

What in the world...?

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An occasional look at some significant rail infrastructure developments overseas with the intention of 'inspiring and exciting' both today's and tomorrow's railway infrastructure engineers.



Image 1

New Zealand

The Kaikoura Job; Rebuilding Kiwirail's Main North Line

The 2016 Kaikoura earthquake was a magnitude 7.5 (Mw) earthquake in the South Island of New Zealand that occurred two minutes after midnight on 14 November 2016. Ruptures occurred on multiple faults and the earthquake has been described as the "most complex earthquake ever studied".

Your author happened to be on holiday in the Marlborough Region of New Zealand not long after the events and was able to witness the devastation at first hand through the good offices of local residents, first responders and KiwiRail staff.

The earthquake started 15 kilometres north-east of Culverden and 60 kilometres south-west of the tourist town of Kaikoura and at a depth of approximately 15 kilometres.

The complex sequence of ruptures lasted for about two minutes, raising the sea bed several metres over a distance of 110 kilometres, destroying port facilities, State Highway 1, the Main North Railway Line, water, electricity, utility supplies and services, property, life and much, much more. Significant landslides blocked State Highway 1 and the North Main Railway Line in fifty places. More than 150 kilometres of the line was damaged in the November earthquake, which twisted railway tracks, sent slips over the route and caused structural damage to bridges and tunnels.

November 2016's quake devastated the coast-hugging railway which, before the earthquake, had carried more than one million tonnes of freight a year. It triggered one of the biggest railway rebuilds since World War Two. Workers had to clear more than 100 slips and landslides, and repair more than 750 individual sites. Twenty tunnels and 60 bridges were damaged. **See image 3.**

The permanent way was heaved and pushed in directions hitherto not seen around the world. The forces of mother nature drove stressed CWR off the track bed, across the state highway and over the beach into the sea.

High quality track was twisted and contorted into amazing geometrical shapes, whilst in other locations instant severe track gradients appeared that rendered normal train operations impossible.

The Press release that no rail company wishes to issue quickly followed the event from the Chief Executive:

14 November 2016 06:06am

To our valued customers,

As you will be aware the 7.5 magnitude earthquake in the South Island this morning has caused damage to many parts of New Zealand. Our rail and ferry services are currently suspended from Palmerston North to Christchurch while assessments are being made. We believe there could be extensive damage to the rail network south of Picton, though we will have a clearer picture of that as the morning progresses.

The Port Authorities are currently working with our staff on facilities at Wellington and Picton ferry terminals. Damage was suffered to the link span at Wellington but we are at this stage still assessing the extent of that.

A full assessment is unlikely to be undertaken until daylight hours. The Rail Ferry Kaiarahi is currently standing off Picton and the Rail Ferries Kaitaki and Aratere are at anchor in



Image 2

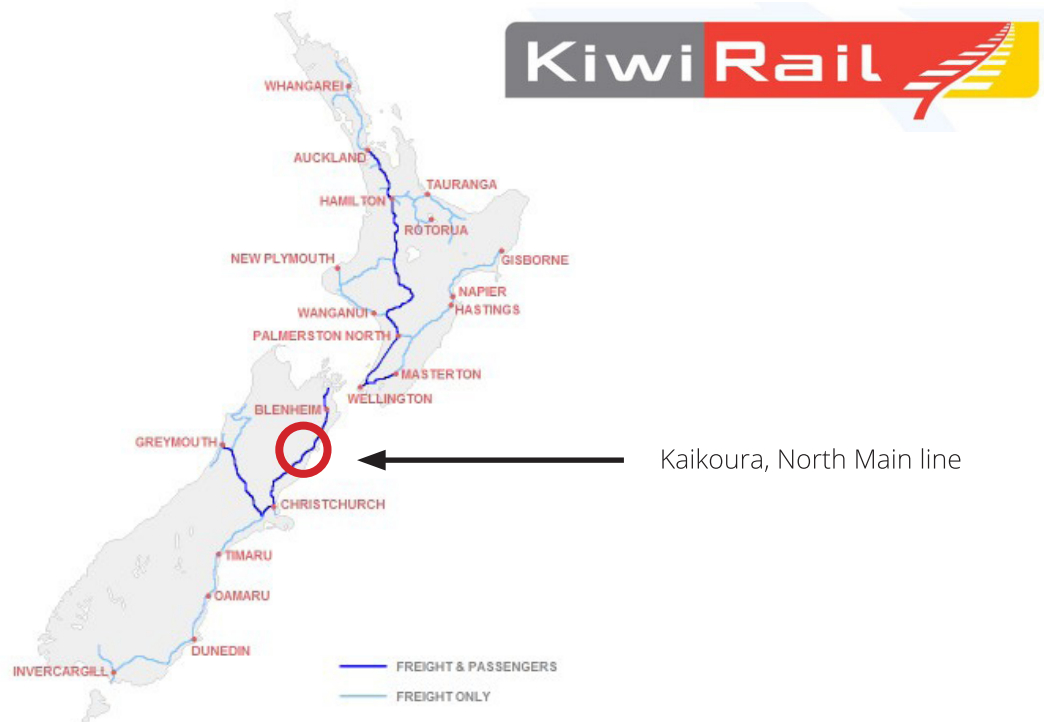


Image 3 Image courtesy LDZ (Latvijas Dzelcels)



Image 4: One of the numerous, devastating landslips that buried State Highway 1 and the North Main line between Kaikoura and Blenheim. Photo courtesy of Tim Burt



Image 5: A twisted and contorted permanent way north of Kaikoura. Photo courtesy of KiwiRail

Wellington Harbour. Please be assured that our staff are working to ensure our services are back up and running for our customers as quickly as possible. Like many of you, we are also working to ensure our staff and their families are safe and to assist them where we can.

