Kia Kaha: Lessons from NZ's Operational Resilience Stories

For Road Management and Maintenance Contracts

Elke Beca

Mtech(pave), BE(EngSci), IntPE

29/02/2024

Acknowledgement to:

Natalia Uran Botero (Cyclone Gabrielle)

John Kreft (Kaikoura Earthquake)

What we'll cover today

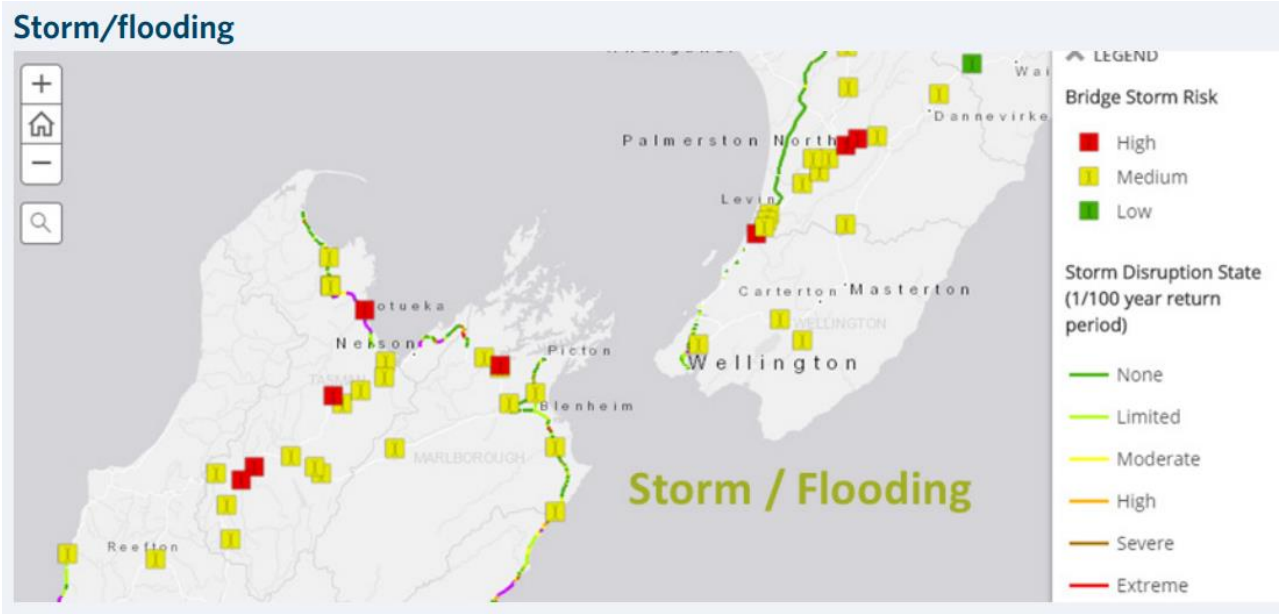
BEFORE

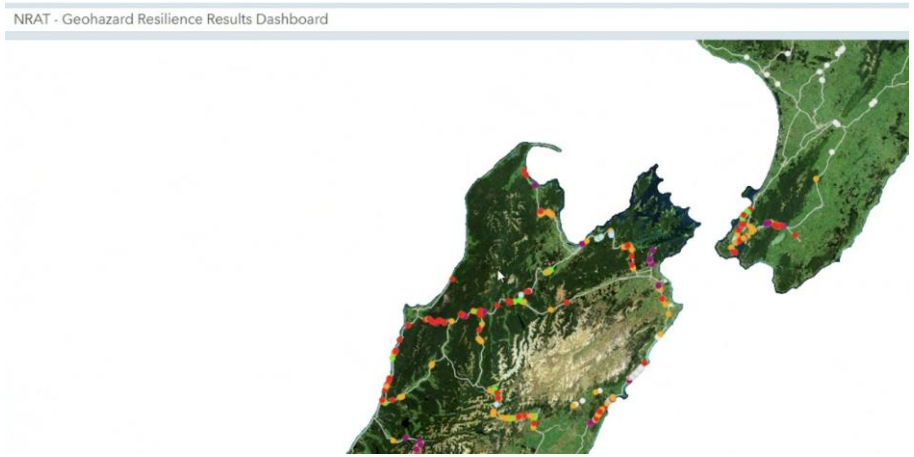
DURING

AFTER

National Resilience Framework

- National level assessment of resilience
- High impact, low frequency
- Datasets (Road/Structures, Geography/Geology, Storms/Flood, Earthquake/Volcanic/Tsunami)
- Use to support:
  - Business Cases for investment
  - Desired vs Current resilience
- Prioritisation (hazard risk)





[Resources and information | Waka Kotahi NZ Transport Agency (nzta.govt.nz)]

