Mechanising Fibre Production
The New Zealand Flax Mill Project

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Abstract

Flax has a long history of use in New Zealand. It was a crucial source of fibre in traditional Māori society, and later sparked the interest of shipborne Europeans, always on the lookout for fibre to make rope. Characteristics of New Zealand flax (*Phormium tenax*) made it difficult to process by methods used in the northern hemisphere and it was not until the invention of specialist machinery and adaptation of powered mills in the mid-19th century that it became possible to sustain commercial levels of production. This thesis provides the first attempt to document the archaeological footprint of this industrial phase of production, which endured through multiple highs and lows, largely in correspondence with global periods of war, from 1860 when the first mill was established, to the 1970s when the last mills closed.
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Chapter One: Introduction

The production of New Zealand flax fibre (*Phormium tenax*) has a long and fluctuating history. Flax was an integral resource in traditional Māori society and was one of New Zealand’s earliest trade commodities following the arrival of European explorers in the late 18th century. This early flax trade later grew into a fully mechanised industry from the 1860s onwards which saw the establishment of hundreds of flax mills nationwide (Figure 1). The industry experienced a series of highs and lows before ultimately collapsing in the mid-20th century. Since then the flax fibre industry has largely been forgotten by history and little research into the industrial subject has been conducted.

![Figure 1. Pownall and Co's Flax Mill at Foxton, circa 1870. (Digitisation ID: 2015P_Fx72_011260, Palmerston North Libraries and Community Services).](image-url)

New Zealand flax mills were simple and utilitarian by nature. Each mill typically had basic buildings made of iron and timber materials which housed the specialist milling equipment (Figure 1). Conceptually the mechanical process was simple. The harvested flax was fed through a stripping machine which extracted the strenuous fibres. It was
then washed, dried, and fed into a scutching machine that combed the fibres smooth, before being baled and exported for the manufacture of rope, twine, and cordage. While influenced from other fibre extractive industries found around the globe, the New Zealand flax fibre industry developed independently and has its own unique technological components. Therefore, the flax milling industry provides a unique opportunity to investigate the technological development of an historical industry specific to the New Zealand context.

Research Aims
This thesis aims to provide an historical and archaeological analysis of flax mill sites of the late 19th and early 20th centuries in New Zealand in order to build an understanding of the development of the historical industry. It will investigate the history of flax milling in New Zealand to provide a background to the industrial subject and examine archaeological sites to compile a record of the surviving material remains associated with the historical industry. Further investigation into technological developments and socio-economic themes will also be pursued and are specified below in the form of research questions:

- How and in what way does the physical record of New Zealand flax mills represent technological change over time?
- What are the wider changes within the socio-economic context of flax fibre production in New Zealand as represented in the archaeological and historical record?

The Archaeological Approach
Archaeology is fundamentally the study of the human past through the investigation of material culture, therefore building upon our knowledge of heritage through physical remains. While archaeology is typically associated with studying the distant past, the core methodology of archaeology in theory allows for its application through until the present day. New Zealand law (Heritage New Zealand Pouhere Taonga Act 2014), however, defines an archaeological site as:
Any place in New Zealand, including any building or structure (or part of a building or structure), that was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand (HNZPTA, 2014: Section 6).

The majority of the physical remains surveyed within the context of this thesis do not fall under the classification of an archaeological site as defined by New Zealand law, despite being of historical significance. However, some surveyed sites are registered as Heritage Places with Heritage New Zealand, and many sites investigated through Site Record Forms date to pre-1900. Although not necessarily discussed in depth, an important stance taken in this thesis is that archaeology should not be defined by an arbitrary date and instead should be employed as a tool to add to our collective knowledge of the past, no matter how recent.

**Industrial Archaeology in New Zealand**

The archaeological investigation of flax mills comes under the broad field of industrial archaeology, which is sub-discipline of historical archaeology. It is therefore necessary to briefly review literature relating to industrial archaeology and consider how the framework fits in the New Zealand context.

The historical industries of New Zealand during the 19th century were pioneering and innovative by nature. They were often small scale, remote, and limited in human, capital, and technological resources, unlike their British counterparts. In many cases they were experimental, inventive, and crucial for the success of early townships. As New Zealand became progressively colonised by European settlers over the mid to late 19th century these pioneering industries gradually grew and ultimately led to the establishment of an industrialised society and economy. Investigating these processes of historical industrialisation is important for understanding historical changes that led to New Zealand becoming the modern developed country that it is today.
The term ‘industrial archaeology’ originated in Britain during the mid-1950s. It was coined by Donald Dudley, head of the University of Birmingham Extra-mural Department, and was first put into print in 1955 by Michael Rix, a member of the same department, in *Amateur Historian* (Minchinton 1983:125). The article, titled ‘Industrial Archaeology’, was concerned with the learning potential of physical industrial remains and their state of neglect (Palmer and Neaverson 1998:1). However, it did not define the new term. Rix later stated that industrial archaeology simply constituted “the study of the early remains produced by the Industrial Revolution” (Hudson 1965:12). However, following this basic and somewhat temporally restrictive definition, and due to the interdisciplinary nature of industrial archaeology, there have been multiple subsequent attempts at defining the framework. Hudson (1979:2) stated that “Industrial archaeology is the discovery, recording, and study of the physical remains of yesterday’s industries and communications.” This definition places primary emphasis on the physical remains of the industries themselves.

In contrast others take a broader approach including aspects of social history. For example, Buchanan (1974:19-20) argues that “Industrial Archaeology is concerned with an examination of this process of industrialisation through a systematic study of its surviving monuments and artefacts.”, while also aiming to “assess the significance of these monuments in the context of social and technological history.” Therefore, although still using the physical remains of industry for archaeological interpretation, Buchanan maintains the need for a social context to allow for the inclusion of the human experience. Following this perspective, industrial archaeology has grown to become a broad discipline that encompasses investigation into buildings, machinery, and structures, as well as landscapes, townscapes, and workers accommodations (Palmer and Neaverson 1998; Caffyn 1983; Crosby, Garwood, Corder-Birch 2008). It therefore extends beyond the immediate location of an industrial worksite to include the associated community and social context.

As described above, archaeological investigations into historical industries are traditionally related to physical evidence in Europe dating to the Industrial Revolution (ca 1760-1840). However, for New Zealand, and many other colonies, the movement from craft specialisation to industrial production falls outside of this time period. Therefore, the industrial archaeology of New Zealand exists within a different context.
to that of the British industrial archaeology and does not comply with some traditional definitions of the framework. Instead, industrial archaeology in New Zealand is recognised as a broad sub-discipline of historical archaeology, concerned with the physical remains and associated social history of local industries.

Important texts on New Zealand’s industries include Thornton (1982) and Smith (2001), which although useful, are largely descriptive. Wilson’s 1984 *New Zealand’s Industrial Past* conveniently provides a compilation of papers presented at a conference on the topic of industrial archaeology. However, a key critique of the compilation, among other sources, is that much of what has been titled ‘industrial archaeology’ is again largely descriptive and lacking in archaeological evidence and should instead be referred to as “industrial heritage” (Smith 1990:86).

Investigations which do engage with archaeological evidence are partial and include research into the basic physical remains, the industrial process (Clough 1991), associated social history (Hill 1999; Watson 2016), industrial elements (Petchey 1996), and industries as a whole (Mitchell 2012; Petchey 2013; Twohill 1984). However, to date, industrial archaeology in New Zealand is still largely limited.

**Research Methods**

In order to successfully achieve its research objectives this thesis employs the use of both field and paper-based survey methodologies. A total of 74 archaeological sites are investigated, with nine being physically surveyed (Appendix One). Additionally, numerous avenues of historical research were undertaken for the purposes of this thesis.

**Historical Research**

The first important methodological step of this research project was to conduct a survey of historical information relating to the New Zealand flax milling industry. This included an investigation of literature directly related to archaeological sites, such as archaeological site record forms and Heritage New Zealand registration reports, as well as supplementary historical information from either archival sources or general
histories that provided broader material relating to the flax milling industry. Archival sources such as Archives New Zealand, the Hocken Collections Archives (Uare Taoka o Hakina), the Palmerston North City Council Archives, Paperspast (paperspast.natlib.govt.nz), and Statistics New Zealand (www.stats.govt.nz) were used and provided imperative primary and secondary information. Additionally, the Templeton Flax Mill Heritage Museum and the Foxton Flax Stripper Museum provided specialist knowledge in relation to the industry and sites surveyed.

ArchSite
ArchSite (www.archsite.org.nz), the New Zealand Archaeological Association’s archaeological site recording scheme website provided site record forms (SRFs) for the recorded flax mill sites throughout New Zealand. A total of 66 flax mill sites were found to be recorded (as of March 2018) and were considered for the purposes of this thesis. An additional 8 sites were recorded (June 2019) on ArchSite as a result of this research, increasing the total flax mill sites recorded and investigated to 74.

Site Selection Representativeness, and Sample Bias
Information gained from ArchSite, Heritage New Zealand, historical data, and local knowledge, was used for the selection of flax mill sites for survey. Sites were selected for surveying largely based on the amount of surviving physical remains and the accessibility to the site. Therefore, sites with known buildings and substantial physical remains were prioritised to ensure enough data was collected for the purposes of this thesis. A total of nine sites were selected for survey based upon these criteria. The investigation of further sites was found to be unachievable due to both time and resource constraints.

The exact number of flax mills to have been in operation in New Zealand throughout history is unknown as the number fluctuated in response to market trends and profitability. According to the New Zealand Official Year Book (Stats NZ) the first (1869-1873) and second (1888-1893) peaks in trade saw the operation of 161 and 171 mills respectively, but the most to be working contemporaneously was during the third major boom in trade (1898-1907) when over 240 flax mills were in operation.
(NZOYB). These statistics may not account for all the flax mills to have been in operation during those periods and when considering the reuse and recycling of flax mills and their components calculating how many mills were ever in operation becomes increasingly unachievable. However, with 74 recorded flax mills sites (as of June 2019), and many of those lacking visible physical remains, it is evident that only a small portion of sites survive. Of these 74 sites 9 have been surveyed, accounting for over 10% of the available dataset, which is a satisfactory sample size given the available material and constraints of this thesis.

This research is unlikely to provide a fully representative sample of New Zealand flax mills due to unavoidable sample biases. As discussed above, the survival rate of flax mill sites in New Zealand is low and of those surviving sites many are in poor condition. Most flax mill sites consist of concrete foundations, machinery scatter, and other robust evidence, biasing the physical remains available for surveying. Additionally, only six sites were found to have complete surviving buildings, all dating to the post-1900 period, and only one site is known to be in an operational condition. Overall, the majority of sites, especially those with the most complete physical remains, dated to either the late 19th or early 20th century. Furthermore, of the sites physically surveyed for this thesis only three were founded prior to 1900 and each operated into the 20th century. It is important to consider that mills are likely to have undergone change or modification over the course of their use and are a record of how they were when they ceased operation. Therefore, the data collected for this thesis is biased towards more modern sites and features. However, this was unavoidable due to the lack of surviving early sites with adequate physical remains available for survey.

Finally, the locations of flax mill sites surveyed is an unavoidable biasing factor that needs acknowledgement. Due to both time and resource constraints surveying was limited to four of New Zealand’s sixteen regions. Therefore, it is plausible that there are inbuilt spatial or regional biases within the dataset. While this research may not provide a fully representative sample of flax mills it is the best approach given the surviving evidence and available time and resources.
Site Survey

From the 74 recorded flax mill sites (Appendix One) nine were selected for physical survey. Of the sites physically surveyed four are located in Manawatū, two in Marlborough, two in Southland, and one in Otago. These sites will be discussed further in Chapters 4 and 5.

The investigation into these selected sites consisted of a non-invasive site survey. A measured sketch or baseline offset map was made for each site and GPS coordinates were taken from Google Earth where necessary. Detailed notes were taken on the machinery, buildings, and any other features, and each site was thoroughly photographed. Following the field survey Adobe Illustrator was used to digitise baseline offset maps made of the flax mill sites, foundations, and buildings. Additional maps showing the location of flax mill sites were created in GIS (Geographic Information Systems). The evidence gained from the sites surveyed, and supplementary information provided by SRFs, will be compared and discussed in Chapters 5 and 6.

Thesis Structure

Chapter Two provides a comprehensive chronological background, detailing the development of the industry to give a broader historical context of flax milling in New Zealand. Chapter Three describes the New Zealand flax milling process and associated features of flax mills in order to provide a technological background. Chapter Four describes the historical backgrounds of the individual archaeological sites surveyed for this thesis. Chapter Five examines the results of the site surveys by comparing mill elements and features. Chapter Six discusses and interprets the results of historical and archaeological survey, addressing the research aims and questions of this thesis. Chapter 7 considers the future research potential for both flax mills and industrial archaeology in New Zealand, before concluding.
Chapter Two: The History of Flax Fibre Use in New Zealand

This chapter aims to detail the history of New Zealand flax fibre use and production to set the broader historical background for this thesis. It begins by briefly describing the use of flax in traditional Māori society, early European interests in flax fibre, and the early flax fibre trade of the 1820s and 1830s. It will then more thoroughly detail the movement to the industrial production of flax fibre in New Zealand from the 1860s onwards and describe the subsequent development of the industry through until its collapse in the mid-20th century. Particular attention is paid to this later period, since it relates most directly to the archaeological remains surveyed in this thesis.

New Zealand Flax

New Zealand is home to two different species of flax; harakeke or New Zealand flax (*Phormium tenax*) (Figure 2), and wharariki or mountain flax (*Phormium cookianum*). Harakeke has long, broad, stiff, green leaves which spread out like a fan, and red flowers with large curved seed pods. In contrast, wharariki has softer, shorter leaves, green to yellow flowers, and has weaker fibres not suitable for commercial production. Therefore, further discussion of flax and fibre production within this thesis is in reference to harakeke (*P. tenax*).

Harakeke is endemic to New Zealand, the Chatham Islands, and Norfolk Island, and has been introduced to other offshore islands by either Māori or early Europeans (Wehi and Clarkson 2007:529). Belonging to the lily family (*Hemerocallidaceae*), harakeke is an evergreen, perennial, monocotyledonous plant. It is very robust and is found abundantly throughout New Zealand in a wide range of environments and soil types. It can tolerate periods of flooding or drought and recovers quickly from fire damage. However, it is vulnerable to yellow leaf disease and other insect transmitted infections. The indigenous plant gained its now common name (flax) when early European traders saw Māori using the natural fibres of the plant and recognised their similarity to the European linen flax, however, the two plants are not related. New Zealand flax
leaves have bundles of sclerenchyma fibres bonded together by hemicellulose and lignin, making the leaves hardy and difficult to process (Wehi and Clarkson 2007:522). The bonds can be broken by boiling or exposure to alkali solutions, allowing for the extraction of fibre (Wehi and Clarkson 2007:522). The natural fibres extracted from harakeke are one of the strongest in the world (Wardle 1991:310).

Figure 2. Flax Bush (*Phormium tenax*).
Traditional Māori Uses

Flax was a key resource in traditional Māori society and almost all parts of the plant had a use. The sap was used for medicinal purposes, flax nectar sweetened food, the leaves could be used to wrap wounds or stabilise broken bones, the juice from the plant acted as a disinfectant, and fibre was extracted from the leaves for weaving (Bidois, Taylor, Bargh 2015: 15). Throughout New Zealand there are over 60 known varieties of harakeke which were cultivated by Māori for their strength, colour, fibre, softness, or other uses (Clarke 2007:202). Each village had their own plantation, or pā harakeke, of different flax cultivars that was tended to by women. Flax was delicately cared for and was kept clear of dying vegetation, was never cut when raining or at night, and new seedlings were planted where they would receive the optimum amount of sunlight (Clarke 2007:206). Once the leaves were collected the fibre could be extracted by running a sharp mussel shell along the blade of the leaf, removing the epidermis and revealing the fibre (muka) underneath. Depending on the intended use the fibre may have then been rubbed, rolled, soaked, or beaten by a patu muka (flax beater) to soften the fibre.

The importance of harakeke extends beyond solely being a resource. The weaving of flax embodies histories, genealogies, and mythologies, and serves as an integral symbol of Māori identity. The plant itself is representative of a family unit, with the smaller inner leaves (rito) representing the children, the next layer representing the parents (awhi rito), and the outer leaves representing the grandparents (tūpuna). As such, only the outer leaves and mature middle leaves were cut for fibre production to ensure the growth of the plant for the future (Bidois, Taylor, Bargh 2015:5).
Early European Arrivals

In October 1769 Captain Cook and his crew onboard the Endeavor became the first Europeans to set foot in New Zealand. While their journey to the South Pacific had primarily been to view the transit of Venus, it doubled as an opportunity to further explore Australia and New Zealand, mapping their coastlines and documenting their flora and fauna. Cook and Banks both kept journals within which they described New Zealand's native harakeke. Banks noted that the fibrous New Zealand flax was the “most excellent” of hems and flaxes and stated the following:

“From these leaves also by another preparation of a kind of snow-white fibre is drawn, shining almost as silk, and likewise surprisingly strong; of this all their finer cloths are made: their fishing-nets are also made of these leaves, without any other preparation than splitting them into proper breadths and tying the strips together. So useful a plant would doubtless be a great acquisition to England...”

(Banks 1770:229).

Unbeknownst to Cook and Banks, their French maritime counterparts were also in New Zealand waters. The St Jean Baptise, captained by Jean François Marie de Surville, reached the western coast of New Zealand in December 1769 (L’Horne 1769:297). Like the British, the French kept extensive notes on the flora and fauna of New Zealand. Two of de Surville’s officers, Monneron and L’Horne, described the flax fibre clothing of the Māori as several mats sewn together, with exception to chiefly cloaks (L’Horne 1769:317-319, Monneron 1769:281). Monneron also stated that they observed “...some ropes made of excellent hemp.” (Monneron 1769:287). However, neither officer described the methods of fibre production, the flax plant, or the possibility for commercial production. Subsequent explorers continued to intermittently describe New Zealand flax and its indigenous uses.

Following these positive accounts of New Zealand flax by early explorers other subsequent early European peoples to visit New Zealand became interested in the plant’s potential. This led to a series of experiments, trials, and endeavours aiming to utilise the plant for European purposes. One of the most notable schemes from this period was the attempt to manufacture New Zealand flax fibre on the Norfolk Island
penal colony, established in 1787 (McNab 1914:78). This venture aimed to create a supply of natural fibre (hemp) for the British Navy and the abundant supply of flax on Norfolk Island was set to be capitalised upon. However, it was soon discovered that preparing New Zealand flax was difficult. It was unable to be stripped the machinery used for linen fibre production, and without specialist knowledge the European colonists were unable to successfully manufacture flax fibre. Consequently, in April 1793, two Māori chiefs, Tuki Tahua (a priest) and Huru Kokoti (or Ngahuruuru, a warrior) were kidnapped from the Cavalli Islands (McNab 1914:79). Though once they arrived at Norfolk Island it became apparent that Tuki and Huru did not know much about flax dressing, as it was traditionally women’s work, and the venture was subsequently abandoned.

Further attempts at developing a mechanised means of fibre production or establishing flax fibre trading stations and companies continued over the next several decades. While most of these ventures were unsuccessful, they lay the foundations for the flax fibre trade of the 1820s and 1830s, as well as the later mechanised flax fibre industry of the 1860s onwards. Further information from this period is comprehensively detailed in S. McCay’s (1952) *Phormium Tenax in New Zealand History* and R. Wigglesworth’s (1981) *The New Zealand Timber and Flax Trade 1769-1840.*

**The Flax Fibre Trade 1820s-1830s**

From the early 1820s onwards the New Zealand flax fibre trade began to gain traction. As a mechanical means of flax fibre production was yet to be successfully developed, the trade of the 1820s and 1830s relied on Māori production of flax fibre through traditional methods. European traders then purchased the prepared fibre and exported it, predominantly to Australia and Great Britain.