See image 4.

After the initial emergency responses and site assessments, the subsequent press release read:

15 December 2016 10:10am

"KiwiRail will work to restore freight services for customers on the Main North Line from Picton to Christchurch as soon as possible with work beginning immediately. Today's announcement that the Government has committed to restoring road and rail services is a welcome certainty for South Island communities and New Zealand's freight movers. Our job now is to try to make that happen as quickly as possible, to keep New Zealand moving and help grow the economy. KiwiRail will look for temporary fixes in some parts of the line to allow for restricted, freight-only rail services in the first instance while the permanent road and rail lines are completed."

"KiwiRail will use the latest technology in slip identification and movement to allow our train drivers to safely navigate areas while permanent repairs are made. KiwiRail's teams of engineers have been analysing the damaged parts of the Main North Line since the Kaikoura earthquake hit last month and have detailed plans of where work will begin. The complexity of the job ahead means no date can be set yet for reopening the line, but work will begin at pace working in conjunction with NZTA (New Zealand Transport Agency)

Then the common sense, good news press release arrived:

21 December 2016 15:03pm

"The Government has announced an alliance between KiwiRail and NZTA that will work to reinstate the coastal rail and road route north of Kaikoura." Here is Minister of Transport Simon Bridges' press release: "An Order in Council will accelerate the reinstatement of State Highway 1 north of Kaikōura," says Transport Minister Simon Bridges. "The Governor-General signed the Order into force yesterday, ensuring work to restore the coastal road and rail route can progress in a timely fashion. The agencies responsible for the rebuild, as outlined in the Order, are the NZ

Transport Agency (NZTA) and KiwiRail. The Order will modify provisions of the Resource Management Act and nine other pieces of legislation, to streamline the recovery work."

For KiwiRail, aside from removing the significant landslides, recovering stranded locomotives and wagons, repairing the sea defences and bridge structures etc along the route, more than 12km of track needed complete rebuilding and 5km of track realigned following the earthquake. Rail engineering teams' equipment, contractors and consultants would be brought in from all over New Zealand and from further afield to take on the mammoth task in some of the most inaccessible parts of the south coast.

See images 5, 6 and 7.

The works would commence with a myriad of surveys covering landslips, bridges, tunnels, retaining walls and other structures, permanent way, signalling equipment, earthworks and formations, drainage systems to name but a few. These activities would be delayed because of dangerous aftershocks, and the uncertainty of prevailing conditions. Access was limited at the time, naval vessels being used to rescue trapped communities, along with air force helicopters and specialist imaging



Image 6: Permanent Way damage south of Blenheim. Photo by Phil Kirkland



Image 7: Permanent Way damage south of Blenheim. Photo by Phil Kirkland

and reconnaissance helicopters and aircraft. A long freight train had also become trapped between landslides, fortuitously not being buried or colliding with any debris. However, the train could not be moved in either a forward or propelling direction because of debris. This in itself presented challenges as all of the perishable goods had to be recovered from the train, the majority being donated to locals, and locomotives had to be drained of fuel, and protected from the sea etc.

See image 8.

As many staff as possible were committed to the job, so difficult because much of the line couldn't be reached by road, with even the loco drivers being co-opted because of their intimate knowledge of the line and their familiarity with radio communications.

Hundreds of bridges, culverts and embankments had been destroyed, and in places the line had disappeared completely under vast tonnages of rock and soil where the quake had heaved entire hillsides across the line. Water courses had become blocked and either formed large high risk lakes or had taken completely new routes across rail and road.

The stranded train was near a damaged bridge which had to be strengthened to allow the train across and into a tunnel where the locomotives sat for weeks until they could be rescued.

About 30 two-person teams of assessors were assigned to working out of Kaikoura on damage assessment. Communicating with them was initially a major problem because KiwiRail's own radio equipment, sited on

hilltops and at tunnel entrances, had been destroyed, so a pool of satellite phones was required.

All the assessor teams were tracked and marked on a 20 metre long map set up in the KiwiRail Christchurch office, and by holding a conference call with all the teams of assessors each morning, managers could find out where they were going to be, and again in the evening to find out where they'd got to and what damage they'd recorded. Assessing some of the tunnels was challenging as significant safety measures had to be put in place prior to staff being able to enter given both the damage and potential for aftershocks.

