

# Making productive space from sawmill waste: timber production and reclamation at Kohukohu, Northland, New Zealand (1879–1912)

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*This paper explores local-scale landscape change as a consequence of waste disposal practices employed by the New Zealand (NZ) timber industry during the nineteenth and early twentieth centuries, and considers whether there was concern about effects of these practices on receiving environments. The research focuses on Kohukohu, Northland, where a steam-powered sawmill operated between 1879 and 1912. Sawn waste was used to reclaim six acres (2.43 ha) of land at Kohukohu, which converted waste material into something useful (lining and fill) and improved the working conditions of the mill by creating flat land. Local concern about disposal of sawn waste by reclamation appears limited until the early 1900s, when anxiety about the negative effect of sawdust on the harbour increased. Such local scale modifications occurred elsewhere in the kauri district and are a (sometimes forgotten) legacy of industrialised timber production in NZ.*

## INTRODUCTION

In 1891 the *New Zealand Herald* ‘Country News’ for Hokianga, in northern New Zealand (NZ), reported that ‘The barque *Presto*, from Auckland, arrived this morning and proceeded to Kohukohu, or more appropriately ‘Sawdust City’’ (27 Jul. 1891: 6). Sawdust, slabs, offcuts and shavings were a by-product of the nineteenth and early twentieth century exploitation of NZ’s forests for timber. Such waste was an ever-present feature of sawmill settlements and ‘sawdust city’ was a common epithet applied to sawmill towns. Waste was an issue. It needed to be disposed of and disposal practises may have left a landscape legacy. However, unlike other extractive industries such as mining where tailing dams and waste dumps may be prominent and at a large scale, sawdust is organic, disposal may be localised, and the associated landscape changes less obvious. In many cases the sawmills have long since been removed and the land turned over to other uses, with decay and erosional processes occurring in the decades (or century) since sawmilling ceased. The resulting features may also have become familiar and therefore are ‘unseen’.

This paper explores local-scale landscape change as a consequence of waste disposal practices employed by the timber industry during the nineteenth and early twentieth centuries, and explores whether there was concern over the effects of these practices on the receiving environment, particularly waterways. Sawmill waste can have negative impacts on waterways, being an aesthetic nuisance, potential navigation hazard, and harmful to aquatic life (McLaren 1984; Lichatowich, 1999). In New Zealand, release of waste into watercourses was acknowledged as a problem from the mid-1800s, particularly associated with industrial scale mining from the 1870s (e.g. Hearn 2013). Fisheries legislation enacted from the late 1860s regulated waste disposal in rivers (to protect introduced salmon and trout) and *The Harbours Acts 1878*, and subsequent amendments, restricted deposition of material, including sawdust, on the foreshore.

Here we focus on Kohukohu, Northland, where a steam-powered sawmill operated between 1879 and 1912 cutting mainly kauri (*Agathis australis*) and sawmill waste was used to infill the bay. A combination of archival research and physical investigation was used to identify key players in the

sawmill business, reconstruct the reclamation process, and assess whether there was any concern expressed locally and elsewhere about the environmental impact of sawn waste on the bay and harbour. Such local scale modifications occurred elsewhere at sawmill sites and are a sometimes forgotten legacy of industrialised timber production in nineteenth and early twentieth-century NZ.

## SAWMILL WASTE

Investigation of sawmill waste fits within wider studies of environmental change in NZ in the nineteenth and early twentieth century as a consequence of resource exploitation and shift to a pastoral landscape. Given the physical impact of deforestation and the importance of forests as a source of material to develop NZ’s built environment, considerable attention has been given to forest loss and timber production. Ecologists have explored aspects such as fire ecology (e.g. Perry *et al.* 2014), while geographers and environmental historians have focused on large-scale environmental changes, discussing the social, economic and political context of forest exploitation (e.g. Roche 1990a, 1990b; Wynn 2013). Social historians and industrial archaeologists have described and recorded the spatial and temporal expansion of sawmilling, as well as processes, places and objects connected to tree felling, transportation, and timber production (Boswijk *et al.* 2014; Diamond and Hayward, 1991; Hayward and Diamond 1984; Mahoney 1984; Orwin 2004; Reed 1953, 1967; Thornton 1982; Wilton 2014). Tramways and, in the upper North Island, driving dams have received particular attention (Hayward and Diamond 1984; Mackay 1991; Mahoney 1998; Napier *et al.* 2009; Wilton and Soltani 2014), including impacts on the geomorphology of headwater streams (Napier 2009). However, the physical investigation of local scale environmental impacts of sawmill sites is rare, particularly in the context of waste production and disposal.

Sawn timber was produced by breaking down logs into flitches which were then reduced to boards using different saws, depending on the size of timber required and end purpose (Reed 1953). At every step waste wood and sawdust would be generated. The amount of sawdust produced was directly related to the saw gauge; the higher the gauge the wider the kerf (bite of the blade) (Simpson 1973:188). Additionally, further quantities of sawdust and shavings would be produced during the manufacture of timber products in the sash, door and box manufactories, often co-located with sawmills.

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Large quantities of waste were produced. Simpson (1973) calculated that in the conversion of good quality indigenous wood approximately one third of a log would be lost as waste during sawing. Hutchins (1919:75-76) estimated that in working kauri, a rough circular saw could generate  $\frac{1}{4}$  inch (0.64 cm) of sawdust when cutting a 1 inch (2.5 cm) plank and Carter (1972:468) noted that for the period 1901–1902 the Kauri Timber Company's (KTC) average loss in sawing was 25.05 per cent. In 1905, 49 timber mills operated in the Auckland region, with an annual cutting capacity of 244 million superficial feet (sp ft) (c. 580,000 m<sup>3</sup>) of timber and a total output of 182.5 million sp ft (c. 431,000 m<sup>3</sup>) (AJHR 1905). Allowing for 25 per cent loss, such output would have generated approximately 5.07 m ft<sup>3</sup> (143,550 m<sup>3</sup>) of waste in the year within the region, which had to be disposed of somewhere and somehow.

## KOHUKOHU, NORTHLAND

Kohukohu is located on the north side of the upper Hokianga Harbour, a drowned river valley on the west coast of Northland, upper North Island (Figure 1). The harbour covers an area of 11,065 ha and is the fourth largest estuarine harbour in NZ (Conning *et al.* 2004). It is surrounded by moderately steep hill country up to 250 m elevation and prior to human settlement the region was covered in forest, apart from dunes on the headlands at the harbour entrance and extensive wetlands on the harbour margins (Conning *et al.* 2004). Several rivers drain into the Hokianga, including the Mangamuka and Waihou Rivers.

Kohukohu is situated a few kilometres downstream of the confluence of the rivers. The harbour is tidal at Kohukohu, and the channel could accommodate ocean going sailing vessels. Flat land is scarce and shops, public buildings and the Kohukohu Road occupy a narrow stretch of mostly reclaimed land to the north of the bay (Figure 1). Most houses and public buildings are located on hill slopes to the west and south of the bay. Since 1972, Kohukohu School has occupied the former sawmill site, along with tennis courts, bowling green, and fire station.

The Hokianga forms a boundary between the traditional lands of the Muriwhenua iwi (tribes) to the north and Ngapuhi to the south and east (Taonui 2014). Kohukohu is in the area of the Ihutai hapu (clan), part of Te Iwi Te Rarawa and who also have close whakapapa associations with Ngapuhi (Te Runuanga o Te Rarawa nd). In the early 1800s, Ihutai was led by the rangatira Wharapapa Tohu. In 1834, Frederick E. Maning purchased land at Kohukohu from Tohu and established a timber station with a business partner (Harrison 2007). At the time New Zealand's northern kauri forests were beginning to be exploited for spars and sawn timber. Speculative voyages of the early 1800s had given way in the 1820s and 1830s to the establishment of shore-based timber stations and development of a trans-Tasman trade in spars and sawn timber (Roche 1990b:14). The Hokianga, despite the

potentially treacherous bar at the harbour entrance, was attractive for access to the forest resource and proximity to Sydney, and timber stations were established at a number of locations on the harbour (Stokes 2013).