As this early flax trade grew so too did the interest in establishing shore-based trading stations and colonies. One of the earliest examples is Baron Charles de Theirry’s attempt to establish a colony near Hokianganga in 1823, where he claimed to have purchased a large area of land (McCay 1952:77). In addition to a settlement he intended to establish a factory for the purposes of fibre manufacture and trade flax,
however, his claims of land ownership were not validated, and the scheme quickly fell through (McCay 1952:78). Other examples of early flax trading schemes include those of Captain William Stewart, who in 1825 sought to establish two flax and timber trading stations in the north at either Hauraki or Hokiang, and in the south on Stewart Island (McCay 1952:78). The Stewart Island trading settlement was established in 1826, however, the initial trading voyages resulted in a trade deficit and the schemes were discontinued as they were no longer considered viable (McCay 1952:79).

Concurrently to Stewart’s settlement attempts, the newly founded New Zealand Flax Society also had aims of establishing a colony in New Zealand for the purposes of flax and timber trade. In 1825 the Society, later known as the (first) New Zealand Company, was formed in England (McCay 1952:79). The Company aimed to establish a settlement in northern New Zealand for large scale flax cultivation and fibre production, and to exploit timber resources for building materials (D’Urville 1826:192). In early 1825 the Company employed a group of Scottish settlers and set sail for New South Wales before continuing to New Zealand, reaching Stewart Island in March 1826 (McDonnell 2002:6). While on Stewart Island the settlers visited Stewart’s soon to fail colony (McCay 1952:79). After six weeks the group sailed up the east coast of New Zealand reaching the Bay of Islands in October 1826 (McDonnell 2002:6). However, upon hearing of a planned attack to their settlement by local Māori, the settlers were forced to flee (D’Urville 1826:192). They briefly relocated to the mouth of the Hokiang, but abandoned plans to settle once the advantages of settlement and trade proved non-existent and returned to New South Wales (D’Urville 1826:192). Therefore, the three main attempts of the mid-1820s to establish Pākehā colonies, permanent industry, and trading posts in New Zealand for the purposes of the flax fibre production had failed, as had those previously.

**Increase in Exports**

From 1828 onwards, the New Zealand flax trade, although somewhat irregular, gained momentum. An increase in Trans-Tasman shipping and positive British market forces created further commercial opportunities and a boom in the flax fibre trade emerged. There was a 25% increase in the volume of flax fibre re-exported out of New South Wales in 1828, followed by a 350% increase in 1829, and a further 123% increase in
1830 (Wigglesworth 1981:79). The peak in traded flax from New Zealand occurred in 1831 when 1240 tons of flax was imported to New South Wales valued at £26,004 (Wigglesworth 1981:79). Market prices in London also steadily increased and by August 1830 one ton of flax was being sold for £45 (Sydney Gazette 24 August 1830:2). During this peak most trading vessels returning from New Zealand were carrying substantial cargoes of flax (Sydney Gazette 24 August 1830:2). Additionally, other trading vessels such as whaling ships, were trading in flax to supplement the remaining space in their cargoes (Sydney Gazette 24 August 1830:2). Therefore, the New Zealand flax trade was both opportunistic, and an established and viable commercial venture by this period.

**Trading Stations**

As the flax trade flourished, flax trading stations with resident agents were successfully established in New Zealand (Figure 3). In 1830, Phillip Tapsell established a trading post at Maketu in the Bay of Plenty (Thornton 1982:13). Local Māori moved into swamplands to increase flax fibre production for the trade, which saw products regularly exported to New South Wales (Thornton 1982:13). Shortly afterwards in early 1831, a trading station was established at Turanga (Gisborne) by Sydney merchant Henry Donnison (Wigglesworth 1981:96). This station employed five to six men and prospered for many years (Wigglesworth 1981:96). Additionally, well-known historical figure Barnet Burns was to establish his flax trading business on the East Coast at Mahia during this period.

By the early 1830s, the Bay of Islands, Hokianga, Thames, the Bay of Plenty, Taranaki, Kawhia, Port Nicholson, Cloudy Bay, Kapiti, Banks Peninsula, and several other places had become major exporting points for flax fibre (Figure 3) (Wigglesworth 1981:94). An estimated 50-100 stations serving the flax trade were established during this period, and large buildings were built by Māori for the purposes of storing prepared flax fibre for later trade (Wigglesworth 1981:91-93). Therefore, the industry had finally found its footing, but it was by no means stable.
Decline in Trade

The prosperity of the early New Zealand flax trade was short lived; following the boom years of 1830-1831, and a brief resurgence in 1834-1835, the trade essentially collapsed. The wealth of the trade had attracted many inexperienced traders resulting in an inconsistent supply and quality of products. This then led to product rejection in Britain and lowered the market price of New Zealand flax fibre. In late 1831, the price for fibre in London almost halved, decreasing from £30-£32 in September, to £16-£25 by the end of the year (Wigglesworth 1981:82). This decrease market prices soon reached New South Wales and left many voyages unprofitable. Concurrently, Māori capitalised on the desperation of Europeans to trade and bargained for higher prices.
or refused to prepare flax. This led to an increase in traded guns and ammunition, further fuelling the raging Musket Wars, which had been enabled by earlier trade. The newly prosperous flax trade came to an abrupt halt and despite some continued enthusiasm for the industry, it would not become re-established until the 1860s.

**Development of Mechanisation: 1840s-1860s**

Following the European settlement of New Zealand after the signing of the Treaty of Waitangi in 1840, there were renewed endeavours to establish a permanent and profitable flax fibre industry. An important cause of this returned enthusiasm was the emergence of the New Zealand Wars, which saw the relationship between Māori and Pākehā sour, bringing an end to the trade in hand processed fibre. As such it was necessary to invent specialist flax dressing machinery for trade to endure.

Various proposals and rewards were put forward to encourage the development of machinery and establishment of factories for the flax fibre trade in New Zealand (*Nelson Examiner* 9 January 1841:1, *New Zealand Gazette* 12 December 1840:2). This encouragement and general enthusiasm at the time led to an increase in innovation and attempts to establish profitable mills (*Nelson Examiner* 16 November 1844:2, *New Zealand Gazette* 30 September 1843:2). For example, in 1851, Mr F. J. M’Glashen built a flax mill and other buildings at a cost of £400 on leased land at Wakapuaka, Nelson (*Nelson Examiner* 31 May 1851:58). There is little description of the mill, however, it was driven by a water wheel and by 1853 was in a state of disrepair (*Nelson Examiner* 20 August 1853:5). During the same period Baron Charles de Thierry established a flax mill at Mechanics Bay in Auckland (*New Zealander* 1 September 1855:2). The building was originally a flour mill and the flax working machinery consisted of a large iron pot, used as a makeshift steam boiler, two wooden puncheons as steam chests, and the frame of an old crab winch, which had fitted metal rollers to act as a flax pressing machine (*New Zealander* 1 September 1855:2). The process involved steaming the raw flax, pressing the softened leaves through the make-shift winch to extract the fibres, before washing and hanging out the fibres to dry (*New Zealander* 1 September 1855:2). Despite the praise and enthusiasm expressed for this method, it did not become popularised as it was inefficient and left the product discoloured.
In December 1856, the Government introduced £4,000 in monetary awards for the development of efficient and effective flax milling machinery. The monetary awards and conditions were as follows:

“£2,000—To the person who shall, by some process of his own invention, first produce from the phormium tenax or other fibrous plant indigenous to New Zealand, one hundred tons of merchandise.

£1,000—To any person, other than the person entitled to the first reward, who shall by some process of his own invention, next produce from the phormium tenax, or other fibrous plant indigenous to New Zealand, one hundred tons of merchandise.

£1,000—Viz.: —£200 to each of the first five persons, other than those entitled to the first and second rewards, who shall by any process, whether of his own invention or not, produce from the phormium tenax, or other fibrous plant indigenous to New Zealand, twenty-five tons of merchandise.”

(Nelson Examiner 24 January 1857:3).

The merchandise had to be saleable, reasonably priced, and the methods had to be made known to the public (New Zealand Gazette 25 March1859:3). Initially, each claim for the above rewards had to be submitted in writing before the 1st of January 1860 to the principle officer of Customs at the nearest port of entry, where an examination would take place to determine the validity of the claim (New Zealand Gazette 25 March 1859:3). Despite many claims for the Government prizes being submitted, none were judged to comply with the conditions of the award (Hawke’s Bay Herald 30 June 1860:3). This led to an extension of the due date for submissions to the 1st of January 1864 (Wellington Independent 8 November 1861:4). However, by 1867 the prizes were yet to be claimed, as all previous submissions had been found to be defective by some extent, and it is unclear whether the prizes were ever awarded (North Otago Times 19 November 1867:3).

These Government awards, although likely never allocated, caused a flurry of innovative activity resulting in the development of reliable and economical flax dressing machinery and the establishment of mechanised flax mills in New Zealand. In 1860, Mr A. G. Purchas and Mr J. Ninnis set up a flax mill at Waitangi Creek, Waiuku,
south of Auckland (Lowe 2009:9). Their mill was powered by water wheel and housed three flax stripping machines of their own invention (New Zealander 21 August 1961:3). Their design was simple and based on the concept of percussion, where raw flax would be crushed between ridged beaters, stripping away the epidermis of the flax leaf, leaving behind the lengthy flax fibres for further processing (Figure 4). Their invention led to the passing of the “Purchas and Ninnis Flax Patent Act” which both protected their intellectual property and saw their machinery credited as New Zealand Patent No. 1 (Nelson Examiner 18 May 1861:5). The patent proved successful and by 1866, flax fibre produced by this method was sold at £37 per ton (Timaru Herald 11 July 1866:2). This marked the beginning of a new period in New Zealand flax fibre production and signified an important point in New Zealand’s innovative history. Following the granting of the Purchas and Ninnis Patent other colonial entrepreneurs were quick to apply for their own patents and between 1861 and 1871 a total of 28 patents for the processing of New Zealand flax were granted (Sparrow 1965:339). These technological developments saw the New Zealand flax fibre industry become established by the mid-1860s, just shy of the first boom in trade.

The First Boom 1869-1873
Between 1869 and 1873 New Zealand experienced the first of three major booms in the flax fibre trade. A shortage in Manila hemp, due to a hurricane in the Philippines, caused an increase in demand for New Zealand flax fibre and saw rope manufacturers in America and Britain offering high prices for the product (Matheson 1969:15). In 1869, there was over a 400% increase in total value of exported fibre, and a 280% increase in the quantity of New Zealand flax exported from the previous year (Figure 5). With the market in a propitious state exports and profits continued to increase rapidly. In 1870, the value of exported fibre amounted to £132,578, and in 1873 it increased to £143,799 (Figure 5). The increase in export rates led to a drastic increase in established mills, and by 1870 there were 161 flax mills in New Zealand (Figure 6).

Figure 5. Graph showing total value (pounds) and volume (tons) of flax fibre exports 1853-1942 (New Zealand Official Yearbook 1860-1945, www.archive.stats.govt.nz).
However, the prosperity of the market was short lived, and the industry experienced a sudden slump in 1874, marking the end of the first boom. The total volume of exported flax in 1874 decreased by 68% and the total value reduced by 74% (Figure 5). As the industry had grown profitable an increasing amount of inexperienced men were employed, resulting in lower quality flax fibre that was not equal to Manila hemp or Māori dressed flax fibre (Matheson 1969:15). Additionally, the Manila hemp industry of the Philippines had recovered from the hurricane, and their products returned to the market. Following the industry collapse of 1874, and the onset of the Long Depression from the late 1870s onwards, exports and values remained low for over a decade. During this period many mills went bankrupt and closed, but there were those that proved tenacious and persevered until the beginning of the second boom in 1888.


**The Second Boom 1888-1893**

In 1888, the second boom in the flax trade occurred, caused by another shortage in Manila hemp from the Philippines and an increased American demand for binder twine (Matheson 1969:15). The total quantity of flax exported rose from 4,042 tons in 1888
to 17,084 tons in 1889, before peaking in 1890 at 21,158 tons (Figure 5). The value of exported goods reached their height in 1890 at £381,789, more than double of the peak during the previous boom (Figure 5). This sharp increase in profitability led to a so-called “flax fever”, resulting in the establishment of more flax mills nationwide (Lyttleton Times 29 March 1889:2). By 1890, there were 171 mills distributed throughout New Zealand, employing 3,204 men and boys (Figure 6). Many mills were concentrated in similar areas, such as the Manawatū region, where the township of Bulls was nicknamed “Flaxopolis” due to the large number of mills in the town’s surrounds (New Zealand Times 21 November 1889:4).

Despite the prosperity of the boom in trade, many flax mills of this period were temporary and small by nature. The discontinuation of government incentives resulted in less experimentation than witnessed during the previous boom, and initiatives around environmental management were yet to be put in place. Consequently, during the second boom many mills were haphazardly established by those keen to make a quick profit. As observed previously, this eagerness to trade resulted in the employment of inexperienced men, causing a decrease in quality of goods and lowering the reputation of products (Matheson 1969:15). Additionally, by 1891, the American demand for fibre was declining and Manila hemp was returning to the market, leading to another market crash. In 1894, the quantity of flax fibre exported had decreased by 78% since the height of the boom during 1890 (Figure 5). As the export value plummeted, mills again began to close, with many going bankrupt.

**Flaxmillers Association**

In response to the slump in industry the New Zealand Flaxmillers Association was formed in 1893, with experienced miller Robert Gardner as chairman (New Zealand Herald 21 July 1893:5). The formation of this group created a support network for flax millers and led to better organisation and uniformity within the industry. The Flaxmillers Association urged the government to take a greater interest in the flax fibre industry and advocated for the introduction of a national grading system, investigation of foreign market requirements, financial incentives for the development of improved machinery, and the decrease in charges for re-opening, re-packing, and dumping of bales prior to export (Manawatu Herald, 3 October 1893:2). The appeal proved
successful and the Government took a more active interest in the flax milling industry, investigating foreign markets and providing monetary incentives. In 1894, the Government announced a series of new bonuses. In January 1894, the government offered £1,750 for the development of an improved fibre production method, and £250 for the development of a process which utilised waste products of flax fibre production (Ellesmere Guardian 31 January 1894:3). A second round of bonuses were introduced by the Government in late 1894, offering £1,500 for flax fibre, and £500 for tow of a higher quality (Opunake Times 13 November 1894:4). However, the government did not decrease the charges associated with the exporting of flax goods, nor did they establish a national flax fibre grading system during this period. Instead, the Flaxmillers Association established a voluntary grading system at the Port of Wellington, led by Mr J. Holmes, in order to create more uniformity in exported product (Thames Advertiser 11 September 1893:3).

The Third Boom 1898-1907

The third boom in the New Zealand flax trade began in 1898, due to the emergence of the Philippine Revolution (1896-1898), the Spanish-American War (1898), and the Philippine-American War (1899-1902), which again saw a shortage in Manila hemp (Matheson 1969:15). Additionally, the onset of the Boer War (1899-1902) caused an increase in demand for natural fibres by the British. This resulted in a 74% increase in total quantity of flax fibre exported in 1898 from the previous year (Figure 5). The exports continued to steadily rise during this period, before peaking in 1907 at a quantity of 28,547 tons valued at £832,067 (Figure 5). Following this peak there was a minor slump between 1908 and 1912. However, by this period the industry had developed improved milling systems causing the industry to be more firmly established. Therefore, unlike during the previous boom periods, the industry did not collapse as a result of the slump, and instead survived into the mid to late 20th century.

In response to the boom in trade many new mills were established throughout New Zealand, especially in the Manawatū where water and flax was readily available. During this peak a total of 240 flax mills, employing 4076 hands, were operating nationwide (Figure 6). Flax mills during this period became larger, better equipped, and more permanent than observed previously. The prime example being Miranui or
'The Big Mill' located near Shannon which housed 7 flax strippers and employed more than 300 hands during its peak in operation (Figure 7) (Ayson 1977:1). Additionally, during this period the industry became better supported by the government, unions were established to fight for workers’ rights and to improve living and working conditions, and swamplands became actively managed to ensure a consistent supply of flax to mills.

![Figure 7. Miranui Flax Mill Stripping Shed, circa 1909. (Digitisation ID: 2011N_Fx2_004624, Manawatū Heritage, Palmerston North Libraries and Community Services).](image)

**Government Involvement**

During the third boom the New Zealand Government once again supported the flax fibre industry. Government bonuses for the development of improved flax dressing machinery continued from the previous boom period (*Nelson Evening Mail* 11 March 1898:2). However, one of the most significant acts of the Government was to introduce a formal flax grading system, as had been previously requested by the New Zealand Flaxmillers Association in 1893 (*Manawatu Herald* 3 October 1893:2). From the 1st of
May 1901 a compulsory flax grading system was introduced by the Department of Agriculture for the price of 3d per bale (Marlborough Express 26 April 1901:2). Bales of flax were inspected at the port of Wellington before being exported (Marlborough Express 26 April 1901:2). The grading system for flax was based on points out of 100, with 25 points each being allocated to stripping, scutching, colour, and strength. The fibre was graded into eight categories, ranging from superior grade to rejected grade, whereas tow, based on the same scale, fell into three basic grades. The introduction of standardised grading led to a reliable, high-quality, and consistent product entering the foreign market. It also ensured the positive reputation of New Zealand flax fibre and prevented the market from being compromised by inadequate goods as seen during the end of previous boom periods.

**Unionism**

During the third boom of the New Zealand flax fibre industry the first union groups related to flax milling were established. This was due to the passing of the 1894 Industrial Conciliation and Arbitration Act, which ushered in a new era of industrial relations in New Zealand. The Act aimed to provide negotiating services between employees and employers and avert strikes, following the disruption from the 1890 Maritime strike. It also gave employees of registered unions the opportunity to advocate for the improvement and standardisation of wages, working and living conditions, and working hours. However, not all industrial groups were in favour of this system and as a result the early 20th century saw many episodes of industrial turmoil.

In 1904 the Canterbury Flax and Twine Mill Employees' Union became the first group of flax workers to register under the Industrial Conciliation and Arbitration Act (Burnett 2012:71). The small group proved successful and encouraged the formation of other unions, such as the Manawatu Flaxmills Employees' Industrial Union of Workers (MFEIUW), which was established in 1906. The comradeship of flax workers in the Manawatū and their shared dissatisfaction over working and living conditions made them a large and militant union (Fitzgerald 1970:7). Their efforts were largely successful and can be read about more thoroughly in Fitzgerald's (1970) *The Manawatu Flaxmills Employees' Industrial Union of Workers 1903-1921.*
Swamp Development

During the turn of the 20th century many of the wetlands and swamps of New Zealand were being converted into pasture for agriculture, resulting in a decrease in suitable flax growing areas. Concurrently, confidence grew for the future stability of the flax milling industry, causing an increase in interest of resource management. This resulted in the active management of swamplands by both individual mills and landowners, as well as the establishment of larger companies and estates. For example, the Makerua Estate Company Limited (established 1902) and the Moutoa Estate (established in 1903) in the Manawatū region were two of the largest managed swamplands for flax milling in New Zealand (Figure 8) (Akers 2003:15). These two companies were primarily concerned with swamp development and the cultivation of flax for local flax mills in the Manawatū region, including sites surveyed for the purposes of this thesis. The companies cultivated and supplied flax to mills of the area until the mid-20th century when the industry collapsed. They have since been converted to pasture, as have many of the other flax bearing swamplands around New Zealand.

Figure 8. Location of Moutoa and Makerua Swamps, Manawatū region. (Adapted from Ayson 1977:1).
Decline

Following the peak in trade of 1907 the flax fibre industry was met with an abrupt slump. In 1907 the value of flax exports had totalled at £832,068, but in 1908 it fell to £396,288 (Figure 5). Market forces saw the export value fall further in 1909 to £300,973, reaching the lowest point in the slump (Figure 5). This was largely due to the return of Manila hemp to foreign markets at a cheaper price than New Zealand flax (Manawatu Herald 29 October 1907:2). However, the industry slowly improved from this point and by 1913 had recovered with exports increasing to nearly the same quantity as during 1907 (Figure 5).

Despite the third boom arguably ending in 1908, the New Zealand flax fibre industry survived and found itself well established. Unlike during the previous two booms where slumps were sudden, drastic, and resulted in industry collapse, the slump at the end of the third boom proved different and the industry endured. This was largely due to the standardisation of exported flax fibre which saw New Zealand flax gain good reputation, through a more consistent and reliable product. Additionally, mills were better equipped due to improvements in technology, and workers were more experienced in their roles in mills. Finally, with the emergence of World War One in 1914 the demand for fibre increased and prices rose exponentially, which ensured the continuation of the New Zealand flax fibre industry for at least the following six years (Figure 5).

