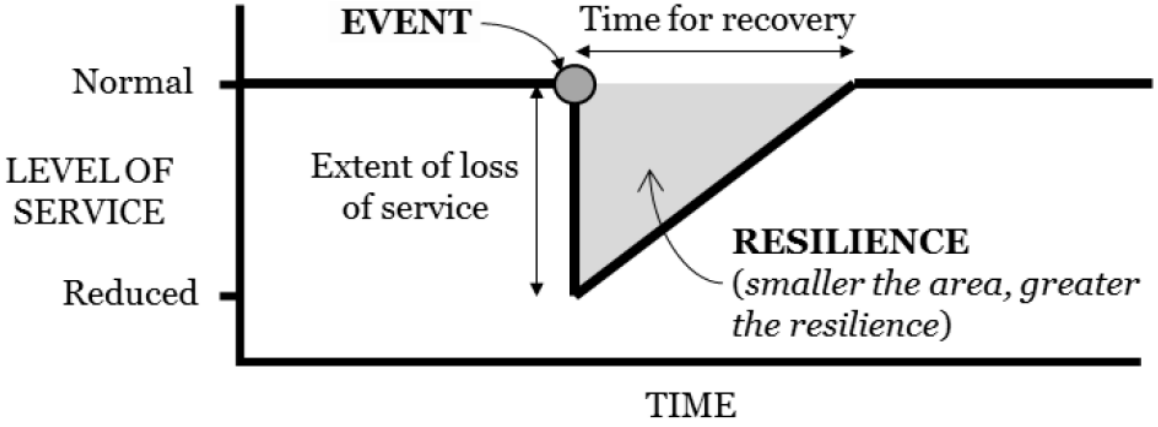
Main North Line Resilence – Kaikoura Earthquake

15 November 2018

What is Resilience?

