Floods and Railways in Nineteenth-century New Zealand

GEORGE SISSON COOPER attained the highest position in New Zealand's public service, under-secretary for the colony, in 1870. He soon received a melancholy task: enumerating the deaths by drowning that had occurred since organized Pākehā colonization commenced in 1840. Settlers from Britain were unaccustomed to fast-flowing, mountain-fed watercourses that rose rapidly and without warning. New Zealand's rivers, especially the wide braided rivers of the South Island, posed such a threat to Pākehā that drowning became nicknamed the 'New Zealand death'.[1] Premier Edward Stafford, in his third and final term, requested that a return of these fatalities be laid before Parliament. Cooper researched widely, examining newspaper accounts and inquest reports, and requesting information from the eight provincial governments then in existence. Three provinces did not respond, and records of drownings where the body was never found were incomplete, so Cooper emphasized that his estimate was a bare minimum. He found that at least 1115 people had drowned in the preceding three decades.[2] Returns of drownings continued to be tabled in Parliament annually until the 1880s.

The same year that Cooper prepared his estimate, Julius Vogel as colonial treasurer unveiled the government's transformative Great Public Works Policy. In 1870 there were only 74 kilometres of operational railways, constructed by provincial governments that would be abolished in 1876. The Works Policy effected a rapid expansion overseen by the central government: there were 2073 kilometres of railway in 1880 and, despite an economic depression, 3386 kilometres in 1900.[3] Eric Pawson, applying a concept first articulated by Donald Janelle, has defined the extent of this time-space convergence. Prior to 1870, steamships and overland journeys on foot or horseback were the only forms of interprovincial travel, with the quickest passage from Dunedin to Auckland taking 15 days; after the completion of the North Island Main Trunk Railway, travellers required no more than 47 hours.[4] One contribution to this time-space convergence was that railways bridged many rivers; train travel gave the opportunity to avoid dangerous watercourses for the first time.

But rail transport was by no means a perfect solution to the dangers of New Zealand's rivers; the network experienced and created problems of its own. Economic accounts have highlighted the high cost of politically motivated policies of development. Russell Stone condemns railway construction in the 1870s as representing the 'pork-barrel era': members

of Parliament obtained funds to build unprofitable rural railways in their electorates at the expense of the national trunk network.[5] Jack Dowie adds that colonial politicians routinely underestimated the cost of construction, often to embarrassing extremes.[6] Unscrupulous land speculators promoted private railway schemes that failed so badly — and exploited Māori owners and prospective Pākehā settlers so wantonly — that the government had to acquire their undertakings.[7] And provincialist politicians wrecked plans to establish land funds or forest reserves as security for loans.[8]

Some criticisms of New Zealand's rapid railway expansion go too far. Tom Brooking is right that mid- and long-term economic expansion facilitated by the railway network outweighed short-term difficulties; he specifically notes the usefulness of bridging rivers.[9] Nonetheless, many poor decisions exacerbated the national debt while limiting the return on investment. To these avoidable costs I add another: the high price of underestimating New Zealand's rivers. Muriel Lloyd Prichard in 1970 hinted at the cost of rebuilding bridges and tunnels, but there has been no subsequent elaboration on how the natural environment thrust expenditure upon the railways.[10]

This article examines the relationship between railways and flooding in the first four decades of New Zealand's railway system, from the inaugural line in 1863 until 1900. How did railways affect the flow of water, and how did the flow of water affect railways? This is not a narrow transport question, but one important to understanding how public works altered New Zealand's natural environment, and how waterways affected land-based mobility and trade. Three main themes emerge from railway records: the evolution of how officials and engineers responded, especially across different environments; the changing effects of floods in environments re-made by railways; and the costs of floods. I illuminate these themes through a roughly chronological sample of flooding events. The first two sections of this article take in railways built before 1878 to identify how railways and rivers interacted in the network's first 15 years, the extent to which engineers considered waterflows and the development of preventative works. The third section deals with the great South Island storm of 1879 to see how a maturing network responded to an extreme weather event. Most of the events in these three sections occurred in the South Island, and there are few reliable figures as to their economic effects. The fourth section, therefore, uses subsequent floods in the North Island to show how railway operations were maintained — or not — during floods and the consequences for revenue. The fifth and final section takes in the extension of railways into mountainous regions, a development that confirmed an increasing awareness of floods and their costs as routine rather than avoidable. The conclusion suggests a rough pattern of responses.

Transport historians have rarely articulated the environmental changes that railways instigated. In broad histories of railways, rivers appear as obstructions to be bridged or as instigators of tragedy.[11] David Leitch romanticizes — or at least sexualizes — railway vistas of rivers, especially the 'scenic orgy' of the central North Island with its 'massive viaducts over mountain streams'.[12] Histories of specific lines or regions also focus on obstruction and hazard — often floods, although in the case of the Remutaka Incline they are overshadowed by the famous accident of 1880 when a gale swept a train from the track.[13] James Watson, whose history of New Zealand transport emphasizes the regularity and risk of fording rivers, suggests railways were protected from floods by their embankments, experiencing effects only in 'extreme cases'.[14] But, as will be shown, the flooding of railways was frequent and commonplace.

New Zealand possesses a strong corpus of environmental history, and the natural obstructions and hazards met by travellers suggest that railways would figure prominently within it. The effects of railways upon water and vice versa, however, have received little attention. The multi-authored *Making a New Land* discusses how railways interacted with nature but does not include floods in that discussion.[15] Catherine Knight's environmental history of the Manawatū unites railways and waterways only for a destructive flood in 1941 and a wetland created by the diversion of a river for a railway embankment. Her subsequent account of New Zealand's rivers surprisingly does not build on this, even though readers might anticipate discussion of railway modifications to floodplains such as embankments confining routine floods and redirecting the course of major rivers.[16] Rollo Arnold used a different environmental disaster, bushfire, to interrogate the Pākehā world of the 1880s, but his account is dismissive of railways, suggesting inaccurately that their effects are well recorded, so it contains little about how they caused or reacted to fire.[17] Environmental history is not the only possible lens by which to investigate this topic, but its assertion of natural agency can elucidate much, especially when paired with an economic sensibility. It shows interactions went both ways: not only did railways encounter and modify rivers, but rivers encountered and modified railways. Economic history is a useful adjunct to environmental analysis, enabling these encounters to be costed.

Early Encounters of Railways and Rivers

Railways were built in four provinces in the 1860s: public railways in Auckland (completed under central authority), Canterbury and Southland, and a private line in Nelson. The central government established the Public Works Department (PWD) in 1870 to oversee Vogel's Works Policy, and

all public railways were brought into the PWD before or in 1876, when the provinces were abolished. After 1880 a free-standing Railways Department — also known as the New Zealand Government Railways — was carved from the PWD. The PWD remained responsible for construction, passing completed lines to the Railways Department to operate and maintain.

The first significant watercourse bridged by a railway in New Zealand was the Heathcote River at Opawa in Canterbury, today in suburban Christchurch (see Map 1 and Map 2 for locations described in this article). It represented the only notable physical obstacle to the colony's first public railway, which opened from Christchurch to Ferrymead in December 1863. The bridge received the exaggerated nickname of the 'Opawa viaduct' and became part of the main line to Lyttelton when a tunnel through the Port Hills opened in December 1867. Although designed as a brick skew arch, the foundations erected in 1862 were not extended above the springing for the arch and the structure was completed with timber. By 1865 the river had scoured the foundations and limited the weight of trains that could cross.[18]

Southland became the second province to open a railway bridge, in November 1864. The failure of experimental wooden rails thoroughly eclipsed problems with the crossing of the Waihopai River between Invercargill and Makarewa.[19] Southland's other railway, a conventional iron-railed line from Invercargill to Bluff, opened in February 1867. It followed the banks of the New River Estuary and Bluff Harbour for most of its length, and the use of poor-quality fill for the waterside embankments threatened to undermine the railway entirely. Large sums were spent stabilizing the railway, which contributed to the province's financial collapse.[20]

So far, the interaction of railways and water had mainly been in the direction of rivers undermining this new incursion to their plains. But Canterbury's next significant bridge demonstrated that railway infrastructure could alter and concentrate waterflows with serious consequences. In October 1867 a bridge across the Selwyn River opened to carry the Main South Line from Christchurch.[21] It fared even worse than its counterpart across the Heathcote, for the embankment approaching the bridge extended too far onto the floodplain, leaving an overly narrow gap for peak floods.[22] In February 1868, heavy rain caused all the rivers near Christchurch to rise to an extent unprecedented in the 18 years since the city's foundation. The Selwyn swept away the entire bridge and damaged the embankment severely.[23] The problems with Canterbury's early railway bridges and the imbroglio in Southland ought to have provided instructive examples to New Zealand's engineers about leaving wide gaps for floods and ensuring the stability of bridges and embankments. The lessons, however, took longer to learn.