World War One

The advent of World War One in 1914 saw the New Zealand flax fibre industry reach its highest production point in history. The sharp increase in demand for natural fibre, paired with the supply of other fibres being disrupted, caused New Zealand flax fibre to become a highly sought-after product. Between 1914 and 1918 over 100,000 tons of flax fibre was exported from New Zealand for the War effort, with the price per ton rising to over £50 (Matheson 1969:15) (Figure 5). The increase in price per ton saw export values in 1916, 1917, and 1918 each rise to over £1,000,000 (Figure). This exponential growth in industry saw flax fibre become a substantial contributor to the New Zealand economy.
The prosperity of the New Zealand flax fibre industry briefly continued following the conclusion of World War One in 1918, as export quantities and values remained moderately high during 1919 and 1920 (Figure 5). However, in 1921 and 1922 export quantities and values dropped to near half of those observed in 1920 (Figure 5). In 1921, only 9,643 tons of flax fibre were exported, which was the lowest quantity shipped since the 1890s (Figure 5). Exports slightly increased following the low of 1921-1922, however, the 1920s saw continued meagre prices and slim profit margins (Matheson 1969:15) (Figure 5). This was partly due to the return of alternative natural fibres, such as Manila hemp or East African sisal fibre, which proved cheaper than New Zealand flax fibre (Matheson 1969:15). Additionally, New Zealand flax was slow and difficult to process when compared with alternatives, which meant the total exports could not compete with the increasing global demand for natural fibres (Kirkland 1970:16).

Yellow Leaf Disease
In addition to market competition, New Zealand flax was afflicted with yellow leaf disease, further hindering the flax fibre industry. Yellow leaf disease is caused by a phytoplasma, an obligate bacterial parasite, which is spread by hopper insects (Hindmarsh 1999). The phytoplasma impacts the absorption of nutrients in plants, resulting in the yellowing of leaves and stunting of their growth (Hindmarsh 1999). Therefore, yellow leaf disease rendered infected plants unusable for fibre production, causing a shortage in supply of healthy flax leaf. Without a steady and reliable supply of healthy flax leaf many mills, especially smaller ones, were forced to close. Those that stayed open experimented with new methods of flax cultivation and harvesting in order to try and combat the disease. While none proved overly successful some mills were able to endure on small profit margins for almost the remainder of the 1920s.

Depression Era
The advent of the Great Depression in 1929 signalled the beginning of the end for the exporting of New Zealand flax fibre. With the industry already in decline due to yellow leaf disease, the addition of an economic downturn proved unsurvivable. During this
period the price of prepared flax fibre dropped to less than £20 per ton and exports sank to less than 2,000 tons in 1931, the lowest export quantity in 35 years (Figure 5) (Matheson 1969:15). Most mills were forced to close, leaving many unemployed. Exports and prices continued to remain low during the 1930s, and in 1940 only 67 tons of New Zealand flax fibre was exported, signalling the end of the export industry (Figure 5).

New Zealand Woolpack and Textiles Company

In 1933, the New Zealand Woolpack and Textiles Limited (NZWTL) company was formed largely in an attempt to save the New Zealand flax fibre industry. The company aimed to turn the previously export-based New Zealand flax fibre industry into a domestic one that would supply their company with fibre for the manufacture of woolpacks and other textiles. Until this period New Zealand wool was baled in jute packs, largely due to the unsuitable pliability of New Zealand flax. However, this issue was supposedly solved by Mr R. D. Coghill of Dunedin who had invented a new method of fibre production in 1931, which the company adopted (Hunt 1969:18). Originally, the company planned to establish three factories, one in each of the Auckland, Southland, and Wellington regions, however, only the Wellington region factory eventuated (Kirkland 1970:22). The Wellington region factory was established in Foxton on a nine-acre site donated by Mr M. Perreau, the then mayor, and commenced operations in 1933 (Hunt 1969:18). The new factory provided many affected by the Great Depression with employment and gave a brighter outlook for the New Zealand flax fibre industry.

The NZWTL produced its first woolpacks in March 1934, however, despite new methods to improve pliability the product was still unsatisfactory, and the Coghill method proved a failure (Hunt 1969:18). Production costs were also considerably high in comparison with alternatives such as jute packs (Kirkland 1970:24). These early issues saw the company come close to closure and a Managing Director was appointed to oversee the closing down of the industry (Hunt 1969:18). However, the difficulties of the company were identified as misfortune and mismanagement and a new Chairman of Directors to better direct the company (Hunt 1969:18). Soon after, the government introduced new measures to protect the domestic industry from foreign
competition. A set quota and price of imported woolpacks was introduced, which essentially gave NZWTL a monopoly over the market (Kirkland 1970:24).

With the new increase in demand and guarantee to sell all their products the industry experienced a series of new problems. Firstly, a steady supply of raw flax leaf was not always available, and the Great Depression had caused the closure of many stripping mills resulting in lack of obtainable prepared fibre (Kirkland 1970:25). In 1941, this was solved with the government purchase and management of the near 5,000-acre Moutua Estate, one of the last, large, remaining natural swamplands in the Manawatu (Figure 8) (Kirkland 1970:25). Additionally, the NZWTL company bought Ross, Rough & Co. Ltd’s stripping mill in Foxton and established stripping mills in Westport and Kerepehi to supply the factory with processed flax fibre (Hunt 1969:18). Other suppliers of flax fibre were in Invercargill, Buller, and Birchfield (Hunt 1969:18). Another issue faced by the company were labour shortages, largely due to World War Two, which were somewhat remedied by the provision of houses and hostels for workers by both the government and the company (Kirkland 1970:31). Finally, the supply of water to the main factory became problematic in 1943 when a flood saw the Manawatu River rerouted due to a spillway, known as the Whirokino cut (Hunt 1969:18). The Foxton loop of the river suffered a severely reduced water flow which continued to be a problem for the company.

**World War Two**

The advent of World War Two in 1939 provided a stimulus for the New Zealand flax fibre industry. During the war the industry supplied cordage to the navies of the Allies and the New Zealand Woolpack and Textiles Limited company manufactured gun mats for the Royal Navy (Kirkland 1970:33). Additionally, the occupation of the Philippines by Japan from 1942 onwards saw the New Zealand flax fibre industry again became of tactical importance as the supply of Manila hemp was disrupted (Kirkland 1970:32). During the war the NZWTL company prospered, despite staffing issues, and was able to pay its first dividends (Hunt 1969:18). However, with the New Zealand flax fibre industry having suffered from the effects of the Global Depression and transforming into a domestic industry the increase in production caused by World War Two was nothing compared to that of World War One. Additionally, New Zealand had turned to
the cultivation and processing of linen flax for fibre during this period which replaced some of the needs for New Zealand flax fibre.

After the War the Government established a Price Tribunal which controlled product prices, safeguarding domestic industries and businesses (Templeton 2004:7). As a result, flax milling once again became profitable and the industry was modernised. The post-World War Two period that ensued became known by many as the “Golden Era” of flax milling, due to the modern technology and stability of the industry (Templeton 2004:7).

The 1950s Onwards
Following the conclusion of World War Two the NZWTL company underwent a period of great manufacture due to the shortage in floor coverings and similar textiles from wartime restrictions (Kirkland 1970:33). The company began experimenting with different dyes, weaving, and blending, resulting in a range of new and improved products (Hunt 1969:19). The company also established a new factory in Levin with a dye plant which further improved products (Hunt 1969:19). Additionally, in 1955 the formation of associate company Bonded Felts Limited saw waste products from NZWTL utilised for the manufacture of underfelt and numerous types of padding (Hunt 1969:19). Due to the prosperity of the industry over 300 people were employed by NZWTL by the mid-1950s (Kirkland 1970:37).

The 1960s saw a series of new developments and the installation of modern machinery to factories due to the success of the company. During this height of production, the NZWTL employed nearly 400 people (Kirkland 1970:37). However, this peak was not set to continue. In 1969, the government abolished the Price Tribunal and flax mills had to negotiate prices directly with NZWTL and other fibre buying companies such as Donaghys Ropeworks (Templeton 2004:7). This put a strain on the few remaining independent flax mills as production and wage costs increased, but product prices remained static. Furthermore, cheaper imported fibres such as East African Sisal hemp left New Zealand flax fibre unable to compete in the free market and flax mills were forced to closed from the 1970s onwards. The early 1970s also saw the removal of the restrictions on imported woolpacks set by the government, which paired with the rise
in cheaper synthetic materials, ultimately saw the demise of the NZWTL. By 1972 all of the independent flax mills in New Zealand had closed and the textile manufacturing plants moved to woollen products or closed, signalling the end of the Golden Era of flax milling and the final collapse of the industry (Templeton 1997:104). Finally, the Foxton based company Bonded Felts Limited continued to commercially operate a single flax stripper to produce padding and underlay, but it was lost to a fire in 1985 (Hindmarsh 1999).

Summary
This chapter has provided an in-depth background to the history of the use of New Zealand flax fibre. It has covered indigenous uses, the early flax trade, the mechanisation of flax fibre production, and the subsequent collapse of the industry. The remainder of this thesis aims to investigate the enduring gaps in our archaeological knowledge on the subject. The following chapter will detail the New Zealand flax milling process, explaining the operation and anatomy of the specialist machinery.
Chapter Three: Flax Milling Technology and Processes

It is the intention of this chapter to discuss the New Zealand flax milling process, including the nature and characteristics of New Zealand flax, the operation and anatomy of mill machinery, and the different types of fibre product. This will give context and background information to the surviving mechanical and industrial components in the archaeological record discussed in later chapters. This chapter will then identify additional elements of New Zealand flax mills and other associated features that will be used to compare different archaeological sites in the results chapter.

The Flax Milling Process

The extraction of fibre from the leaf blade of the New Zealand flax plant is a difficult and lengthy process. The methods and technologies used to manufacture fibre from other plants, such as linen or manila hemp, proved unsuccessful and were unable to be transferred to the New Zealand context. Instead it took decades of tests, trials, and innovation to develop an efficient and effective means of mechanical processing for New Zealand flax. By the 1860s a standardised method, with minor technological variations between mills, had been established and is as follows.

Harvesting

The first step in the flax milling process was the harvesting of flax leaves (Figure 9). The blades of the flax plant were cut on an angle at the base of the leaf with a specialist angled flax knife or a similar sickle blade (Figure 10). Cutting at an angle created a triangular point that ensured the stripping machine would firmly grip the leaf. The flax cutters organised the cut leaves into tied bundles and left them to be collected and transported by horse, tramline, lorry, or by hand. In swampy areas that impeded the use of vehicles bundles of flax were attached to a chain and transported to a collection point (Templeton 2004:4). Bundles of flax weighed roughly 90 pounds each, with 25 bundles making one imperial ton (Figure 9) (Esler 2012:27). Between eight and nine
tons of raw green flax was required to produce one ton of prepared flax fibre (Templeton 2004:7). The amount of flax processed each day varied depending on the scale and skill of each mill. The harvested flax was then transported to the mill and graded by length and quality (Figure 10). Some mills had inbuilt grading holes which they placed the flax into to more easily manage and measure the lengthy leaves, whereas other did without (Figure 11). Once measured the flax was stored by grade in the stripping shed or laid on a bench ready for stripping (Figure 14).

Figure 9. Young man with bundle of flax at Marshlands Flax Mill, 1909. (Reference no. 0000.900.1174, Marlborough Museum, Blenheim).
Figure 10. Men collecting flax and transporting flax. Note specialist flax cutting knife held by man in centre-left. (Reference no. 0000.900.1175, Marlborough Museum, Blenheim).

Figure 11. Flax grading hole, Templeton Flax Mill.
**Stripping**

The flax stripper is a piece of machinery specific to the New Zealand flax milling industry (Figures 12, 13, 14, 15). The machine consists of a mouthpiece that guides the flax between two feed rollers, through and over a guide or ribber, before being squeezed between a beater bar and stripper drum to extract the fibres (Figures 12 and 13). The distance between the beater bar and drum was adjusted several times throughout the day to ensure the flax leaves were stripped correctly. If the gap was too small the flax would be over-stripped and shredded into pieces, whereas if the gap was too large the flax was under-stripped, and the remaining vegetation would rot, rendering the product useless. Therefore, the machine required an experienced operator. After passing through the stripper drum and beater the stripped flax was either caught and moved by a worker sitting under the machine in the so-called ‘glory hole’ or was placed on a loop chain by an automatic catcher (Figure 15). Any remaining vegetation was removed in the later washing and scutching processes.

![Figure 12. Sectional view of flax stripper machine, showing internal workings. (Image taken from Atkinson 1922:33, courtesy of Hocken Collections, Uare Taoka o Hākena, University of Otago).](image-url)
Figure 13. A Booth, MacDonald, and Co. Ltd. stripper, showing internal workings. (Image from Atkinson 1922:35, courtesy Hocken Collections, Uare Taoka o Hákena, University of Otago).

Figure 14. Worker using stripper machine at Miranui, Shannon, circa 1910. (Digitisation ID. 2007P_Fx19_FLA_0615, Manawatū Heritage, Palmerston North Libraries and Community Services).
Figure 15. Workers stripping flax and collecting fibres in the ‘glory hole’, circa 1913. (Record ID: JTD-22G-01896, Auckland Council Libraries, Ngā Pātaka Kōrero o TāmārikīMakaurau).

Washing, Bleaching, and Drying
As the stripped flax was stained green by the removal of the vegetation, it was necessary to wash and bleach the product to meet market requirements. Once stripped, the fibre was either automatically passed through a wash system or rinsed by hand in a tank. Then six or so feeds of stripped flax were gathered together to form a hank and twisted to ensure they remained together.

Following being washed, hanks of fibre were either laid out on the ground in paddocks or twisted on to wire fences in order to dry and bleach in the sun (Figure 16). After two to three weeks of good weather and being turned regularly the hanks of flax were whitened and dried. The hanks were then collected into bundles and transported to the scutching shed ready for the final part of the process.
Scutching

The scutching process removed the remaining impurities from the stripped and dried flax fibre while smoothing and softening the product, making it ready for export. Scutching was initially done by hand, using a wooden scutching knife to scrape the length of the fibres and a metal comb ( heckling comb) to refine the product further.

The process was mechanised from the 1860s onwards and fully automated in the early 20th century. The mechanised scutching machine consisted of either a series of rotating wooden beaters, iron hackles, or fluted rollers, that beat and combed the flax smooth removing any remaining vegetation or foreign material (Figure 17). Early mechanised scutchers required a worker to feed one end of a hank of flax into the rotating beaters, hackles, or rollers, drawing the hank in and out to smooth it, before flipping it over and working the other side (Figure 18). This method was highly dangerous as workers could be pulled into the machine. The automated scutching machines saw this issue remedied as hanks of flax were fed onto a looped chain that pulled the fibre through the scutching machine instead.

Figure 16. A paddocker trimming the tails of drying flax fibre hanks, circa 1912. (Digitisation ID: 2007N_Fx34_FLA_0624, Manawatū Heritage, Palmerston North Libraries and Community Services).
Figure 17. Interior of scutching machine, Foxton Flax Stripper Museum.

Figure 18. Men scutching flax fibre, Miranui Flax Mill, Shannon, circa 1907. (Digitisation ID. 2007P_Fx26_FLA_0619, Manawatū Heritage, Palmerston North Libraries and Community Services).
Baling and Weighing

Scutched hanks of the same grade were then collected in groups of four or five and twisted into a larger hank ready for baling (Figure 19). The larger hanks were then pressed into a bale of 4 cwt (Templeton 2004:6). Bales were then loaded on to a truck and weighed on a weighbridge ready for export.

Figure 19. Workers posing in front of bale of flax circa 1905. (Digitisation ID. 2011P_Fx11_004585, Manawatū Heritage, Palmerston North Libraries and Community Services).
Waste Products-Slips and Tow

In addition to producing flax fibre the flax milling process created two waste products; slips and tow. Slips are the short pieces of fibre that were washed away with other vegetative material following the stripping and washing process. These fibres were recovered from the drain either by hand or a spiked wheel. Slips were known for retaining their spring and were used to pack furniture or stuff gymnastic mats (Templeton 2004:7).

The other waste product is tow, which is the shorter residual fibres removed during the scutching process. Tow was collected from inside the scutcher once stationary and was used for the manufacture of sacks, matting, or rope (Figure 20).

Figure 20. Tow fibres removed during scutching process (Image courtesy of Janice Templeton).
**Additional Flax Mill Elements and Features**

As detailed above, the processing of New Zealand flax fibre required many different components. However, the features of a New Zealand flax mill extend beyond the sheds and machinery and encompass a wider industrial landscape. Features within this landscape include cultivation and drying areas, transportation networks, and water systems. Additionally, many historical mill sites provided workers accommodations, cook houses, dining halls, and recreational areas, which are further components of flax mill sites that provide a more social aspect to an otherwise industrial landscape. These elements and features will be investigated further in subsequent chapters.
Chapter Four: The Archaeological Sites

This thesis is based on the field survey of nine historical flax mill sites and additional information taken from flax mill sites recorded on ArchSite (Figure 21) (Appendix One). Of the sites surveyed there were four in Manawatū, two in Southland, two in Marlborough, and one in Otago (Figure 21). This chapter aims to describe the historical information relating to the surveyed flax mill sites in order to provide a thorough background of each site that will aid in the interpretation of the field results in subsequent chapters.

Figure 21. Locations of recorded and surveyed flax mill sites in New Zealand.
Marshlands Flax Mill 1888-1964

The Marshlands Flax Mill (P28/161) is located 10km north of Blenheim on the former Marshlands Estate and is situated on the southern side of Chaytors Road on privately owned land (Figure 22). The site complex consists of a large open-sided shed that houses the stripping, washing, and sawmilling machinery, a scutching shed, and a weighbridge. The site provides one of the most complete examples of an historical flax mill in New Zealand and is recognised as a Category 2 Historic Place (list no.1475) by Heritage New Zealand Pouhere Taonga.

In 1880 John Clervaux Chaytor, an English farmer, purchased the Marshlands Estate and by 1886 purchased a flax mill in Tauranga and leased another a few kilometres away at Spring Creek (Wood 1982:1). Following the experience and information gained from the first two milling ventures, Chaytor established the Marshlands Flax Mill on his estate in 1888. The mill was opened on the 30th of April and employed 20 hands (Thames Star 30 April 1888:2). Flax was cultivated on the Marshlands Estate and harvested from nearby Pukaka Valley (Wood 1982:2). The harvested flax was then
transported to the mill by a teamster of horses and a dray, before being graded (Figure 23) (Wood 1982:2). Originally, the mill was powered by steam and had one stripping machine, however, over the course of its use it had many additions and improvements made.

In 1903 Chaytor purchased a large boiler and a 15h.p. Marshall horizontal engine from the defunct Tap Valley Gold Mining Company and installed them at Marshlands, upgrading the power source of the mill and increasing its efficiency (Marlborough Express 31 October 1906:3). Further upgrades were made to the mill in 1906 when the stripping shed was dismantled and re-erected to increase working space, ventilation, and natural light, ultimately working towards a safer work environment (Figure 23) (Marlborough Express 31 October 1906:3). During the same year a scraping machine was installed, which functioned similarly to a scutching machine. The scraper, consisting of three equally spaced blades, would fall onto the laid-out fibre and scrape along the hanks (Wood 1982:2). This was the first machine of its kind to be installed in a flax mill in Marlborough (Marlborough Express 31 October 1906:3).

Figure 23. The Marshlands flax mill ca.1909. (Reference no. 0000.900.0648, Marlborough Museum, Blenheim).
In 1924 machinery recovered from a derelict sawmill in Crail Bay, Pelorus Sound was recovered and installed at the Marshlands Flax Mill (Wood 1982). This included a reciprocating breakdown saw and a twin circular breakdown saw (Wood 1982). The addition of the sawmill to the flax mill complex would have provided work for the flax workers in Winter and when it was otherwise too wet to work, highlighting an example of integrated industry.