TARPs

- **Trigger:** Indicators to determine level of risk *to infrastructure* e.g. weather, asset/non-asset condition
- **Action:** Steps taken before/during event to address risk e.g. increase monitoring through to closing access
- **Response:** Steps taken following event to bring *infrastructure* back to acceptable level of risk e.g. inspections, structural assessments

Status	Trigger	Action	Response
White Status (Preparedness Phase)	High Rainfall or significant event forecast (i.e., NIWA RED warning level)	**SMC** to commence monitoring of flow levels. **SMC** and **NOC** to make contact. **NOC** to place Traffic Management on call to be deployed as required.	**SMC** or **NOC** to notify all parties of green status if green trigger is reached.
Green Status (Moderate Risk)	River flow rate or debris > **Green Threshold Level**	Twice-daily day time monitoring by **NOC**; report observations to **SMC**. **SMC** to review any information or photos from **NOC**.	**SMC** to advise any increased monitoring or response required based on performance of structure.
Amber Status (High Risk)	River flow rate or debris > **Amber Threshold Level**	**NOC** to close the bridge to traffic during dark hours. Continuous daytime monitoring by **NOC**; report observations to **SMC**. **SMC** to review any information or photos from **NOC**.	**SMC** to advise any increased monitoring or response required based on performance of structure.
Red Status (Critical Risk)	River flow rate or debris > **Red Threshold Level**	**NOC** to close structure to all traffic. **NOC** to immediately call client and **SMC**. All parties to follow Emergency Protocols and Procedures.	**SMC** and/or **NOC** to continuously monitor the bridge throughout closure until flood water levels are subsiding.

Table 1: Example of a basic TARP

Routine Mtce

Section 6.2.1 - Routine Drainage Maintenance					
OPM group 6.2.4	OPM number	Sample size	Audit frequency	PIP	Defect
Unlined surface water channels	52	10%	Monthly	1 week	Isolated blockage that would allow water to pond or flow onto the carriageway or undermine the asset integrity

Contract Standard				
NSHVH	NSH	RSH	RCH	RDH
≤ 1 defect per audit section				

Example Defects

Over slip debris blocking surface water channel, build-up of debris blocking surface water channel

Assessment Guideline

Initial assessment of surface water channels by vehicle observer.

Individual asset inspection may be required in some situations to determine whether surface water channel capacity is limited by debris such that water could flow onto carriageway during periods of rain

Tip – use a trip meter or measuring wheel to measure out 100m if multiple defects are identified

Acceptable

Defect Description:

Example – surface water channel recently cleaned with no obstructions

Defect

Defect Description:

Example - Fretting material from adjacent cut batter blocking surface water channel allowing water to pond and potentially flow onto the carriageway or undermine the asset integrity

Defect

Defect Description:

Example - Obstruction in surface water channel allowing water to pond

Defect

Defect Description:

Example - Slip debris from adjacent cut batter blocking surface water channel allowing water to pond and potentially flow onto the carriageway or undermine the asset integrity

SECTION 6.2.1 – ROUTINE DRAINAGE MAINTENANCE

OPM group 6.2.1	OPM number	Sample size	Audit frequency	PIP	Defect
Non-vulnerable sumps, manholes and catchpit	46	100%	Annually	1 month	Debris < 200mm below the internal outlet pipe invert or > 20% of the cross-sectional area of outlet pipe covered with debris or for manholes and like features, >33% of the grate is blocked, not remedied within 2 months as identified from an annual drainage inspection

Contract Standard

NSHVH	NSH	RSH	RCH	RDH
No defects				

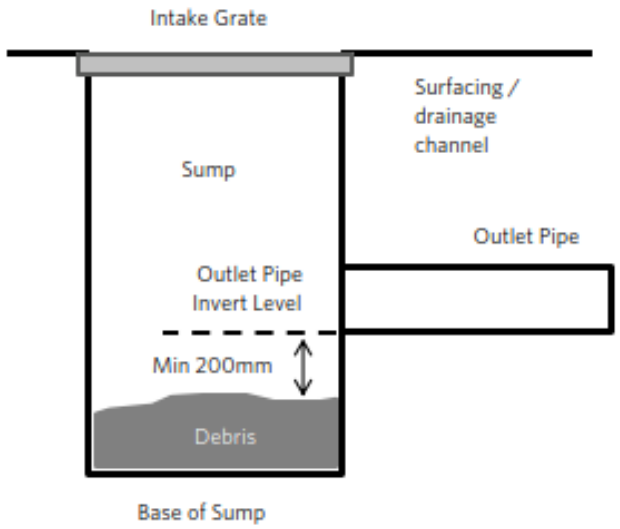
Example Defects

Blocked sump, manhole, catchpit, outlet pipe, etc.