The timber station at Kohukohu operated under a succession of owners until 1874 when it was purchased from John Webster by Alfred Cooke-Yarborough and Alfred Andrewes who already operated general stores at several locations around the harbour. Yarborough and Andrewes shipped squared logs (predominantly kauri) to southern New Zealand ports, Australia and China. Squared logs and 'junk' timber, comprising the bulk of the Hokianga trade (NZ Herald 6 Dec. 1879:6), would have been manually prepared for shipment. The introduction of steam power to Kohukohu in 1879 marks a significant change. The sawmill was built by a NZ-based syndicate of timber merchants from Wellington and the South Island (Table 1), most likely in collaboration with

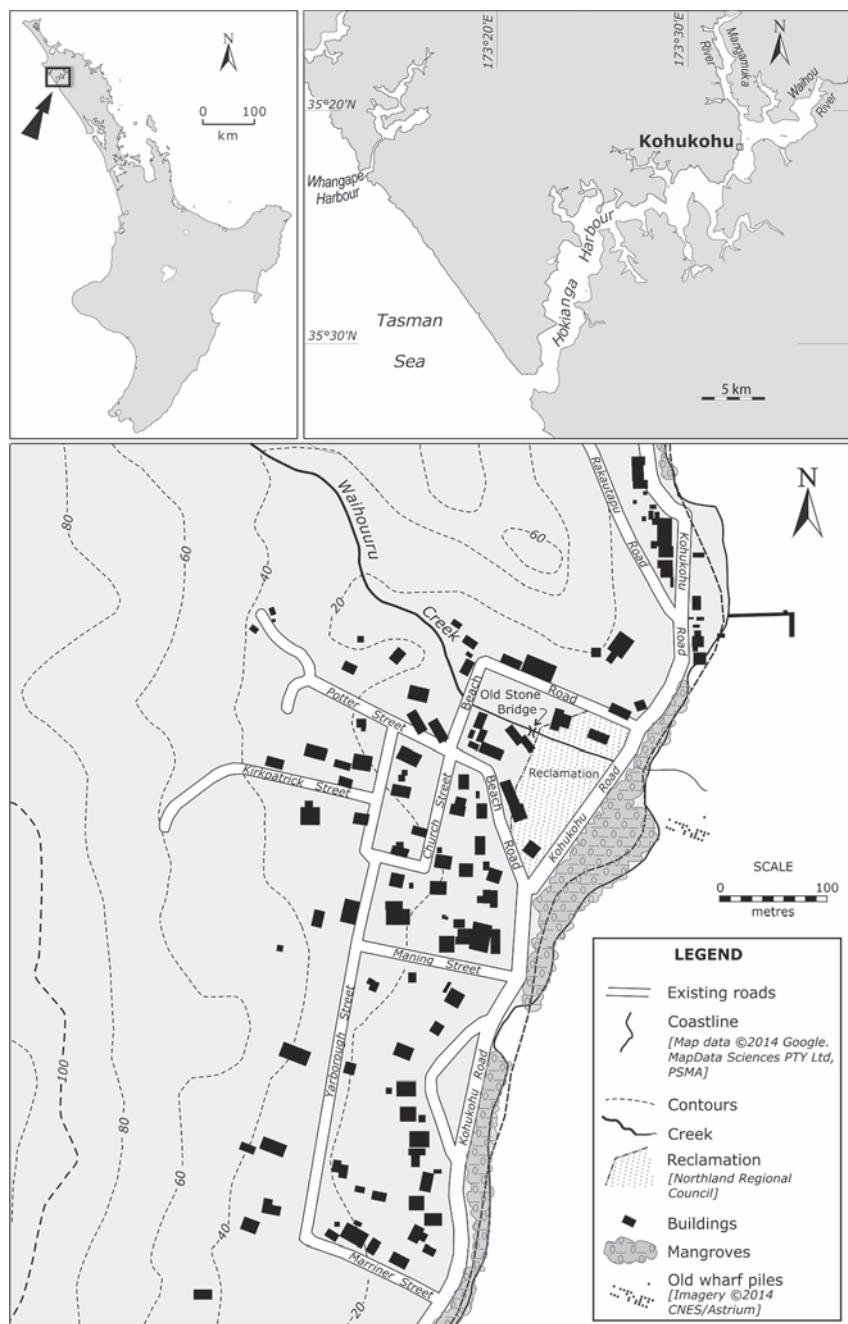


Figure 1: a) North Island, New Zealand and location of the Hokianga Harbour. b) Location of Kohukohu, Hokianga Harbour, Northland. c) Kohukohu township. The reclamation is the largest area of flat land in the town. The Waihouuru Creek crosses the reclamation, passing under the Stone Bridge and the Kohukohu Road, entering the harbour north of the sawmill wharf.

**Table 1: Hokianga Sawmill Company syndicate members. The names of members were obtained from Liquidation notices in 1887, e.g. in the Southland Times 15 Jan. 1887: 1. The 'New Zealand Loan and Mercantile Agency Company Limited' was also listed as an interested party.**

Company and location	Comments
Stewart and Co., Wellington (formerly Greenfield and Stewart).	Sawmill and timber yard established 1865, Courtney Place, Wellington ( <i>Evening Post</i> 4 December 1865:2). Sold matai, kauri and imported timber ('Scotch' and 'deal') ( <i>Evening Post</i> 25 April 1867:1) and operated own ships. Business connections to Brownlee and Co. Became Stewart and Co. in 1887, and were timber, glass and iron merchants ( <i>Cyclopaedia of New Zealand</i> 1897).
Brownlee and Co., Havelock	Operated two large sawmills at Havelock, Marlborough Sounds ( <i>Nelson Examiner and New Zealand Chronicle</i> 18 January 1871:2) supplying Wellington and southern cities ( <i>Colonist</i> 28 March 1878:3, <i>Marlborough Express</i> 25 October 1905:3). Firm operated into the 1900s.
Captain J. Henry Dalton, Picton	Sawmill at Koromiko, Picton, 1866 (Wellington Independent 30 January, 1866: 4) and Captain of the <i>Cynthia</i> . Sawmill and chattels sold by auction in January 1878 ( <i>Marlborough Express</i> 12 January 1878:3). Named by <i>NZ Herald</i> as Chairman of the Hokianga Sawmill Company (26 October 1883:6). In syndicate with Greenfield & Stewart and Brownlee, for construction of Brownlee's sawmill and an associated tramway ( <i>Evening Post</i> 29 April 1893:1).
J.T. Brown, Christchurch	Timber, coal and firewood yard, Tuam St Christchurch, 1866 ( <i>The Press</i> 5 January 1869:1). Sold 'colonial and foreign' timber ( <i>The Press</i> 8 December 1875:1). Reported as bankrupt in November 1884 ( <i>The Press</i> 5 November 1884:4; 18 November 1884:4) but was trading again by 1886 ( <i>The Press</i> 8 March 1886:1). Advertisements in <i>The Press</i> indicate the firm traded as J.T. Brown and Son into the 1900s.
Guthrie and Larnach, Dunedin (became the Dunedin Iron and Woodware Co.)	Timber merchants and importers, Dunedin, established 1873 ( <i>Otago Daily Times</i> 6 January 1874:3). Operated sawmills, manufactories and ironworks, sold native and imported timber, and shipping ( <i>Otago Daily Times</i> 5 January 1874:4, <i>Southland Times</i> 18 May 1874:3). Branch office in Wellington ( <i>Evening Post</i> 9 July 1878:1) and a sawmill in Auckland ( <i>NZ Herald</i> 20 October 1879:8; <i>Evening Post</i> 26 March 1881:2). 'New Zealand Timber and Woodware Factories Company (Limited)' liquidated in 1883, reformed as the 'Dunedin Iron and Woodware Company' ( <i>New Zealand Tablet</i> 29 June 1883:12).

Yarborough and Andrewes. An increase in the resident population, particularly working men and their families, would have improved business and the development of the settlement. Several of the southern merchants were already in partnership (Table 1), and circumstantial evidence strongly suggests that all the parties were known to each other (e.g. *NZ Herald* 19 Dec. 1877:2, 5 Mar. 1879:2). The mill operated under the name 'Hokianga Sawmill Company' (HSC) although newspaper reports variously refer to it as Greenfield and Stewart's (G&S) sawmill or Brownlee and Co.'s sawmill (e.g. *Evening Post* 21 Sept. 1878:2; *NZ Herald* 9 Apr. 1879:3).

The investment by southern capitalists in a sawmill at Kohukohu, as well as the purchase or lease of kauri bush blocks in the Hokianga, occurred during the boom years of the timber industry in NZ. Stone (1973:14) describes the 1870s as 'a decade of great capital formation, investment, and business expansion'. The domestic economy had been stimulated by the gold rushes of the 1860s and early 1870s, followed by Vogel's public works and immigration schemes. During the 1870s timber companies responded to increased demand for timber and land by borrowing money capital, investing in new machinery, and expanding their business interests to supply the growing market.