The final major changes to the Marshlands Flax Mill occurred in 1927 when Blenheim gained electricity. This saw an electric motor replace the steam engine at the mill, allowing a greater output of energy that enabled further modifications to mill systems. This included the instalment of an automated flax catcher and washer, which consisted of a chain system that caught the flax once passed through the stripper machine and ran it through a series of washes (Wood 1982:3). Prior to this instalment a worker, known as the catcher, had to catch the stripped flax before passing it to the ‘fly boys’ who were typically younger workers responsible for shaking off any vegetative material (Wood 1982:2).

Following the establishment and success of the Marshlands Flax Mill the Marshlands Estate grew to include a large local community. Many of the flax millers lived and were born on the Estate and attended the local school (Figure 24) (Wood 1982:1). However, as the flax milling industry became more automated and eventually declined, so too did the community. The mill eventually closed in the mid-1960s, by which point it was the last flax mill to be operating in the Marlborough region.

*Figure 24.* Marshlands Flax Mill circa 1922. Stripped flax fibre hanging in paddocks in foreground. Main mill buildings on left, houses on far right. (Marlborough Museum, Blenheim).

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Vercoes Flax Mill 1890-1937

The remains of Vercoes Flax Mill (P28/160) are located near Mill Stream Lane on the Taylor River Reserve in Springlands, East Blenheim (Figure 25). The visible remains consist of extensive concrete foundations and include a diverted stream that served as a power source for the mill. The site is recognised as a Category 2 Historic Place (list no.5470) by Heritage New Zealand Pouhere Taonga.

![Map of Blenheim with location of Vercoes Flax Mill](image)

**Figure 25.** Location of Vercoes Flax Mill, Blenheim.

In 1888 Phillip Vercoe established a brickworks on the site, however, by 1890 the local source of natural clay had been exhausted and the site had been converted to a flax mill (Hadfield 1993). Photographic evidence shows the building was constructed out of basic timber and corrugated iron materials (Figure 26). The nearby Murphy's Creek was redirected to provide a water source for the mill which was controlled by two water gates. The creek drove a waterwheel that powered the mill, unlike other contemporary mills which were mainly powered by steam or gas by this period (Hadfield 1993). The mill also employed a different method of flax fibre drying and bleaching to that of other contemporary mills. In 1889 a wire fence structure was
installed for the purposes of drying flax fibre upright, rather than laying it out on the ground (*Te Aroha News*, 16 October 1889:2). This aimed to reduce labour costs as laid out flax had to regularly turned to prevent rotting, as well as save space by storing flax vertically rather than horizontally (*Te Aroha News*, 16 October 1889:2). Lastly, by 1898 the mill had installed patented Booth, MacDonald and Co. flax stripper machine that aided in the production of high-quality fibre in large quantities (*Otago Witness*, 15 December 1898:40).

In 1905 Vercoe sold the flax mill to Mr. A. Paine, who after one year of ownership sold the mill to Mr E. S. Parker, causing the mill to be renamed Parkers Mill (Hadfield 1993). By this period much of the local sources of naturally growing flax had been exhausted and many of the swamp lands surrounding Blenheim had been drained and converted to pasture. As such, the mill had to source its raw material from increasingly distant localities including Tuamarina and Rarangi, both north of Blenheim (Hadfield 1993). While the Parker family continued to operate the mill for over two decades successfully, the advent of the Great Depression and continued shortage of raw material saw the mill close in 1937 (Hadfield 1993). The mill was dismantled soon after the closure, leaving only foundational remains.

**Figure 26.** Parkers (Vercoes) Flax Mill off Nelson Street. Flax mill hand washer in background. Stripped and washed flax fibre hanging in hanks in middle and foreground. (Reference no. 2009.135.0357, Marlborough Museum, Blenheim).
Whitanui Flax Mill 1891-1929

The Whitanui Flax Mill (S24/96) was located on the eastern bank of the Manawatū River, halfway between Purcell Street and Union Street in Foxton (Figure 27). The site is easily accessible as it is situated on public land. The visible physical remains of the site are limited to concrete foundations.

The original flax mill established at this site was constructed in 1891 by Mr A. Speirs and changed ownership half a dozen times over the course of its use (Hunt 1969:17). By 1908 the flax mill had been purchased by Mr H. Greig's company Whitanui Ltd, which saw the mill gain the name Whitanui (Hunt 1969:17). The Whitanui Mill housed a suction gas engine which powered a single Booth, MacDonald and Co. stripping machine, a Burges washing machine, and a scutching machine (Manawatu Herald, 28 August 1909:2). The mill was one of many along the Foxton waterfront during this period.

In October 1909 a fire broke out at the mill, originating in the tow-hole (Manawatu Herald, 19 October 1909:2). While the speedy reaction of the local bucket brigade saw the fire contained and the scutching shed and prepared fibre saved, the engine shed
was destroyed (Manawatu Herald, 19 October 1909:2). This loss saw the temporary unemployment of several mill hands, although this was remedied by running night shifts at the Company's other mill, the Ora, also located on the Foxton waterfront (Manawatu Herald, 19 October 1909:2). The engine shed was quickly rebuilt, and the machinery, which had survived the fire, was overhauled and reused (Manawatu Herald, 19 October 1909:2). By November the Whitanui Flax Mill was back in operation. The rebuilt mill was eventually sold to the Huia Flaxmilling Co. Ltd (A. Ross, Rough, and Co. Ltd) who continued to operate the mill until its permanent closure in 1929 (Hunt 1969:17).

Photographic evidence from 1912 shows that the rebuilt mill comprised of basic timber framing and corrugated iron cladding (Figure 28). The mill also had a yard where harvested flax could be stored and graded, and where stripped flax could be stored, dried, and bleached prior to scutching (Figure 28). Other visible features of the mill include a chimney, water tank, and a jetty. Further information on the Whitanui Flax Mill is limited.

Figure 28. Four flax mills on riverbank at Foxton, 1912. Whitanui Flax Mill is in foreground. (Digitisation no. 2011N_Fx42_004633, Manawatū Heritage, Palmerston North City Library).
Foxton Flax Mill 1902-1931

The Foxton Flax Mill (S24/94) was located on the eastern bank of the Manawatū River south of the wharf and railway yards in Foxton (Figure 27). The mill site is easily accessible as it is located on public land and is included in the Foxton Historical Walkway. The visible physical remains of the site are limited to concrete foundations.

The Foxton Flax Mill was established in 1902 by local flax miller Mr G. Coley, who also owned the neighbouring Star/Ida Flax Mill (Hunt 1969:17). The mill was powered by steam and operated a single Crosbie stripper (Manawatu Herald, 28 August 1909:2). The mill employed at least eight hands, excluding flax cutters, paddockers, and trammers (Manawatu Herald, 28 August 1909:2). In 1908 the mill was sold to Messrs A. King and Co. who continued to operate the mill until its permanent closure in 1930 (Hunt 1969:17).

Further information on the Foxton Flax Mill is limited. However, photographic evidence shows that the Foxton flax mill was constructed out of basic timber framing and corrugated iron cladding (Figure 29).

Figure 29. Flax Mills on riverbank at Foxton, circa 1910. Foxton Flax Mill in foreground. (Digitisation no. 2011N_Fx67_004639, Manawatu Heritage, Palmerston North Libraries and Community Services).
Ora Flax Mill 1906-1940

The Ora Flax Mill (S24/95) was located on the eastern bank of the Manawatū River near the junction of Union Street and Harbour Street, between the Awa Flax Mill and Star/Ida Flax Mill (Figure 27). The site of the mill is easily accessible as it is located on public land. The physical remains of the site are limited to concrete foundations.

The Ora Flax Mill was established in 1906 by local flax miller Mr. W. Jupp, who operated the site until 1910 when it was purchased by Mr. H. Grieg (Whitanui Ltd.) (Hunt 1969:17). The mill comprised of basic timber framed and corrugated iron clad buildings and had a large yard for storing and grading flax (Figure 30). A Booth, MacDonald and Co. stripping machine and a Burges patented washing machine were both installed in the mill (Manawatu Herald, 28 August 1909:2). The mill also had a jetty that extended into the Manawatū River that was used for the transportation of both raw and processed flax (Figure 30). In 1916 the Ora Flax Mill was purchased by Mr. W. Ross (Ora Flaxmilling Co.) before later being sold to Mr. H. Berry who saw the continued operation of the site until its permanent closure in 1940 (Hunt 1969:17).

Figure 30. Flax mills on the riverbank at Foxton, 1912. Ora Mill located in centre with flax being unloaded from boat. (Digitisation no. 2017P_Fx49.022156, Manawatū Heritage, Palmerston North Libraries and Community Services).
Redan Flax Mill 1906-1972

The Redan Flax Mill (F46/36) was located on the northern side of Wyndham-Mokoreta Road on the Johnstone family farm (previously Shalimar Farm) 12km east of Wyndham in Southland (Figure 31). The visible physical remains of the Redan Flax Mill include the single men’s quarters, the dam floodgates and controls, and a scutching machine which is stored in a farm shed. No further buildings or machinery from the historical mill have survived.

![Figure 31. Location of Redan Flax Mill, Southland.](image)

The first Redan Flax Mill was built in 1906 the early 20th century during the third major boom in the New Zealand flax trade. It was owned by A. W. Hall and operated successfully until it was partially destroyed by fire in April 1913 (Redan District Book Committee 1990:171). The mill was quickly rebuilt and operated at full capacity throughout World War One. During this period owner A. W. Hall commissioned the construction of a new accommodation building for employees. The building comprised of four bedrooms and a communal sitting room, all of which were furnished (Southern Cross 11 November 1916:10). The building could accommodate eight single men and had been constructed to allow good ventilation and natural light, ensuring the comfort
and wellbeing of staff (Southern Cross 11 November 1916:10). Further accommodations at the mill available during this period included the managers residence, two small houses for married couples, and other single men’s huts (Redan District Book Committee 1990:179). Additionally, a basic corrugated iron cookshop, operated by an employed cook, was located centrally to the accommodation area to cater to the single men (Redan District Book Committee 1990:171). The provision of these basic accommodations and amenities was necessary to ensure the retention of a permanent workforce at a rural locality.

In 1918 the Redan Flax Mill was sold to the Maddren brothers who continued to run the mill for the next decade. During this period the nearby Redan Stream was dammed 1 kilometre away from the mill site in order to provide a reliable source of water to wash stripped flax fibre and drive the 40h.p. water turbine that powered the mill (Redan District Book Committee 1990:171). The Maddren brothers also conducted experiments throughout their ownership of the mill with the intention of improving flax cultivation and the flax milling process. In 1918 every part of the 600-acre property on which the Redan Flax Mill was established was planted out with flax (Colonist 10 May 1918:3). This method not only saw the utilisation of every inch of available land, but also ensured continued work for employees during the winter when the mill would temporarily close, further aiding in the retention of workers (Colonist 10 May 1918:3).

In December 1922 a fire started in the tow room of the scutching shed and the building, and much of the machinery in it, was quickly destroyed (Temuka Leader 19 December 1922:2). With the mill insured it was quickly rebuilt, however, the advent of the Great Depression saw the Redan Flax Mill close in December 1929 (Redan District Book Committee 1990:168). The mill remained closed until 1933 when the Johnston brothers, in conjunction with L. A. Neiderer, leased the mill from the Maddren brothers, resuming operations (Redan District Book Committee 1990:168). Following two years of leasing the Johnston brothers decided to purchase the Redan Flax Mill outright for £9000 (Redan District Book Committee 1990:168). By this period the complete site included the stripping and scutching sheds, a blacksmith, a tool shed, an office, and accommodation buildings (Figure 32). The stripping and scutching buildings were unusual shapes due to modifications and extensions, as well as repairs from fire.
damage, and largely comprised of basic timber framing, corrugated iron roofing, and recycled weatherboards (Redan District Book Committee 1990:177). During the 1930s the mill also gained electrical power, which saw the instalment of a new hand scutcher (Redan District Book Committee 1990:177). In 1947 an automatic scutcher was installed, and the scutching shed was extended to allow for a second hand operated scutcher (Redan District Book Committee 1990:177). Unfortunately, the scutching shed and plant fell victim to a fire in 1971 and was destroyed, much like its predecessors (Redan District Book Committee 1990:177).

![Figure 32](image.png)

*Figure 32.* Redan Flax Mill 1960. (Image taken from information board at site).

Lastly, the Johnston family bought and relocated six houses to the mill site in an attempted to encourage a more permanent workforce (Figure 32). At this point the mill typically employed 18 men, at least half of whom had families, and as such a small, yet strong, local community grew (Esler 2012: 35). The Johnston family had been involved with the mill since 1912 and continued to own and operate the mill until its permanent closure in 1972. The Johnston family are still the owners of the property on which the flax mill was located. It has since been converted to pasture.
Templeton Flax Mill 1911-1972

The Templeton Flax Mill is located on privately owned farmland off Templeton Road at Otaitai Bush, 7km north of Riverton in Southland (Figure 33). In 2000 the Templeton Flax Milling Heritage Trust was formed to restore the mill, which had been out of operation since the 1970s, and by 2004 the Templeton Flax Mill was officially opened as a museum. The museum showcases flax milling technology from the 1860s-1970s and the site (D46/116) provides the only complete and authentic flax mill plant currently operating on its original site in all of New Zealand. In 2010 the Templeton Flax Mill was recognised as a Category One Historical Place by Heritage New Zealand Pouhere Taonga due to its outstanding historical significance.

Figure 33. Location of Templeton Flax Mill, Southland.

The Templeton family of Southland first became involved in flax milling in the late 1880s during the second major boom in the flax fibre trade. During this period William Templeton built and managed a flax mill on his brother’s property at Dipton, however, within the first year of operation a fire broke out destroying the whole plant (Templeton 1997:87). The loss of £500 was too large to allow the rebuilding of the mill causing William Templeton and his family to return to Riverton where they turned to farming, transportation, and established two stores (Templeton 1997:87-89).
family did not return to the flax milling industry until 1911 when William Templeton purchased the Bennet Brothers flax mill at Pahia, west of Riverton (Templeton 1997:92). The Bennet Brothers had purchased the flax mill in 1903 from the Challis Brothers in Waimatuku and relocated it to the Pahia site (Trotter 2005:153). Following William Templeton’s purchase of the mill it was once again relocated to the current mill location at Otaitai Bush (Templeton 1997:92). William Templeton leased nearly 2000 acres of land at Otaitai Bush for his flax milling venture and purchased an old hotel (or Joss house as reported elsewhere) from Round Hill for housing (Templeton 1997:92, Trotter 2005:89). A cookhouse, dining hall, outbuildings, and other accommodations were also established for the employees and family (Trotter 2005:89).

Once established, the Templeton Flax Mill employed over a dozen hands and operated successfully through the early to mid-20th century supplying Donaghy’s, the Dunedin based ropeworks, with flax fibre (Figure 34). The outbreak of World War One and the increase in demand for natural fibres saw the Templeton mill flourish, however, following the conclusion of the War and advent of the Great Depression it operated on slim profits (Esler 2012: 37). During this period, when many other flax mills throughout New Zealand permanently closed, the Templeton Flax Mill persevered.

In 1933 the mill gained electricity, replacing the stationary steam engine that had previously powered the site (Esler 2012:37). In 1940 Andrew Templeton, Muir Templeton, and builder Alf Campbell invented an electric powered automatic scutching machine, the first of its kind in the Southland area (Templeton 1997:100). This invention allowed for a faster and safer means of preparing flax fibre. However, at the time there were limited industrial safety standards and a lack of fire suppressants, and an electrical fault caused a fire in the scutching shed in 1943 (Templeton 1997:100). The dusty environment encouraged the blaze and saw the scutching shed destroyed, ceasing production for several weeks. A new scutching shed and automatic scutcher were quickly rebuilt and the mill was back in operation within six weeks. Additionally, a new stripping shed was also built in 1943.
The emergence of World War Two saw the flax milling again declared an essential industry. However, while this caused an increase in demand for flax fibre, the introduction of governmental price control moderated profits (Templeton 1997:103). Regardless, the modest profitability safeguarded the flax milling industry and was enough to allow the development of the Otaitai Bush land holdings (Templeton 1997:103). The milling operation continued steadily until 1969 when governmental price control of flax fibre was removed. Unable to compete with cheaper imported fibres, such as sisal or jute, the Templeton flax mill closed in 1971.

Further information on the history of the Templeton Flax mill and flax milling in Southland is available in Hugh Templeton's (1997) family history The Problematical Journey and Margaret Trotter's (2005) Flaxmill's of the South.
Tane Flax Mill 1916-1921

The Tane Flax Mill was located on the western side of the Manawatū River at Opiki, 16km south of Palmerston North (Figure 35). The visible remains at the site (S24/48) include concrete foundations, a chimney, and a derelict suspension bridge. The site is recognised as a Category One Historic Place (list no. 9619) by Heritage New Zealand Pouhere Taonga.

Figure 35. Location of Tane Flax Mill, Manawatū.

The Tane Flax Mill was established in 1915 by the Tane Hemp Company Limited, whose principal shareholders were notable local businessmen and flaxmillers Messrs H. and A. Akers and Mr L. Seifert (Matheson 2003:21). Its establishment was relatively late within the history of the flax milling industry and was in response to the increase in demand for natural fibres during World War One (Matheson 2003:21). The mill consisted of a stripping shed, a scutching shed, a tow shed, a slips shed, and a smithy (Figure 44) (Matheson 1969). The stripping shed housed four stripping machines, making the Tane Flax Mill one of the largest in New Zealand (Matheson 1969). There were also numerous tramlines for the transportation of raw and processed goods and extensive paddocks for the drying of stripped flax fibre (Figure 44) (Matheson 1969).
The Tane Flax Mill was situated next to two other flax mills, the Rangitane Flax Mill (1902-1919) and the River Flax Mill (1904-1918) (Figure 44). The Rangitane Mill was originally established by Mr O. Gardner but was quickly sold to Mr L. Seifert who later sold the mill to his co-owned company the Tane Hemp Company Limited during World War One (Matheson 2003:19). The River Mill was also owned and operated by Mr L. Seifert (Matheson 2003:19). Together these mills made up a large industrial landscape and had substantial supportive infrastructure (Figure 44). Due to the increase in demand for natural fibres and the rise in profitability a considerable network of tramlines and roadways were established throughout Opiki and the Makerua Swamp for the purposes of the flax milling industry (Matheson 2003:21). Additionally, in 1917 the Opiki Suspension Bridge was built by the Tane Hemp Company Limited. It replaced the earlier wire ropes that crossed the Manawatū River and created better transportation of goods and access between the different mills (Figure 36). Following the collapse of the flax fibre industry it continued to operate as a toll bridge before closing in 1969 (Matheson 2003:26).

Figure 36. Tane Flax Mill and Suspension Bridge, 1917. (Digitisation ID. 2011N_Fx118_004647, Manawatū Heritage, Palmerston North City Library).
The Tane Flax Mill operated successfully throughout the duration of World War One, however, following the conclusion of the War the demand for natural fibres fell drastically. This placed economic stress on flax mills throughout New Zealand and resulted in slim profit margins. Additionally, the Makerua Swamp, which supplied the Opiki mills with green flax, had become infected with yellow-leaf disease, causing flax to weaken, discolour, and die (Matheson 2003:22). The lack of raw materials and economic pressures saw the River Mill and Rangitane Mill permanently close in 1919, whereas the Tane Mill briefly persevered before closing permanently in 1921 (Matheson 2003:22). Soon after their permanent closure the buildings of the mills were demolished or repurposed (Figure 37).

**Figure 37.** Opiki suspension bridge and old mill chimney, Rangitāne, 1963. (Digitisation ID: 2007N_Fx127_FLA_0641, Manawatū Heritage, Ian Matheson-Palmerston North City Council).
Otanomomo Flax Mill 1917-1972

The Otanomomo Flax Mill is located on the eastern bank of the Puerua River at the end of Flaxmill Road, 7km south of Balclutha (Figure 38). The site (H46/60) has extensive physical remains including complete mill buildings, machinery, workers huts, a weighbridge, and water races. Its substantial remains make it one of the most intact flax mill sites in New Zealand.