Assessment Guideline

Evidence needs to be provided showing remedial works have been completed

Example of assessment



Tip 1 – Stormwater assets in urban areas are likely to be maintained by the local authority – check the agreement between the TLA and the Transport Agency

Tip 2 - An inspection of the asset may not actually be required when auditing this OPM as other methods for appropriately demonstrating remedial works have been undertaken.

Defect

Defect Description:

Example - Catchpit with debris less than 200mm below the invert level of the outlet pipe

Defect

Defect Description:

Example - Blocked outlet pipe

Defect

Defect Description:

Example - Blocked intake grate

SECTION 6.2.1 – ROUTINE DRAINAGE MAINTENANCE

OPM group 6.2.2	OPM number	Sample size	Audit frequency	PIP	Defect
Non-vulnerable culverts, subsoil and horizontal drains	47	100%	Annually	1 month	> 20% of the cross-sectional area of the culvert inlet, outlet or barrel filled with debris, not repaired within 2 months as identified from an annual drainage inspection

Contract Standard

NSHVH	NSH	RSH	RCH	RDH
No defects				

Example Defects

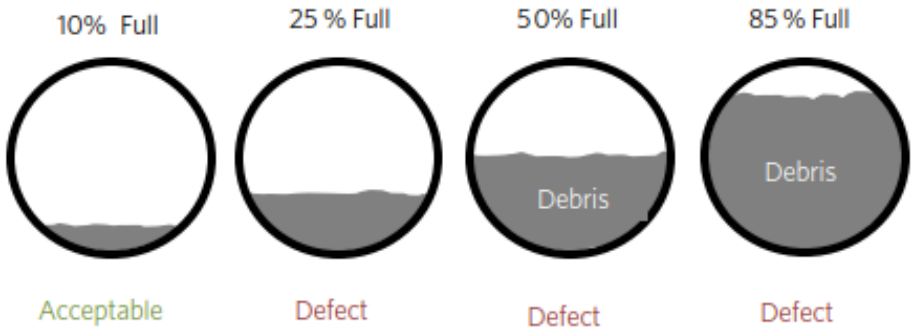
Blocked culvert

Assessment Guideline

Evidence needs to be provided showing remedial works have been completed

The following sketches are provided to assist with the visual assessment of the percentage of the cross-sectional area of the culvert inlet, outlet or barrel that is filled with debris

Example of assessment



Tip 1 - An inspection of the asset may not actually be required when auditing this OPM as other methods for appropriately demonstrating remedial works have been undertaken

Acceptable

Defect Description:
Example - Culvert barrel clear

Defect

Defect Description:
Example - > 20% of the cross-sectional area of the culvert barrel filled with debris

Defect

Defect Description:
Example – > 20% of the cross-sectional area of the culvert inlet filled with debris

SECTION 6.2.1 - ROUTINE DRAINAGE MAINTENANCE					
OPM group 6.2.5	OPM number	Sample size	Audit frequency	PIP	Defect
Vulnerable flooding areas	55 - 57	100%	Every 2 months	24 hours	Water does not readily flow to the outlet point (55), Isolated blockage that would allow water to pond or flow onto the carriageway or undermine the asset integrity (56), > 20% of the channel hydraulic cross-section inoperative (57)

Contract Standard				
NSHVH	NSH	RSH	RCH	RDH
No defects				

Example Defects

Vulnerable surface water channel blockages

Assessment Guideline

Refer to contract appendix 6.5 for the schedule of nominated vulnerable flooding areas and drainage assets.

Initial assessment by vehicle observer, supported by detailed site/asset inspection if required

Tip 1 – Use people who are regularly travelling the network (e.g. network inspectors) to stop and inspect the nominated vulnerable flooding areas and drainage assets

Defect

Defect Description:

Example - Water does not readily flow to the outlet point

Defect

Defect Description:

Example - Isolated blockage that would allow water to pond or flow onto the carriageway or undermine the asset integrity

Defect

Defect Description:

Example - > 20% of the channel hydraulic cross section inoperative

Emergency Procedures & Preparedness Plan

- Identifies key parties involved, roles, responsibilities to effectively manage and emergency event
- Communications
- Operational Processes
- Incident Checklists
- Detours