This does not condemn the early engineers as inept; rather, they were trying to introduce a new technology to a country of which no Pākehā had long-term experience. The first generation of settlers arrived during a comparatively mild period; their first rail-building endeavours coincided with wetter events they could not have foretold.[24] Unsurprisingly, given the backgrounds and training of railway engineers, none of the early railway reports or files indicate engagement with Māori knowledge — engineers followed developments in Britain and North America. Many simply underestimated the force of New Zealand's rivers, or did not grasp the potential extent of flooding. A case in point is the construction of a main line in the North Island from Napier to Palmerston North. Much difficulty attended the selection of a route to link the Heretaunga Plain with Napier, which was effectively on an island before the 1931 earthquake raised the surrounding land. Between Napier and the Heretaunga Plain sat the shallow Inner Harbour, swamps, lagoons, and three rivers — the Clive, the Ngaruroro and the Tutaekuri — that met the sea in the complex Waitangi Estuary. Moreover, the Ngaruroro had followed the bed of the Clive until as recently as 1867, when it diverted into a new channel after a major flood. A regional engineer's preliminary report in October 1870 acknowledged the swampy soil and floods, noting that flooding events were likely to increase, that gaps for stormwater were essential, and that the Tutaekuri 'carried heavy timber' in floods while the Ngaruroro's surges were of 'considerable power'.[25] Bridges, therefore, had to not only be sturdy, but also provide clearance for debris.

John Carruthers, the government's engineer-in-chief, was conscious of these problems when he discussed three possible routes in May 1872. Raising the railway on embankments and lengthy bridges increased the cost, which ran counter to Vogel's policy for light railways built cheaply and quickly. In the case of one route, Carruthers feared litigation from landowners if embankments prevented water draining into lagoons or the Ngaruroro. But constructing a railway at a lower level, with floods permitted to pass over the line, presented its own risks. He cited the 1867 flood, during which one major road

> was covered with 3 feet of silt, and the present road has been metalled over the silt; and there are still visible, at other parts of the line, the tops of fences which have been buried. The effect on the working expenses of the line may be imagined, if rails, sleepers, and ballast had to be dug up. Floods like this do not often occur; but every year the rails would be under water, the traffic stopped, and the ballast spoilt by the silt and the mud mixed with it.[26]

Carruthers recommended a coastal route along the shingle beach south of Napier, with four bridges near the township of Clive, where the line would turn towards Hastings: one across the Waitangi Estuary, another across the

Ngaruroro, and two over the Ngaruroro's former bed, now the Clive River. This route, he believed, presented little risk of flood.[27] In a comparative sense he was right, and the railway opened in October 1874. But despite his knowledge of local conditions, and that of his fellow engineers and surveyors, he still made insufficient allowances for floods. The railway formation held up significant volumes of water and debris from reaching the ocean, and floodwaters regularly impeded operations in the line's first years. Rockwork had to be installed in January 1876 to stabilize the bridges across the Waitangi and Ngaruroro, and repairs performed on the latter.[28] It was not enough to simply be aware of the flood risk; for many routes across coastal plains, the engineers had to experience a major flood to appreciate the consequences and the protective works required.

Experience in other regions where consequences were rather easier to predict suggests that, even then, not all lines were laid with sufficient forethought. Carruthers lamented in 1875 the need for more work on the Picton–Blenheim railway in Marlborough:

> The whole district through which the railway passes is subject to extensive floods, the full extent of which was not known until the railway embankments confined the flood waters and made them pass through defined openings, instead of spreading over the whole country.[29]

This is misleading. The full extent was apparent to anyone who had experienced an earlier flood — Carruthers ought to have said that the engineers responsible for planning the line had not appreciated the magnitude of the floods or the consequences of confinement. And given the regular storms and floods in the Wairau River's valley during the three decades since Pākehā first settled it, this was inexcusable. Blenheim, located on the Wairau floodplain at the junction of the Ōpaoa (then spelt Opawa) and Taylor rivers, had a reputation for inundation; one condescending visitor remarked that there were 'fearfully exciting times here during a flood … I think the people here welcome a little flood as a relief to the monotony of their existence'.[30] Most notable was the storm of February 1868 when a flood — part of the same weather system that destroyed Canterbury's Selwyn River bridge — almost entirely submerged the town and valley. 'The streets, Venice-like, were transformed into canals', reported the *Marlborough Express*, 'and the only communication was by boat.' The under-construction Presbyterian church was carried from its piles and down the current alongside firewood and furniture; the newspaper could publish only because its premises possessed a second storey.[31]

Even a casual observer could recognize that floodwaters from multiple sources spread across the Wairau valley, yet the railway was built with insufficient regard for this reality. It was first conceived as a light line, 'little

better than a tramway', and floods and storms caused damage worth £13,500 ($1.9 million) before it even opened.[32] Cuttings were built too tight, so that slips fell easily.[33] Locals nicknamed the embankment at the Blenheim terminus the 'Railway Dam' for the manner in which it held up water; it had only two limited openings, so it 'forc[ed] the river upon Blenheim'. By September 1875 — before the railway had opened — this 'dam' had exacerbated the damage of three floods.[34] Superintendent Arthur Seymour had sought a trestle bridge across low-lying land rather than an embankment, but to no avail.[35] Nor was he the only person to make representations for more flood openings. The waters simply would not be constrained: the construction bill in September 1875 was almost £140,000 ($20.3 million), far exceeding the £60,000–£75,000 loans ($7–$8.5 million) that the province's optimists had sought for earlier proposals.[36]

Floods not only increased the cost of the railway or affected the soundness of the permanent way, they also influenced the location of Blenheim's railway station. When opened on 17 November 1875, the railway did not enter the town, stopping on the opposite bank of the Ōpaoa in what is now Grovetown. This was to save money: the lengthy bridge across the Wairau was a major reason to build the line but avoiding another over the Ōpaoa saved at least £10,000–£15,000 ($1.5–$2.2 million). In any town this would have been an inconvenience; in Blenheim it proved especially so, for floodwaters routinely filled the low ground between the river and the railway station. At times, boats conveyed prospective passengers to the station.[37] The *Marlborough Express*, which had proclaimed the railway capable of revolutionizing daily life when it opened, now condemned the line as 'a delusion and a snare' until Blenheim received a station less susceptible to flooding.[38] The arguments of convenience and of mitigating the effects of floods were compelling, but further government apathy meant an extension was not sanctioned promptly. The railway across the Ōpaoa finally opened on 26 May 1880.[39]

The Braided Rivers of Canterbury

The flood-prone Wairau valley posed challenges to railway engineers, but the issues confronting engineers in Canterbury were greater. There, the wide, rocky beds of braided rivers were expensive to bridge, and floods dispersed large quantities of water across the Canterbury Plains. The Waimakariri, for example, caused great consternation. James Edward FitzGerald, Canterbury's first provincial superintendent, wondered in 1863 how to 'educat[e] that tricksy and mischievous river'.[40] River crossings dictated the route of the Main South Line from Christchurch to Dunedin, in particular those across the Ashburton, Rakaia, Rangitata and Waitaki rivers. A direct coastal route

required long, expensive bridges and could be subject to regular damage by shifting river channels. Inland options offered narrower crossings of more stable channels, such as in the Rakaia Gorge, but this would be circuitous and steeply graded.[41] The engineers ultimately chose a straight route: it did not hug the coast north of Timaru, but still cut across the Canterbury Plains directly, as the annual costs of operating an inland line would exceed construction costs for longer bridges. This route might appear obvious, but it was no foregone conclusion; the decision to bridge the Rangitata at Rangitata Island — requiring crossings of both the northern and southern branches of the river, both braided — rather than using an existing road bridge 15 kilometres further inland at Arundel, was made very late.[42] The Main North Line from Christchurch towards Marlborough province did, in fact, eschew the direct route across the Kaiapoi and Ashley rivers. Of four competing routes, the least direct was chosen, a decision dictated as much by the sites of Kaiapoi and Rangiora townships as by the river crossings.[43]