![Location of Otanomomo Flax Mill](image.jpg)

**Figure 38.** Location of Otanomomo Flax Mill, Otago.

The processing of flax fibre was one of the most important primary industries of the Lower Clutha area and mechanised flax mills had been operating in the district from the 1860s (Palmer 2000:131). Information relating to the Otanomomo Flax Mill is limited and the exact establishment date of the mill is uncertain, however, it was likely established before 1912 (Palmer 2000:131). The original flax mill at Otanomomo was owned and operated by Mr G. Bichans and was destroyed by fire in 1917 (Star 12 February 1917:2). The total loss was estimated to be over £1000, although the wartime demand for fibre saw it quickly rebuilt (Star 12 February 1917:2). By 1926 the previously steam powered mill gained electricity and operated two motors with an
output of 60h.p. (a 40h.p. motor and a 20h.p. motor) that drove the scutcher and other machinery (Otago Daily Times 7 August 1926:10). Sometime over the following years the mill closed due to economic pressure but was reopened in 1935 due to the foundation of the Foxton based company New Zealand Woolpack and Textiles Limited that saw the increase in demand for flax fibre for the production of woolpacks (Evening Star 20 May 1935:2). The successful revival of the flax mill saw the extension of the local Otanomomo tramline directly to the mill site to better facilitate the transportation of raw flax to the mill (Otago Daily Times 18 September 1937:20). Unfortunately, the Otanomomo flax swamp that supplied the mill with raw flax caught fire the following year, destroying all the flax on the 500-acre property (Otago Daily Times 3 February 1938:17). The mill, which had been processing 12 ton of flax per day, was subsequently put out of business resulting in the immediate unemployment of 30 men (Otago Daily Times 3 February 1938:17).

Following the fire in the flax swamp the Otanomomo Flax Mill remained closed until 1943 when it was purchased by Donaghy's Rope and Twine Company Limited and Mr A. Templeton (owner Templeton Flax Mill) (Otago Daily Times 2 June 1934:4). The Templeton family managed and operated the mill, manufacturing flax fibre for Donaghy's ropeworks and fibre by products, such as tow, to produce woolpacks and mats in Foxton (Templeton 1997:104). The operation continued well until a fire broke out in the flax swamp on the 26th of December 1956 caused by stray clinkers from passing railway engines (Templeton 1997:102). The fire burnt out the flax swamp and saw the destruction of the stripping shed and machinery (Palmer 2000:140). Production ceased temporarily for a few years while the flax regrew, and the stripping shed was rebuilt under the guidance of the Templeton family (Esler 2012:38). By the 1960s the mill was producing 250 tons of processed flax fibre annually and employed 10 permanent staff members, including four married couples and six single workers, all of whom were accommodated at the mill in single huts or larger cottages (Palmer 2000:140). However, the removal of governmental price protection and inflating wage costs in 1969 saw the industry lose its profit margin (Templeton 1997:103-104). As a result, most flax mills in New Zealand closed within the following 12 months and the Otanomomo Flax Mill closed in early 1972, making it one of the final mills to be in operation in the country (Templeton 1997:104).
Currently, the Otanomomo Flax Mill is located on privately owned farmland and most of the remains are in situ (Figure 39). However, some of the workers huts have been moved and as of late 2000 much of the machinery, most notably the scutching machine, was relocated to the Templeton Flax Mill Heritage Museum in Riverton. The surviving buildings and other physical remains of the Otanomomo Flax Mill are largely complete but are in a deteriorating condition.

Figure 39. Otanomomo Flax Mill 2018, facing south.

**Summary**

This chapter has aimed to provide the historical backgrounds of archaeological flax mill sites surveyed for the purposes of this thesis. This sought to provide an individual context for each of the sites prior to the investigation and comparison of the physical remains at each location. The following chapter aims to describe the visible physical remains at each flax mill site surveyed, as well as provide a comparison of the mill sites, elements, and features, in order to assess the surviving archaeological evidence of the flax milling industry in New Zealand.
Chapter 5: Archaeological Site Comparison

This chapter examines the archaeological evidence of the nine New Zealand flax mills surveyed for the purposes of this thesis. Further evidence of archaeological flax mill remains will be provided by site record forms from the New Zealand Archaeological Association’s (NZAA) database where relevant. This chapter will arrange evidence by mill features and elements, rather than site by site, to allow for a direct comparison of archaeological remains from each mill site surveyed.

Site Size and Layout

Due to the fragmentary nature of the surviving archaeological evidence for New Zealand flax mills, it is difficult to compare the original size and layout of all sites surveyed, let alone all that are recorded. As will be discussed in this chapter, the majority of sites are limited to foundational or machinery remains, and many have no surviving visible evidence at all. However, the Marshlands (Figure 40), Templeton (Figure 41), and Otanomomo (Figure 42) flax mills are largely intact and provide examples of complete historical flax mill sites. Additionally, the foundations of Vercoes Flax Mill (Figure 43), while incomplete, are indicative of the structure’s original scale and layout, as are the archival sketch maps of the Tane Flax Mill, and neighbouring Rangitane and River flax mills (Figure 44). When compared, these maps show that each site was of a different size and layout but had many of the same basic features. The maps of these sites also give an understanding to the varying spatial layouts of remains and provide context to the individual features and other elements that will be discussed during this chapter.

In addition to this archaeological evidence, historical photographs and archival data provide further evidence for the size and layout of other flax mills. This additional data will be considered with the current archaeological information in more depth in Chapter Six, as will greater interpretations around changes in size and layout of sites over time.
Figure 40. Marshlands Flax Mill and Sawmill (Adapted from HNZ map provided at site).
Figure 41. Templeton Flax Mill site plan.
Figure 42. Otanomomo Flax Mill site plan.
Figure 43. Vercoes Flax Mill foundations.
Figure 44. Layout of the flax mills at Opiki, Manawatū, circa 1917. (Adapted from sketch map compiled by Ian Matheson 1969, available in: IRM Papers, Series 3-1, Folder 2, Box 38, Palmerston North City Library Archives).
Buildings
A total of four flax mill sites surveyed were found to have surviving buildings relating to the flax milling industry (Table 1). A further four sites on the NZAA’s database were recorded as having buildings or physical remains relating to buildings and one previously unrecorded site that was unable to be surveyed was also identified as having surviving buildings (Table 1).

Table 1. Flax mill sites with buildings

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Surviving Buildings</th>
<th>Other Remains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>Stripping Shed Scutching Shed Weighbridge Shed</td>
<td>Stone semi-walls of workers huts</td>
</tr>
<tr>
<td></td>
<td>F39/1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redan Flax Mill</td>
<td>F46/36</td>
<td>Single Men's Quarters</td>
<td></td>
</tr>
<tr>
<td>Otanomomo Flax Mill</td>
<td>H46/60</td>
<td>Stripping Shed Scutching Shed Two Workers Huts Storage Shed</td>
<td>Stone structures/remains of workers huts</td>
</tr>
<tr>
<td></td>
<td>O07/85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O28/65</td>
<td></td>
<td>Stone chimneys relating to workers huts</td>
</tr>
<tr>
<td>Wright's Flax Mill</td>
<td>P20/94</td>
<td>Main Mill Building Two Workers Huts (Both heavily modified)</td>
<td></td>
</tr>
<tr>
<td>Marshlands Flax Mill</td>
<td>P28/161</td>
<td>Stripping Shed Scutching Shed Weighbridge Shed</td>
<td></td>
</tr>
<tr>
<td>Paetawa Flax Mill</td>
<td>R26/745</td>
<td>Scutching/Engine Shed Stables</td>
<td></td>
</tr>
</tbody>
</table>
Stripper Sheds

The Templeton, Marshlands, and Otanomomo flax mill sites each have a surviving stripper shed, although they are in varying conditions.

**Templeton Flax Mill Stripper Shed**

The Templeton Flax Mill stripper shed is the best preserved of the surviving three stripper buildings. The shed is built in a west to east orientation and is a single gabled structure. It has a shallow pitched roof and a lean-to addition on the southern elevation. The utilitarian structure comprises of concrete foundations, timber framing, and corrugated iron cladding that has been painted red (Figure 45 and 47). The main entrance is located on the eastern elevation, which includes a large roller garage door and a single timber door (Figure 45). A modern dust shed has been attached to the southern elevation to ensure the removal of dust produced by the scutching machine. The lean-to structure on the southern elevation also has a large roller garage door, located on its eastern side, to allow easier access to the stripped flax (Figure 45). On the western elevation is a concrete channel that runs south along the side of the building, under the access road, to a creek (Figure 46). This channel works as a drain for the stripping and washing machinery in the shed that requires a lot of water. A water wheel is mounted in the channel with prongs attached to collect any fibre washed down the drain (Figure 46). The northern elevation has one window and a water tank standing outside of the smoko room (Figure 48).
Figure 45. Templeton Flax Mill stripping shed showing eastern elevation.

Figure 46. Templeton Flax Mill stripping shed, western elevation, featuring concrete drain and spiked water wheel.
The interior of the stripping shed includes the working floor (which comprises of the stripping, washing, and scutching machinery and accounts for the majority of the space), the workshop, smoko room, and toilet and storage area (Figure 48). In the middle of the building are the two grading pits where raw flax was graded by length before being sorted into the appropriate stalls situated along the northern elevation (Figure 48). The stripping and washing machinery are located along the western side of the building in their original location (Figure 48). The large scutching machine is situated in the south eastern side of the shed and the baling press is located next to it (Figure 48). The workshop, smoko room, storage, and toilets are located along the northern elevation (Figure 48). The toilet and storage area have been modernised following the mills conversion to a museum.

Figure 47. Templeton Flax Mill. Stripping shed left; weighbridge shed right.
Figure 48. Templeton Flax Mill stripping shed layout. (Adapted from plan provided by J. Templeton).
Marshlands Flax Mill Stripper Shed

The Marshlands Flax Mill was not fully surveyed as access to the site was not attainable. However, the site was viewed from the road and with the aid of information from Heritage New Zealand Pouhere Taonga and aerial photography the following observations can be made. The stripping shed is situated in a west to east orientation. The complete structure appears to consist of an amalgamation of five single gabled sheds that were added as needed (Figure 49). The building is utilitarian and consists of timber framing and corrugated iron cladding (Figure 49). The building materials are beginning to deteriorate, with much of the corrugated iron rusting and some panels lifting. The western elevation is partially open sided providing the main entrance to the mill (Figure 50). There is also an entrance on the northern side of the building into the workshop (Figure 49). The eastern and southern elevations were unable to be viewed and subsequently any features or entrances along those sides were not able to be observed.

Figure 49. Marshlands Flax Mill. Scutching shed left, stripping shed right.
The interior of the stripper shed can be divided into three parts; the flax milling area, the saw milling area, and the workshop (Figure 40). The flax milling equipment and working floor takes up the eastern half of the building (Figure 40). The easternmost side comprises of the flax loading ramp and sorting area, whereas the stripper and wash area are located more centrally within the building (Figure 40). The saw milling machinery is located on the western side of the building and includes a log loading platform that extends to the south (Figure 40). The workshop is located near the centre of the building and extends north.

Figure 50. Marshlands Flax Mill and Sawmill. Blacksmiths shop small structure on the left. Entrance to main building on right.
Otanomomo Flax Mill Stripper Shed

The Otanomomo Flax Mill stripper shed is situated in a north to south orientation. It is a single gabled building with a shallow pitched roof (Figure 51). The structure is utilitarian and comprises of concrete flooring and foundations, timber framing, and corrugated iron cladding that has been painted red (Figure 51). Much of the cladding is rusting, lifting, and in some cases missing, leaving holes in the building (Figure 51). Therefore, while the structure is currently standing it is slowly deteriorating.

![Figure 51. Otanomomo Flax Mill stripping shed, northern elevation.](image)

The northern elevation has a large opening that functions as the main entrance to the building (Figure 51). The eastern elevation has a lean-to structure at the southern end that houses the washing machinery (Figure 52). The lean-to structure is open ended on the northern facing side and has railing extending northward where stripped and washed flax was stored and sorted (Figure 52). The southern elevation has a small lean-to structure situated on the western side that would have been used for storage (Figure 53). A single doorway is in the middle of the southern elevation providing access to the rear of the building, although the door has not survived. Situated next to
the doorway is a concrete channel that comes out of the building from where the stripper machine was mounted and runs along the southern elevation for roughly two metres before turning south towards the scutching shed (Figure 54). A water wheel, with an attached grinding stone, is situated inside the channel with metal prongs attached to collect loose pieces of fibre, similar to the Templeton Flax Mill (Figure 54).

![Figure 52. Otanomomo stripping shed, eastern elevation.](image)

The interior of the building is largely taken up by modern farming machinery and rubbish, making it difficult to navigate and observe all the surviving features. However, at the south-eastern end of the building the stripper mount is clearly visible, although the stripping machinery has been removed. At the base of the concrete machinery mount is the start of the concrete channel that runs outside and along the side of the building (Figure 54). A small motor that is attached to the water wheel mechanism is still installed on the machinery mount but is not in an operational condition. Next to this is the orange painted wash machinery that is driven by a network of overhead pipelines. The wash machinery extends into the eastern lean-to structure and while not in an operational condition, appears to largely be complete (Figure 52).
Figure 53. Otanomomo stripping shed, southern elevation.

Figure 54. Spiked water wheel located on southern elevation.
Scutching Sheds
The Templeton, Marshlands, Otanomomo, and Paetawa flax mill sites were found to have surviving historical scutching sheds.

Templeton Flax Mill Scutching Shed
The Templeton Flax Mill scutching shed is the easternmost building at the site and is laid out in an east to west direction (Figure 55). The structure is utilitarian and comprises of basic timber framing and corrugated iron cladding, which has been painted red on most sides to match the rest of the mill buildings (Figure 55). The eastern elevation has two large entrances, the southernmost having a rolling door and the northernmost being a permanent opening (Figure 55). There is a small lean-to structure on the northern elevation and a sunken loading bay that can be driven into from the east (Figure 55). This is where finished flax fibre was loaded onto a vehicle. The western elevation has been re-clad with newer corrugated iron and some clear plastic panels to allow more natural light into the interior of the building (Figure 56). The southern elevation has another large roller door on its western side.

The interior of the scutching shed is largely empty, although is sometimes used to store farming equipment. There is no longer any historical milling equipment installed, however, on the floor on the southern side of the shed there is evidence of where the scutching machine was originally installed.
Figure 55. Templeton Flax Mill Scutching Shed eastern elevation.

Figure 56. Templeton Flax Mill scutching shed, western elevation.
Marshlands Flax Mill Scutching Shed

The Marshlands Flax Mill scutching shed is situated in a west to east orientation (Figure 57). The building is slightly L-shaped with multiple lean-to structures (Figure 57). The building is timber framed and horizontally timber clad, unlike the other buildings on the site, and the external timbers have been painted brown (Figure 57). The corrugated iron roof is shallow pitched and flat on the eastern side (Figure 57). The western elevation has large double timber doors that lead directly to the scutching machine, a smaller single timber door that leads to the office, and a third timber door on the southern lean-to structure (Figure 57). The northern elevation has a single window, a tall hinged door, and a smaller wall mounted sliding door. The eastern and southern elevations were unable to be viewed.

The interior of the scutching shed at the Marshlands Flax Mill was unable to be observed. However, maps provided by Heritage New Zealand Pouhere Taonga show that the scutching machine and baling press were located centrally within the building.

Figure 57. Marshlands Flax Mill scutching shed, western elevation.
**Otanomomo Flax Mill Scutching Shed**

The Otanomomo Flax Mill scutching shed is a large rectangular building orientated in a north to south direction. It is a single gabled structure with a low-pitched corrugated iron roof that is heavily rusted and covered in lichen (Figure 58). The structure is timber framed and vertically timber clad, with some panels missing (Figure 59). The northern elevation has a regular doorway at its easternmost point and a collapsing lean-to structure in the centre (Figure 58). The western elevation has a large wall mounted hanging barn door (Figure 59). This is where the finished flax fibre would have been loaded onto a vehicle. The southern and eastern elevations have no windows, doors, or other features. A concrete channel that functions as a drain from the stripper shed runs directly under the scutching shed. The concrete channel lines up with the eastern side of the lean-to structure on the northern elevation and is covered by wooden boards in the interior of the building. The interior of the scutching shed at the Otanomomo flax mill is largely filled with farming machinery and junk. There is no remaining historical milling machinery.

![Figure 58. Otanomomo Flax Mill scutching shed, northern elevation.](image)
Paetawa Flax Mill Scutching Shed

The Paetawa Flax Mill, also known historically as Brown’s Flax Mill (R26/745), is located at 267 State Highway 1 north of Waikanae. The mill operated between 1905 and 1930 and was owned by Archibald Brown (Kapiti Coast District Council 2019). While the site was unable to be visited in person, information from the local District Council and aerial photography confirms the survival of much on the site, including the former scutching and engine shed.

The scutching and engine shed is the westernmost building on the site. It is a simple timber framed structure with red corrugated iron cladding (Figure 60). It is a single gabled building with a shallow pitched roof and a small extension on the south-eastern side of the building. Further investigation of the site and structure is required.
Weighbridge Sheds
The Templeton and Marshlands flax mill sites were the only two that had surviving weighbridge sheds. The Otanomomo Flax Mill has the weighbridge machinery, but the shed has not survived.

*Templeton Flax Mill Weighbridge Shed*

The Templeton flax mill weighbridge shed is situated in an east to west orientation (Figure 61). It is a small rectangular timber framed structure with corrugated iron cladding that has been painted red to match the other mill buildings (Figure 61). The flooring is concrete, and it has a shallow skillion roof (Figure 61). There is a large opening on the eastern elevation to allow vehicle access (Figure 61). The southern elevation has a small lean-to structure and the western elevation has a timber-framed casement window (Figure 61). The shed no longer houses any weighbridge machinery, however, the cut where the weighbridge was situated is still visible and is covered by a sheet of plywood.
Marshlands Flax Mill Weighbridge Shed

The Marshlands Flax Mill weighbridge shed is located to the west of the stripper and scutching sheds and is in the same west to east orientation as the other mill buildings (Figure 62). It is a small rectangular structure that is timber framed and has vertical timber cladding (Figure 62). The shed has a skillion shaped roof that is also made out of wood. The eastern elevation has a timber door serving as the only entrance to the shed. The northern elevation has a small window facing the weighbridge platform, which is outside unlike the Templeton Flax Mill weighbridge (Figure 62). Inside the shed are the complete weighbridge scales, however, their operational status is unknown.
Workers Accommodations
The Redan and Otanomomo flax mills were the only two sites surveyed found to have surviving examples of workers accommodations. An additional four sites recorded on ArchSite also provide evidence of archaeological remains relating to workers accommodations. Furthermore, historical evidence such as photographs provide supplementary information about workers accommodations and associated buildings such as cookhouses, dining rooms, and ablution blocks, which have not survived.

Redan Flax Mill Workers Accommodations
The single men’s quarters at the Redan Flax Mill site is one of few surviving historical examples of workers accommodations at a flax mill in New Zealand. It is located on the northern side of Wyndham-Mokoreta Road 12km east of Wyndham and is the only surviving building relating to the milling industry at the site (Figure 63). The single
gabled structure is timber framed and clad in corrugated iron (Figures 63 and 64). The interior of the building is divided into four single bedrooms with plain wooden floors and walls. Each bedroom has a fireplace and single timber sash window, which are located along the southern elevation of the building (Figure 63). The northern elevation has four plain timber doors, one for each of the bedrooms (Figure 64).

Figure 63. Redan Flax Mill single men’s quarters, southern elevation.

Historical photographs of the Redan Flax Mill also show that there were several cottages established at the site to provide housing for workers who had families (Figure 32). Additionally, next to the surviving single men’s quarters was a cookhouse and dining hall, as well as an ablution block. Following the closure of the mill these buildings were dismantled or otherwise relocated as the land was converted to pasture. There are no visible remains of their existence, although there may be surviving subsurface features.
Otanomomo Flax Mill Workers Accommodations

The Otanomomo Flax Mill has two surviving single workers huts (Figures 65 and 66). The two workers huts have been moved from their original location and are situated near the main flax mill buildings, one directly to the east of the stripper shed (Figure 66) and the other south of the scutching shed (Figure 65). The huts are small structures measuring 3.10m by 2.6m, providing just enough space for a single worker, and have one door and window. Both structures are single gabled with a pitched roof and were originally timber framed with a corrugated iron roof. However, the southern hut has been re-clad in corrugated iron and the interior has been re-lined with plasterboard (Figure 65). Both structures are in a deteriorating condition, and the northern hut is at risk of collapsing (Figure 66). The northern hut is missing considerable portions of its cladding causing large holes in the structure, and due to the wet soil has rotting timbers (Figure 66). Additionally, the roof is rusting, and the interior is filled with debris. The
southern hut is in a more complete condition, although lacks a door and window glass (Figure 65).