Incident Response Levels Guide

Level	Name	Definitions				Responses		
		Description	Incident Response	Expected Delay/Impact	Impact on the Road	Incident Management Responsibility	Traveller Information and Media	Notification
0	Normal	No Incidents	N/A	N/A	N/A	N/A	N/A	N/A
1	Minor	An event resulting in a small impact to traffic flow. No delays or very minor delays to travel times. No queues but may result in slower traffic past scene.	• Police	No longer than 10 minute delay. No TREIS notification required, no longer than 10 minutes.	• Vehicle breakdown on shoulder • Vehicle crash or breakdown that clears from the live lanes to the shoulder fairly quickly • Loss of load requiring a rolling block by the Police	Police NOC	N/A	• None required • Unofficial in TREIS, less than 20 minute delay • Stays within JTOC/Contractor TREIS unofficial
2	Significant	An event resulting in an impact to traffic flow of no longer than 90 minutes. Minor or non-injury accident.	• Police • Fire/Ambulance	Longer than 10 minutes and up to 90 minutes in light traffic conditions or at off peak times.	•Diversion time or delay to stop/go	Availability of fixed VMS NOC	• TREIS (official)	• None required • TREIS Official - system, social media • Longer than 20 minutes but not media significant
3	Serious	An event resulting in serious injury/fatality or any road closure	• As above + • Police Investigation (Serious Crash Unit) • NZTA Network Response Person • Press release required	No longer than 3 hours in normal traffic conditions (may be longer if light traffic or off-peak). OR Diversion in place up to 2 days	• Multiple lanes causing significant delay • Longer term full carriageway closure • Major restriction to traffic flow requiring diversion	Contractor and Transport Agency on call person JM, Senior Network Managers, I Cox (0800 Response)	• JTOC/TREIS	• NZTA response person, State Highway Manager and Comms
4	Headline	An event resulting in major disruption with regional effects and required a coordinated response from a command centre.	• As above + • Increased resources & response • CIMMS	Longer than 90 minutes. Diversion in place for longer than 2 days.	• Long term full carriageway closures • Major restriction to traffic flow • Large diversions > 1 hour	Regional Network Operations Manager, Regional Manager and National Operations Manager	• All assets used	• As above + • Regional Manager (24 hours) • National Operations Manager
5	Catastrophic	An event involving massive long term disruption to traffic flows, probably due to a natural disaster and damage to roading, requiring a strategic response (includes Civil Emergencies).	• As above + • Multi-discipline response • Civil Defence (CDEMG)	> 1 day delay or closure	• Long term full carriageway closures or loss of critical infrastructure • Major restriction to traffic flow	As above plus NZTA Chief Executive	• As above, except road condition press releases issued by the Civil Defence	• As above + • NZTA Chief Executive

Tomo caused by stormwater drain failure

"A hole in the road is raising some eyebrows - how that can close down New Zealand's fifth-biggest city - but it happened on the wrong road.