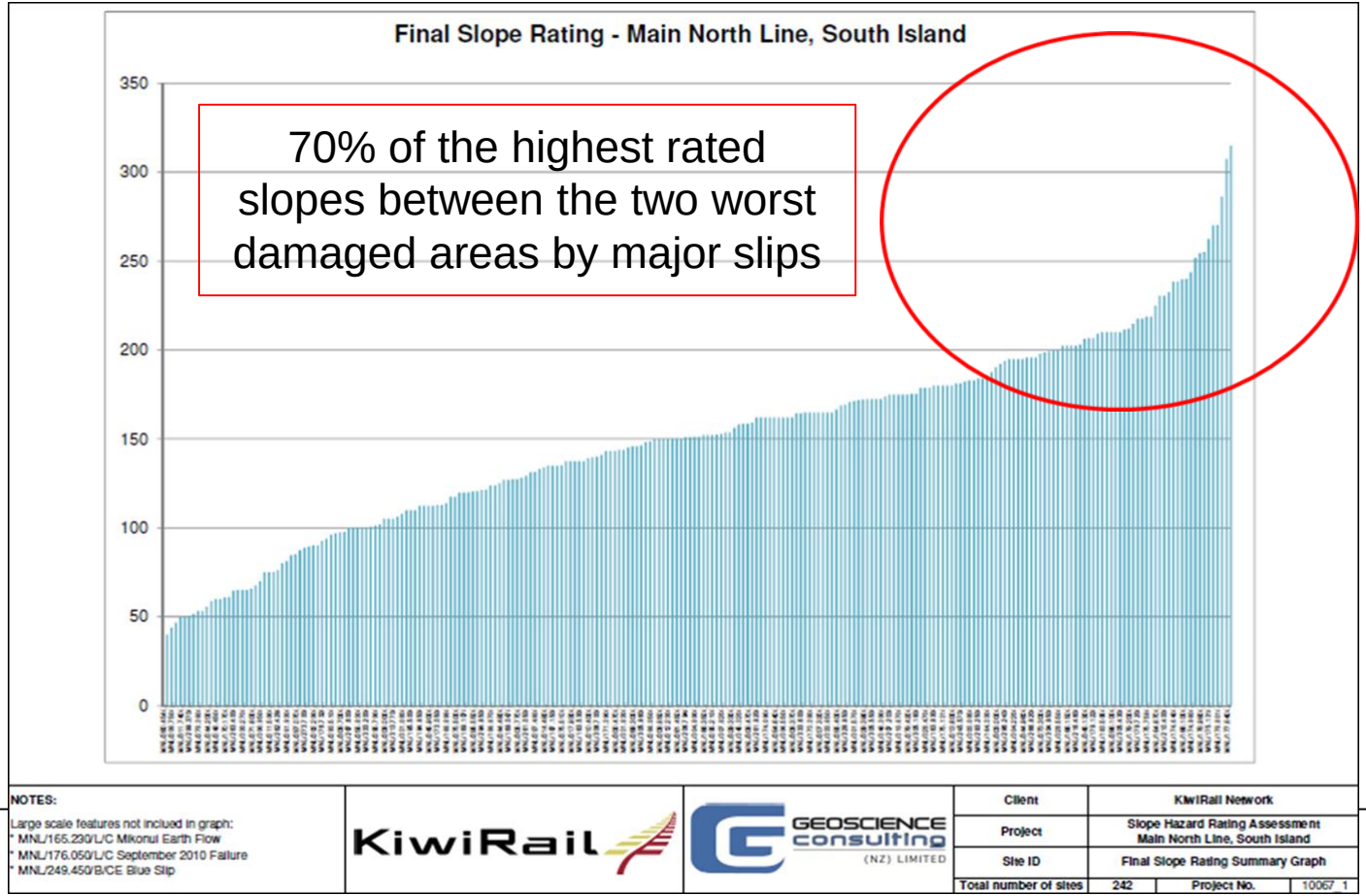
- Using the NCTIR Resilience Study



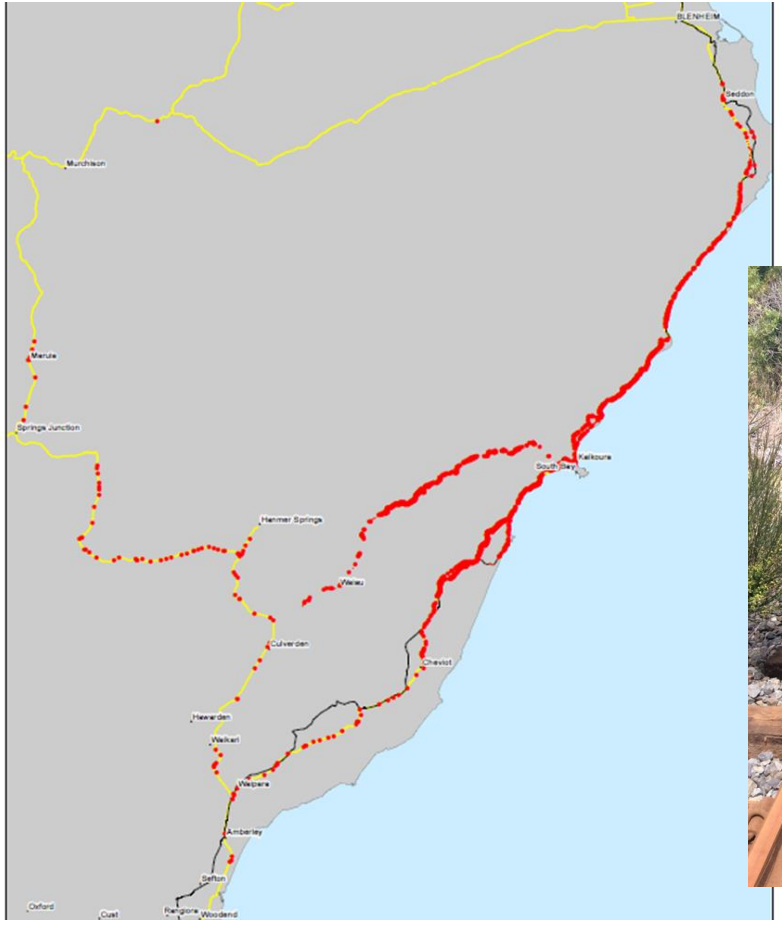
Resilience = Robustness + Redundancy + Response

State of Asset Knowledge pre EQ?