Figure 65. Otanomomo Flax Mill workers hut (southern).
**Additional Accommodation Sites**

In addition to the evidence previously discussed, four sites recorded on ArchSite, that were unable to be visited during this thesis, are documented as having evidence relating to workers accommodations at historical flax mills.

The site of Wright's Flax Mill (P20/94) in Taranaki, which operated during the 1890s, has extensive evidence of historical milling activities, including surviving buildings. Two workers huts, one for dining and the other for sleeping, have been moved and combined to form part of the homestead that now exists on the site. The original huts
are recorded as being clearly visible at the back of the house. Additionally, the original mill building, that was changed into a butter factory, has since been converted into a worker’s cottage. Further information is limited and the surviving features, building materials, and current condition of these buildings is uncertain.

The physical remains at the other three sites (F39/1, O07/85, O28/65) include stone foundations, stone walls, and stone chimneys of workers huts. While incomplete, they comprise of different building materials than of those sites previously discussed, providing an interesting comparison. However, it is important to note that these sites have not been revisited in decades and the current status of the remains described in their site record forms is uncertain.

**Other Mill Buildings**

In addition to the above buildings that made up the central components of an historical flax mill, there are other structures that may have been established on site, although few examples have survived. For instance, many mill sites had storage sheds for either fibre products or general mill equipment, stables, and a blacksmith shed.

An example of a storage shed can be found at the Otanomomo Flax Mill where the southernmost historical building is a storage shed. The rectangular structure is made up of basic timber framing and corrugated iron cladding, with a door and window on the northern elevation (Figure 67). No further surviving examples of storage sheds have been identified; however, historical maps and photographs show they were common. For example, the Tane Flax Mill had storage sheds for slips and tow and the neighbouring River Flax Mill also exhibited storage sheds (Figure 44).
While horses were often crucial for the transportation of both raw flax and processed fibre, only one surviving example of a stable at an historical flax mill was identified. The Paetawa Flax Mill stable is the easternmost building at the site and is directly to the right of the gate (Figure 60). The single gabled building is timber framed and clad in red corrugated iron (Figure 60). The entrance is on the western elevation and a vent is located on the eastern elevation. The stable housed the draught horses that pulled drays to deliver raw green flax from the nearby swamps to the mill as well as transport bales of finished fibre to the Waikanae Railway Station (Kapiti Coast District Council 2019). Further investigation into this site is required as it was unable to be surveyed.

Finally, historical research has highlighted that in some instance’s blacksmiths were established at flax milling sites. For example, the Tane Flax Mill had a blacksmith located to the east of the stripping shed, however, no remains of the blacksmith shed were identified at the site (Figure 44). Additionally, the Marshlands Flax Mill has a blacksmith shed on site (Figure 40). No other sites surveyed were found to have remains relating to blacksmithing activities.
Buildings Summary

In summary, there are few surviving examples of historical flax mill buildings in New Zealand and those that do survive predominantly date to the early 20th century. The buildings were not universally standardised and were sometimes constructed haphazardly, allowing for additions when and where necessary. Flax mill buildings were simple utilitarian structures that were constructed out of the same basic building materials including timber, corrugated iron, and stone. Further ideas relating to buildings will be discussed in the subsequent chapter.

The Machinery

Of the flax mill sites surveyed, few were found to have surviving machinery, and only one site (Templeton Flax Mill) is known to have original and fully functional mill equipment. The only other current location with operational historical flax milling machinery is the Foxton Flax Stripper Museum. There are additional archaeological flax mill sites recorded on ArchSite that have incomplete machinery remains that will also be discussed in the subsequent section.

Stripper Machines

The flax stripper was an essential machinery component of each flax mill; however, few sites have any surviving stripping machinery today (Table 2).

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>2x Booth, MacDonald, and Co. Ltd patented strippers</td>
</tr>
<tr>
<td>Marshlands Flax Mill</td>
<td>P28/161</td>
<td>Not fully surveyed</td>
</tr>
<tr>
<td>Foxton Flax Stripper Museum</td>
<td>N/A</td>
<td>Sutton stripper</td>
</tr>
</tbody>
</table>
**Templeton Flax Mill Stripper**

The Templeton Flax Mill’s stripper machine is in situ and in a fully functional condition (Figure 68). The stripper was designed and manufactured by Booth, MacDonald and Co Ltd, a Christchurch based agricultural machinery company. Inside the stripper the rollers which held the flax were set to 400 revs per minute and the stripping drum, which removed the vegetation, was set to 2000 revs per minute (Templeton 2004:5). Under the right conditions this machine was able to strip up to 12 tons of raw flax per day, producing one and a quarter ton of flax fibre (Templeton 1997:102). Connected to the Templeton stripper is an automated chain catching system which collects the stripped fibres and moves them to the wash area (Figure 68).

![Image of Templeton Flax Mill stripper station](image)

**Figure 68.** Templeton Flax Mill stripper station.

In addition, the Templeton Flax Mill currently houses the stripper machine that was originally installed at the Otanomomo Flax Mill (Figure 69). This second stripper is not installed and is stored in a modern shed on site with other examples of machinery and historical information. It is also a Booth, MacDonald and Co Ltd patented machine and
is stored with its cowling open to display the interior workings of the apparatus (Figure 69).

![Uninstalled stripper machine at Templeton Flax Mill Heritage Museum.](image)

**Figure 69.** Uninstalled stripper machine at Templeton Flax Mill Heritage Museum.

**Foxton Flax Stripper Museum Stripper**

The only other flax stripper known to be in an operational condition is installed in the Foxton Flax Stripper Museum. The machine was originally installed at the Foxton based textile company Bonded Felts Ltd and was designed by Mr E. Sutton in 1930. The device could strip up to 16 ton of raw flax per day. In 1990 the museum was established which saw the stripper moved to its current location. Currently it is in an operational
condition with a complete automated chain catchment system attached, however, it is missing its mouthpiece (Figure 70).

![Figure 70. Sutton flax stripper machine with missing mouthpiece, Foxton Flax Stripper Museum.](image)

**Marshlands Flax Mill Stripper**

The Marshlands Flax Mill is recorded as housing an intact flax stripper (Wood 1982). However, the site was unable to be visited, therefore it is uncertain if the machine is still in situ and whether it is in an operational condition. No further stripping machines were identified through field survey or an investigation into NZAA site record forms.
Wash Machinery

Three flax mill sites have surviving examples of washing machinery (Table 3). There is some variation in the washing process and machinery between these sites and further differences are described historically.

Table 3. Flax mill sites with wash machinery

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>Operational</td>
</tr>
<tr>
<td>Otanomomo Flax Mill</td>
<td>H46/60</td>
<td>Non-operational</td>
</tr>
<tr>
<td>Marshlands Flax Mill</td>
<td>P28/161</td>
<td>Not fully surveyed</td>
</tr>
</tbody>
</table>

Templeton Flax Mill Wash Machinery

The Templeton Flax Mill houses a complete and operational example of wash machinery. The machinery consists of an automated chain system that catches flax fibre once fed through the stripper machine and runs it through a primary and secondary washer. The washer is situated on concrete foundations and comprises of tin sides that keep water from spreading and direct it to the drain below (Figure 71). Above the tin sides is a length of pipe with multiple spouts that provide a continuous shower of water (Figure 72). The water is supplied by an overhead pipeline network. Following passing through this primary wash the flax fibre is collected in hanks and hung over a wooden bench (Figure 73). The flax is then showered by the secondary washing mechanism, which comprises of an overhead horizontal spray washer that is also fed by the above pipeline network (Figure 73). The water runs into a concrete channel covered by a duckboard and drains out of the building on the western side (Figure 73).
Figure 71. Templeton Flax Mill primary wash with automated chain system.

Figure 72. Templeton Flax Mill belt drive system and primary wash with automated chain loop.
Otanomomo Flax Mill Wash Machinery

The Otanomomo Flax Mill has a flax wash system similar to the Templeton Flax Mill, however, it lacks the secondary wash feature. The machinery comprises of the same elements as the Templeton primary wash including tin sidings, overhead pipe networks, a length of horizontal pipe with multiple spouts, and an automated chain system that catches the stripped fibre and pulls it through the wash mechanism (Figure 74). However, the Otanomomo wash machinery appears to be more robust than its Templeton counterpart as it has cast iron struts which support the structure (Figure 74). The machinery is mounted on concrete foundations and excess water drained to the south of the building through a concrete channel (Figure 74). The wash machinery is currently in a non-operational condition and is at risk of further decay.
As previously stated, the Marshlands Flax Mill was not able to be surveyed in full, however, the report provided by Heritage New Zealand provides a description of the wash machinery installed within the plant. Prior to 1927 the stripped flax fibre was washed by hand in large concrete tubs (Wood 1982:3). After 1927 an automated catching system was installed, along with a shaking table, and new wash system (Wood 1982:3-4). The stripped flax would pass over the shaking table, which shook off excess vegetation, before being pulled to the first wash stage. The first wash consisted of a rotating drum that was 1m in diameter which scraped the passing flax fibre as it was wet from a four-inch overhead water pipe (Wood 1982:4). The fibre then passed through the second wash which comprised of an overhead shower and tin sides, similar to the Templeton and Otanomomo set ups (Wood 1982:4). The wash process at Marshlands concluded with the flax fibre being collected and twisted into hanks before being stored on a pole over the large concrete rinsing tanks where and overhead
shower system continued to wet the flax until it was ready to be moved outside for drying (Wood 1982:4). It is uncertain whether this machinery is still installed or what condition it is in, however, the description alone highlights variation within the washing process as well as showing the earlier washing methods employed.

Scutching Machines

A total of three sites surveyed were found to have surviving scutching machines (Table 4). Additionally, the Foxton Flax Stripper Museum houses an operational scutching machine and the Wyper’s Creek Flax Mill site (I44/86) is reported to have a derelict scutching machine (Table 4).

Table 4. Flax mill sites with scutchers

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>Automated and operational</td>
</tr>
<tr>
<td>Redan Flax Mill</td>
<td>F46/36</td>
<td>Complete, non-operational</td>
</tr>
<tr>
<td>Wyper’s Creek Flax Mill</td>
<td>I44/86</td>
<td>Not visited</td>
</tr>
<tr>
<td>Marshlands Flax Mill</td>
<td>P28/161</td>
<td>Not visited</td>
</tr>
<tr>
<td>Foxton Flax Stripper Museum</td>
<td>N/A</td>
<td>Manual and operational</td>
</tr>
</tbody>
</table>

Templeton Flax Mill Scutcher

The Templeton Flax Mill contains the only known functional automatic scutching machine in New Zealand. This machine was originally installed at the Otanomomo Flax Mill and was relocated to the Templeton site in 2001. It replaced the original automated scutching machine which was unable to be restored to a functioning condition.

The scutcher consists of a large rotating drum with six beater arms that is enclosed within a wooden cabinet. The rotating beater arms remove any remaining vegetation and soften the final product. A horizontal slit roughly one metre off the ground is where the fibre is fed into before being pulled through the machine by an automated chain system (Figure 75). The chain system automatically flips the hank of flax so both sides are scutched smooth and the finished product is pulled around to the northern side of the machine where it can be collected for baling (Figure 76 and 77).
Figure 75. Templeton Flax Mill scutching machine. Fibre loading point on right.

Figure 76. Templeton Flax Mill scutching machine.
The other scutching machine that is known to be in a functional condition is in the Foxton Flax Stripper Museum and was originally installed at an unknown flax mill in Blenheim. The scutcher is not automated but consists of the same components as the Templeton scutcher, including the rotating internal drum with six wooden beater arms. The drum is enclosed in a wooden cabinet and has a horizontal slit roughly one metre off the ground on the front where hanks of dried flax were fed into the machine (Figure 78). This part of the process was done by hand and a worker had to feed the flax fibre into the slit, holding on tightly to the other end, before swapping it over and working the other side to produce the finished product.
Figure 78. Foxton Flax Stripper Museum manual scutching machine. The two red metal pieces indicate where the flax is fed into the machine.

**Redan Flax Mill Scutcher**
The Redan Flax Mill’s scutching machine is intact and stored in an implement shed on the farm that the mill was originally established on. It is not currently connected to any power source and it is uncertain whether the machine is able to be operated or needs refurbishment. The Redan scutcher is not automatic and has the same parts and operating process as the scutcher installed at the Foxton Flax Mill Museum (Figure 79).
Figure 79. Redan Flax Mill scutching machine. Stored in a farm shed.

Marshlands Flax Mill Scutcher
While the Marshlands Flax Mill was unable to be fully surveyed, the registration report compiled by Heritage New Zealand provides a description of the scutcher. However, as the report is not recent it is uncertain whether the scutcher is still at the site or what its current condition is.

The scutcher comprised of a drum that is 2 metres long and 1.6 metres in diameter (Wood 1982:5). The drum had six internal beater arms, three of which were fitted with spikes on them to comb the fibre, which rotated at 300rpm (Wood 1982:5). The drum mechanism was encased in a wooden cabinet and had a horizontal slit 1 metre off the ground where flax fibre was fed into, much like the scutchers at Redan and Foxton (Wood 1982:5). It was originally connected to the main drive shaft at the mill but following the instalment of electricity had its own 20hp engine (Wood 1982:5).
Wyper’s Creek Flax Mill Scutcher

The Wyper's Creek Flax Mill (144/86) site on the Otago Peninsula is reported to have a derelict scutching machine (Petchey 1996:112). Photographic evidence shows the wooden scutching machine missing its exterior cabinet, but in an otherwise near complete condition (Figure 80). However, the site was not able to be visited and the current condition of the scutching machinery is uncertain.

Figure 80. Derelict scutching machine at Wyper’s Creek Flax Mill site. (Image taken from Knight 1979:72).
Weighbridges
Only two sites were identified as having surviving weighbridge machinery, despite all mills needing access to some means of weighing and quantifying their product.

Otanomomo Flax Mill Weighbridge
The remains of the original weighbridge at the Otanomomo Flax Mill are located immediately north of the mill buildings (Figure 81). The iron bridge is partially covered with vegetation and is inscribed on all sides with: ‘To weigh 8 tons W & T Avery Ltd. Makers London Birmingham’ (Figure 81). It also has a repeated diamond pattern that likely provided traction for vehicles (Figure 81). The scale mechanism has fallen from its original concrete mount and is heavily rusted (Figure 82). While it is not in an operational condition, it provides a good example of an historical weighbridge and is not at risk of further decay.

Figure 81. Otanomomo Flax Mill weighbridge.
The only other site found to have a surviving weighbridge is the Marshlands Flax Mill. The weighbridge appears to be more modern than the Otanomomo Mill counterpart. It consists of two parallel plain metal strips where vehicles would drive onto and a scale mechanism housed in a small shed to the side (Figure 62). The scale mechanism appears to be intact and operational, however, it was unable to be closely examined and no makers mark was visible.

Marshlands Flax Mill Weighbridge

Figure 82. Otanomomo Flax Mill weighbridge scale mechanism.
Other Machinery Evidence

In addition to the sites surveyed there are a further thirteen recorded sites described as having some form of machinery remains (Table 5). The remains present at these sites are far more fragmentary than those described above and are more generic with many record forms not providing a thorough description of the surviving machinery elements. Additionally, as these sites were unable to be visited their current condition is uncertain.

Table 5. Flax mill sites with machinery remains

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Machinery Remains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Flax Mill</td>
<td>D48/7</td>
<td>Not specified</td>
</tr>
<tr>
<td>Cascade Flax Mill</td>
<td>E38/19</td>
<td>Crankshaft</td>
</tr>
<tr>
<td></td>
<td>E44/18</td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>F39/1</td>
<td>Gears, pulleys, and piping</td>
</tr>
<tr>
<td>Waitaha Flax Mill</td>
<td>I33/1</td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>K29/52</td>
<td>Not specified</td>
</tr>
<tr>
<td></td>
<td>O28/65</td>
<td>Iron wheel and other non-specified machinery</td>
</tr>
<tr>
<td>Gray's Flax Mill</td>
<td>P20/9</td>
<td>Turbine shaft</td>
</tr>
<tr>
<td>Rutherford's Flax Mill</td>
<td>R14/356</td>
<td>Flywheel and shaft</td>
</tr>
<tr>
<td>Otway's Flax Mill</td>
<td>R17/136</td>
<td>Valve chest</td>
</tr>
<tr>
<td>Ototoka Flax Mill</td>
<td>R22/433</td>
<td>Two axles</td>
</tr>
<tr>
<td>Pokeno Flax/Flour Mill</td>
<td>S12/360</td>
<td>Cogs, shafts, axles, wheels, feed rollers, and ribbed drums</td>
</tr>
<tr>
<td></td>
<td>S23/64</td>
<td>Feed rollers and other non-specified machinery</td>
</tr>
</tbody>
</table>

Machinery Summary

From the above discussion it is apparent that there are few surviving examples of flax milling machinery in New Zealand and even fewer examples of machines in an operational condition. Those that do survive indicate slight variations in machinery and processes between flax mill sites.
Power Sources

Based on archaeological evidence described in site record forms and observed during field surveys, 21 flax mill sites were identified as having physical remains relating to their source of power. A total of ten were found to have used waterpower, seven used steam, three used electricity, and one used a gas combustion gas engine.

Waterpower

New Zealand flax mills were often located near swampland areas to ensure a reliable supply of raw flax. These areas typically had an available water source that mills could harness as a means of cheap power by use of a water wheel or turbine. The surviving evidence relating to water powered mills is summarised in the below table (Table 6).

Table 6. Flax mill sites with evidence of waterpower

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Remains</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Flax Mill</td>
<td>D48/7</td>
<td>Waterwheel</td>
<td>No further description</td>
</tr>
<tr>
<td></td>
<td>F39/1</td>
<td>Waterwheel mount and water race</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K29/52</td>
<td>Waterwheel</td>
<td>No further description</td>
</tr>
<tr>
<td></td>
<td>O06/443</td>
<td>Mount (buried)</td>
<td>Large wooden overshot waterwheel dismantled</td>
</tr>
<tr>
<td>Binnie’s Flax Mill</td>
<td>P20/10</td>
<td>Waterwheel segment</td>
<td>Wooden</td>
</tr>
<tr>
<td>Vercoe’s Flax Mill</td>
<td>P28/160</td>
<td>Waterwheel attachment</td>
<td></td>
</tr>
</tbody>
</table>
| Foster’s Flax Mill   | Q11/380       | Waterwheel slot and axle attachment | Slot: 3m x 7m  
|                      |               |                               | Depth: 6-7m                                               |
| Ototoka Flax Mill    | R22/433       | Iron waterwheel axle, hub, and spokes |                                                            |
| Pokeno Flax/Flour Mill | S12/360    | Waterwheel and chamber        | Waterwheel wooden and deteriorating                       |
| Wallis Brothers Flax Mill | N/A          | Pelton wheel                  | Pelton wheel relocated to Raglan Museum                    |

Historical photographs show the common use of wooden waterwheels at flax mills (Figures 83 and 84). However, there are few surviving examples of complete wooden water wheels as they have simply rotted away, and many sites only have fragmentary evidence or wheel mounts remaining (Figure 85).
Figure 83. Example of breast shot waterwheel at Meharrys Flax Mill, Kōwhitirangi, Hokitika, circa 1900. (Available at: https://westcoast.recollect.co.nz/nodes/view/3004).

Figure 84. Example of overshot waterwheel at Grant’s Flax Mill, Waitati. (Copy Negative no. c/n E2475/25, Hocken Collections, Uare Taoka o Hākena, University of Otago).
There were few examples of water turbines used to power flax mills identified during both physical and historical surveys. However, historical sources state that the Redan Flax Mill was powered by some form of water turbine, although no remains of the turbine were identified at the site (Redan District Book Committee 1990:171). Additionally, the Raglan Museum houses a Pelton wheel that once powered the nearby Wallis Brothers Flax Mill.