The syndicate members were well established sawmillers and timber merchants (Table 1). Some were located in provincial centres that had limited local timber supplies as a consequence of pre-European landscape changes and traded in timber obtained elsewhere. Operating a sawmill in the kauri district would have enabled the syndicate to control production and supply, limit dependency on other suppliers, and reduce transport costs. They could also capitalise on demand for NZ kauri from Australia and elsewhere. The mill was fitted out with a 50 horse-power steam engine from Harvey and Co. of Glasgow and machinery from McDowall and Sons, Johnstone, Scotland (*NZ Herald* 12 Nov. 1879: 3). Locally manufactured boilers and saw benches were obtained from Robertson and Company's Phoenix Foundry, Wellington (*Evening Post* 21 Sept. 1878:2). When built, the sawmill cut mostly kauri and had a capacity of 4 million sp ft (9,440 m<sup>3</sup>)

per annum. By April 1879 the *NZ Herald* reported that 'Messrs. Brownlee and Co's sawmill at Kohukohu has commenced working in sober earnest, and apparently everything is shaping to the satisfaction of those most interested' (*NZ Herald* 9 April 1879:3).

During the 1880s a nationwide economic depression affected the national timber trade. This, combined with various misfortunes, appears to have affected the HSC such that the business went into liquidation in mid-1886 and was put up for auction in January 1887 (*Auckland Star* 20 Jan. 1887:3; *NZ Herald* 17 Jul. 1887:1). After a brief period of ownership by J.W. Henderson (*NZ Herald* 25 April 1887:12), the HSC was one of 28 sawmill complexes purchased by the newly formed, Melbourne-based Kauri Timber Company (KTC). The KTC operated the sawmill until 1912 when it was closed and demolished and the land subsequently sold (Munro 2012). By that time the kauri resource had become depleted and the KTC was rationalising its business (Carter 1972).

## THE SAWMILL COMPLEX

In 1876, Yarborough and Andrewes' establishment was described as including a 'wharf, stores, blacksmiths' and engineers' shop, saw-pits &c' (*Daily Southern Cross*, 2 May 1876:3). Early photographs and paintings (e.g. Munday n.d.; Yarborough 1877, 1878a, 1878b) suggest activity was focused on the area north of the bay. In the bay itself, little sign of timber works on the foreshore is evident in photographs or paintings (e.g. Figure 2; Yarborough 1877).

A significant feature is the stone bridge on the foreshore at the mouth of the Waihouuru Creek (Figure 2). The bridge is still *in situ* and therefore serves as a marker for the original high-water mark and for reconstructing changes to the bay. It was built from Sydney sandstone, probably brought to the Hokianga as ballast, and is thought to have been constructed between 1843 and 1851 by Russell (Park 2007). It is considered to be one of the earliest surviving bridges in New Zealand and is a Category 1 Historic Place (Heritage New Zealand Pouhere Taonga (HNZPT) List 7741; Park 2007).



Figure 2: Kohukohu bay before the sawmill. Webster property and stone bridge, Kohukohu. Hocken Collections Uare Taoka o Hakena, University of Otago, Library. Asset ID 18775. Filename: 1535\_01\_001A. Photographer and date unknown.

Construction of the steam-powered sawmill in 1879 immediately impacted on the bay through development of an industrial complex on the former Webster property. The mill buildings were located on the edge of the bay, south of the Waihouuru Creek, with low-lying land becoming part of the working area behind the mill (Figure 3). Photographs of the sawmill from the early 1900s show two two-storey cutting halls, side-by-side, built of timber and roofed with corrugated iron (Figure 4). These were the largest structures in the complex and were apparently erected in two stages with the first part operating for about six months before the second portion opened (*NZ Herald* 12 Nov. 1879:3). Sawing took place on the ground floor whilst the upper storey, lit by large 16-pane windows, was a sash and door manufactory. Later photographs indicate that there were two single-storey sheds to the south, and single and multiple-storey ancillary buildings to the rear of the cutting halls. These included the engine room and a detached brick boiler room (*NZ Herald* 12 Nov. 1879:3) with a tall brick chimney. A long wharf projected out into the bay at the front of the mill.

The wharf was apparently the first piece of infrastructure to be built and was 'carried out in a most creditable manner by Mr Lowe, ship-wright, of Auckland with native labour' (*Auckland Star* 25 Sept. 1878:2). It was 447 ft (136.6 m) long and was constructed from 16 inch (0.4 m) piles which ranged in length from 30 to 57 ft (9.1-17.4 m) long. A tramway was installed 'from the mill to the end' (*Auckland Star* 25 Sept. 1878:2). By 1892, the landward end of the wharf had been covered by a timber shed apparently to protect certain classes of timber from the weather (*NZ Herald* 12 March 1892:1).

Logs were held in a boom to the north of the wharf. From there they were floated along a channel and dragged by endless chain up a slipway into the cutting halls. Sawmill machinery included a twin circular saw and a horizontal German breaking down saw 'capable of taking a log eight feet in girth', ripping benches, planing machines, moulders, as well as a fruit box bench, and lath cutter (*NZ Herald* 12 Nov. 1879:3; 12 March 1892:1). The mill produced sawn timber as well as fruit box materials, broom-handles and staves, and by 1892 had 'attached to it some eight acres of ground, so that there is ample room for carrying on a large trade' (*NZ Herald* 12 March 1892:1). Photographs from the early 1900s show the mill surrounded by sawn timber stacks, including along the wharf, and large mounds of sawdust.

## ARCHAEOLOGY

An archaeological assessment by Johnson and Callaghan (2008) recorded off-cuts lying on the mudflats which were then layered with sawdust, rock, soil and other material including glass and ceramics. Recent field observation identified the following features on the foreshore and reclamation.

- Piles: Two squared piles located close to the road reserve and opposite the promontory (Figure 3). One pile is notched around its circumference, possibly for a mooring rope or similar.
- Wharf piles: Thirty rows of kauri piles (E-W) grouped in sets of four (N-S) extend 107 m from the road edge to the low water mark in the channel (Figure 3). These are the