Key Asset Knowledge pre EQ



Damage – where it happened



Safety Considerations

- KiwiRail set client safety requirements for train running.
- Assets such as bridges are more binary – they either meet “code” or not.
- Assets such as slopes require a greater degree of engineering judgement and utilise comparative scoring systems.
- KiwiRail made use of So Far as is Reasonably Practical for its Assurance Process for defining “safety” in opening of the MNL.
- A key feature of this is operational rail controls used in addition to engineering ones – rainfall forecasting, remote monitoring, speed restrictions.

Reliability Considerations

- A weakened state around assets, particularly slopes, will exist for some years.
- Compared to pre earthquake, outages from storm events are going to higher.
- Likewise heightened seismic activity will likely cause additional outages.

But…is it Resilient?

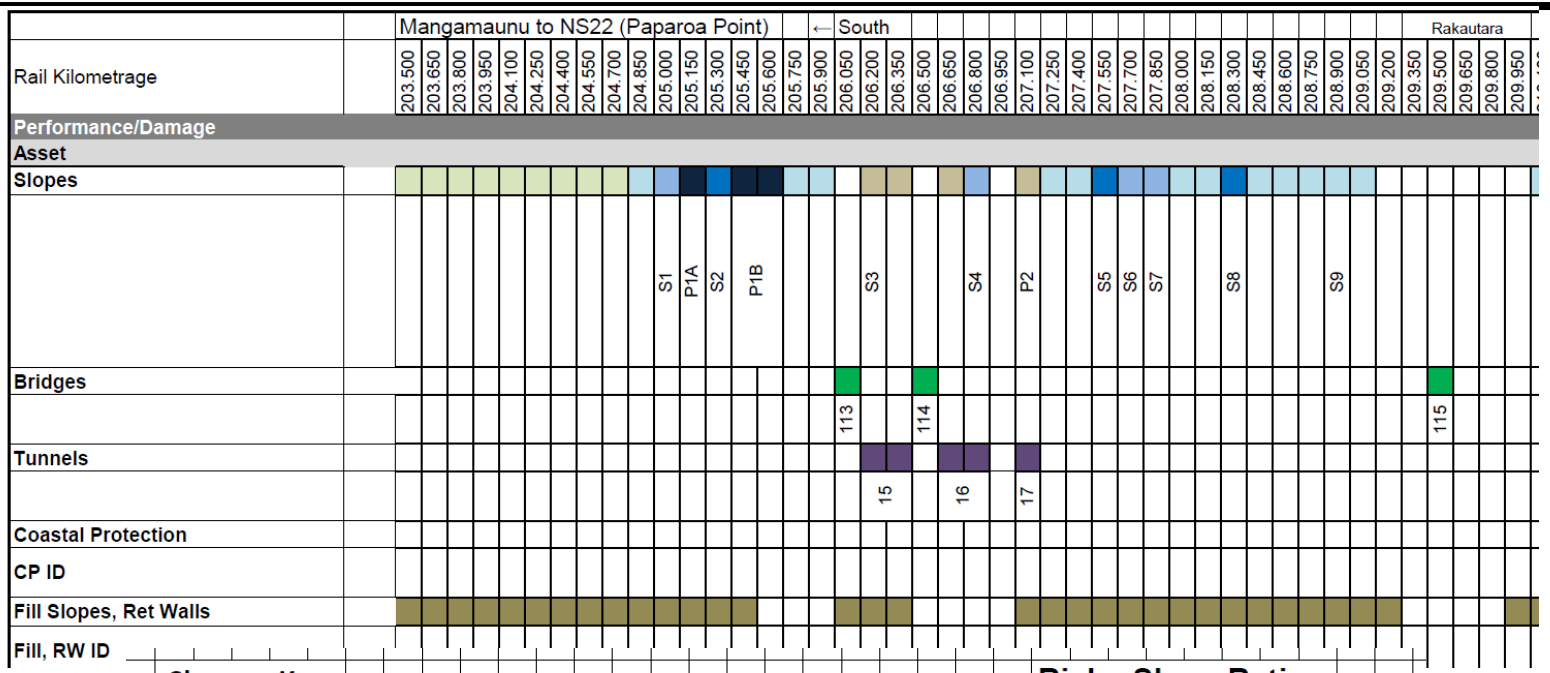
NCTIR undertook a study in mid July 2017 to answer this.
There were three time horizons considered:

- August target for re-opening for commissioning trains
- December 2017 target for SH1 re-opening
- End of NCTIR and Reinstatement Works

In broad terms:

- Resilience improves as time moves on and permanent repairs are completed
- Risk management controls increasingly moved to engineering controls rather than the high levels of operational controls that were used initially
- There will be outages when bad weather is forecast and some clean up work may be required after an event - but the length of outage is important!

Mapping the Corridor



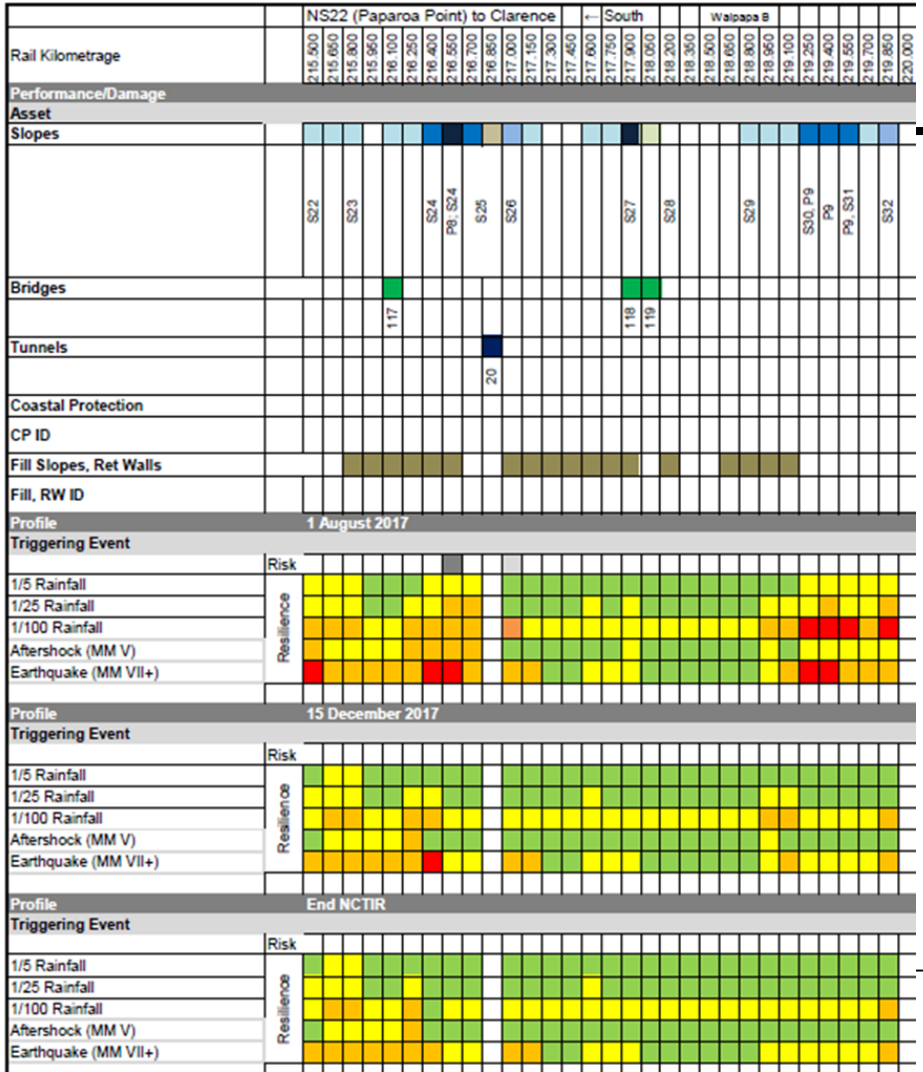
Slopes - Key

1. Closed Transport Corridor
2. Affected TC (e.g. partial closure or post-earthquake closure)
3. Did not affect TC, but likely to in future
4. Did not affect TC, future hazard poorly understood
5. Did not affect TC & unlikely to in future
6. TC in tunnel, no affect

Risk - Slope Rating

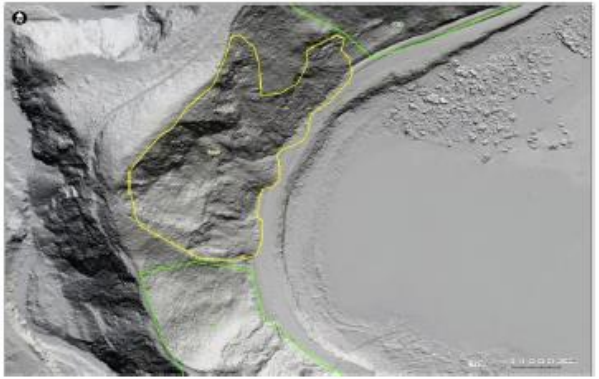
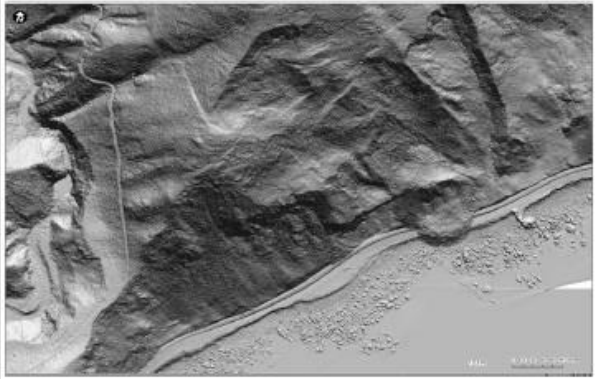
- less than 200
- between 200 and 250
- greater than 250

Heat Maps



Outage duration
- Open
- <1 day
- 1-5 days
- 5-14 days
- 14-50 days
- 50-120 days
- >120 days

Slopes are Key Assets