Towards the end of the year KiwiRail and NZTA were working together to address the mutual challenge, and NCTIR (North Canterbury Transport Infrastructure Recovery Alliance) was set up in January, initially headed by Duncan Gibb of NZ contractor Fulton Hogan who had been the first project director for the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) alliance in the wake of the earlier quakes there. KiwiRail's damage assessment had largely been completed by Christmas 2016, and remedial work, which had till then been restricted to local contractors and KiwiRail staff working on access to road and rail damage spots, began in earnest.

With the establishment of NCTIR, the workforce for both road and rail was rapidly escalated up to around 1500, and the four main contractors (HEB Construction, Downers, Higgins/Fletcher and Fulton Hogan) began working jointly on both road and rail. KiwiRail concentrated first on clearing the line from

Blenheim to Lake Grassmere, then began working on the heavily damaged section between Spotswood south of Kaikoura to Grassmere. The track to the south was cleared first, allowing work trains loaded with ballast and aggregates to get through to work-sites.

Many bridges could be temporarily repaired with steel parts from KiwiRail's stores, but others, like the arch-bridge 131 north of Kaikoura and the Boundary Stream Bridge 90 to the south, were completely destroyed. As work progressed, helped by the establishment of a railway village at Kaikoura accommodating 300 workers, the projected recovery time for resuming rail services on a restricted basis, was shortened by four months.

On 15 March 2017, additional KiwiRail on track plant was transported across Cook Strait on the rail ferry Aratere comprising Tamper, Ballast Regulator and DTS at a combined weight of 230 tonnes. The equipment, along with its crew of six, is normally based in Palmerston North, in the North Island, and was moved south as part of the plan to re-open the earthquake-damaged line as quickly as possible. Bringing the equipment down from the North Island enabled work on the line from both ends at once to get the line up and running as quickly as possible. The on-track machines followed the daytime maintenance trains, which were replacing ballast that was lost during the earthquake. There were already two sets of on track machines based in the South Island but they were both south of where the line was cut. Eventually they were also brought up to the Kaikoura site. **See image 9.**



Image 8: Locomotives being recovered from the earthquake site once a route had been constructed alongside State Highway 1 at Kaikoura. Photo courtesy of KiwiRail



Image 9: KiwiRail Harsco MkVI tamping machine and ballast Regulator. Photo by Phil Kirkland



Image 10: The final Thermit rail weld at Kaikoura . Photo courtesy of KiwiRail

A milestone on the rail line's repair was reached on August 8 2017 when a thermit welding ceremony at Half Moon Bay on the Kaikoura coast marked the joining of the north and south sections, with work trains able to get through from both ends to help with the reconstruction. **See image 10.**

Test trains started running back and forth, north and south, later that month, de-rusting the rails, ensuring that signalling track circuit equipment was working again, and refining timetables.

On 15th September 2017, the first freight train rolled into Kaikoura station. This marked the official reopening of the Main North Line - ten months after the Kaikoura earthquake. A ceremony was organised to celebrate the occasion and the train was driven by KiwiRail Driver Paul Foskett, who was at the controls the night the Kaikoura earthquake struck. Trains were now running on a restricted basis; not during wet weather and only at night so as not to interfere with ongoing reconstruction work during the day. The unusually wet weather in late September and early October 2017 (rainfall in Kaikoura in the first 10 days of October was almost twice the long term average for the entire month), caused further slips affecting road and rail and impacted on rail services.

KiwiRail suffered further significant infrastructure problems in the South Island during the summer of 2017. Major forest fires ravaged the TranzApline line between Christchurch and Greymouth resulting in a six week closure of that route. Again, a heavy demand on already stretched railway engineering resources. **See image 11.**

May I pay tribute to all involved in this emergency project who showed outstanding Permanent Way engineering skills, professionalism and dedication, something we should all aspire to. May I also thank my great friends at KiwiRail for access and arrangements whilst simply 'passing through', something else we should reciprocate if ever approached by any fellow professionals from overseas.

I do sincerely hope you have found another story of interest, especially those of you who are 'on call', or about to take up such responsibility on the railway.

Just remember, when that 'phone rings..... you never know quite what to expect!

Have a look at You Tube www.youtube.com/watch?v=hqjob7hjpf&t=114s

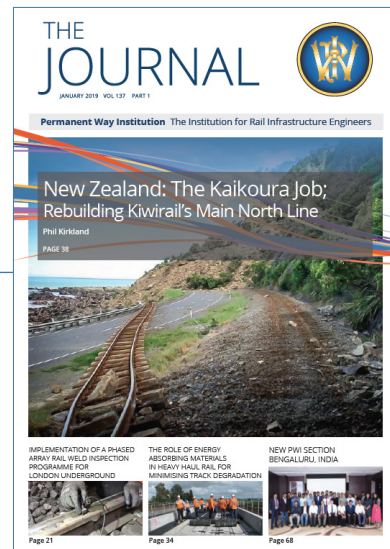


Image 11: KiwiRail freight train on the rebuilt North Main line. Photo courtesy of KiwiRail

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