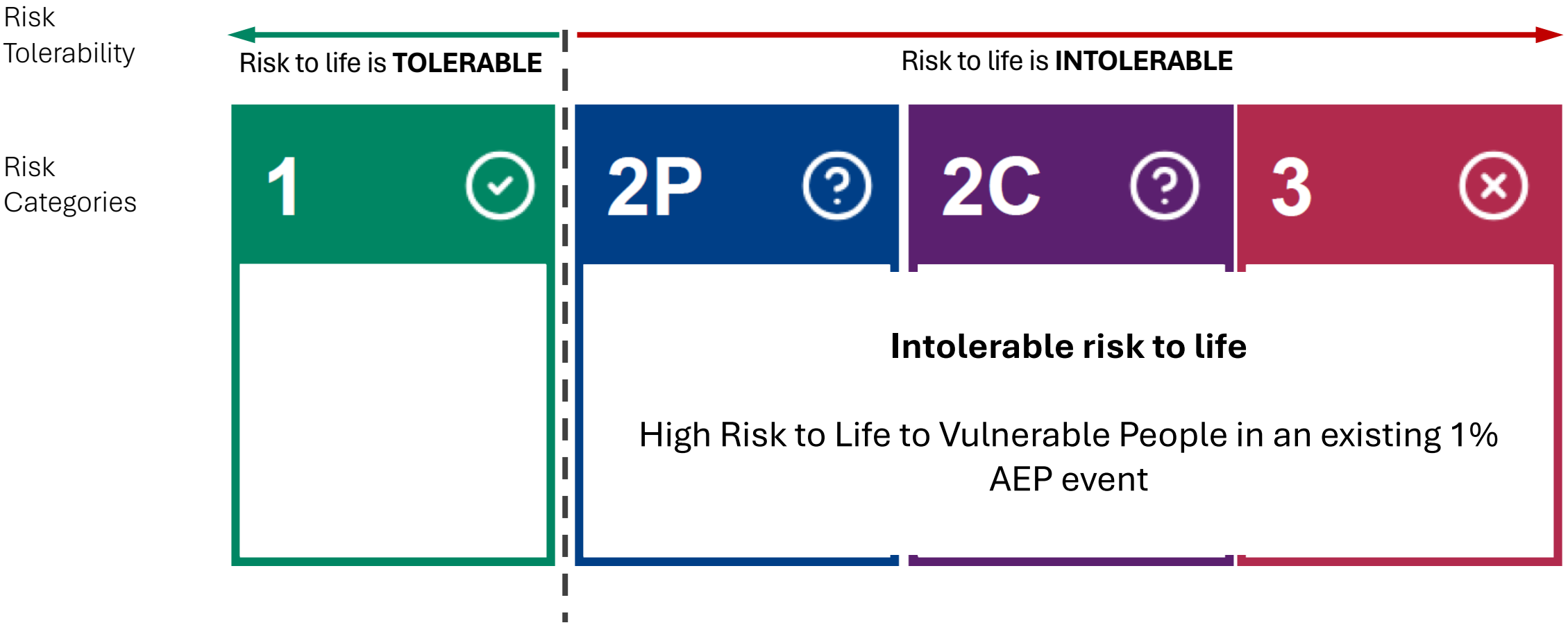
"Today's announcement will help councils get the right solution in the right place and avoid significant financial hardship for property owners."

The Government is committed to providing funding to support councils and will work through the details with them on how that will work in practice for both Category 2 and 3 properties. We expect to have those details resolved in June.