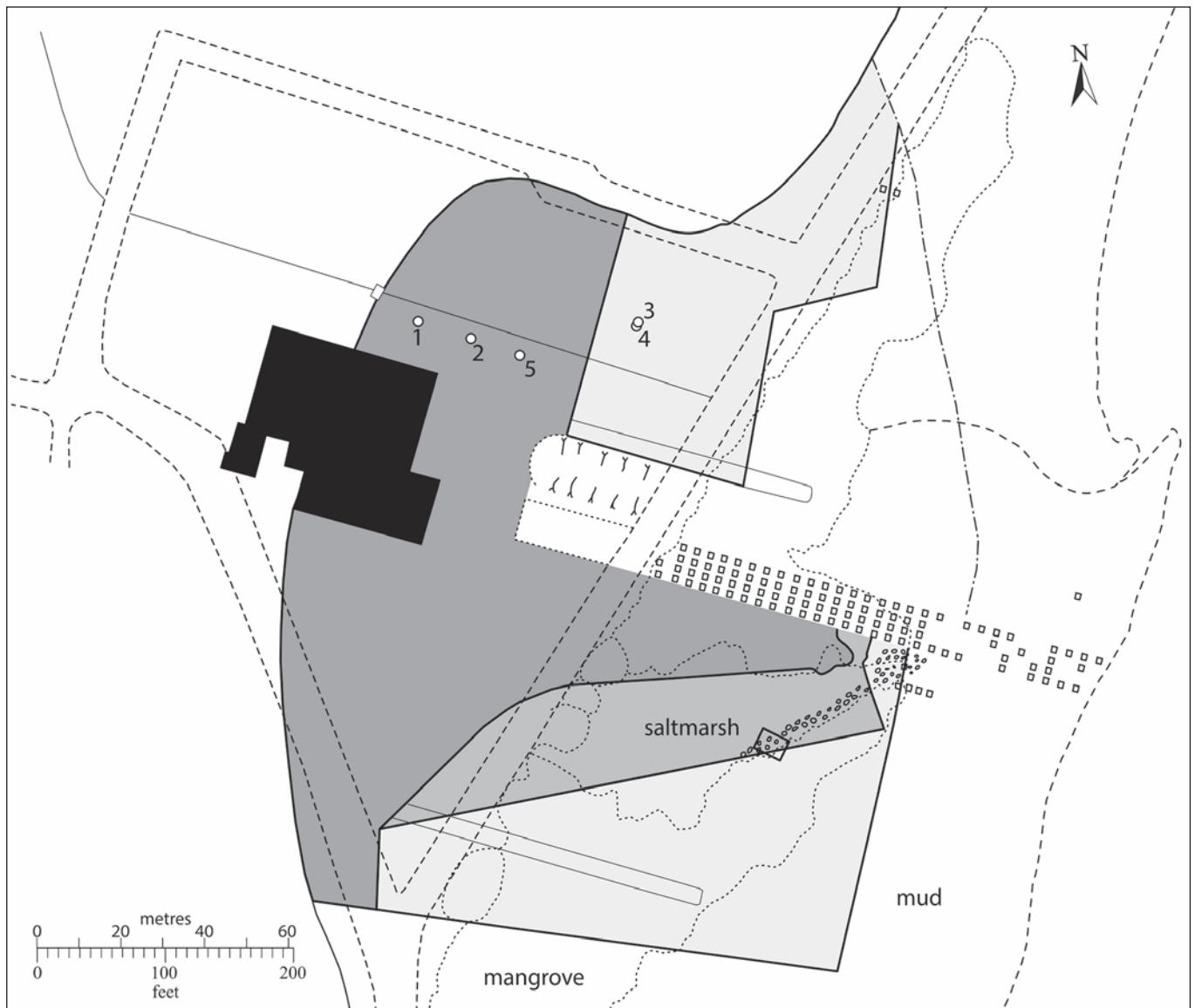


Figure 3: Location of the sawmill, wharf, two slab jetties and the reclamation. Reclamation expansion phases: 1878–1888 dark grey; 1888–1903 medium grey; 1903–1912 light grey. These were based on SO 3976 [1888], an unpublished KTC property map (1907), and SO 20286 (1918). Circles mark the location of boreholes. Access for sampling was restricted to a public path alongside the creek and the grounds of the fire station. The approximate location of the landward end of the wharf and log channel are indicated.



Figure 4: Kauri Timber Company mill at Kohukohu, Northland. Northwood brothers: Photographs of Northland. Ref: 1/2-029835-F. Alexander Turnbull Library, Wellington, New Zealand. Undated, but between 1903 and 1912, based on the extent of reclamation.

remains of the sawmill wharf and are a Category 2 Historic Place (HNZPT List 3947). It is estimated that the landward end of the wharf is located 30 m inland of the first visible row of piles. The piles are spaced 3.6 m apart N-S and 3 m apart E-W, with the top of the piles nearest the road c. 1.3 m above ground level. They are of boxed heartwood, typically measuring 400 x 400 mm (16 x 16 inches). All observed piles had pith present and some retained sapwood on the corners, indicating that they were cut from whole trees. Each pile has a N-S oriented tenon c. 400 mm long x 122 mm wide x 300 mm high. The east and west faces of the tenon have a centrally placed hole, 36 mm diameter. Some tenons also have a hole in the top, offset from centre, to receive a long iron spike (observed *in situ*). Twenty rows of piles are located in the mangrove zone and are in reasonable condition, but those in the channel proper are degraded with several posts rotted to the level of the channel muds. After 1888, the end of the wharf was altered to form a T-shape. One pile may be from this extension.

- Horizontal boards: Horizontal boards are attached to the wharf piles, at rows 18–20, spanning the gap between E-W orientated rows. These are at ground level, sticking out of the mud at low tide.
- Piles: One pile is located on the foreshore c. 5 m south of the wharf. A row of four piles, c. 9 m from the wharf, extend into the channel (Figure 3).
- Saltmarsh: Immediately south of the wharf is a roughly rectangular area of saltmarsh (c. 45 x 50 m) formed on sediment from the reclamation. The saltmarsh is characterised by sea rush (*Juncus kraussii*), salt marsh ribbonwood (*Plagianthus divaricatus*), glasswort (*Sacrocornia quinqueflora*) and an unidentified plant nicknamed ‘sea thyme’. Mangrove (*Avicennia marina*) trees, seedlings and pneumatophores occur in lower, damper areas. The saltmarsh is surrounded by tall mangrove on the north, east and south sides and abuts the road reserve on the west. Pohutukawa (*Metrosideros excelsa*) and introduced buffalo grass (*Stenotaphrum secundatum*) grow close to the road, in areas not submerged at high tide. At the boundary with tall mangrove on the north and south sides the sediments are exposed in an irregular erosion edge c. 300 mm high. The east side is bounded by a line of rubble.
- Rubble: A line of basalt, mudstone and greywacke rubble extends 45 m SW from the wharf. Close to the wharf are numerous large basalt rocks, scattered over several meters, as well as complete bricks and brick fragments intermixed with the stone. At the SW end the rubble deposit is 2.5 m wide (Figure 5).
- Small posts: The remains of three posts are located on the west edge of the rubble line (two shown in Figure 5 are ~1.9 m apart).
- Timber: A low quantity of timber boards and offcuts are present in mangrove mud north of the saltmarsh and protrude out of the erosion edge. The size of timber is variable and orientation mixed, like a lattice. Few timbers were observed in the main part of the saltmarsh but became common at the southern end of the rubble line. Close to the rubble, the planks were laid at an angle, abutting each other (Figure 5). South of the saltmarsh considerable quantities of timber protrude from the erosion edge and are present in mangrove mud. The timber was laid flat and close together. An N-S alignment was common, but material was also orientated E-W. Timbers in the mangrove mud were partially exposed or buried, indicated only by a linear alignment of mangrove pneumatophores growing between the boards. In all areas, timbers include rectangular planks, squared sections, slabs and offcuts. Allowing for degradation, dimensions are comparable to sizes of sawn timber produced for market.
- Boiler: The remains of a large boiler (approximately 5 m long and 1.2 m diameter) is located on the foreshore south of the saltmarsh, propped on wooden posts. It was made from curved metal plates riveted together. Plates have been lost from one side of the boiler and one end section only is still intact in the round. This section also retains an inner plate with large perforations. No nameplate or makers mark was observed.