William Conyers, commissioner of railways in the South Island, identified the Rangitata River as most difficult, describing it in 1878 as 'a source of great trouble'.[44] This assessment was plain to lay observers, with one journalist in 1879 condemning the river as having 'the most unreliable bridge on the whole line of the Canterbury railways'.[45] Rivers took on personalities, be they stable or capricious. J. Henry Lowe, Canterbury's resident engineer, reported in detail. The railway crossed the Rangitata's northern branch with a 1950-foot (594-metre) bridge and the southern with one of 1964 feet (599 metres), both brought into service when the line south opened to Timaru on 4 February 1876. The Rangitata was prone to breaking its low southern bank; in flood, water followed the southern branch to a much greater extent than the northern, and also escaped down a natural channel that crossed the railway about three-quarters of a mile (1.2 kilometres) from the southern bridge. Floods regularly overtopped stopbanks erected during the railway's construction, for the river had eroded them quickly. Temporary breaches were installed in the railway embankment to allow floodwaters passage, but if the river changed course — as Lowe feared it might — it would destroy a railway station, submerge prime agricultural land, and require an expensive new bridge estimated at £20,000 ($3.1 million).[46] Such a bridge would have imposed a significant charge upon the annual revenue, which in 1878 was £467,316 ($72.7 million).[47] The concern was very much with 'educating' the Rangitata so that it did not threaten the railway or local agriculture.

Lowe resolved to bring the Rangitata's braids together as much as possible, and to divide floodwaters more evenly between the northern and southern branches. He believed it would not be an artificial intervention to unite the

braids — though he would not have opposed artificial modification if he viewed it as necessary — as his observations suggested the river was already concentrating and deepening. Protective works would, in his opinion, simply promote this behaviour. Three deflecting groynes would guide floodwaters towards the northern branch; these were to be made of about 10,000 cubic yards (7650m^3) of boulders, soil, tussock, flax and other materials. Lowe did, however, urge that future maintenance and flood prevention should not be exclusively the railway's responsibility; agriculturalists benefiting from protection should contribute. He advocated for a board of conservators to take on the duties.[48] His call would be heeded — but not until the 1910s, as New Zealand's post-provincial system of local counties and single-issue boards proliferated.

Before Lowe's works were complete, the Rangitata flooded repeatedly. In the year to 30 June 1879, three separate floods stopped traffic for a total of 21 days (not counting the flood of 28 June 1879 covered below). These events exposed the poor construction of the bridge over the northern arm, where the pilings had been driven insufficiently deep, so that the river scoured them out easily; a flood at Christmas 1878 carried away three piers, and it was only through quick action by railway staff that two entire spans were not also lost. Fifteen of 28 piles were replaced, with most work done at night so as to maintain regular traffic. The bridge had, by this point, cost almost £4422 to maintain ($750,000). But successful flood mitigation works on the Ashburton River suggested to Conyers that Lowe's works under way on the Rangitata would reduce future maintenance expenditure.[49]

The original protective works might have been inadequate, but this time confidence was not misplaced. In 1880 Conyers reported success to the Minister of Public Works: two floods of greater height than any in the previous financial year had occurred on the Rangitata, but the protective works and bridges held firm. Works on the Rakaia and Waimakariri had also reduced flood damage.[50] By the mid-1880s, floods caused much less damage to Canterbury railways than before, with the lessons of the early years having been absorbed.[51] To further reduce the effects of floods before reaching Rangitata Island, the Railways Department installed a large levee near Arundel in 1887 with protective groynes upriver, stabilized by the planting of poplar trees. The gravel and boulders for these works came from pits alongside the river.[52] The use of trees for stability was not uncommon; willows were planted to protect railway infrastructure near Southland's Mataura River around the same time.[53] In 1892, Lowe — now chief engineer for the whole railway system — summarized the effect of the works undertaken on the Rangitata and other rivers in Canterbury. Flood-related expenses had not been

eliminated, but the works of the previous 15 years had reduced the liability. He again emphasized their wider utility: 'besides protecting the railway [they] also protect large areas of adjacent [agricultural] country'.[54] The twin priorities of operating railways and protecting agricultural production had now constrained Canterbury's rivers considerably. As Catherine Knight describes, these official efforts to control rivers — legislation, commissions, local boards, drainage schemes — would proliferate during the twentieth century.[55] But most of this activity remained in the future when a severe flooding event in 1879 tested the young network's resilience.

The Great Flood of 1879

Rain set in across the east coast of the South Island before dawn on Saturday 28 June 1879, and in some regions fell until Monday. A heavy easterly gale accompanied it, and by Sunday morning railways throughout the island were impassable. Newspapers published vivid accounts of this storm, providing glimpses into how floods behaved around railways. The network was reaching maturity — the Main South Line connected Christchurch and Dunedin in September 1878, then Invercargill in January 1879, with branches to townships such as Duntroon, Kingston, Lawrence, Southbridge, Waimate and Whitecliffs. Inter-city trade and regional economies depended heavily on these links. An inspection train left Christchurch on Sunday morning as the rain and wind eased, with a *Lyttelton Times* reporter aboard. It ran north first, where the Waimakariri possessed a consistency that 'might almost be compared to that of liquid mud'. The Cust and Eyre rivers spread across much of the country beyond Kaiapoi, where the train was forced to stop; 'north, west and east the scene can only be described as deplorable in the extreme … toward the ranges, as far as the eye could reach, was one vast lake'. It then ran south and could go no further than Selwyn, which the reporter found 'desolate indeed'. Streets ran with water, residents had taken refuge on roofs overnight, and the railway beyond was submerged, with some rails lifted from their foundations. Telegrams revealed that the branch to Southbridge was covered in debris and part of that to Whitecliffs was washed away. Remarkably, the only human deaths were five lost in a shipwreck near Timaru, but thousands of livestock drowned, many trapped in waters pooled along railway embankments. The reporter gave a distressing account of cattle straining to keep their heads above water near Kaiapoi.[56]

The damage around Christchurch detailed in the *Lyttelton Times* was replicated up and down the coast. On Saturday afternoon, a passenger train from Port Chalmers to Dunedin narrowly avoided disaster when a small slip fell on the locomotive, which limped, damaged, to its destination.[57] That night,

a freight train from Oamaru to Timaru derailed, with four wagons destroyed and the locomotive submerged, the crew having to swim for high ground.[58] And north of Timaru, the ocean encroached heavily upon the railway, necessitating bridge repairs and the deposit of 5200 tons of rocks, at a cost of £3000 ($513,000).[59] Some of the worst damage originated inland. A heavy snowfall at Naseby thawed rapidly and flowed into the Taieri River, which spread to cover its floodplain. Protective works kept dry many farms and residents on the Taieri's western bank, but this pushed the flood onto the unprotected eastern side and it concentrated along 18 kilometres of railway between Allanton (then called Greytown) and Waihola.[60] This 'sheet of water' across the eastern Taieri Plain also submerged much of the branch line from Mosgiel to Outram. The bridge across the Taieri River into Outram, for which sturdy ironbark timber had been imported from New South Wales, gave way, while other flood outlets were no match for the volume spreading from the Taieri.[61]

Recriminations and repairs were both swift. Some people turned on the railway engineers, accusing them of negligence, and on those who used private or political influence to induce deviations when the original route was safer and superior. The *Bruce Herald* of Milton, reporting from a heavily affected part of South Otago, decried the 'sadly if not painfully deficient' engineers who installed too few culverts and did not make bridges wide enough for floods.[62] The Waitaki County Council in North Otago heard that the Maheno road bridge, south of Oamaru where the council sat, was now too small for floodwaters as a nearby railway embankment confined water into one place.[63] The railway managers did not remain supine, soon sending inspectors to arrange better drainage and enlarge bridges and culverts.[64] And such a ferocious storm would have likely overwhelmed a better-prepared network. It is hard to avoid the conclusion, however, that many flood-mitigation works should have been installed from the outset, and that engineers had given insufficient consideration to how railway embankments would concentrate floods.