Policy settings for the severe weather recovery scheme



Policy settings for the severe weather recovery scheme



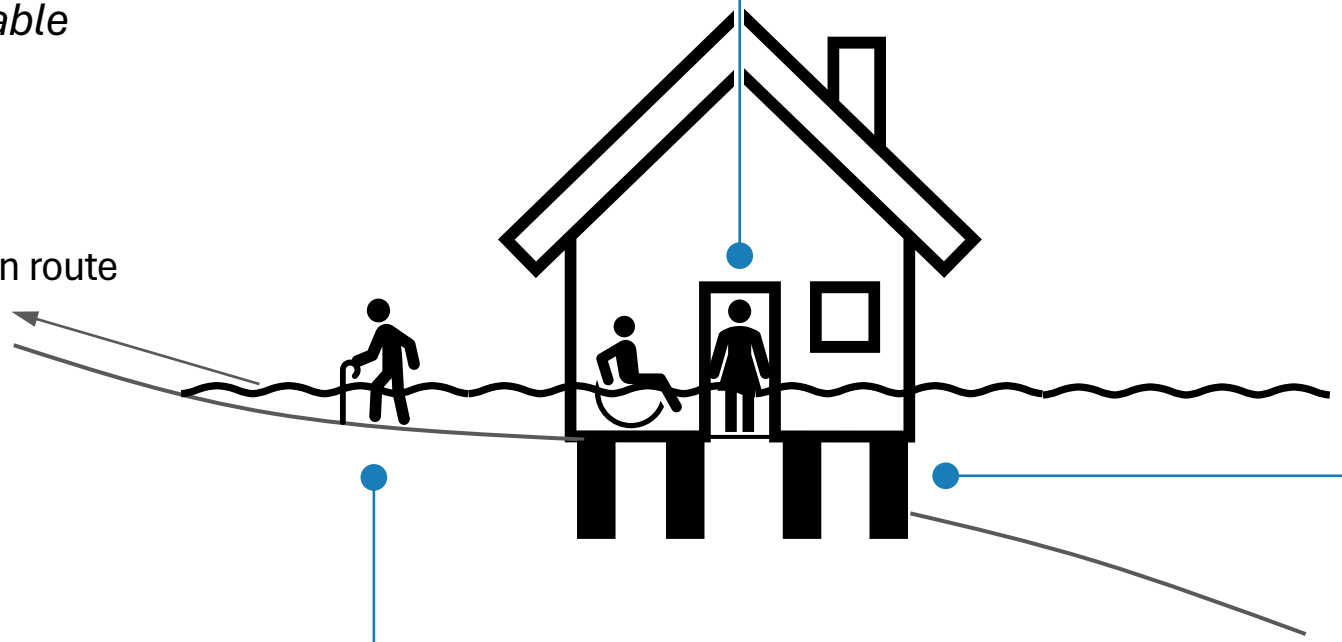

P S
Zone
BEGINS


Clover Dr

Spatially variable flood hazard and vulnerability

Hazard to People Inside

Mobility impaired people are most vulnerable



Hazard to Building Stability

Everyone is vulnerable

Hazard to People Outside

Children and the elderly are most vulnerable

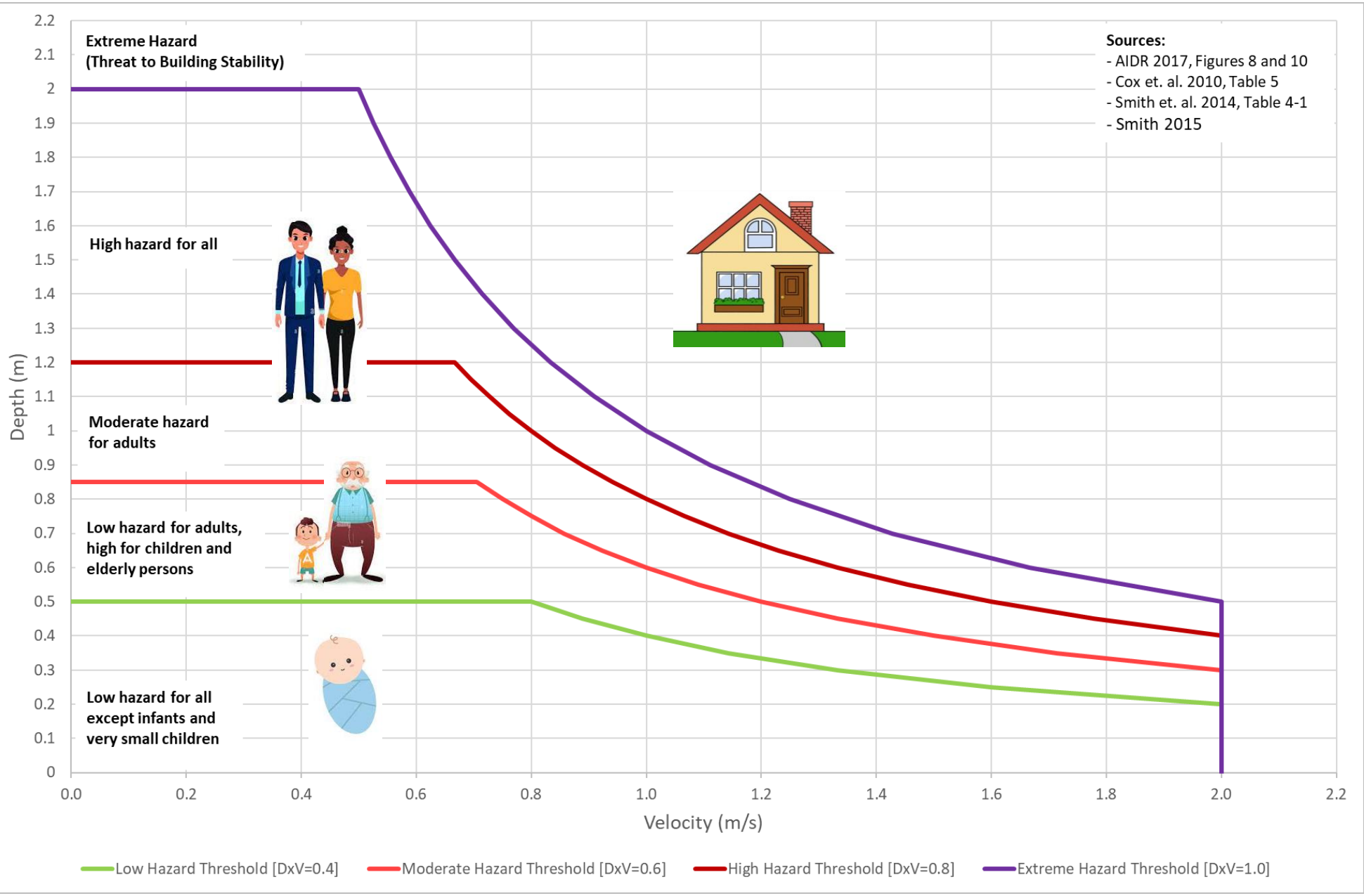
Stability of people and buildings in flood waters