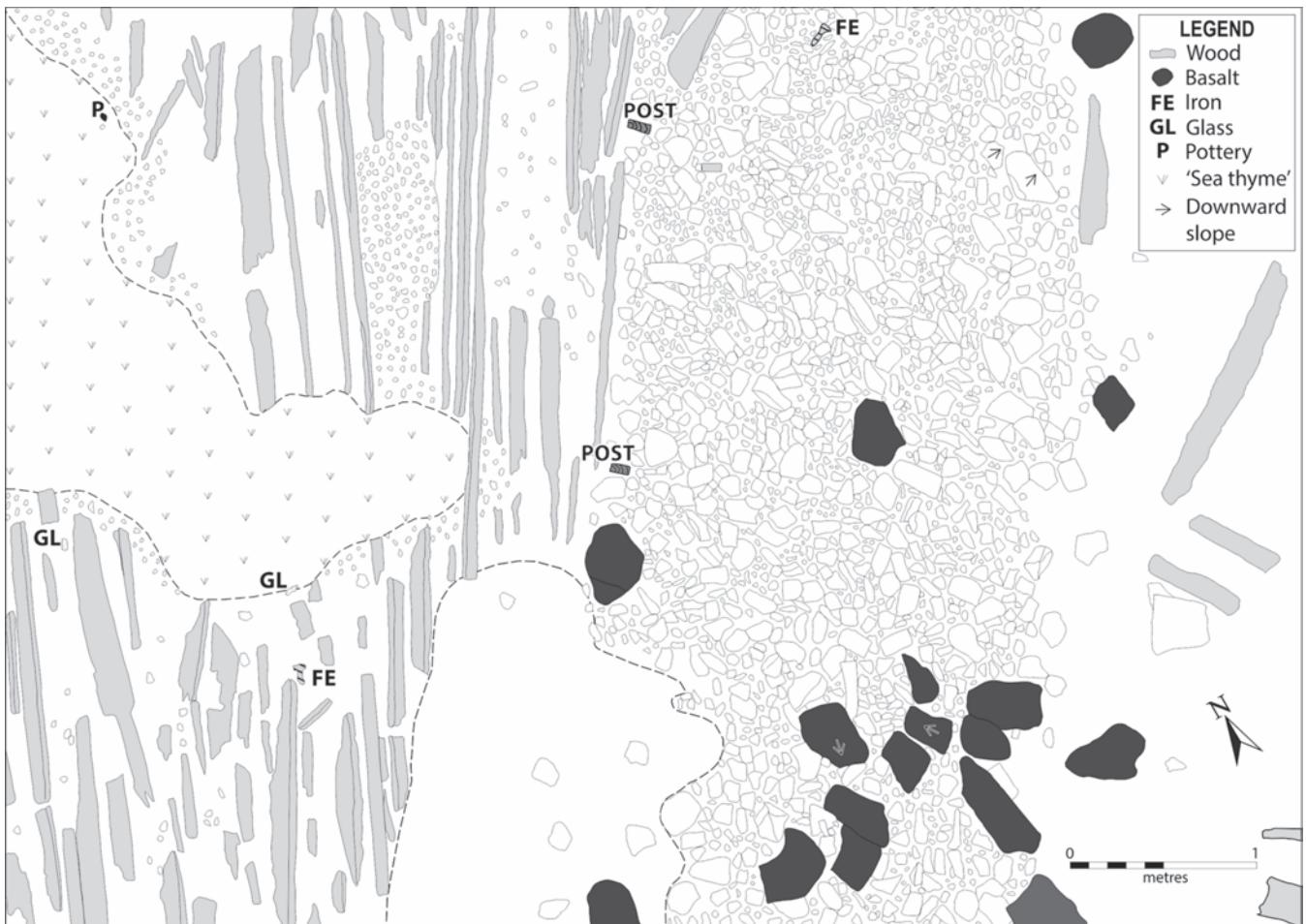


Figure 5: Rubble and timber planks on Kohukohu foreshore. The east edge was mangrove mud. Rubble was ~2.5 m wide and included large basalt rocks (dark grey). Two posts mark the west edge of the rubble. Planks (light grey) were laid on edge to the west (landward) of the rubble, with some partly covered by sediment and saltmarsh vegetation. A low amount of glass, pottery, and iron was observed. The lower mid-section was obscured by mangrove roots. Scale 1:20. Base plan by M. Jones, April 2015.

- Ceramic, glass, metal, and other objects: Ceramic, glass and metal surface scatter is present on the north edges of saltmarsh, along the rubble course, and in mangrove mud to the south, but rarely in the central area of the saltmarsh. Ceramic was not very common. Observed material included plain white ware, patterned ware (blue and white, red and white), a platter rim, and the top of a ceramic bottle. Glass was more prevalent and white, brown and black bottle glass was seen in all areas. One fragment of clear glass was embossed ‘Grey and Men[zies]’. Several bases and necks of heavy black bottles, as well as broken fragments, were located close to the boiler. Metal spikes, a metal strap and rectangular piece of metal were noted on the south side of the saltmarsh. There are several abandoned boats on the foreshore, as well car tyres and plastic bottles.
- Log channel: In the school playing fields a U-shaped depression was evident immediately north of the predicted location of the wharf, which corresponded to the position of the log channel (Figure 3).
- Bore holes: To establish the depth and composition of sediments on the former sawmill site, Munro (2012) augured bore holes on a council-owned strip on the south side of the Waihouuru Creek and at the rear of the fire station (Figure 3). At the latter site, sampling was restricted due to hitting wood less than a meter below the surface. In the council strip, estuarine sediments occurred approximately 2.5 m below ground surface (Figure 6). A 250–500 mm thick layer of sawdust and larger woody fragments sat directly above the estuarine sediment. Sawdust from the upper part of the layer was partly decomposed which may indicate exposure for some time before burial, but the lower levels were still ‘bright and yellow in colour’ (Munro 2012:47). Bore holes two and five had two layers of charcoal mixed with brick fragments and clay above the sawdust. These could be related to debris from the demolition of the mill in or after 1912 or may be from a later event. A sawmill and box manufactory owned by KDV Boxes Limited operated on the site in the 1930s but burnt down in 1937 (*NZ Herald* 2 April 1937:10). The woody layers were capped by clay ranging in colour from dark grey to light brown. Part of the clay cap at least may relate to modifications to the site carried out in the early 1970s which Park (2007) indicates occurred prior to construction of the school.

## GENERATION AND STORAGE OF SAWMILL WASTE

To date, little evidence has been found to suggest that any reclamation in the bay occurred prior to the construction of the sawmill, although further physical investigation would be required to test this. Photographs suggest that, until 1879, the stone bridge marked the edge of the foreshore and high water mark. Once the saws were running, waste material would have started accumulating. Production at a maximum capacity of 5 m sp ft (11,800 m<sup>3</sup>) by 1905 (Lee 1987) would have generated approximately 1.66 m ft<sup>3</sup> (4000 m<sup>3</sup>) of waste material per annum that required disposal. Offcuts could be used to fuel the boilers or be sold as firewood, but sawdust is less suitable for burning (Munro 2012) so had to be disposed of elsewhere.

## HOKIANGA SAWMILL COMPANY (1879–1888)

The HSC managed sawn waste primarily by using it to create flat land for working and stacking sawn timber, and for dumping sawdust (Figure 3). The boreholes and photographs suggest that north of the sawmill buildings, sawdust and

woody fragments were dumped directly on to the mudflats, probably behind a timber wall which extended from the end of the log channel to dry land. The shape of the reclamation south of the wharf strongly suggests that waste was dumped off the wharf, eventually forming a triangular area of infill. Much of the HSC-era reclamation directly south of the wharf has eroded, but low quantities of timber in the mud suggests that mixed waste was placed directly on the foreshore. No evidence of a retaining wall separating the waste dump from the channel was observed. However, the remains of planks attached to the wharf posts could be from a wall constructed to prevent waste escaping under the wharf and into the log channel.

## KAURI TIMBER COMPANY (1888–1912)

The KTC may have continued dumping waste on the original reclamation but between 1888 and 1912 the reclamation was expanded further into the channel (Figure 3).

**1888–1903:** Infilling appears to have occurred mainly south of the wharf. The rubble (excluding bricks) may have been deposited in the early 1890s, perhaps as ballast discharged when ships came to load timber. It is within an area proposed for reclamation in 1893, when the KTC applied to the Governor in Council for a licence to occupy part of the foreshore and land on which the wharf was erected (*NZ Gazette* 18 May 1893). Preparatory work may already have been underway as an 1892 travelogue mentions that ‘some reclamation work is being done to the frontage, ship’s ballast and sawdust being tipped in, so as to give space for further extensions of the works if required (*NZ Herald* 12 March 1892:1). The posts may mark a line for depositing ballast, with mill waste being dumped on the landward side (Figure 5).

**1903–1912:** In 1903 the KTC was awarded a licence by the Marine Department to increase its working area by reclamation north and south of the wharf. Terms were specified for reclamation: sawdust could be used but was not to be permitted to enter the harbour. It was to be covered by 12 inches of earth, and slabs were to be used to prevent sawdust and dirt escaping into the water (*NZ Gazette* 1903; Marine Department 1903a, 1903b). The latter point could mean a slab wall or laying down slabs on the mudflats.

North of the wharf part of the log boom was infilled (Figure 3). Most of this area is now under modern buildings and the road reserve so no observations of fill were possible. The two piles located opposite the promontory may be relics from a retaining wall and/or log boom. The KTC used the new reclamation for stacking sawn timber, with timber buildings situated on the northern edge.

South of the wharf, the reclaimed area was extended to form a square (Figure 3). The KTC followed the Marine Department conditions. Slabs and offcuts were laid on the mudflats forming the base of a ‘timber box’ built to contain the waste, with retaining walls on the east and (probably) south sides (from photographic evidence). Two of the five piles located south of the wharf may be relics of the east wall; the three other piles may have been for mooring ships (Figure 7). No features from the south retaining wall were observed in the mangroves. By 1912, 6 acres (2.43 ha) of flat land had been created, extending into the channel. The depth of fill across the reclamation appears to have been level with the top of the wharf, at least 1.3 m above the modern mudflats based on the height of the wharf piles nearest the road. Timber was stacked near the wharf and the remaining area was for higher mounds of sawdust and slabs. Positioning the main sawdust dump away from the mill buildings and close to water may have been a way to keep the working and stacking areas clear, and manage the fire risk.