The effect of rivers upon railways is not just an environmental question but also an economic one, and the consequences of this storm for the railway budget were obvious. Even though the new financial year had scarcely begun, the *Bruce Herald* feared (unnecessarily, as it transpired) that flood-related expenditure would erase any profit.[65] Traffic throughout the South Island was almost at a standstill until Wednesday, 2 July. Most branch lines were operational by then, but the Main South Line took longer to repair on account of the heavy damage from the Taieri. Invercargill went four days without mail from Dunedin, and arrangements were made mid-week to transfer passengers between Allanton and Waihola by coach.[66] Unlike modern train replacement buses, passengers in 1879 had to 'pay, of course, their own coach fare'.[67]

Trains finally resumed between Dunedin and Invercargill on Friday, 4 July; the next evening an express from Christchurch reached Dunedin, with regular services restored Monday, 7 July.[68] The loss of a week's traffic receipts on this route linking New Zealand's then-largest city, Dunedin, with one of the most commercially important, Christchurch, was a major blow for railway revenue.

It is difficult, however, to quantify the losses. The Main South Line had not been complete 12 months previously, so comparison cannot be made with receipts for the same period in 1878, and the annual report makes little attempt to measure losses another way. It simply referred to 'considerable loss of revenue, and a heavy expenditure', stating the outlay for a few works.[69] The railways were, at least, fortunate this flood happened mid-winter. Non-perishable commodities such as coal could be held without loss until services resumed, and it was the off-season for wheat, hay, wool and similar goods. Many important categories of freight were seasonal, and a flood of this scale in February would have imposed far greater losses.

The consequences fell heaviest on branch lines. Many railways were built ahead of demand to encourage closer settlement, stimulate economic activity and feed traffic to the main line.[70] They often struggled to break even, and the costs of lost traffic and repairs were sharp. Worst affected was the Outram branch. The damage to the Taieri River bridge closed the line for two months. It cost £1510 ($260,000) to mend and extend the bridge and to reinforce embankments with 6000 cubic yards (4600m^3) of earth and 1800 cubic yards (1400m^3) of rubble.[71] When a government Railway Commission reported in July 1880, it found this line one of the most unprofitable, losing £967 ($165,000) during 1879.[72] But it is unclear whether flood repairs were charged against each line's revenue, or to a separate maintenance account — the commissioners stated only that expenditure included 'wear and tear'. (A later annual report laments the unreliability and incompleteness of financial data before 1880.[73]) If repairs were charged against a line's revenue, some unprofitable lines would have shown a profit sans flood. Outram, for example, would have returned a profit greater than £500 without the £1510 repair bill. But if repairs were not charged to the line's account but elsewhere, the branch lost £2477. It is unfortunate that this flood's costs cannot be estimated more precisely given the extensive newspaper accounts — but a flood in the North Island three years later presents a clearer picture.

The Consequences and Costs of Floods in Manawatū–Whanganui

As the railways matured, their accounting and recordkeeping became more detailed and standardized. Floods in the North Island during the early 1880s provide one of the earliest opportunities to identify the economic component

of the interactions between railways and rivers beyond the upfront cost of bridges. They also reveal the diverse, sometimes ingenious, responses of traffic managers to limit losses. Minor rural branch lines could be suspended for weeks to complete repairs, but it was a different story when floods severed main lines. The first priority was restoring some semblance of communication. If a road or track provided a path around the blockage, mails and passengers travelled by coach, or in some instances coastal shipping filled the gap. At times it was possible to carry parcels across a damaged bridge on a light trolley, or for passengers to walk around an obstruction from one train to another. But some events required more novel solutions. This section, therefore, takes two floods in Manawatū–Whanganui, in 1880 and 1882, to show how railway managers kept (some) traffic moving during floods, and then uses financial information from 1882 to identify in more detail the losses involved.

In both floods, the railways employed water-based transport to maintain operations. The first flood, in March 1880, inundated the line between Foxton and Palmerston North — later a branch line, but at this point the southern section of the main line from Whanganui[74] — for 4.5 miles (7.25 kilometres) between the villages of Jackeytown and Oroua River, to a depth of over 7.5 feet (2.3 metres). The water lifted the track and dumped it at the base of the railway formation.[75] Thomas Forth Rotheram, the district railway manager and later an eminent railway official in both New Zealand and Western Australia, made great efforts to maintain services. Trains carried passengers from Foxton to Oroua River, where they took a trolley across the 184-foot (56-metre) bridge and then — quite remarkably — canoes to Jackeytown, where they continued onwards by train.[76] This improvised solution was perhaps suitable only in a lightly populated district: at the census in 1881, Palmerston North had 1366 residents, Foxton 728, Oroua River 52 and Jackeytown 27, with 8738 Pākehā throughout Manawatū County. For Māori, the census identifies 172 members of Ngāti Raukawa and 55 of Rangitāne.[77] But, crucially, the canoe service sustained the passage of people and parcels between Palmerston North and its port of Foxton, even if bulky goods were delayed or carried at greater expense via Whanganui.

The next flood presented a sterner test of the Railway Department's resolve and constrained Whanganui's economy. On 9 June 1882, the morning train from Palmerston North to Whanganui could not cross the Rangitikei River, for the river had become a torrent overnight and carried away three bridge spans, pieces of which residents downstream in Bulls saw floating past. Damage was estimated at over £1200 ($213,000).[78] The Railway Department, however, had no iron cylinder piers available for rebuilding the

bridge. It resolved to maintain passenger and parcels traffic by running trains to each bank and putting on a river ferry until a temporary wooden pile bridge could be erected, with that bridge to serve until cylinders were available. Delays in driving piles through the Rangitikei's shingle bed, however, meant construction of this bridge blew out from a month to almost two.[79]

Worse was to come seven weeks later. On 29 July the temporary bridge, due to open in two days, fell during a light flood. Firewood and timber, for heating and construction, had been scarce in Whanganui since the first collapse, as much of the town's supply came from Manawatū mills across the Rangitikei.[80] Some builders by July were at a standstill for want of material, while others wore the expense of carting timber via a circuitous route.[81] Without firewood, coal soared in price. Local traders looked keenly to the opening of the temporary bridge, and the town and district reacted glumly to news of its collapse.[82] These effects carried up the coast. In early August, approximately 20 carpenters in Patea were idle.[83] The ferry for passengers and parcels continued, but it could not accommodate bulk timber.

Finally, in late August, the Railways Department brought the temporary bridge into service. The arrival in Whanganui of a train of timber and firewood on 27 August occasioned 'unusual activity' at the railway station, where 'nearly all the drays procurable' were pressed into service to distribute loads to merchants.[84] This resolved the dire situation in communities from Whanganui to Patea, but for the railways the saga was not over. Work-arounds remained necessary, for the temporary bridge was too light for locomotives. Instead, one locomotive brought a train to the bridge and pushed it to a counterpart opposite.[85] It would be over a year after the original flood before a locomotive crossed the Rangitikei, on 23 June 1883. Regular services resumed two days later, bringing to an end one of the lengthiest interruptions to traffic in New Zealand railway history.[86]

Four-weekly returns of revenue for the Manawatū–Whanganui network permit estimation of how much this flood cost the Railways Department in lost income (Figures 1–5).[87] Significant tonnages continued to be conveyed between towns on either side of the Rangitikei, yet it is easy to see the effect of the interruption on trade between Palmerston North and Whanganui. The Railways Department was fortunate that the flood occurred during winter; livestock and wool traffic was trifling. Minerals were little affected, for in Manawatū–Whanganui they travelled between ports and nearby towns. But other commodities took a major hit. Figures 1–2 show tonnages of the two worst-affected commodities, timber and firewood. Figures 3–4 show the overall goods tonnage and revenue, and Figure 5 shows the passenger and parcel revenue. Each four-week period is presented alongside equivalent

periods in 1881 and 1883. The 27 May 1882 period is routine, the bridge collapsed halfway through the 24 June period, and the line remained broken for the next two periods before being restored early in the four weeks to 16 September 1882. The 14 October 1882 period provides another routine period for comparison, with the caveat that an abnormally high volume of minerals distorts 1881's total goods tonnage and revenue. The line coped well in June 1882 — the revenue of £1581 was almost level with £1618 in 1881 despite two weeks of interruption, for traffic early in the period had been heavy. But the protracted obstruction was felt strongly. For the reporting periods 24 June, 22 July and 19 August 1882, the Railways Department carried 1941 tons less timber and 1125 tons less firewood than in 1881, comprising most of the overall reduction of 3219 tons and £1363 revenue. Goods traffic sat at half to two-thirds its usual level. But, as Figure 5 shows, the ferry service meant passenger and parcel conveyance continued unabated, with revenue increasing modestly. Floods had a much greater effect on revenue from goods than passengers, as traffic managers could not employ the same novel solutions for bulk commodities as for people. Goods traffic surged when the bridge reopened, but the tonnage for that period in excess of 1881 represented less than half the losses of the preceding weeks; overall winter revenue from goods was more than 10% below that of 1881 and 1883. The annual report found that, as a result of repairs and lost traffic, expenditure consumed 74.63% of revenue compared to 65.2% the previous year — and in Hawke's Bay, where the floods also inflicted damage, this ratio was 60.26% to 53.87%.[88]