Pelton wheels are a form of popular impulse turbine that were used throughout multiple historical industries in New Zealand. The double curved buckets are hit with a high-pressure tangential flow of water which powers the wheel. The Wallis Brothers Pelton wheel consists of a single piece cast iron wheel with six spokes and buckets bolted to the rim (Figure 86). This particular Pelton wheel was imported from England in 1902, however, the Thames based A & G Price Ltd held the rights to manufacture the Pelton wheel and would have been the main supplier within New Zealand.
Steam engines were a common power source for flax mills, and numerous other historical industries, as they were reliable and easy to use. Steam engines could be removed, reused, and in some cases be mobile. These were useful characteristics as flax mills themselves could be transitory and portable.
A total of seven flax mill sites were found to have evidence relating to steam power, two of which were able to be surveyed (Table 7). Many of these sites have retained their boiler, although most have been dismounted and are missing their associated engine. This can be observed at Rutherford’s Flax Mill site where the Cornish style boiler has been dismounted and is resting a bank in the Raglan lagoon (Figure 87). No remains relating to its engine or any other evidence of the flax mill were identified at the boiler site when visited.

Table 7. Flax mill sites with evidence of steam power

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Remains</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascade Flax Mill</td>
<td>E38/19</td>
<td>Portable steam boiler</td>
<td></td>
</tr>
<tr>
<td>Chinn’s Flax Mill</td>
<td>G36/6</td>
<td>Two boilers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P05/836</td>
<td>Boiler</td>
<td>Dimensions: 3.5m x 1m</td>
</tr>
<tr>
<td>Marshlands Flax Mill</td>
<td>P28/161</td>
<td>Boiler and steam engine</td>
<td>15h.p Horizontal Marshall engine</td>
</tr>
<tr>
<td></td>
<td>R13/153</td>
<td>Boiler</td>
<td></td>
</tr>
<tr>
<td>Rutherford’s Flax Mill</td>
<td>R14/356</td>
<td>Cornish boiler</td>
<td></td>
</tr>
<tr>
<td>Tane Flax Mill</td>
<td>S24/48</td>
<td>Concrete chimney</td>
<td>Steam engine exhaust</td>
</tr>
</tbody>
</table>

Additional evidence relating to steam powered flax mills includes chimneys and machinery mounts, as demonstrated by the Tane Flax Mill site (Figure 88). The 20m high chimney functioned as an exhaust for the steam engine, which was installed on the neighbouring concrete pad (Figure 88). The Tane Flax Mill site provides a rare example of this type of infrastructure as few sites with surviving chimneys exist today.

Further flax mill sites with machinery mounts and other concrete foundations are common, however, without building plans, photographs, or other historical sources it is impossible to definitively state what machinery the remains relate to.

Finally, the Marshlands Flax Mill is recorded as having an intact steam engine and boiler (Figure 40). However, the site was unable to be visited and further investigation is needed.
Figure 87. Cornish style boiler, Rutherford’s Flax Mill site, Raglan.

Figure 88. Tane Flax Mill chimney and boiler mount.
**Internal Combustion Engines**

The use of internal combustion engines, either gas, oil, or petrol fuelled, was common in New Zealand flax mills. There is little surviving archaeological evidence that represents this power source as internal combustion engines were expensive and could be relocated and reused. However, historical photographs demonstrate their common use, especially at later, larger flax milling operations (Figures 89 and 90).

Additionally, the site of the Whitanui Flax Mill in Foxton consists of concrete foundations that are known to have had a suction gas engine installed on them (Figure 93). Other flax mill sites with engine mounts may have originally had combustion engines installed on them, however, further historical research into each site would be necessary to confirm this.

![Image of internal combustion engine](image-url)

**Figure 89.** Gas suction engine installed at Paetawa Flax Mill, 1916. (Reference no. 2000.508.0001, Horowhenua Historical Society Inc.).
Electricity

Electric power was first established in New Zealand in 1888, however, it was not immediately adopted by the flax milling industry. The mills identified as having converted to electrical power did so from the 1920s onwards, by which stage the industry was largely in decline. Therefore, it is not unexpected that there are few surviving examples of electrically powered flax mills. However, it is likely that the flax mills which survived and continued to operate into the mid-20th century all converted to electrical power as it was made available to their local area.

Three flax mill sites have been identified as having evidence relating to the use of electrical power (Table 8).
Table 8. Flax mill sites with evidence of electric power

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Engines</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>15h.p Pump Motor</td>
<td>Converted to electricity in early 1930s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25h.p Primary Drive Motor</td>
<td></td>
</tr>
<tr>
<td>Otanomomo Flax Mill</td>
<td>H46/60</td>
<td>40h.p Motor</td>
<td>Converted to electricity in 1926</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20h.p Motor</td>
<td></td>
</tr>
<tr>
<td>Marshlands Flax Mill</td>
<td>P28/161</td>
<td>50h.p Motor</td>
<td>Converted to electricity in 1927</td>
</tr>
</tbody>
</table>

The engines installed at the Templeton Flax Mill are in working condition and continue to drive the machinery in the mill (Figure 48). The condition of the electric motor installed at the Marshlands Flax Mill is uncertain and the electric motors installed at the Otanomomo Flax Mill are in a derelict state (Figure 91).

Figure 91. Derelict electric motor at Otanomomo Flax Mill.
Concrete Foundations

While examples of complete historical flax mill buildings and features in New Zealand are relatively rare, there are several examples of sites with concrete foundations. These concrete remains are durable and survive well, however, their level of preservation varies between sites. Despite this they can broadly be divided into two categories: concrete foundations relating to the entire mill structure and concrete remains relating to the mounting of an engine or other machinery. The sites observed as having these features are listed in the table below (Table 9).

Table 9. Flax mill sites with concrete foundations

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Remains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bennett’s Flax Mill</td>
<td>D46/20</td>
<td>Machinery mounts and concrete drain</td>
</tr>
<tr>
<td></td>
<td>E44/18</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td>Royd’s Flax Mill</td>
<td>E47/143</td>
<td>Concrete and timber foundations</td>
</tr>
<tr>
<td></td>
<td>F31/9</td>
<td>Concrete engine mounts</td>
</tr>
<tr>
<td></td>
<td>K29/52</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td></td>
<td>P05/835</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td>Tararamaha Flax Mill</td>
<td>P19/235</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td>Binnie’s Flax Mill</td>
<td>P20/10</td>
<td>Concrete foundations, possible engine mount</td>
</tr>
<tr>
<td>Rutherford’s Flax Mill</td>
<td>P20/98</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td>Vercoe’s Flax Mill</td>
<td>P28/160</td>
<td>Extensive concrete foundations and machinery mounts</td>
</tr>
<tr>
<td>Ototoka Flax Mill</td>
<td>R22/433</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td>Pokeno Flax/Flour Mill</td>
<td>S12/360</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td></td>
<td>S23/64</td>
<td>Concrete engine mount</td>
</tr>
<tr>
<td></td>
<td>S23/68</td>
<td>Concrete foundations</td>
</tr>
<tr>
<td>Tane Flax Mill</td>
<td>S24/48</td>
<td>Concrete engine mount and other foundations</td>
</tr>
<tr>
<td>Foxton Flax Mill</td>
<td>S24/94</td>
<td>Concrete foundations and machinery mount</td>
</tr>
<tr>
<td>Ora Flax Mill</td>
<td>S24/95</td>
<td>Concrete machinery mount</td>
</tr>
<tr>
<td>Whitanui Flax Mill</td>
<td>S24/96</td>
<td>Concrete engine mount</td>
</tr>
<tr>
<td>Tuhara Flax Mill</td>
<td>X19/80</td>
<td>Concrete foundations (10mx4m) and machinery mounts</td>
</tr>
</tbody>
</table>

The Vercoes Flax Mill site demonstrates both categories of concrete foundations. The site is roughly 24m by 16m in size and has extensive concrete foundations (Figure 92). The foundations include retaining walls, waterwheel attachments, multiple machinery mounts, a chimney base, and other plain concrete components (Figure 92). Many of the concrete machinery mounts have exposed iron rods for the attachment of machinery and cut outs for wheels, pipes, or other machinery components (Figure 93).
The Vercoes Flax Mill site provides one of the most complete examples of flax mill foundations in New Zealand, and other sites are typically much smaller and more fragmented. For example, the remains at the flax mill sites along the Foxton riverbank are limited to single engine or machinery mounts (Figures 93-95). The Whitanui Flax Mill site (S24/96) consists of two square concrete plinths with iron rods functioning as a machinery mount and a concrete pad (Figure 93). The larger of the two foundations has a large wheel cut out on the eastern side, for the gas suction engine that drove the mill (Figure 93). In comparison, the remains of the Ora Flax Mill comprise of an unusually shaped concrete machinery mount (Figure 94). The eastern side of the mount has exposed iron rods for the attachment of machinery and the western side has a large cut-out (Figure 94). The local museum suggests this is the mount for a boiler, however, based on a comparison with other sites this may be the stripping machine mount with the cut-out functioning as the collection point of stripped flax for a worker or automated fibre catching system.
Figure 93. Whitanui Flax Mill foundations, facing west.

Figure 94. Ora Flax Mill foundations, facing south.
The final surviving site on the Foxton riverbank is the foundations of the Foxton Flax Mill. This site comprises of a concrete pad and two machinery mounts; however, they are in a deteriorating state and have no features that indicate their specific use or function (Figure 95). The larger of the two machinery mounts has exposed railway sleepers and three complete sleepers are located upright in the river next to the foundations (Figure 95). The Foxton Flax Mill was established contemporarily to the nearby Foxton Railway Yards and the exposure of these railway sleepers indicates an opportunistic use of nearby materials as a means of reinforcing the concrete foundations of the mill (Figure 96).

![Figure 95. Foxton Flax Mill foundations, facing south.](image-url)
Dams and Waterways
As previously stated, flax mills require a reliable source of water, whether water powered or not, in order to wash flax fibre once it has been stripped. As a result, there are numerous flax mill sites with evidence of dams, water races, or other waterway systems (Tables 10 and 11).

Flax mill sites with surviving dams or holding ponds are clearly visible in aerial imagery (D46/116, P20/94, P20/98, Q11/380), however, some dams have been drained following the closure of the mill (F46/, I44/79) and evidence is limited to the outline of the dam, holding pond, or surviving floodgate controls (Figure 97).
Table 10. Flax mill sites with evidence of dams and holding ponds

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>Lagoon</td>
</tr>
<tr>
<td>Redan Flax Mill</td>
<td>F46/36</td>
<td>Dam (drained)</td>
</tr>
<tr>
<td>Robertson’s Flax Mill</td>
<td>J44/79</td>
<td>Large dam (drained)</td>
</tr>
<tr>
<td></td>
<td>O28/65</td>
<td>Holding pond</td>
</tr>
<tr>
<td>Tararamaha Flax Mill</td>
<td>P19/235</td>
<td>Dam site</td>
</tr>
<tr>
<td>Wright’s Flax Mill</td>
<td>P20/94</td>
<td>Square concrete dam</td>
</tr>
<tr>
<td>Rutherford’s Flax Mill</td>
<td>P20/98</td>
<td>Square concrete dam</td>
</tr>
<tr>
<td>Foster’s Flax Mill</td>
<td>Q11/380</td>
<td>Holding pond</td>
</tr>
<tr>
<td>Omahina Flax Mill</td>
<td>R14/448</td>
<td>Dam</td>
</tr>
</tbody>
</table>

Figure 97. Floodgate controls for Redan Flax Mill dam.

The condition of surviving water races at flax mill locations varies greatly between site. Sites such as the Otanomomo Flax Mill (Figure 42) and Foster’s Flax Mill (Q11/380) have complete water race systems, whereas others have smaller sections surviving or have been infilled leaving only trace remains (Table 11).
Table 11. Flax mill sites with evidence of water races

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>Concrete water race</td>
</tr>
<tr>
<td>Redan Flax Mill</td>
<td>F46/36</td>
<td>Water race</td>
</tr>
<tr>
<td>Chinn’s Flax Mill</td>
<td>G36/6</td>
<td>Water Race</td>
</tr>
<tr>
<td>Otanomomo Flax Mill</td>
<td>H46/60</td>
<td>Multiple water races</td>
</tr>
<tr>
<td>Robertson's Flax Mill</td>
<td>I44/79</td>
<td>Water races</td>
</tr>
<tr>
<td>Kohatu Flax Mill</td>
<td>N28/13</td>
<td>Remnant of stone lined water race, 10m long</td>
</tr>
<tr>
<td></td>
<td>O28/65</td>
<td>Three water races</td>
</tr>
<tr>
<td>Langley Dale Flax Mill</td>
<td>O28/85</td>
<td>Water Race</td>
</tr>
<tr>
<td>Gray's Flax Mill</td>
<td>P19/235</td>
<td>Infilled water race and stone lined platform</td>
</tr>
<tr>
<td>Binnie’s Flax Mill</td>
<td>P20/9</td>
<td>Water Race</td>
</tr>
<tr>
<td>Bayly’s Flax Mill</td>
<td>P20/91</td>
<td>Filled in water race approximately 74m</td>
</tr>
<tr>
<td>Wright’s Flax Mill</td>
<td>P20/94</td>
<td>Water race 50m</td>
</tr>
<tr>
<td>Rutherford’s Flax Mill</td>
<td>P20/98</td>
<td>Water race</td>
</tr>
<tr>
<td>Piha Flax Mill</td>
<td>Q11/66</td>
<td>Ditch/stream deviations (infilled)</td>
</tr>
<tr>
<td>Foster's Flax Mill</td>
<td>Q11/380</td>
<td>Water race/diversion system</td>
</tr>
<tr>
<td>Leakey’s Flax Mill</td>
<td>R14/244</td>
<td>Water race 105m long, 0.5m deep</td>
</tr>
<tr>
<td>Rutherford's Flax Mill</td>
<td>R14/356</td>
<td>Water race/channel extending 400m up norther</td>
</tr>
<tr>
<td>Omahina Flax Mill</td>
<td>R14/448</td>
<td>Two water races</td>
</tr>
<tr>
<td>Pokeno Flax/Flour Mill</td>
<td>S12/360</td>
<td>Water race</td>
</tr>
</tbody>
</table>

Drying Paddocks

Due to stripped flax fibre needing to be dried and bleached in the sun, flax mills typically had nearby drying paddocks where flax would be hung on a wire fence or laid out on the ground and regularly rotated. Historical photographs highlight the large amounts of space drying paddocks used to accommodate at flax mill sites (Figure 98). The Templeton Flax Mill was the only site found to have a surviving drying paddock and it is much smaller than its historical predecessors (Figure 99). Following the collapse of the flax industry drying paddocks were largely repurposed for agricultural uses, as such few examples survive today.
Figure 98. Drying paddocks at Tane Flax Mill. (Digitisation ID: 2011N_Fx119_004648, Manawatū Heritage, Palmerston North Libraries and Community Services).

Figure 99. Drying Paddock, Templeton Flax Mill.
Transportation

Transport networks were essential for the operation of flax mills and highlight the situation of flax mills in a broader industrial landscape. Mill sites often had tramlines, railway lines, roads, tracks, wharfs, or otherwise to allow for the transportation of raw and processed flax. While many of these networks have since closed or been dismantled there are some sites that have evidence relating to these historical transport systems (Table 12). These are summarised and discussed below.

Table 12. Flax mill sites with archaeological evidence relating to transportation

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templeton Flax Mill</td>
<td>D46/116</td>
<td>Track/farm track</td>
</tr>
<tr>
<td>Redan Flax Mill</td>
<td>F46/36</td>
<td>Track/farm track</td>
</tr>
<tr>
<td>Otanomomo Flax Mill</td>
<td>H46/60</td>
<td>Tracks/farm track, boat landing</td>
</tr>
<tr>
<td></td>
<td>K29/52</td>
<td>Horse tramway</td>
</tr>
<tr>
<td></td>
<td>O07/85</td>
<td>Horse track</td>
</tr>
<tr>
<td></td>
<td>R17/99</td>
<td>Tramway, sleepers, wagon wheel and axle</td>
</tr>
<tr>
<td>Tane Flax Mill</td>
<td>S24/48</td>
<td>Old road/tramline and suspension bridge</td>
</tr>
</tbody>
</table>

Tracks and Roadways

Of the sites surveyed four were found to have surviving tracks and roadways relating to flax milling, however few other recorded flax mill sites were recorded as having tracks and roadways. The sites of the Templeton, Redan, and Otanomomo flax mills each had tracks leading to and around the location of the flax mill. These tracks have since been repurposed as farm tracks and are still in use today.

The Tane Flax Mill site also has evidence of an historical roadway, previously a tramline; however, it is no longer used and has since been grassed over (Figure 100). Additionally, the site includes the remains of the large derelict Opiki Suspension Bridge that was designed and built by Joseph Dawson in 1917 (Akers 2003:25). The bridge provided a more direct transport to the Rangitou Railway Station where prepared fibre was exported from, as well as easier movement between the mill established on either side of the Manawatū River (Akers 2003:25). The suspension bridge replaced the earlier wire ropes and punts that had previously been used and proved inefficient. The bridge spans 477 feet (145.4m) across the Manawatū River and its four reinforced
concrete towers are 48 feet (14.6 m) tall (Akers 2003:25). The towers taper towards the top and each pair is linked by three slightly arched horizontal braces (Figure 100). While the towers are in a good condition the bridges wire ropes are rusting, the cables are loose, and the deck has been removed (Figure 100).

Figure 100. Opiki Suspension Bridge.
Tramlines and Railways

The use of tramlines and railways was relatively common for historical flax mills in New Zealand. Horse-led tramlines were an effective way of moving flax through cultivated swamplands or to and from mill sites (Figure 101). The use of locomotives was trialled in some places, such as the Miranui Flax Mill and associated swamplands, however their use did not often prove successful due to the soft ground (Figure 102). As such transportation through swamplands was typically limited to horse-led vehicles, chain systems, or was moved manually by people, and the use of locomotives and railways was reserved for the export of the final product through the local branch and main lines of the national railway network. Processed flax fibre was also transported by horse drawn carts and later by motor vehicles.

The Tane Flax Mill originally had a tramline that split into four branches for the transportation of raw flax to each of the four stripping machines installed on site (Figure 44). The tramline also continued over the neighbouring Opiki Suspension Bridge to the neighbouring River Flax Mill and to the nearby Rangitou Railway Station. No evidence directly relating to this tramline survives today. The Otanomomo Flax Mill also used a tramline to export bales of flax fibre to the nearby Otanomomo Railway Sliding (Palmer 2000:139). There are numerous other historical examples of flax mill tramlines, however, little archaeological evidence of their existence survives and only two flax mill sites (R17/99, K29/52) are recorded as having evidence of historical tramlines.
Figure 101. Horse-drawn trams transporting flax to Foxton flax mills on the bank of the Manawatū River, circa 1912. (Digitisation ID: 2007N_Fx30_FLA_0621, Manawatū Heritage, Palmerston North Libraries and Community Services). 2007N_Fx127_FLA_0641

Figure 102. Locomotive at Miranui Flax Mill, near Shannon, 1907. (Digitisation ID: 2011P_Fx13_004586, Manawatū Heritage, Palmerston North Libraries and Community Services).
**Water Transportation**

Finally, flax mills located coastally or near rivers would often use waterways as a means of transportation (Figure 103). For example, the numerous flax mills established along the banks of the Manawatū River in Foxton each had their own jetty (Figures 28 and 30). From here mills could receive raw flax from the Motoua Swamp located upstream or otherwise transport goods. Little evidence relating to this survives today however railway sleepers erected in the Manawatū River next to the foundations of the Foxton Flax Mill may relate to the mills jetty structure (Figure 95). Additionally, the Otanomomo Flax Mill made use of the neighbouring Puerua River and once had a jetty and mooring, however, only two posts survive (Palmer 2000:140).

![Figure 103](image-url). Steamboat transporting flax from Motoua Swamp to Foxton flax mills ca. 1910. (Digitisation ID: 2007N_Fx31_FLA_0622, Manawatū Heritage, Palmerston North Libraries and Community Services).
Other Mill Sites

In addition to the sites discussed above with various archaeological remains and features, there are a considerable amount of recorded flax mill sites that do not have any visible physical remains (Table 13). It is likely that some sites have subsurface features, as indicated by undulating ground or other unusual ground features, whereas others have been totally destroyed. Further investigation into these sites would be useful as many have not been revisited since first being recorded decades ago and are in need of re-surveying. Finally, the large number of flax mill sites with no surviving visible remains highlights the rarity and importance of the sites that do survive.