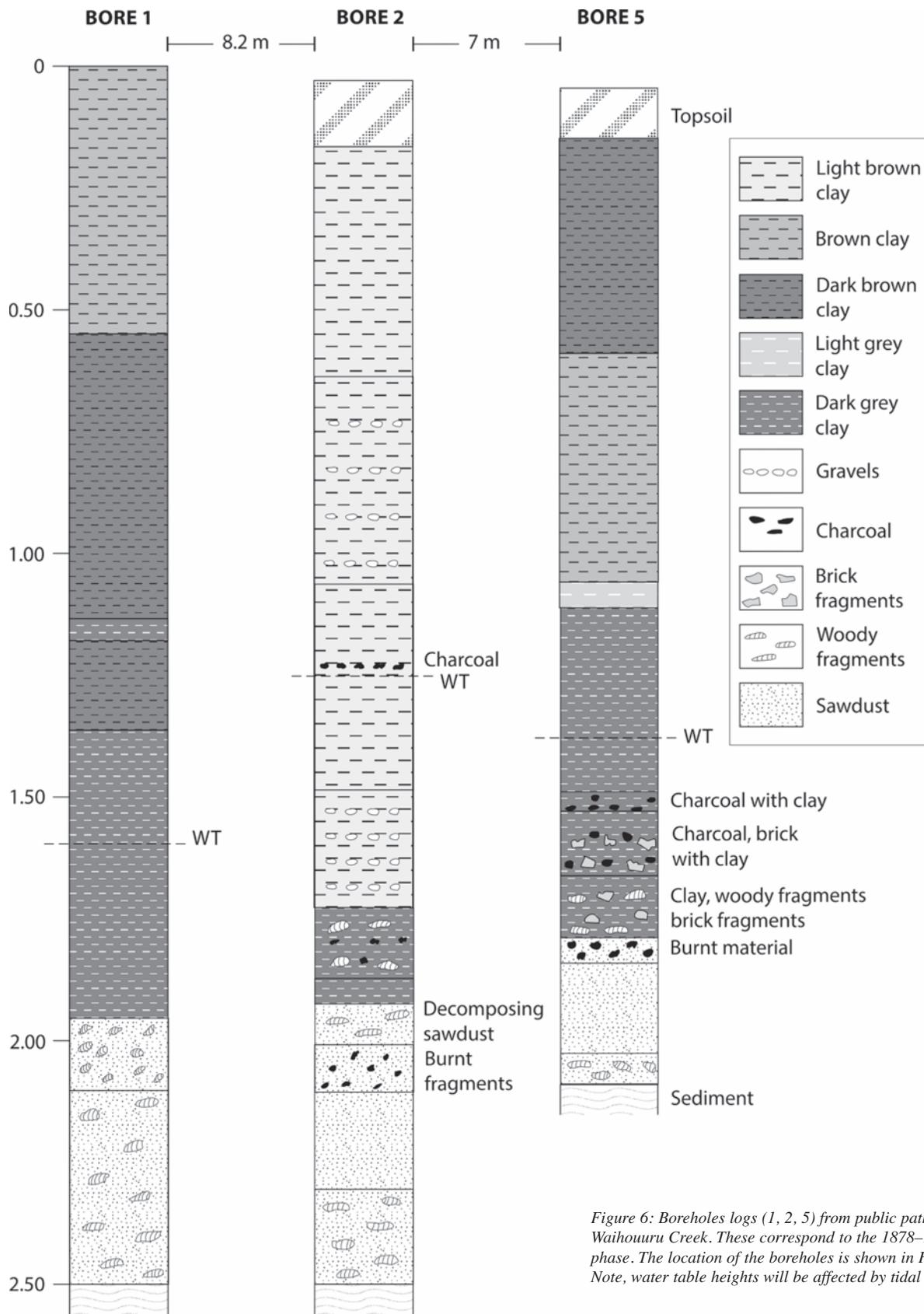


Figure 6: Boreholes logs (1, 2, 5) from public path adjacent to the Waihouuru Creek. These correspond to the 1878–1888 reclamation phase. The location of the boreholes is shown in Figure 3. Note, water table heights will be affected by tidal changes.

Household waste, such as ceramics and glass, occur in areas associated with each phase but does not seem to have been common. Observed material was on the surface and so may have been reworked by tidal action, and later deposition (e.g. of bottles) should not be discounted. The bricks close to the wharf warrant further investigation, as they could be from demolished mill structures such as the boiler house and chimney.

## DISCUSSION

Both the Hokianga Sawmill Company and Kauri Timber Company dealt with waste material by creating a reclamation. On one level, this may have been a pragmatic response to geography. The location of Kohukoku in the upper harbour, rather than on a fast flowing river or close to the sea, limited use of water as a means to carry waste away, whilst

reclamation compensated for hilly terrain and a limited working space. But the HSC and KTC were also subject to the law, specifically the *Harbours Act* of 1878, which placed restrictions on the deposition of ballast or rubbish and other material within the tidal zone, and the *Fisheries Conservation Act 1884*, which regulated against sawdust and sawmill refuse being released into any waters (fresh or salt water). The reclamation of coastal land came under the jurisdiction of the Marine Department who regulated reclamations. No evidence was found that the HSC was licensed to reclaim land. Licences granted to the KTC under the *Harbour Act* of 1878 included conditions for use of the foreshore and land on which the wharf was erected, and in 1903 detailed how reclamation should proceed (*NZ Gazette* 11 August 1892, 18 May 1893, 19 March 1903, 1 March 1906).

Reclamation is one way in which landscapes were rearranged to enhance their utility during the nineteenth century, and is a process which continues in the twenty-first century. The word ‘reclamation’ means ‘the conversion of wasteland, especially land previously under water, into land fit for use’ (OED 2015). Reclaiming land can be tied into enlightenment ideas of progress and improvement which were transported to New Zealand with European settlers. As Wynn (2014:127) writes, ‘the replacement of existing ecosystems by new forms of land use was taken for granted in the march of ‘improvement’’. The removal of forest was necessary to create a farm landscape and to produce the material used to build the new colony. Alongside this, swamps were drained and in the process ceased to be ‘waste’ and ‘wilderness’ (Park 2013). Like swamp land, tidal margins were wasteland to be improved by enclosure and conversion to pasture or, in urban coastal settings, to increase the availability of flat land for occupation by industry, business and port-related facilities.

At Kohukohu, reclamation had the dual benefit of converting waste material into something useful (lining and fill) and transforming non-useful mudflats into a productive, functional place. This action considerably improved the working area of the sawmill, creating a larger area for stacking sawn timber and a larger area for dumping sawdust. Deposition would have been ongoing except when the sawmill ceased work due to economic conditions. The use of sawn waste in this manner was not uncommon within the kauri district. Contemporary reports indicate that at Aratapu, Kaipara Harbour, sawdust was used to reclaim swampland (*Daily Southern Cross* 15 April 1876:3) and sawmill waste was apparently used in reclamations at Mechanics Bay and Freemans Bay in Auckland city (*Auckland Star* 19 Oct.1894; 16 Nov. 1894); all were locations of substantial sawmill and manufactory complexes. Such practices were not limited to New Zealand’s timber industry. In America, much of downtown Seattle is reputedly built upon land reclaimed by sawdust from what was the city’s first sawmill (Finger 1972:52).

Individual entrepreneurs were agents of change, transforming landscapes through industrial activities (Macready *et al.* 2012) whilst city-based companies also influenced the development of rural areas (Roche, 1990a). At Kohukohu, the progressive infilling of the bay was instigated by a combination of local entrepreneurs (Yarborough and Andrewes) in conjunction with a syndicate based elsewhere (HSC), and then continued by the KTC whose NZ headquarters were in Auckland. Most of the key players, therefore, did not live in the settlement and were not directly affected by changes wrought as a consequence of timber production. The local people did, however, have to live with the sawmill and its waste. Little evidence came to light from Kohukohu that the reclamation of mudflats using wood waste was perceived locally as harmful to the receiving environment. Sawdust and waste timber may have been a nuisance to people and the

reclamation a source of noxious smells – according to a somewhat tongue-in-cheek article in the *NZ Herald* (1891:6) ‘the reclaimed sawdust ground occasionally ferments, and we are told by medical gentlemen that the perfume arising therefrom is enough to give us typhoid fever ...’ – but there does not seem to be much commentary about waste as a problem until the early 1900s. The sawmill was an important source of work and income, and a means by which the settlement was advancing. In the years after the sawmill opened, Kohukohu gained a public hall, hotel, church, school, as well as a cricket club. The dominance of the industry in the town from 1879 until the early 1900s may have constrained complaint, but a combination of geography and town layout also meant that most domestic, social and economic activity took place on the margins of the complex so that direct impacts on people were likely limited.

Complaints from local bodies do, however, become evident towards the end of the life of the sawmill, when it was outgrowing its space and economic reliance on timber was weakening as farming developed. These concerned potential impacts on people and the harbour. In 1905, the KTC was warned about keeping sawn timber off public roads and keeping sawdust reclamations level with the roads (Davidson 1948), and there was concern that the company was exceeding the bounds of the reclamation. The latter was raised with the Marine Department in 1907 by Mr F.R. Phillips, although his specific complaint was that the continued reclamation into the river ‘was injuriously affecting his adjoining property’ (Marine Department 1908).