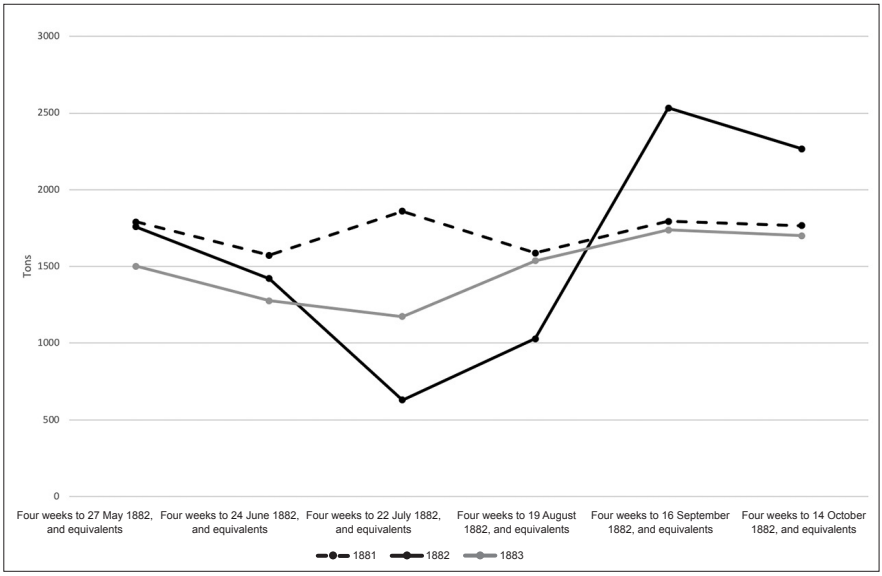

Figure 1: Timber Tonnage on Manuwatū–Whanganui Railway in Four-weekly Periods

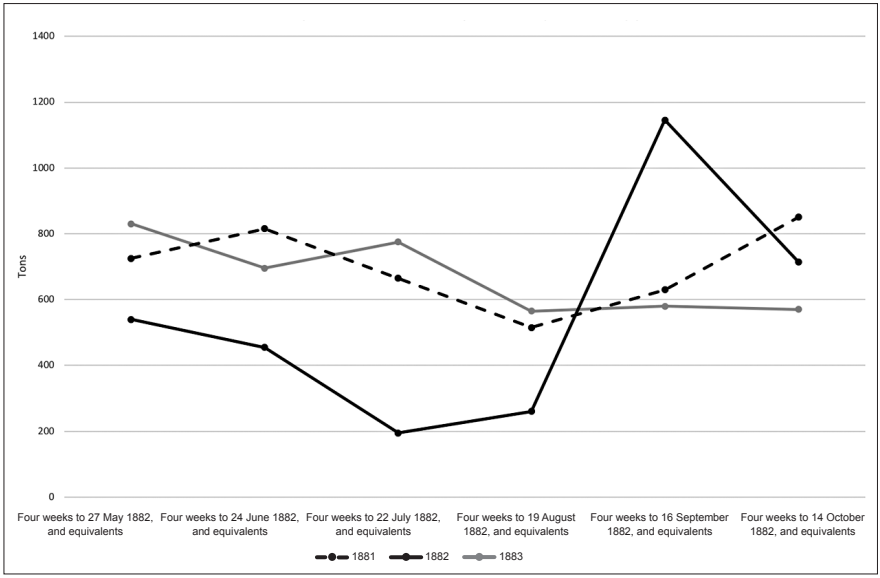

Figure 2: Firewood Tonnage on Manuwatū–Whanganui Railway in Four-weekly Periods

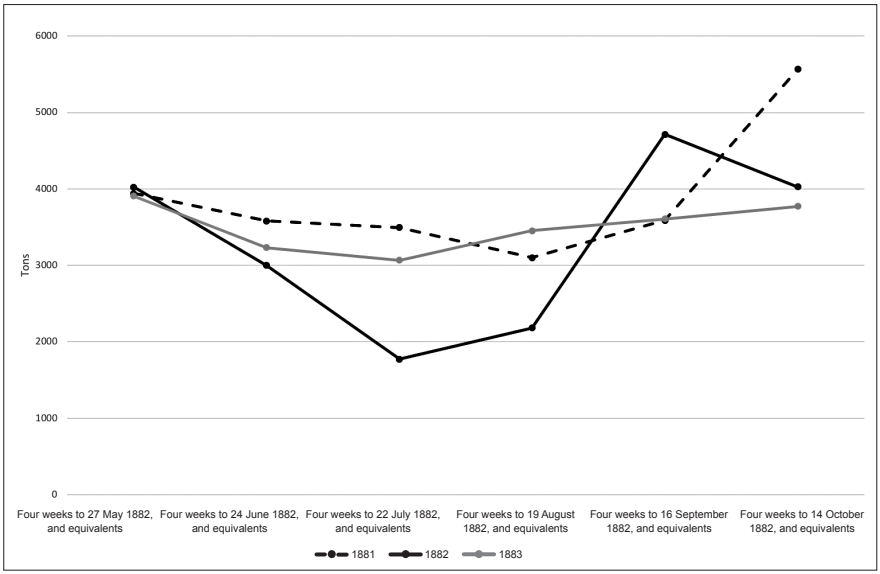

Figure 3: Total Goods Tonnage on Manuwatū–Whanganui Railway in Four-weekly Periods

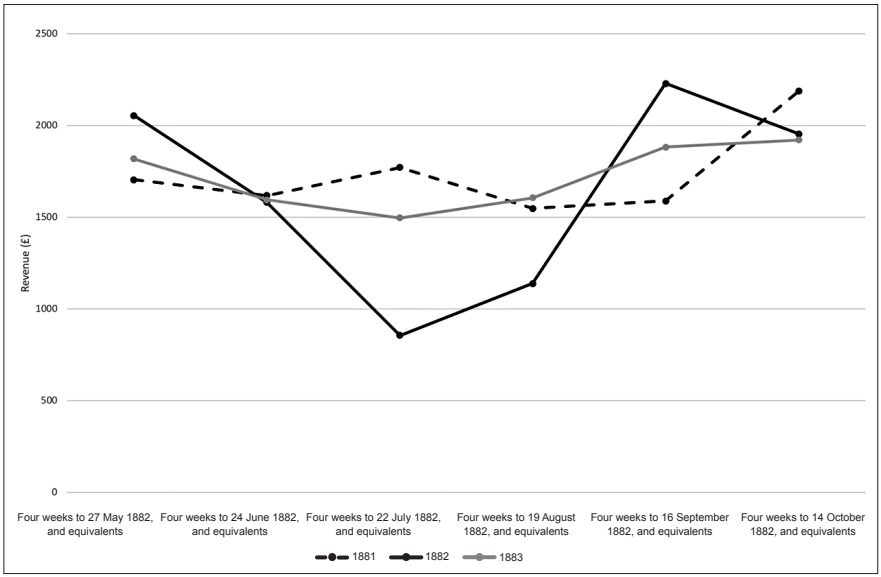

Figure 4: Total Goods Revenue on Manuwatū–Whanganui Railway in Four-weekly Periods