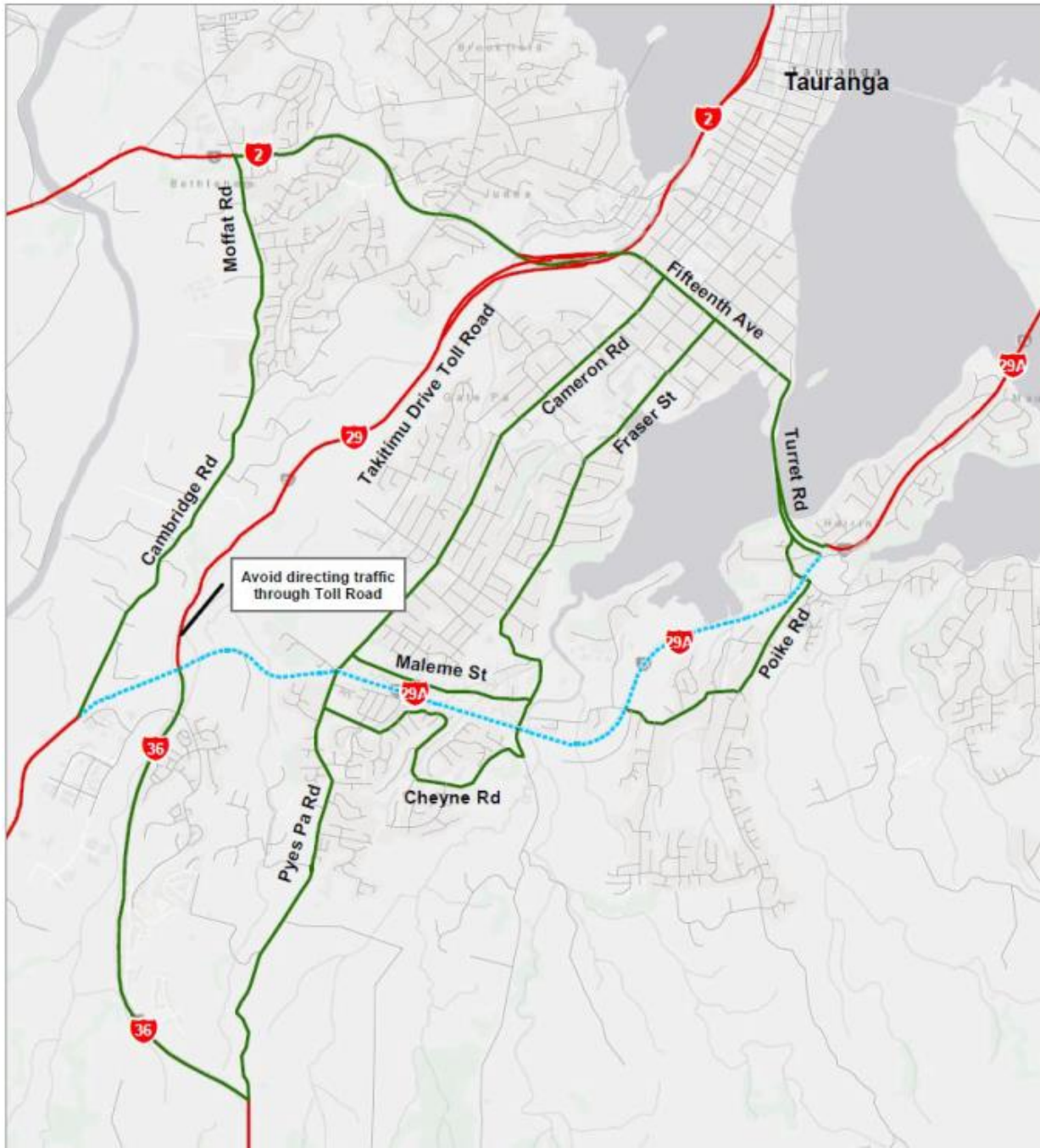
No. 5 - WATERMAIN/WASTEWATER BREAK

ITEM	CHECKLIST
1	Identify and record location of event
2	WestLink Incident Manager to action checklist as appropriate
3	If closure of road is necessary: • close road • confirm detour route open and clear • during events requiring an extended detour, monitor the detour condition and check that TTM signage and cones are appropriate and functioning • provide stacking for HPMV and Heavy/Towing vehicles as appropriate • action Detour Plan
4	Advise, and keep updated, Waka Kotahi First Response Manager, their respective offices during work hours.
5	In the unlikely event that closure is not required: • establish barriers and warning signs • Isolate any hazards • Implement detours if appropriate
6	Advise appropriate Utility owner
7	At completion of remedial action reopen roadway as appropriate

Location of Main feeder water mains and sewer line on the ONMC network are as follows:

- SH2: Athenree to Tauranga (water)
- SH2: Omokoroa to Tauranga (sewer)
- SH2 Harbour Link Causeway (water)
- SH2 under Takitimu Drive at 22nd Ave, SH2A 15th Ave at Devonport Road (sewer)
- SH29 at Matapihi (sewer)
- Oropi Road
- Pyes Pa Road (SH36)

DETOUR ROUTE MAP 15
SH29A - Maungatapu RAB to Cambridge Rd



New Zealand Transport Agency Waka Kotahi (NZTA) and different companies across the infrastructure industry collaborated well together to deliver a faster than normal solution to repair a section of State Highway 25A (SH25A), including building the new Taparahi Bridge, in the Coromandel.

The accelerated re-opening is estimated to have increased tourism expenditure in the region by $69.30 million or about 15% compared to a non- accelerated schedule. It also is estimated to have increased GDP in the region by $85.88 million.[1]

Damage to the section of SH25A caused by the storm event and resulting slip
Source: Waka Kotahi

- Several regional – or one national emergency panel should be established (single source, open book) to respond to similar events. This would take a long-term multiyear arrangement and would develop best practice approaches that will inform and improve business as usual work. This should include ongoing resilience planning for availability of plant and labour. This could be modelled on the TREC or NCTIR examples to provide a commercial framework.

The accelerated re-opening is estimated to deliver at least $69m in increased tourism expenditure for the region, and will increase regional GDP by a total of $86m

Source: SH25A Taparahi Bridge Case Study. *Infrastructure NZ*

Business as usual learnings

There are learnings from the SH25A – Taparahi Bridge project that can be applied to business-as-usual projects to speed up delivery and benefits of infrastructure:

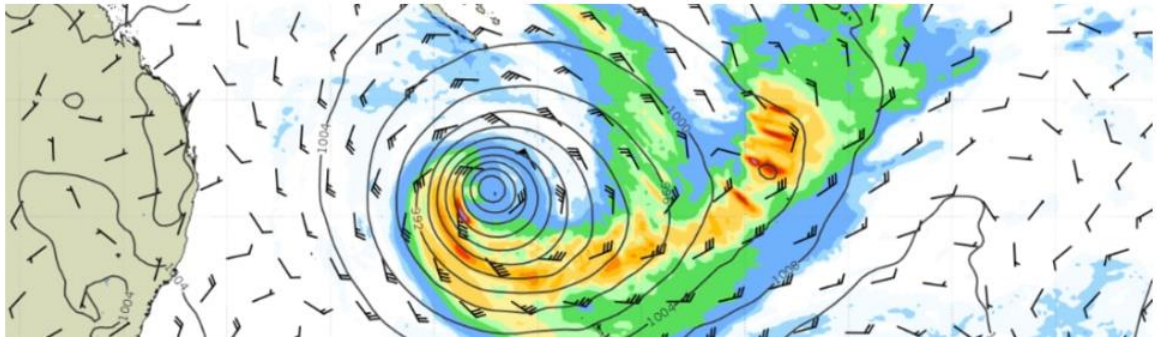
- Strong and robust up front option selection, risk assessment and planning.
- Accepting additional short term road user impacts by closing roads to enable faster and safer construction
- The use of standardised design. This can accelerate both design and provide in country supply of materials with long lead times.
- Off-site fabrication undertaken in parallel with other works and decoupled from the site specific and weather conditions.
- Factoring in decision making the opportunity cost of delaying infrastructure investment and long construction programmes, versus understanding the value of investing in and delivering infrastructure to enjoy the benefits it provides early.
- Fast track consenting to shorten the design and construction programme.
- Procurement and decision-making models that allow a balance between cost certainty and pace of delivery.

NEW ZEALAND / WEATHER

Cyclone Gabrielle closes in on Aotearoa: Warnings and forecasts

9:33 pm on 11 February 2023

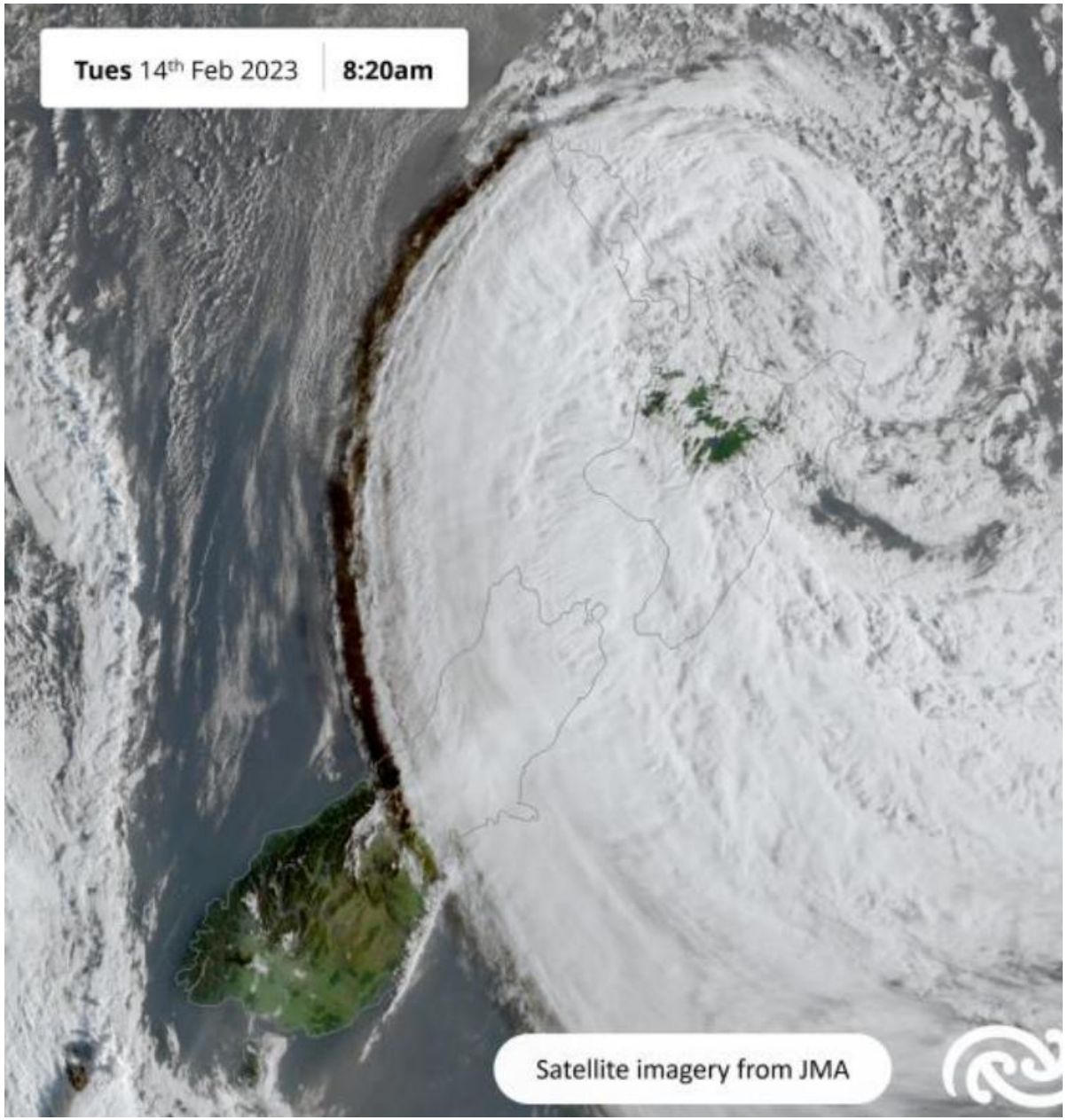
Share this



Cyclone Gabrielle worst storm to hit New Zealand this century, says PM

National state of emergency invoked and thousands displaced as storm devastates large parts of North Island and minister says 'this is climate change'