The State may have been more anxious about the impact of disposal practices on the receiving environment. Correspondence from 1907–1908, prompted by Phillips’ complaint, indicates that the Hokianga County Council (HCC) and Marine Department were specifically concerned about sawn waste entering the harbour (Marine Department 1908). Sawdust was a nuisance and potential threat to aquatic life as well as causing infilling of channels and being a navigation hazard. Specific conditions were imposed on how reclamation could proceed, and although the archaeological evidence indicates that the KTC adhered to these, in later years at least they do not seem to have taken due care to prevent sawdust and wood entering the water. Photographs from the early 1900s show that the south reclamation had a ‘bleeding edge’ of timber slabs, planks and sawdust (e.g. Figure 7). The company was advised to desist overstepping the bounds of the reclamation or risk losing their licence (Marine Department 1908). For the KTC, mitigation was through further reclamation. They argued that expansion would be a positive act, giving material improvement to the town’s port facilities thus being beneficial to the wider community, but the Marine Department declined the proposal (Marine Department 1908).

Elsewhere in New Zealand, discharge of sawdust directly into waterways was a common practice. It compensated for limited space for dumping or provided, from the sawmillers’ perspective, an efficient and economical means of disposal because sawdust would be carried away downstream or flushed out on the tide. As in mining districts, where there was tension over use of rivers as sludge channels (Hearn 2013; Lawrence and Davis 2014), conflict occurred between users. Munro (2012) reports that West Coast, South Island, sawmillers and acclimatisation societies clashed over release of sawdust in rivers where salmon and trout had been introduced for sport fishing, and that pollution of rivers with sawdust remained a significant problem into the 1950s. He also describes how, in the early 1900s, as the Marine Department took action to control the KTC’s activities at Kohukohu, both the Coastwaiter and Maori were expressing concern over the release of sand ballast and sawn waste from the Mitchelson Timber Company (MTC) Ltd sawmill into



*Figure 7: The reclamation during demolition of the sawmill, probably 1912 or soon after. The remains of the cutting halls (partly dismantled) are in the mid-left of the image. Note the large mounds of sawdust and slabs on the south side of the wharf with material entering the water. Other images from 1908–1910 show a more ragged ‘bleeding edge’.*  
Photographer: C P Dawes, Sir George Grey Special Collections, Auckland Libraries, 1142-D230.

Whangape Harbour, Northland. In particular, Maori were worried about the impact that the pollution was having on the river and their fishing and pipi grounds (Marine Department, 1907–1919). The company director seemed unconcerned, and was quoted in a letter from the complainant as saying: ‘What do I care if this river is silted up for will not my time in Whangape River be soon completed, and as to their fish and pipis, what does it matter if they are destroyed’ (Marine Department, 1907–1919). Efforts at regulating sawmillers’ actions were variable. The Marine Department seems to have been ineffectual in enforcing the law at Whangape, as little appears to have been done by the MTC to repair breaches in retaining walls at that time or in succeeding years. The remoteness of sawmill sites from centres of power, and a lack of regard for Maori traditional rights by both owners and enforcers, may all have had an effect.

## CONCLUSION

The former sawmill site at Kohukohu demonstrates a utilitarian approach to dealing with wood waste the late 1800s and early 1900s. The immediate landscape of the sawmill was rearranged to create working spaces. Such modifications fit with other activities, such as the construction of tramways, dams, and canals, which facilitated the extraction and milling of trees. As surviving features on the foreshore show, sawdust was dealt with in a way that, post 1888, (mostly) met legislative requirements and complaints about sawmill waste appears limited in the 1800s. They became evident in the early 1900s and, although focused on local concerns, the timing coincides with an increasing national awareness of the wider environmental impacts of deforestation such as erosion and loss of bird life and unique forest systems.

The sawmill at Kohukohu was closed and demolished in 1912, and the machinery was removed. The full extent of the reclamation remained in place until the 1950s. By then the wharf had been stripped of its deck and the Kohukohu Road formed a divide between land and sea. The retaining walls were breached, enabling the residue fill on the seaward side of the Kohukohu Road to be washed away (Opus International Consultants Ltd 1926–1956). Perhaps the sawdust was in a condition no longer deemed hazardous to the harbour or navigation (shipping had also declined). On the landward side of the road, the reclamation was covered with a clay cap before it became the school grounds in the 1970s, as well other being

used for other facilities and services. It is beyond the scope of this paper to consider the engineering implications of such sites for development, except to note that some settling of fill may have occurred, especially around the log channel. Russell’s stone bridge, only parts of which are now visible, and the wharf piles in the bay are prominent archaeological features of the pre- and sawmill period. Other relics associated with the sawmill also survive, including the timber slabs, bricks and parts of a boiler, and the patch of saltmarsh on the foreshore. Yet, arguably, the main (local) legacy of the sawmill era is the infilling of Kohukohu Bay, resulting in a flat space which has become an accepted part of the town landscape.

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## Glossary

Superficial feet: a board feet measure, 12 inches x 12 inches x 1 inch.

## REFERENCES

- APPENDIX TO THE JOURNALS OF THE HOUSE OF REPRESENTATIVES 1905. The Timber Industry of New Zealand, C-6.
- AUCKLAND STAR 25 September 1878:2, 20 January 1887:3, 19 October 1894:2, 16 November 1894:8.
- BOSWIJK, G., D. MUNRO and M. JONES 2014 Tree-rings and transportation in the New Zealand kauri (*Agathis australis*) timber industry: Investigating the time lag from tree to building, *Dendrochronologia* 32: 245–255.
- CARTER, B. 1972 The Kauri Timber Company, MA thesis, University of Melbourne.
- COLONIST 1871 31 October 1871:3, 28 March 1878:3.
- CONNING, L., W. HOLLAND and N. MILLER 2004 *Natural areas of Hokianga Ecological District: Reconnaissance Survey Report for the Protected Natural Areas Programme*, Department of Conservation, Northland Conservancy, Whangarei.
- CYCLOPEDIA OF NEW ZEALAND [WELLINGTON PROVINCIAL DISTRICT] 1897, Stewart and Co., The Cyclopedias Company Limited, Wellington, <http://nzetc.victoria.ac.nz//tm/scholarly/tei-Cyc01Cycl-t1-body-d4-d49-d11.html>, retrieved 9 December 2014.
- DAILY SOUTHERN CROSS 15 April 1876:3, 2 May 1876:3
- DAVIDSON, W.S. 1948 The Settlement Of Hokianga 1820–1920. MA thesis, University of New Zealand.
- DIAMOND, J. and B. HAYWARD 1991 *Kauri Timber Days: A Pictorial Account of the Kauri Timber Industry in New Zealand*, Gordon Ell, The Bush Press, Auckland.
- EVENING POST 4 December 1865:2, 25 April 1867:1, 9 July 1878:1, 21 September 1878:2, 26 March 1881:2, 28 April 1893:1.
- FINGER, J.R. 1972 Seattle’s First Sawmill 1853–1969: A