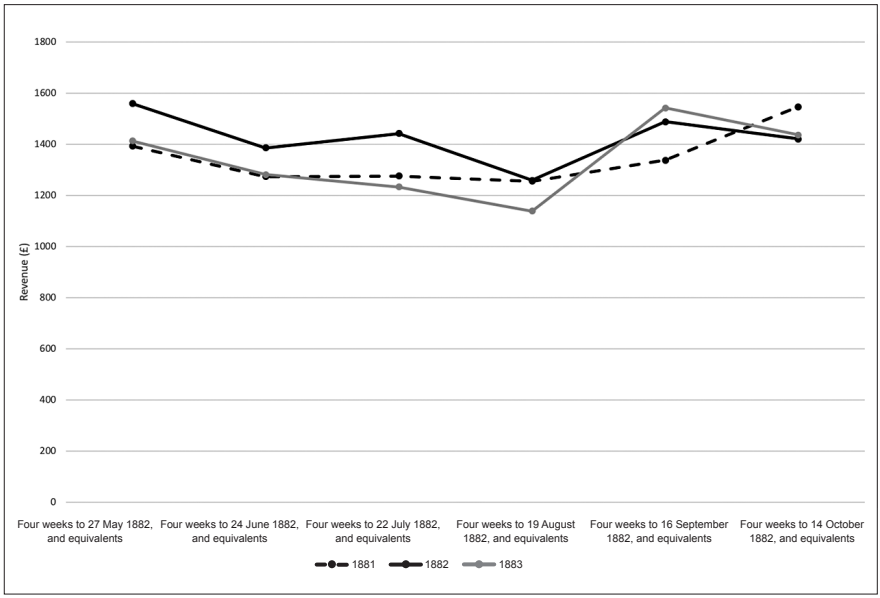

Figure 5: Passenger Revenue on Manuwatū–Whanganui Railway in Four-weekly Periods

Flooding of Mountain Railways

The most dramatic floods on New Zealand's first railways occurred on floodplains, but this was largely because few mountain railways had opened. The official attitudes shown above take protective works as for total prevention, not just mitigation, of flooding costs and effects. The new challenges of rain and rivers wearing away daily at mountain railways, however, confirmed an increasing recognition that the consequences of floods can only be accommodated, not eliminated. Lowe wrote in 1899 that:

> New Zealand has an item of expense which is peculiar when comparing with other colonial lines — that is, the mountainous nature of the country, its heavy rainfall, numerous and swift-running rivers, which, since the railways were constructed, have annually caused damages more or less costly to repair, and involving expensive works to hold the rivers in control.[89]

He exaggerated the distinctiveness. New South Wales incurred substantial expenses associated with its main line from Sydney through the Blue Mountains; Queensland chose a narrow gauge to reduce the cost of construction across the Great Dividing Range; Tasmania built cheap main lines that hugged the contours and forewent direct routes (hence its dubious

distinction as Australia's only state without passenger services today). But, with the exception of Tasmania, New Zealand railways faced more mountainous terrain more often than did other Australasian networks.

Lowe singled out the Midland Railway in the South Island as especially troublesome. This was not so much a single route as it was a bold plan never completed. In 1886 the government contracted the Midland Railway Company to construct two lines from the coalmining town of Brunner, the government's railhead near Greymouth in Westland: one east to Ōtira and across the Southern Alps to Springfield, Canterbury, where it would meet a government line to Christchurch; and another northeast via Reefton and Īnangahua to meet Nelson's isolated government railway at Belgrove. The company could not complete the works and the government took possession in 1895. Little work had been completed in Canterbury or Nelson, but trains in Westland soon served Reefton and Ōtira.[90] The line from the West Coast to Canterbury eventually opened in 1923 with the 8.5 kilometre Ōtira Tunnel through the Alps, while the route through Reefton became a main line to Westport rather than Nelson.

In the late nineteenth century, the Midland Railway posed ongoing challenges. Lowe emphasized that it experienced rainfall and destructive floods 'in a special degree'.[91] Company construction standards had been low, and the government found it had to repair and extend river protection works immediately. Bridge ironwork on the West Coast corroded from inclement weather and inadequate maintenance, while additional funds were necessary to restore the Canterbury section after floods rendered it impassable.[92] Money was not always at hand; after a flood on 10 March 1897 damaged the West Coast section, temporary flood-openings were installed, limiting the speed and weight of trains until permanent bridges could be erected. Meanwhile, a major bridge near Stillwater required reconstruction, and grades and culverts in Canterbury were modified to secure the line from recurrent flood damage.[93] The Snowy River's banks near Ikamatua were raised to guard the Reefton line against flooding, protective works were constructed for the approaches of the Ōtira line's bridge over the Teremakau River, and reinforcements were provided at other river crossings.[94]

These efforts were tested in February 1899 when a tremendous flood — residents described it as the worst in 20 years — filled rivers in Grey County. Greymouth survived unscathed, the town's bar along the Grey River serving to check the 'roaring, wicked looking torrent', and the new railway bridge to Cobden held firm (the telegraph network was less fortunate, with the *Grey River Argus* apologetic for the lack of telegraphic news).[95] But as news from the interior reached reporters, it became clear that worse had occurred on

the route to Ōtira. An emergency ballast train deposited tons of boulders to protect embankments, but little could be done about the Teremakau bridge. Some piles shifted, and others were washed out entirely; rails were bent; passengers had to walk across; mails could be carried by trolley, but freight service was impossible.[96] Similar examples are legion, with newspapers routinely informing readers that Midland trains were delayed, extra works in hand, or that a recent service had passed rising rivers in pelting rain. This led the Minister of Railways, Alfred Cadman, to lament that 'The Midland lines are very liable to flood damage, and heavy expenditure must be incurred from time to time on this account.'[97] Modifying rivers on plains was fairly straightforward; waterways in the Alps presented as more wilful. Disruptions, minor and major, had to be accepted as routine.

The Midland Line was not unique. From 1891 one of the North Island's most important railways operated through the Manawatū Gorge, linking Hawke's Bay with the Manawatū, Wellington, Whanganui and New Plymouth. The gorge, carved by the Manawatū River between the Ruahine and Tararua ranges, forms a rare break in the North Island's rugged spine. The railway line follows the northern, Ruahine, bank, with a road — later State Highway 3 — opposite. From the moment construction began, the Railways Department engaged in a great struggle with the Ruahine Range's unstable flank. In the first two years of operation, passenger trains were twice detained overnight by slips in the gorge, in September 1892 and July 1893. Arrangements were made both times to rescue passengers before nightfall, but additional slips made this impossible.[98] Further compounding the September 1892 incident, the relief train sent to collect passengers also became stuck, with five slips falling across the line.[99] The Railways Department undertook many protective works in the gorge, but again had to accept that there was no lasting solution. It could modify, ameliorate and respond, but could not eliminate deleterious effects from rain and floods. At the time of writing, the gorge road is closed indefinitely and likely to be replaced with an alternative route, but the railway remains open after almost 130 years. It is creditable that in this time there has been only one fatal train accident, when the driver and fireman of a freight service in August 1946 drowned after their locomotive plunged into a flooded Manawatū River.[100]

Conclusion

Railways are an agent of landscape change, not only crossing rivers but affecting where and how they flow. In turn, rivers are not objects simply acted upon. They affect where railways are built and how they operate, especially when in flood; they undermine structures, erode embankments, fill cuttings

and obstruct trains. They impose costs and impede traffic revenue. To some extent, damage from floods was initially a result of limited experience despite recognition of possible dangers, as in Hawke's Bay, but cases such as Marlborough reveal that even when the effects of flooding were predictable, engineers often failed to give them sufficient consideration. The sight of floods pooling alongside and spilling over railway embankments became common as the network grew.

Rivers compelled the Railways Department to pay greater attention to floods and accept them as a routine force on fixed infrastructure. A rough pattern of response emerged: first reaction, then prevention and, later, accommodation. This accords closely with the processes of settler learning described by Peter Holland, and the Railways Department possessed nationwide information unavailable to Holland's isolated rural farmers.[101] The reactive repairs of the 1860s — mending bridges, stabilizing embankments, distributing fresh ballast — led to preventative measures in the 1870s. The Railways Department incorporated longer bridges, more culverts and better drainage, and altered waterflows with stopbanks, groynes and other measures. These responses often relied on trial-and-error, but by the late 1880s the Railways Department had modified rivers such that they had fewer and less-damaging effects on most lines. Importantly, works were not performed to conserve the condition or quality of rivers, but to protect public investment in transport infrastructure and rural prosperity. Rivers initially took a greater toll on railways than vice versa, but within 15 years of the first railways, the course and floodplains of many major rivers had been altered permanently.