- Minister gives furious speech about 'lost decades spent bickering' over climate crisis
- Cyclone Gabrielle batters New Zealand – in pictures
- Tell us: have you been affected by Cyclone Gabrielle?



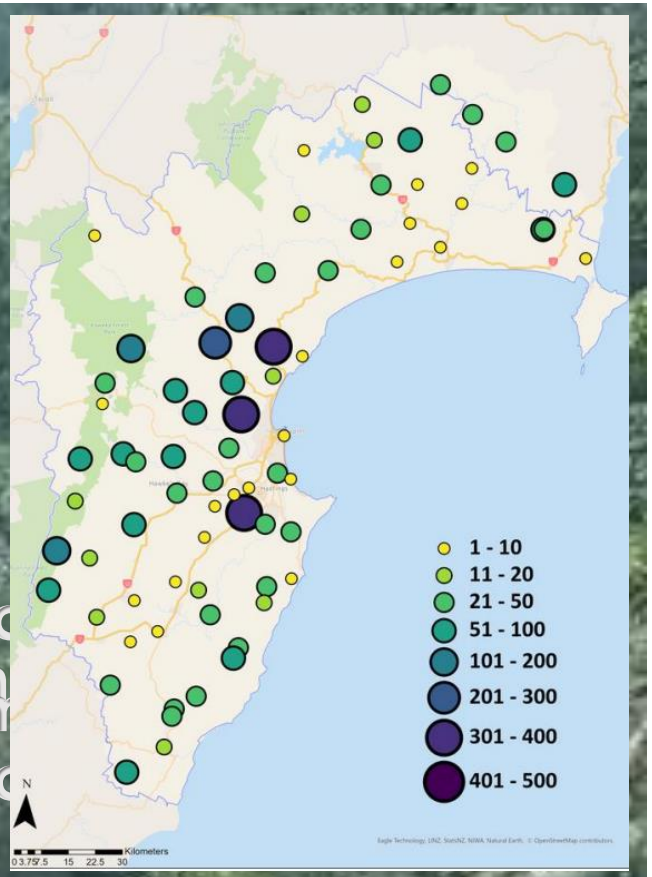
Level 5 National State of Emergency dec

Stop banks breached in 22 location

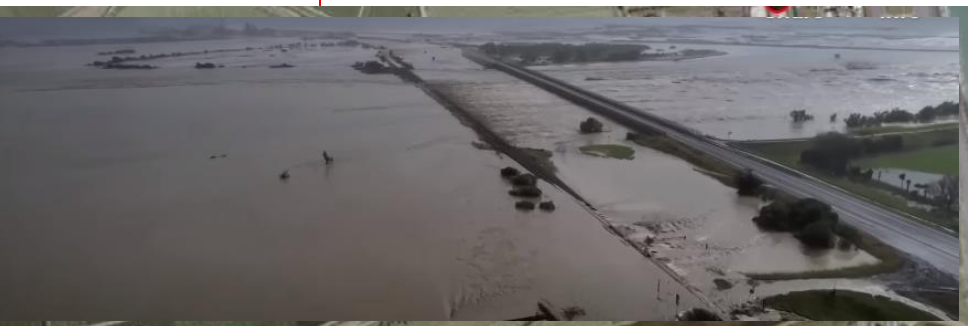
Heavy rainfall caused in extreme flows in n

resulting in damage and collapse of numero

Rainfall well beyond forecast and previous recordings



SH2 Devil's Elbow area



Pre-Cyclone

Post-Cyclone

Monday 13th and days before → Tuesday 14th → Wednesday 15th → Thursday 16th → Friday 17th