Stability of light residential buildings at risk

All adults become unstable

Some adults may have difficulty

Children and elderly people become unstable



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Flood Danger

Determined from the combination of **Hazard Inside** and **Hazard Outside**

Determined from the **Hazard to Building Stability**

LOW DANGER

Not dangerous for all, including vulnerable people.

MODERATE DANGER

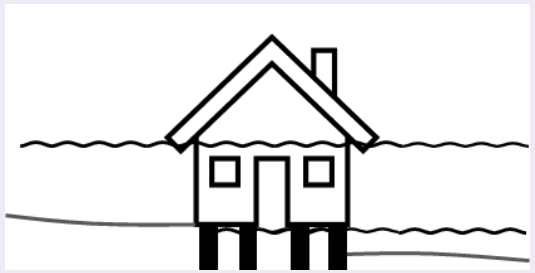
May be dangerous depending on what people decide to do.

HIGH DANGER

Dangerous for vulnerable people and may be dangerous for all.

EXTREME DANGER

Building stability at risk. Dangerous for all.



Risk to life is **TOLERABLE @ 1% AEP**

High risk to life to vulnerable people = **INTOLERABLE @ 1% AEP**

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Deciding the Danger Ratings

- This is the hazard space for someone on a flooded property.
- How should the cells of the matrix be rated?

Person Stability Danger Rating Matrix

Hazard				Hazard to People Outside				
	Conditions			An evacuation route is available and does not require wading	An evacuation route may be available but requires wading. Hazard is a function of depth and velocity of flooding along the evacuation route. Refer DxV Chart 2.			
		Hazard Rating		Very Low	Low hazard for all except infants and very young children	Low hazard for adults / High for children and elderly	Moderate hazard for adults	High hazard for all
			D & V Thresholds	n/a	Refer DV Chart	Refer DV Chart	Refer DV Chart	Refer DV Chart
Hazard to People Inside	Habitable floor remains dry	Very Low	Floodwaters are NOT touching the building footprint. Nil depth over habitable floor.					
			Floodwaters are touching the building footprint. Nil depth over habitable floor.					
	Habitable floor is wet.	Low hazard for all except infants and very young children	Depth (D) over habitable floor: 0 ≤ D < 0.5m					
		Low hazard for able-bodied adults / High for mobility impaired people	Depth (D) over habitable floor: 0.5 ≤ D < 0.85m					
		Moderate hazard for able-bodied adults	Depth (D) over habitable floor: 0.85 ≤ D < 1.2m					
		High hazard for all	Depth (D) over habitable floor: D ≥ 1.2m					

Deciding the Danger Ratings

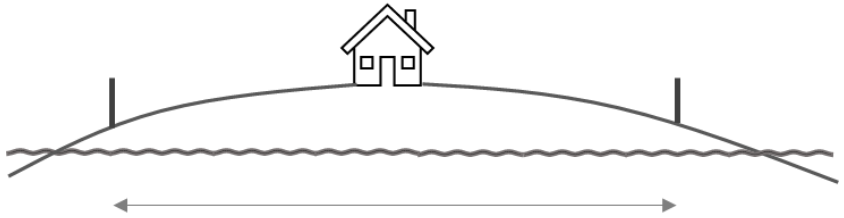
- This is the hazard space for someone on a flooded property.
- Some situations are clearly safe, and some are clearly dangerous.
- In other cases, the danger is contingent.