The Railways Department, as its river modifications became increasingly effective, learnt that these works were protective rather than preventative; flooding effects could be managed and accommodated, but not avoided entirely. This was confirmed as lines were pushed further into rugged areas such as the Southern Alps and the Manawatū Gorge. Mountain railways demonstrated the impossibility of guarding against every extreme weather event. This inevitability was just as true on the plains, and railway managers found solutions to maintain traffic during and after floods — from ferries to temporary bridges, coaches to canoes. If protective works became increasingly sophisticated, the maintenance of traffic retained a reactive, ad hoc aspect, calling upon whatever resources were available to minimize delays. These measures were essential not just for traveller convenience but also to limit revenue losses.

Economic effects, however, are hard to quantify with the limited data available. The 1882 Rangitikei flood provides some indication. Passenger income could be retained, but floods reduced freight revenue heavily

even in mid-winter, the off-season for many important commodities. For developmental branch lines, repairs and extended closures could be the difference between profit and loss. Prolonged interruptions also proved harmful for railway customers, as seen in Whanganui — millers could hold onto timber and firewood for transport later, but their customers had few alternatives. A flood's effects extended well beyond one collapsed bridge, and, as these lines were often only a few years old, show just how quickly railways had acquired regional economic significance.

The lessons learnt in the nineteenth century have not spared the railways from ongoing difficulties with flooding. The worst railway disaster in New Zealand history — one of the world's deadliest — occurred at Tangiwai on 24 December 1953 when Mount Ruapehu's crater lake wall collapsed, unleashing a lahar down the Whangaehu River into the path of the overnight Wellington to Auckland express, killing 151 people. Previously, 21 had perished on 19 February 1938 when a flash flood in the Kopuawhara Valley swept through a construction camp for the Napier–Gisborne railway. And the routine effects of storms continue to challenge KiwiRail: the Hutt Valley railway, to take one example, is no stranger to overflow from Wellington Harbour or the Hutt River. Railways affect, and are affected by, water wherever they go — be that harbour reclamations, the 'railway dams' of solid embankments, or a line clinging to a mountainside. And, even where railways have closed, the earthworks remain as testament to these changes.

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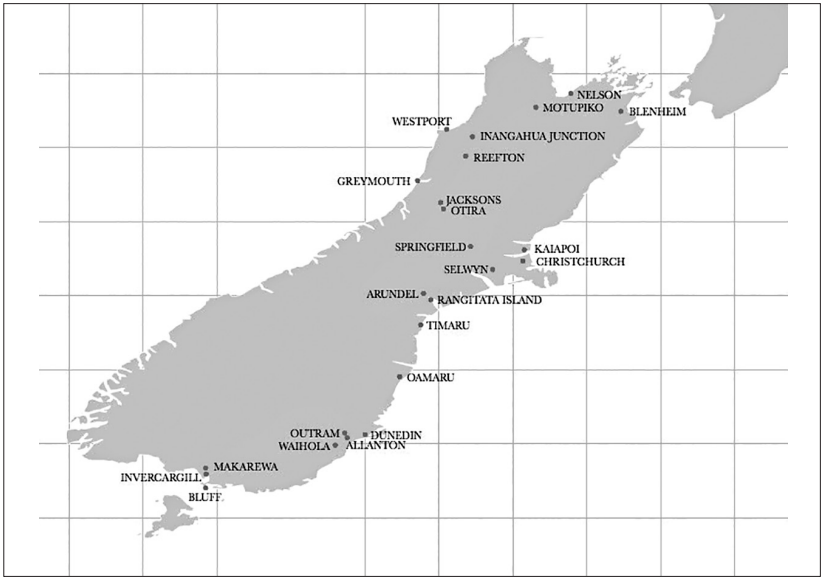
Map 1: Major locations in the lower North Island mentioned in text.



Map 2: Major locations in the South Island mentioned in text.

NOTES

Claire Lowrie and Frances Steel provided invaluable feedback on a draft at a seminar of the Centre for Colonial and Settler Studies (University of Wollongong). Judi Eathorne-Gould of the New Zealand Legal Information Institute facilitated my access from Wollongong to relevant years of the *New Zealand Gazette*. I prepared the maps with a technique suggested by Brett Holman. My reviewers provided the sort of close engagement and warm encouragement that sometimes feels too rare. And my particular gratitude to Simon Ville for his advice throughout the period of writing this article. Thanks to you all.

1 Catherine Knight, *New Zealand's Rivers: An Environmental History*, Canterbury University Press, Christchurch, 2016, p.49.

2 *Appendices to the Journals of the House of Representatives* (AJHR), 1870, D-46. For more on Cooper, see *Otago Daily Times*, 17 August 1898, p.2, and Beryl Hughes, 'G.S. Cooper and Cooper Street', *The Stockade,* 34 (2001), pp.30–32.

3 G.T. Bloomfield, *New Zealand: A Handbook of Historical Statistics*, G.K. Hall and Co., Boston , 1984, p.240.

4 Eric Pawson, 'Time-Space Convergence in New Zealand: 1850s to 1990s', *New Zealand Journal of Geography*, 94 (1992), pp.14–19. This journey in 2018 takes under two hours by direct jet aeroplane; fittingly, I worked on this article on two such flights.

5 R.C.J. Stone, 'The Thames Valley and Rotorua Railway Company Limited 1882–9: A Study of the Relationship of Business and Government in Nineteenth-Century New Zealand', *New Zealand Journal of History*, 8, 1 (1974), p.33.

6 J.A. Dowie, 'Business Politicians in Action: The New Zealand Railway Boom of the 1870s', *Business Archives and History*, 5, 1 (1965), pp.42–44.

7 Stone, 'Thames Valley and Rotorua Railway', pp.22–43; D.A. Hamer, 'The Agricultural Company and New Zealand Politics, 1887–1886', *Historical Studies Australia and New Zealand*, 10, 38 (1962), pp.141–64.

8 Historians across generations concur that the removal of these safeguards was disastrous and contributed to great political upheaval: André Brett, 'A Sudden Fancy for Tree-Planting? Forest Conservation and the Demise of New Zealand's Provinces', *Environment and History*, 23 (2017), pp.123–45; J.B. Condliffe, *New Zealand in the Making*, rev. ed., George Allen and Unwin, London, 1959, pp.120–2; Graeme Wynn, 'Conservation and Society in Late Nineteenth-Century New Zealand', *New Zealand Journal of History*, 11, 2 (1977), pp.124–36.

9 Tom Brooking, *The History of New Zealand*, Greenwood Press, Westport, Connecticut, 2004, p.68. See also G.R. Hawke, *The Making of New Zealand: An Economic History*, Cambridge University Press, Cambridge, 1985, p.81, who points out that waste is likely in any vast scheme and that the Works Policy does not appear excessive in this regard.

10 M.F. Lloyd Prichard, *An Economic History of New Zealand to 1939*, Collins, Auckland, 1970, p.131.

11 See, for example, Neill Atkinson, *Trainland: How Railways Made New Zealand*, Random House, Auckland, 2007; Geoffrey B. Churchman and Tony Hurst, *The Railways of New Zealand: A Journey Through History*, HarperCollins, Auckland, 1990; Geoff Conly and Graham Stewart, *New Zealand Tragedies on the Track: Tangiwai and Other Railway Accidents*, rev. ed., Grantham House, Wellington, 1991.

12 David Leitch, *Railways of New Zealand*, Leonard Fullerton, Auckland, 1972, pp.218–22.

13 W.N. Cameron, *A Line of Railway: The Railway Conquest of the Rimutakas*, New Zealand Railway and Locomotive Society [NZRLS], Wellington, 1976, especially chapter

12. Other examples include J.A. Dangerfield and G.W. Emerson, *Over the Garden Wall: Story of the Otago Central Railway*, 3rd ed., Otago Railway and Locomotive Society, Dunedin, 1995; H.J. Hansen and F.J. Neil, *Tracks in the North*, H.J. Hansen, Auckland, 1992; David Parsons, *Wellington's Railways: Colonial Steam to Matangi*, NZRLS, Wellington, 2010.

14 James Watson, *Links: A History of Transport and New Zealand Society*, GP Publications, Wellington, 1996, pp.9–10, 40–41, quote on p.99.

15 Eric Pawson and Tom Brooking, eds, *Making a New Land: Environmental Histories of New Zealand*, Otago University Press, Dunedin, 2013.