Location / Identifier	Expected performance						Aerial	Hillshade
	1/2 HI ST	1/5 ST	1/25 ST	1/100 ST	MMV EQ	MMVII EQ		
Road RS 118 14.840 15.120 280	No closure	No closure	Single lane for <1 day due to slips	Single lane for 5 days due to slips	No closure	Closed for 2-3 weeks due to landslides		
Rail 211.120 210.820 300	No closure	No closure	Closed for <12 hours	Closed for 5 days from slips	No closure	Closed for >5 days due to landslides		
Road RS 118 14.340 14.840 500	Single lane or slow for <1 day due to debris flow	Single lane for <1 day due to debris flow	Closed for 1-2 days due to debris flow/slips	Closed for 3-5 days due to debris flow/slips	No closure	Closed for ~2 months due to landslides		
Rail 211.620 211.120 500	Short outage due to low volume debris flow	Closed for <12 hours due to debris flow/slip	Closed for ~1 day due to debris flow/slip	Closed for 3-5 days by debris flow/slip	No closure	Closed for >5 days due to landslides		

Response Planning is Critical

Conclusions

- Knowing your assets
- Knowing your network
- Limits to how “robust” you can be
- Planning for response

KiwiRail

Stronger Connections. Better New Zealand.


Questions
KiwiRail