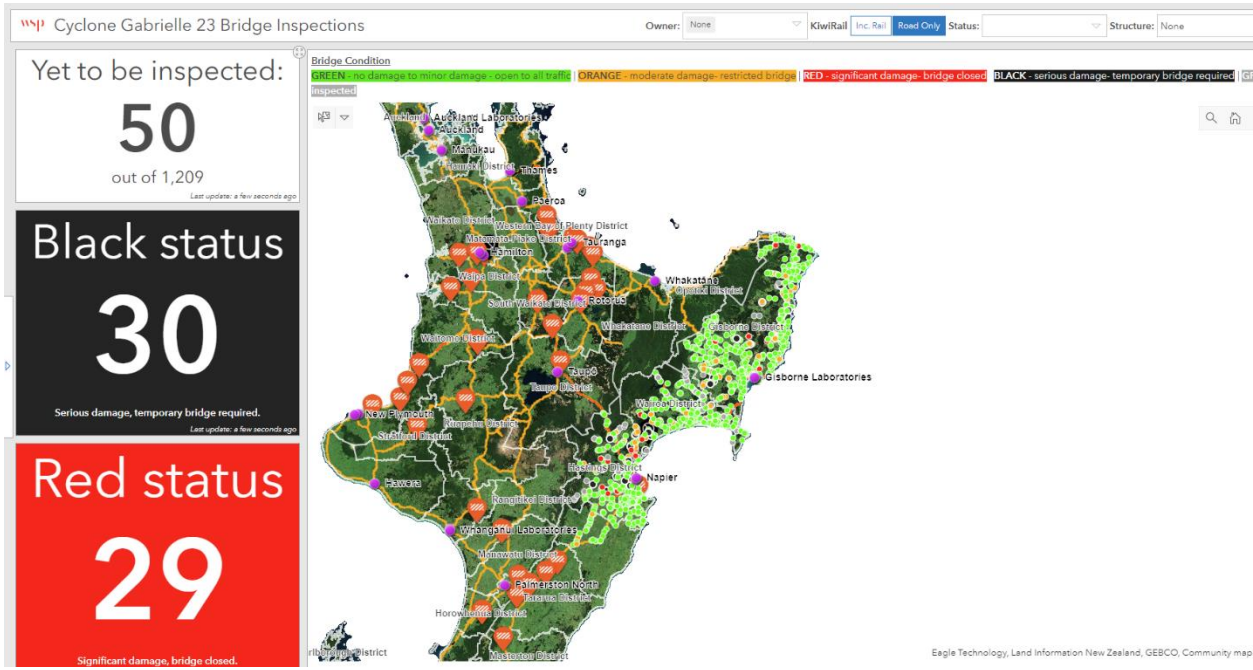
- Met service warnings
- BAM meeting (Monday am).
- Management meeting (Monday am)
- Keep team informed (Monday arvo)
- HDC reached out for inspection support

Monday 13th and days before → **Tuesday 14th** → Wednesday 15th → Thursday 16th → Friday 17th

- Very limited information
- Inspections started
- Power loss
- National State of Emergency declared 8:43am
- Sketchy comms
- Alternative working space needed
- Logistic plans started to be developed

Monday 13th and days before → Tuesday 14th → **Wednesday 15th** → Thursday 16th → Friday 17th

- Started work at HBRC Council Chambers
- Clear roles established early on
- SharePoint for data collection
- Set up GIS platform for inspection work
- Comms plan with WK /HDC
- Inspections continued, designs and assessment started, bailey bridge discussions commenced



Monday 13th and days before → Tuesday 14th → Wednesday 15th → **Thursday 16th** → Friday 17th

- Started daily meetings with WK
- National support for design work continued
- MSQA started onsite
- Napier to Hasting connected by end of Thursday
- Inspections continued for WK and started for HDC

Monday 13th and days before → Tuesday 14th → Wednesday 15th → Thursday 16th → Friday 17th

- Napier office operational
- First Helicopter inspection
- Designs continued for red bridges
- Inspection plan for Gisborne developed
- First weekly summary email to WK
- First meeting with WDC to plan work/inspections. Still no info from GDC.

Learnings

- Inspections (process & QA)
- Data Collection (presentation)
- Response/Recovery (communications)
- Bailey Bridges
- Communications (consistently disseminating info through single source of truth)
- Balance Risk/Benefits/Costs

Stuff ≡ national

$200,000 temporary Gisborne causeway washed away, 25 days after it opens

water level allowed, including installing containers as large culverts to increase the waterway area and putting rock bags on the leading face to slow the scour.

In Summary

Before events:

- ***Emergency Preparedness Plans.***
- *Remote monitoring of key risks and regular inspection programmes of high risk sites.*
- *Routine maintenance (like drainage).*

During events (emergency response):

- *Access to sites.*
- *Readiness of responders.*
- *Safety considerations of staff and road users.*
- *Maintaining critical lifeline routes.*
- *Closing ahead of events and how to communicate this with the public effectively.*
- *Roles, responsibilities and communications*

After events:

- *Prioritisation of repairs – focus on lifeline routes.*
- *Comms resilience*
- *Temporary vs permanent repairs. Cost, benefits, risks*

Kaikoura Earthquake Resilience Story

Seismic shifts in geohazard management (arcgis.com)

Acknowledgement to: ***John Kreft (WSP)***