16 Knight, *New Zealand's Rivers*, and *Ravaged Beauty: An Environmental History of the Manawatu*, Dunmore Publishing, Auckland, 2014, pp.166, 245.

17 Rollo Arnold, *New Zealand's Burning: The Settlers' World in the Mid 1880s*, Victoria University Press, Wellington, 1994, p.194.

18 *Lyttelton Times*, 5 April 1862, p.5; report of Edward Dobson, provincial engineer, in the *Press*, 12 December 1865, p.3.

19 André Brett, 'Wooden Rails and Gold: Southland and the Demise of the Provinces', in Lloyd Carpenter and Lyndon Fraser, eds, *Rushing for Gold: Life and Commerce on the Goldfields of New Zealand and Australia*, Otago University Press, Dunedin, 2016, pp.253–67.

20 See the discussion in the *Appendix to the Votes and Proceedings of the Southland Provincial Council*, pp.162–7, as well as reports in the *Votes and Proceedings of the Southland Provincial Council*, 8 December 1864, p.124 (railway select committee) and p.161 (financial select committee).

21 The Main South Line from Christchurch to Invercargill and the Main North Line from Christchurch to Picton together comprise the South Island Main Trunk Railway; the Main South Line was completed in 1879 but the full route did not open until 1945.

22 W.A. Pierre, *Canterbury Provincial Railways: Genesis of the NZR System*, NZRLS, Wellington, 1964, p.78.

23 *Press*, 5 February 1868, p.2.

24 Peter Holland, *Home in the Howling Wilderness: Settlers and the Environment in Southern New Zealand*, Auckland University Press, Auckland, 2013, p.87.

25 AJHR, 1871, D-06A, p.25.

26 AJHR, 1872, D-5, p.14.

27 AJHR, 1872, D-5, p.13.

28 AJHR, 1876, E-1, p.33.

29 AJHR, 1875, E-3, p.38.

30 *Wanganui Herald*, 29 June 1874, p.2.

31 *Marlborough Express*, 8 February 1868, p.3.

32 AJHR, 1875, E-3, p.38; *Marlborough Express*, 20 August 1873, p.2. All current monetary values in this article are in New Zealand dollars, determined by comparing the relevant quarter (in this case 1875 Q2) with 2019 Q2: https://rbnz.govt.nz/monetary-policy/inflation-calculator

33 Rob Merrifield, *Beyond Dashwood: A History of the Railway in Marlborough*, NZRLS, Wellington, 1990, p.19.

34 *Marlborough Express*, 4 September 1875, p.6.

35 *Marlborough Express*, 28 January 1874, p.2.

36 *Marlborough Express*, 4 September 1875, p.6; André Brett, *Acknowledge No Frontier: The Creation and Demise of New Zealand's Provinces, 1853–76*, Otago University Press, Dunedin, 2016, pp.109–10.

37 *Marlborough Express*, 29 April 1876, p.5.

38 *Marlborough Express*, 17 November 1875, pp.3–4; 24 June 1876, p.5.

39 Merrifield, *Beyond Dashwood*, p.22.

40 *Press*, 11 September 1863, p.2.
41 Pierre, *Canterbury's Provincial Railways*, pp.49–50.
42 AJHR, 1873, E-1, p.6.
43 Pierre, *Canterbury's Provincial Railways*, pp.50–51.
44 AJHR, 1878, E-1, p.59. Separate commissioners oversaw the North Island and the South (or Middle) Island railways until 1880.
45 *Bruce Herald*, 15 July 1879, p.3.
46 AJHR, 1878, E-1, p.69.
47 AJHR, 1878, E-1, p.63. This is just the South Island total, which in the 1870s was kept separately from the North (p.52). The combined national revenue was £569,898 ($86.8 million).
48 AJHR, 1878, E-1, pp.69–70.
49 AJHR, 1879, E-1, p.86; *Star*, 27 December 1878, p.2.
50 AJHR, 1880, E-1, p.107.
51 AJHR, 1885, D-1, p.ii.
52 AJHR, 1920, D-6E, p.3.
53 Southland District Engineer to Chief Engineer, 8 October 1914, Dunedin District Engineer's Office (DABB), series 20097, Box 7/a/207 part 1 (Quarry Reserve—Mataura), Archives New Zealand. This letter and others in the file relate to a later dispute about tree maintenance between the Railways and the PWD.
54 AJHR, 1892, D-2, p.7.
55 Knight, *New Zealand's Rivers*, chapter 8.
56 All details and quotes from *Lyttelton Times*, 30 June 1879, p.3.
57 *Otago Daily Times*, 30 June 1879, p.2; *Southland Times*, 2 July 1879, p.2.
58 AJHR, 1879, E-1, p.86; *Press*, 2 July 1879, p.2.
59 AJHR, 1880, E-1, p.107.
60 *Southland Times*, 2 July 1879, p.2; *Clutha Leader*, 4 July 1879, p.5.
61 *Southland Times*, 4 July 1879, p.2; *Otago Daily Times*, 1 July 1879, p.3.
62 *Bruce Herald*, 15 July 1879, p.3.
63 *Oamaru Mail*, 11 July 1879, p.2.
64 *Lyttelton Times*, 15 July 1879, p.5.
65 *Bruce Herald*, 15 July 1879, p.3.
66 *Southland Times*, 2 July 1879, p.2; *Globe*, 3 July 1879, p.3.
67 *Southland Times*, 3 July 1879, p.2.
68 *Otago Daily Times*, 7 July 1879, p.2; *Grey River Argus*, 9 July 1879, p.2.
69 AJHR, 1880, E-1, p.104.
70 AJHR, 1893, D-2, pp.2–3 articulates this principle well.
71 AJHR, 1880, E-1, p.106.
72 AJHR, 1880, E-3, p.213.
73 AJHR, 1885, D-1, p.iii.
74 Planners originally expected this railway would continue south to Wellington. The Wellington and Manawatu Railway Company, however, later opted for a more direct route to Palmerston North. When that company's line became part of the national network in 1908, the line to Foxton became a branch of the North Island Main Trunk.
75 AJHR, 1880, E-1, p.93.
76 *Manawatu Herald*, 26 March 1880, p.2.
77 *Census of New Zealand 1881*, tables 14, 21, and 26 for Pākehā and table 1 of Appendix A for Māori.
78 *Wanganui Herald*, 9 June 1882, p.2 and 10 June 1882, p.2.
79 *Wanganui Herald*, 6 July 1882, p.2.

80 See Knight, *Ravaged Beauty*, chapter 4 for a detailed examination of the timber industry.

81 *Wanganui Herald*, 6 July 1882, p.2.

82 *Wanganui Herald*, 31 July 1882, p.2.

83 *Patea Mail*, 9 August 1882, p.3.

84 *Wanganui Herald*, 28 August 1882, p.2.

85 *Wanganui Herald*, 9 September 1882, p.2.

86 *Manawatu Standard*, 25 June 1883, p.2.

87 All financial data in this paragraph, and in the figures, is from the *New Zealand Gazette*, 1881–83 (2 vols per annum).

88 AJHR, 1883, D-1, p.66.

89 AJHR, 1899, D-2, p.xx.

90 AJHR, 1895, D-1, pp.xi-xii; Geoffrey B. Churchman, *The Midland Line: New Zealand's Trans-Alpine Railway*, 4th ed., IPL Books, Wellington, 1995, pp.14–19.

91 AJHR, 1899, D-2, p.xxiv.

92 AJHR, 1896, D-2, p.xi.

93 AJHR, 1897, D-2, p.xii.

94 AJHR, 1898, D-2, p.xvi.

95 *Grey River Argus*, 1 February 1899, p.2.

96 AJHR, 1899, D-2, p.xxv; *Grey River Argus*, 3 February 1899, p.4; *Press*, 10 February 1899, p.5.

97 AJHR, 1898, D-2, p.v.

98 E.G. Pilelier, secretary for the Railway Commissioners, to Richard Seddon as Minister of Public Works, Legislative Department (AEBE), series 18507, file 1893/161, Archives New Zealand.

99 *New Zealand Times*, 27 September 1892, p.3; 28 September 1892, p.3.

100 Conly and Stewart, *Tragedies on the Track*, pp.125–7.

101 Holland, *Home in the Howling Wilderness*, chapter 3.