- Study of Frontier Enterprise, *Forest History*, 15(4):24-31.
- HARRISON, E. 2007. *Kohukohu*. Tidal Publications, Hokianga.
- HAYWARD, B. and J. DIAMOND 1984. ‘Archaeology of the Kauri Timber and Kauri Gum Industries’ in J. Wilson (ed.) *New Zealand’s Industrial Past: Papers presented at a Seminar on Industrial Archaeology in New Zealand, Christchurch 29-30 March, 1983*. New Zealand Historic Places Trust, Wellington, pp. 16-19.
- HEARN, T. 2013. ‘Mining the Quarry’ in E. Pawson and T. Brooking (eds) *Making a New Land: Environmental Histories of New Zealand*. Otago University Press, Dunedin, pp. 106-121.
- HUTCHINS, D.E. 1919 *New Zealand Forestry: Part 1, Kauri Forests and Forests of the North and Forest Management*. Government Printers, Wellington, New Zealand.
- JOHNSON L. and E. CALLAGHAN 2008 Archaeological survey and assessment of the proposed Kohukohu Road rehabilitation, Kohukohu, Hokianga, unpublished report, Northern Archaeological Research, Auckland.
- KAURI TIMBER COMPANY 1912. Plans – Real Estate – The Kauri Timber Company. AC 66/12, University of Melbourne Archive.
- LAWRENCE, S. and P. DAVIES 2014 The Sludge Question: The Regulation of Mine Tailings in Nineteenth-Century Victoria, *Environment and History* 20: 85-410.
- LEE, J. 1987 *Hokianga*. New Holland Publishers, Auckland.
- LICHATOWICH, J. 1999 *Salmon Without Rivers: A History of the Pacific Salmon Crisis*. Island Press, Washington, DC.
- MACREADY, S., S.H. BICKLER and R. CLOUGH 2014 ‘Transforming Auckland’s Landscape: the role of the entrepreneur’ in M. Campbell, S. Holdaway and S. Macready (eds) *Finding our Recent Past: Historical Archaeology in New Zealand*. New Zealand Archaeological Association Monograph 29, pp. 167-190.
- MACKAY, D. 1991 *Working the Kauri: A Social and Photographic History of New Zealand’s Pioneer Kauri Bushmen*. Random Century, Auckland.
- MAHONEY, P. 1984 ‘Industrial Archaeology of the Timber Industry’ in J. Wilson (ed.) *New Zealand’s Industrial Past: Papers presented at a Seminar on Industrial Archaeology in New Zealand, Christchurch 29-30 March, 1983*. New Zealand Historic Places Trust, Wellington, pp. 11-15.
- MAHONEY, P. 1998 *The Era of the Bush Tram in New Zealand*, Transpress, Wellington.
- MARINE DEPARTMENT, 1903a *George Allport, for Secretary, Marine Department, Wellington – Kauri timber company – conditions under which further reclamation at Kohukohu will receive favourable consideration*. BBAO 5544 75/1 1903/58. Archives New Zealand/Te Rua Mahara o te Kāwanatanga, Auckland Office.
- MARINE DEPARTMENT, 1903b *George Allport, Secretary, Marine Department, Wellington – Kauri Timber Company – re additional reclamation in connection with their wharf at Kohukohu – instructions [memorandum]*. BBAO 5544 76/a 1903/234. Archives New Zealand/Te Rua Mahara o te Kāwanatanga, Auckland Office.
- MARINE DEPARTMENT, 1908 *George Allport, Secretary, Marine Department – Kauri Timber Company – re application to extend its reclamation at Kohukohu; F.R. Phillips – re his complaint Kauri Timber Company is putting sawdust and slabs beyond his line of frontage on his section [correspondence]*. BBAO 5544/106/a 1908/1005. Archives New Zealand/Te Rua Mahara o te Kāwanatanga, Auckland Office.
- MARINE DEPARTMENT, 1907–1919 *Letter from L. Howard to J.A. Millar, Minister for Marine, 12th October 1908*. BBAO 5544 A133 115/a 1909/1441. Archives New Zealand/Te Rua Mahara o te Kāwanatanga, Auckland Office.
- MARLBOROUGH EXPRESS 12 January 1878:3, 25 October 1905:3.
- MCLAREN, P.S. 1984 The tribulations of Antoine Ratte: A Case Study of the Environmental Regulation of the Canadian Lumbering Industry in the Nineteenth Century. *University of New Brunswick Law Journal*, 33:302-59.
- MUNDAY, D.L. n.d. *Hokianga. Kauri forest, Timber alongside the wharf*. [Kohukohu]. AMC PH-ALB-86, Auckland War Memorial Museum Collection, Auckland.
- MUNRO, D.C. 2012 Sawdust and Slabs: The Disposal of Sawn Waste from Colonial and Dominion-era Sawmills of New Zealand. MSc. Thesis, University of Auckland.
- NAPIER, A. 2009 Geomorphic Response of Headwater Streams to Kauri Driving Dam floods; Kauaeranga Valley, Coromandel Peninsula, MSc Thesis, University of Auckland.
- NAPIER, A., G. BOSWIJK and G. BRIERLEY 2009 Spatial History of kauri driving dam Placement in the Kauaeranga Valley, Coromandel Peninsula, *New Zealand Geographer* 65:171-186.
- NELSON EXAMINER AND NEW ZEALAND CHRONICLE 1871 ‘News of the Day’, 18 January 1871:2.
- NEW ZEALAND GAZETTE 11 August 1892:1152, 18 May 1893:658, 19 March 1903:791, 1 March 1906:667.
- NEW ZEALAND HERALD 19 December 1877:2, 5 March 1879:2, 9 April 1879:3, 20 October 1879:8, 12 November 1879:3, 6 December 1879:6, 25 October, 1883:6, 17 July 1887:1, 25 April, 1887:12, 27 July 1891:6; 21 August 1891:6; 12 March 1892:1; 2 April 1937:10.
- NEW ZEALAND TABLET 1883 ‘Page 12’, 29 June 1883:12.
- OPUS INTERNATIONAL CONSULTANTS LTD 1926–1956 *Kohukohu Reclamation* [correspondence] ZACE 14959 78/f 24/2. Archives New Zealand/Te Rua Mahara o Te Kāwanatanga, Auckland Office.
- ORWIN, J. 2004 *Kauri: Witness to a Nation’s History*. New Holland, Auckland.
- OTAGO DAILY TIMES 5 January, 1874:4; 6 January 1874:3.
- OTAGO WITNESS 1884 ‘Advertisements’, 5 January 1884:5.
- OXFORD ENGLISH DICTIONARY 2015. Oxford University Press.
- PARK, S. 2007 Stone Bridge, Kohukohu Road, Waihouuru (or Waihoura) Stream, Kohukohu. Registration Report, New Zealand Historic Places Trust.
- PARK, G. 2013 ‘Swamps which might doubtless easily be drained’: Swamp Drainage and its Impact on the Indigenous’ in E. Pawson and T. Brooking (eds) *Making a New Land: Environmental Histories of New Zealand*. Otago University Press, Dunedin, pp. 174-189.
- PERRY, G., J.M. WILMSHURST and M.S. McGLONE 2014 Ecology and long-term history of fire in New Zealand. *Journal of New Zealand Ecology* 38 (2):157-176.
- ROCHE, M.M. 1990a The New Zealand timber economy, 1840–1935. *Journal of Historical Geography* 16(3): 295-313.
- ROCHE, M.M. 1990b *History of New Zealand Forestry*. NZ Forestry Corporation in association with GP Books.
- REED, A.H. 1953 *The Story of the Kauri*, Reed, Wellington.
- REED, A.H. 1967 *The New Story of the Kauri*, Reed, Wellington.

- SIMPSON, T.E. 1973 *Kauri to Radiata: Origin and Expansion of the Timber Industry of New Zealand*, Hodder and Stoughton, Auckland.
- SOUTHLAND TIMES* 18 May 1874:3, 15 January 1887:1.
- STOKES, E. 2013 ‘Contesting Resources: Maori, Pakeha and a Tenurial Revolution’ in E. Pawson and T. Brooking (eds) *Making a New Land: Environmental Histories of New Zealand*, Otago University Press, Dunedin, pp. 52-69.
- STONE, R.C.J. 1973 *Makers of Fortune: A Colonial Business Community and its Fall*, Auckland University Press/Oxford University Press.
- TAONUI, R. 2012 Muriwhenua tribes – Ancestors, Te Ara – the Encyclopaedia of New Zealand, Online: <http://www.TeAra.govt.nz/en/muriwhenua-tribes/page-1>, retrieved 17 November 2014.
- TE RUNANGA O TE RARAWA Online <http://www.terarawa.iwi.nz/te-rarawa-te-iwi.html>, retrieved 17 November 2014.
- THE PRESS* 5 January 1869:1, 8 December 1875:1, 2 March 1878:4, 5 November 1884:4, 18 November 1884:4, 8 March 1886:1.
- THORNTON, G. 1982 *New Zealand's Industrial Heritage*, Reed, Wellington.
- WELLINGTON INDEPENDENT* 1866, ‘Advertisements’, 30 January 1866:4.
- WILTON, D. 2014. Kauaeranga Kauri Logging: A Few Interesting Sites Recently Recorded. *Archaeology in New Zealand*, 57:39-51.
- WILTON, D. and L.Z. SOLTANI 2013. Tram or Dam? A Comparison of Kauri Logging Transportation Methods in the Kauaeranga Valley, New Zealand, 1871–1928. *Australasian Historical Archaeology*, 31:78-87.
- WYNN, G. 2013 ‘Destruction under the Guise of Improvement? The Forest, 1840–1920’ in E. Pawson and T. Brooking (eds) *Making a New Land: Environmental Histories of New Zealand*. Otago University Press, Dunedin, pp. 122-138.
- YARBOROUGH, G.F.C. 1877 *Kohukohu, December 1877*. Loose watercolours from scrapbook at E-881-f 1878 and later. ATL A-054-024-1, Alexander Turnbull Library, Wellington.
- YARBOROUGH, G.F.C. 1878a *Kohukohu [1877–1881?]* Scrapbook of watercolours, prints and photographs, 1878 and later. ATL E-881-f-035-1, Alexander Turnbull Library, Wellington.
- YARBOROUGH, G.F.C. 1878b *The old butcher's shop, Kohukohu [1877–1881?]*. Scrapbook of watercolours, prints and photographs, 1878 and later. E-881-f-039, Alexander Turnbull Library, Wellington.