Person Stability Danger Rating Matrix

Hazard				Hazard to People Outside				
	Conditions			An evacuation route is available and does not require wading	An evacuation route may be available but requires wading. Hazard is a function of depth and velocity of flooding along the evacuation route. Refer DxV Chart 2.			
		Hazard Rating		Very Low	Low hazard for all except infants and very young children	Low hazard for adults / High for children and elderly	Moderate hazard for adults	High hazard for all
			D & V Thresholds	n/a	Refer DV Chart	Refer DV Chart	Refer DV Chart	Refer DV Chart
Hazard to People Inside	Habitable floor remains dry	Very Low	Floodwaters are NOT touching the building footprint. Nil depth over habitable floor.	Safe refuge and safe evacuation available	Safe refuge but evacuation route is flooded *Potentially dangerous if people decide to leave*			
			Floodwaters are touching the building footprint. Nil depth over habitable floor.					
	Habitable floor is wet.	Low hazard for all except infants and very young children	Depth (D) over habitable floor: 0 ≤ D < 0.5m					
		Low hazard for able-bodied adults / High for mobility impaired people	Depth (D) over habitable floor: 0.5 ≤ D < 0.85m	Flooded lower floor with safe evacuation available from upstairs *Potentially dangerous for those who can't evacuate unassisted*	Flooded floor and evacuation route is also flooded *Dangerous whether people stay or go*			
		Moderate hazard for able-bodied adults	Depth (D) over habitable floor: 0.85 ≤ D < 1.2m					
		High hazard for all	Depth (D) over habitable floor: D ≥ 1.2m					

When will most people leave?

How close do flood waters have to be to the house before most people will try to evacuate?



A few people will leave

(Safe for most)

Some people will leave

(Still safe for most, who stay)

Most people will leave

(Dangerous for most)

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An aid for thinking about flood hazard and risk

LOW DANGER

MODERATE DANGER

Tolerable @ 1% AEP

HIGH DANGER

EXTREME DANGER (Building Instability)

Intolerable @ 1% AEP

Person Stability Danger Rating Matrix

Hazard			Hazard to People Outside				
Conditions			An evacuation route is available and does not require wading	An evacuation route may be available but requires wading. Hazard is a function of depth and velocity of flooding along the evacuation route. Refer DxV Chart 2.			
	Hazard Rating		Very Low	Low hazard for all except infants and very young children	Low hazard for adults / High for children and elderly	Moderate hazard for adults	High hazard for all
		D & V Thresholds	n/a	Refer DV Chart	Refer DV Chart	Refer DV Chart	Refer DV Chart
Hazard to People Inside	Habitable floor remains dry	Very Low	Floodwaters are NOT touching the building footprint. Nil depth over habitable floor.	Safe for all 	Dangerous for those who choose to leave 		
			Floodwaters are touching the building footprint. Nil depth over habitable floor.				
	Habitable floor is wet.	Low hazard for all except infants and very young children	Depth (D) over habitable floor: 0 ≤ D < 0.5m		Intolerable Risk Threshold @ 1% AEP	Dangerous for children, and the elderly	Dangerous for all
		Low hazard for able-bodied adults / High for mobility impaired people	Depth (D) over habitable floor: 0.5 ≤ D < 0.85m	Dangerous for mobility-impaired people			
		Moderate hazard for able-bodied adults	Depth (D) over habitable floor: 0.85 ≤ D < 1.2m				
		High hazard for all	Depth (D) over habitable floor: D ≥ 1.2m			Dangerous for all	

Application

- Changing expectations of event magnitude in non-stationary climate
- Uncertainty in observed and/or modelled data
- Observed levels >> modelled– flood prone area activation
- No accepted definition of egress route.... to where?
- Extended duration of flooding
- Limitations of DV approach for overland flow – low depths, high velocities
- Lack of research on building stability thresholds in NZ context
- Acceptable level of residual risk post solution
- Etc....

Conclusion

- The Framework is a new approach to assessing risk at a property level
- It accounts for behavioural factors, vulnerability, and flood hazard at multiple locations on a property
- Flood risk is assessed in a consistent, transparent and objective manner
- A threshold for intolerable risk to life has been defined
- Developed for flood recovery context but principles can be applied elsewhere
- Next steps....
- Read the full paper!

Acknowledgements

- **Subject Matter Expert Working Group:** Nick Brown, Richard Smedley, Allan Leahy (Auckland Council), James Reddish (WSP)

- **Expert Panel:** Dr Tim Fisher (Tonkin & Taylor), Peter Christensen (Storm Environmental), Dr Graeme Smart, Wallace Potts (Tauranga City Council)

- All our property assessors

Thank you!
Questions? Patai?

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