Table 13. Flax mill sites with no visible remains

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site no.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young and Fairweather’s Flax Mill</td>
<td>D46/12</td>
<td>No visible surface remains.</td>
</tr>
<tr>
<td>Waihoaka Flax Mill</td>
<td>D46/25</td>
<td>No visible surface remains.</td>
</tr>
<tr>
<td>Freshwater Flax Mill</td>
<td>D48/7</td>
<td>No visible surface remains, but machinery parts have been recovered from site.</td>
</tr>
<tr>
<td></td>
<td>G44/20</td>
<td>No visible surface remains, but undulated ground indicates subsurface features.</td>
</tr>
<tr>
<td>Tokoiti Flax Mill</td>
<td>H45/52</td>
<td>No visible surface remains.</td>
</tr>
<tr>
<td></td>
<td>O04/434</td>
<td>No visible remains relating to flax mill. An aerated water and cordial factory was later established on the site.</td>
</tr>
<tr>
<td></td>
<td>O06/436</td>
<td>Ploughed</td>
</tr>
<tr>
<td></td>
<td>O06/443</td>
<td>Dismantled and covered with fill</td>
</tr>
<tr>
<td>Waikara Flax Mill</td>
<td>O07/59</td>
<td>No visible surface remains, but undulated ground indicates subsurface features.</td>
</tr>
<tr>
<td></td>
<td>P29/33</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Holman’s Flax Mill</td>
<td>Q06/393</td>
<td>Site overgrown and no visible surface remains</td>
</tr>
<tr>
<td>Walker’s Flax Mill</td>
<td>Q07/903</td>
<td>Mill destroyed during 1960s. No visible surface remains</td>
</tr>
<tr>
<td></td>
<td>Q11/39</td>
<td>Site destroyed. No visible surface remains relating to flax mill.</td>
</tr>
<tr>
<td>Gibbon’s Flax Mill</td>
<td>Q11/376</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Murdoch’s Flax Mill</td>
<td>Q11/377</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Brissenden’s Flax Mill</td>
<td>Q11/378</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Burton’s Flax Mill</td>
<td>Q11/379</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Mill Road Flax Mill</td>
<td>R11/2076</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Carteret’s Flax Mill</td>
<td>R11/2078</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td></td>
<td>R13/228</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td></td>
<td>R16/282</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Location</td>
<td>Code</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Milburn Flax Mill</td>
<td>R22/450</td>
<td>No visible surface remains. Site also used as a flour mill and rendering plant.</td>
</tr>
<tr>
<td></td>
<td>S13/63</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td></td>
<td>T11/614</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Frank's and Richard's Flax Mill</td>
<td>T19/93</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Otara Flax Mill</td>
<td>T19/96</td>
<td>Site destroyed; no visible surface remains</td>
</tr>
<tr>
<td></td>
<td>V14/18</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td>Wairere Flax Mill</td>
<td>W15/96</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td></td>
<td>W15/1061</td>
<td>No visible surface remains</td>
</tr>
<tr>
<td></td>
<td>W15/1062</td>
<td>No visible surface remains</td>
</tr>
</tbody>
</table>

**Summary**

As the above discussion has highlighted archaeological sites with substantial remains relating to flax mill infrastructure are rare. The majority of sites lack buildings and are limited to foundations or other more fragmented remains. Additionally, there are a considerable number of recorded sites with no visible surface remains and the overall number of recorded flax mill sites is not representative of the size nor scale of the historical industry. As such, sites with extensive physical remains relating to historical flax milling and infrastructure are of great historical and archaeological significance to New Zealand’s industrial past.
Chapter Six: Discussion

The aim of this thesis has been to document the history and surviving archaeology of New Zealand flax mills, and to investigate technological and socio-economic themes and changes within the historical industry. The first research aim was addressed in Chapters Two and Four where the history of the flax milling industry and the individual archaeological sites surveyed were detailed. Chapter Five addressed the second research aim by documenting and comparing the surviving archaeological materials of flax mill sites through both field survey and desk-based research. This chapter will use the evidence compiled in previous chapters to investigate technological and socio-economic changes to the flax milling industry, in order to answer the specific research questions of this thesis. This will include a broader discussion around themes and interpretations relating to the nature, development, and changes to New Zealand flax mills over time, in addition to technology transfer, integrated industry, and the human experience.

A Comparison of New Zealand Flax Mills

The compilation of archaeological evidence relating to flax mill sites made in Chapter Five highlighted numerous differences between individual historical flax mills. This showed that while all New Zealand flax mills had to have the same basic components in order to operate, no two sites were exactly the same. The following section aims to discuss the main physical differences identified between sites, including the size and durability of flax mills, their power sources, and machinery. Factors that may have influenced these differences will be discussed in the subsequent section.

Size and Durability

Through the surveying of selected flax mill sites and the comparison of historical photographs differences in the size of flax mills and their durability quickly became apparent. Generally early flax mills were smaller, and in many cases were less structurally robust than those from the post-1900 period. A comparison of Vercoes
Flax Mill (est. 1890) and the Otanomomo Flax Mill (est. 1917) highlight this change in size over time. The Vercoes Flax Mill site measures approximately 30m x 25m (Figure 43), whereas the Otanomomo Flax Mill measures approximately 60m x 120m, excluding flax cultivation areas, drying paddocks, and some workers accommodations (Figure 42). Additionally, some sites such as the Marshlands Flax Mill (P28/161) were made larger as the demand for flax fibre increased, resulting in the building of multiple lean-to structures as needed. This was a common practice during earlier periods but became increasingly less common during the post-1900 period.

The structural integrity and durability of flax mills also changed over time. While some early flax mills such as Pownall’s Mill (Figure 1) were well constructed, there were many mills dating to the first (1869-1973), second (1888-1893), and beginning of the third (1898-1907) boom periods that were haphazardly assembled. However, as the third boom period progressed the industry experienced increased governmental support, union activity, positive market forces, and better swamp management. This caused the flax milling industry to become more stable and towards the end of the third boom, and the periods following, flax mills became sturdier, more though-out, and long-term structures.

There are few remaining sites dating to the first, second, and beginning of the third boom periods, and the surviving physical evidence is often limited. However, photographic evidence illustrates the transient nature of flax mills from these earlier periods. For example, photographs of the Waitahuna Flax Mill (Figure 104) and Wall’s Flax Mill (Figure 105) highlight the simple and ramshackle construction of flax mills from this period. Each of the mills comprised of basic thrown-together timber and iron materials, that were likely recycled, which further indicates that the flax mills from this era were more makeshift than their successors. In contrast, later sites from the end of the third boom onwards became increasingly robust and permanent. This change can be observed at the surviving Templeton (est. 1911) and Otanomomo (est. 1917) flax mill sites where each site has been carefully designed and built. The buildings, while still utilitarian, were more securely established and exhibited better building materials, greater foundations, and a more systematic layout. Historical photographs of additional sites from the later period further exhibit this change (Figure 106).
Figure 104. Flax Mill Waitahuna, circa 1900. (Copy Negative No. neg sheet 64/6d, Hocken Collections, Uare Taoka o Hākena, University of Otago).

Figure 105. Wall’s Flax Mill, Cape Foulwind, Westport, 1904. (Available at: https://westcoast.recollect.co.nz/nodes/view/1502).
These differences in size and durability are likely due to the transition of flax milling industry from a generally opportunistic to a more firmly established industry. Many flax mill sites relating to the three main peaks in the flax fibre trade were likely constructed quickly to take advantage of the high export rates, accounting for their haphazard construction and extensions. In contrast, flax mills established at the end of the third peak in trade and afterwards were situated in the period where the flax milling industry was more firmly established and less vulnerable to slumps in trade. This caused mills to be larger and thoroughly planned prior to construction. The change from individual mill sites (Vercoes P28/160, Foxton S24/94, Ora S24/95, Whitanui S24/96), to larger site complexes (Tane S24/48, Templeton D46/116, Otanomomo H46/60) also demonstrates the movement to a more secure and established industry. Additionally, the experience and insights gained during earlier milling ventures would have encouraged and enabled well-planned, robust, and improved flax mills in the later industrial periods. Finally, the changes in power sources of flax mills and the increase in available power would have caused mills to drive more machinery components, increasing their size and product output.
**Power Sources**

One of the main technological changes observed and represented in the archaeological and historical record of New Zealand flax mills is the change in power sources used at mill sites. Water and steam, or a combination of both, were the most common power sources used at flax mills for most of the industry’s history (Figure 107). This use of waterpower is observed archaeologically through the survival of waterwheels, wheel mounts, and associated machinery components (Table 6). Whereas the use of steam power is represented archaeologically through the survival of robust boilers and machinery mounts (Table 7). Census data from 1871 to 1911 shows the continued use of these power sources from the first boom (1869-1873) in the New Zealand flax trade through to after the end of the third boom period (1898-1907). However, from the early 20th century onwards water and steam power sources gradually became replaced with gas, oil, or electricity (Figure 107).

From the turn of the 20th century the use of internal combustion engines, fuelled by gas, oil, or petrol, becomes increasingly common (Figure 107). However, unlike steam and waterpower, the use of internal combustion engines is not as visible in the archaeological record. Machinery mounts with large wheel cut outs may indicate their use (Whitanui S24/96), however, without confirmation from the historical record this cannot be assumed. The lack of archaeological evidence may be due to the recycling of engines and machinery components, in addition to there being less mill sites to have used engines when compared with those employing steam and waterpower.

Finally, the movement to the use of electrical power in the early 20th century was a major technological change to the flax milling industry. Many mills from this later period switched to electrical power as it became available in each region (Templeton D46/116, Otanomomo H46/60, Marshlands P28/161). This led to a further increase in power output which aided in the automation of some mill processes, such as scutching and washing (Templeton D46/116, Otanomomo H46/60). Additionally, the conversion to electricity saw the instalment of electric lighting which would have greatly improved the visibility inside mills. The adoption of electrical power at flax mill sites is visible archaeologically through the survival of electrical motors and other associated fittings observed at sites surveyed (Table 8).
The Machinery

Each New Zealand flax mill housed the same basic equipment and followed the same general process for fibre production. However, investigation into the machinery components of New Zealand flax mills highlighted some technological differences in the mechanical components between sites. Additionally, the setup of the equipment at each mill varied showing that each working station and the general layout of each flax mill site was slightly different.

Few surviving examples of flax strippers were identified during this research; however, a comparison of the surviving strippers, historical accounts, and photographs highlight minor differences between machines. This is likely due to the use of different patented models of flax strippers between sites. For example, the Templeton and Otanomomo flax mills originally had Booth, MacDonald and Co. flax strippers, whereas the Foxton Flax Stripper Museum has a Sutton patented model (Table 2). Some components of these machines can be directly identified to their specific patent. For example, the ribbed stripper drum installed in the Templeton model is New Zealand patent number 36778 (Figure 108), also manufactured by...
Booth, MacDonald and Co. Therefore, variations in the individual components of the machinery can be recognised. While minor variations such as these were easily identified, the limited surviving examples of stripping machines makes further comparisons difficult.

Another technological change observed in the archaeological record is the movement towards the use of automated machinery. For example, both the Otanomomo and Templeton flax mills used automated scutching machines, whereas others such as the Redan Flax Mill used manually operated scutching machines (Figures 75-79). The use of the automated scutchers was a relatively late innovation, occurring in the early-mid 20th century, but provide a good example of technological change as expressed in the surviving archaeological record. Similarly, both the Templeton and Otanomomo flax mills used automated catching and washing equipment, as did several other more modern mills (Figures 71-74). However, many mills, especially earlier ones, manually caught flax and washed it in tubs (Figure 40).

Finally, some sites were identified as having machines or other systems that were less common or specific to the individual site. For example, the Marshlands Flax Mill is reported to have housed a ‘scraping machine’ that was the first of its kind in the Marlborough Region (Marlborough Express 31 October 1906:3). Additionally, the Vercoes Flax Mill is described as developing a vertical fibre drying stand, that was different to methods employed by other flax mills (Te Aroha News 16 October 1889:2). However, these differences in technology were only observed historically, as no related archaeological remains were recorded during field work conducted for this thesis. With other historical sites recorded as having additional individual mechanical designs and components it suggests that those in the New Zealand flax milling industry were always seeking to improve production methods. This is also expressed through the many patent applications relating to the industry, with over 300 listed on the New Zealand Intellectual Property Office’s online archive (www.iponz.govt.nz/manage-ip). This theme of innovation will be discussed further in later sections.
Summary

In summary, the above discussion highlights that New Zealand flax mills were not uniform structures and often had slight variations in layout, size, durability, and machinery. Additionally, temporal changes such as the movement from waterpower to steam, gas, or electricity, and the automation of different mechanical processes within mills were observed. Technological changes between different regions was not considered as less than half of New Zealand’s regions were able to be surveyed. However, this is an avenue of research that could be undertaken in future.
Influencing Factors

Following the above discussion on technological changes expressed in the archaeological and historical record, it is important to consider some of the factors which may have influenced these changes. This will aid in understanding the development and nature of the New Zealand flax milling industry and provide insight into the causes of these technological developments. As such, environmental, economic, governmental, and indigenous influences will be considered.

Environmental Factors

The majority of New Zealand flax mills were established in rural locations where raw flax and water sources were readily available, however, there are examples of urban flax mills, such as those established in Foxton. A comparison of flax mills in rural and urban environments highlight notable differences in these sites. Firstly, rural flax mills are in many cases larger than their urban counterparts. While this change in size can be partly attributed to the movement from ‘cottage industry’ mills to larger industrial-scale operations, the availability of space was a key influencing factor in mill size. For example, the urban Foxton flax mills were smaller compared to the rural Templeton, Otanomomo, and Redan flax mills, which were able to be spread out over a larger area. Secondly, urban sites required a reliable supply of flax through an established transportation network as they did not have space to cultivate their own flax plantations, unlike their rural counterparts. Finally, due to the isolation of many rural flax mills, these sites typically provided accommodations for workers in order to retain labourers, whereas urban sites do not have the same issue. This also leads to the rural flax mill sites occupying larger areas, as well as developing stronger associated community groups. Therefore, while environmental factors influenced the size, layout, and some features of flax mills, it does not appear to directly influence the mechanical components or technological changes witnessed.
Economic and Political Factors

In general, the historical industries of New Zealand were small scale and limited in capital resources, unlike their British counterparts. During the establishment and development of the flax milling industry, New Zealand was not yet an industrialised society and subsequently existed in a different economic context to that of Britain. Additionally, while some historical industries of New Zealand, such as mining, benefitted from the interest and invested capital of international companies, flax milling did not (Petchey 2013:314). This was due to the flax milling industry being specific to New Zealand and developing independently through local economic incentives rather than external influences.

Instead, the flax milling industry of New Zealand was funded and economically influenced by local investors or governmental incentives, which then encouraged technological development. The provision of monetary incentives for the production of flax milling equipment and processes by the Government during the 1850s-early 1870s and 1890s-1910s encouraged technological innovation, resulting in numerous patented machines (Figure 11). Whereas during the late 1870s and 1880s when the Government’s flax bonus’s and awards were removed there was very little technological innovation (Figure 11). Therefore, the New Zealand Government had an important role in influencing technological change and innovation within the flax milling industry.

Māori Influence

The flax trade of the 1820s and 1830s hinged on Māori flax fibre production, and indigenous knowledge about the fibre production process and general nature of flax was crucial for the later development of mechanised fibre production. However, few examples of Māori owned and operated flax mills from the industrial period were identified during this research. Two flax mill sites were found to be recorded as being Māori owned, one with an unknown name located in Northland (O04/434) and the other being the Pokeno Flour/Flax Mill (S12/360). Historical photographs show that Māori worked in later industrial flax mills, yet there is substantially less evidence relating to their role in the flax milling industry (Figure 109).
The lack of Māori presence in the flax milling industry greatly differs to their active role in the flour milling industry of the 1840s and 1850s (Petrie 2006). During this period, commonly known as the ‘golden age’ of Māori enterprise, Māori were quick to adopt Pākēha technology and establish their own flour mills. They became key producers and suppliers of flour and other agricultural goods for New Zealand and Australian cities. However, the 1860s onwards saw an increase in the confiscation of Māori land by the Crown, which in addition to political changes, technological changes, increase in European settlers, market collapse, and the advent of the New Zealand Wars resulted in a sharp decline of the Māori economy (Petrie 2006:234). Because the flax fibre industry was not established until after 1860 it is likely that these same causes are responsible for the apparent lack of Māori ownership and reduced participation in the flax fibre industry. However, further investigation into the role of Māori in the flax milling industry, and other historical industries of New Zealand, is needed to fully understand their influence (or lack thereof) on the technological developments of the industry.
Technology Transfer vs. Local Innovation

As previously stated, the flax milling industry developed independently in New Zealand through local innovation and was not established through the transfer of international technologies, unlike other historical industries of New Zealand. While technology relating to power sources, transportation, and other generic industrial elements were readily transferred and adopted in the New Zealand flax milling context, technology relating specifically to the industry was a result of local innovation. However, there are some early examples of attempts to transfer industrial technologies and processes relating to fibre production into the New Zealand flax milling context. For example, Charles de Thierry experimented with flax fibre production and in 1855 established a flax mill in Mechanics Bay Auckland (New Zealander 1 September 1855:2). His fibre production process was based on other European fibre extractive industries, such as linen, and centred around soaking (retting), steaming, heating, and rolling the raw New Zealand flax (New Zealander 1 September 1855:2). The process did not result in a perfect product and was ultimately abandoned, however, despite its failure it shows an early attempt at technological transfer.

In addition to early attempts at technological transfer, the language used within the New Zealand flax milling industry also shows a relationship with European fibre production industries. Both the New Zealand flax fibre industry and linen flax fibre industry refer to the combing of the natural fibres as scutching, although their scutching machines and methods are different (Figure 110). Therefore, while this shared language highlights a relationship between the industries, the technological components highlight independent innovation.
Figure 110. Scutching machine at linen flax mill, Geraldine, New Zealand. Circa 1940. (Image ID: 1017, Geraldine Historical Museum).

While there are numerous examples of early attempts at manufacturing New Zealand flax fibre following the arrival of early Europeans to New Zealand, this local innovation is not formally recognised until the granting of New Zealand Patent No. 1, the Purchas and Ninnis flax stripper. The Purchas and Ninnis flax stripper was the first of many patents relating to the New Zealand flax milling industry, with over 100 being issued between 1861 and 1930 (Figure 111). Nearly 30 of these patents were issued during the 1860s, as the industry was becoming established, and during the first boom in trade (1869-1873) (Figure 111). However, most of the patents relating to flax milling were issued from the 1890s onwards with the majority relating to the third boom in trade and the World War One era (Figure 111). The concentration of innovation during these periods, as expressed through the patenting of machinery, is likely a result of the introduction of monetary awards and bonuses by the New Zealand government offered in these eras.
Due to the isolation of New Zealand, early settlers of the 19th century often had to adapt and improvise with whatever resources they had at hand. In addition to the invention of numerous patented machines, flax mills also reused and recycled materials from other mills and industrial sites. For example, the owner of the Marshlands Flax Mill recycled a horizontal gas engine from a defunct gold mining company to increase the energy output of the mill (*Marlborough Express* 31 October 1906:3). The resourcefulness of flax mills can also be observed in cases where mills were compiled out of recycled and mismatched materials, or haphazardly extended where necessary. The limited available resources were made to work for the intended purpose, and while the result was not typically elegant it was perfectly functional. These opportunistic and expedient technological approaches are to be expected in colonising and frontier societies and this theme of industrial resourcefulness in New Zealand has been explored by others in different archaeological contexts (Edwards 2008, Petchey 2013).

Retrospectively, these opportunistic and expedient approaches of early New Zealand settlers embody the can-do attitude that has since become an integral quality in our
national sense of self. Their resourcefulness, determination, and innovation has led to national themes of identity such as ‘kiwi ingenuity’ and the ‘No. 8 wire approach’. As the above discussion has highlighted, the New Zealand flax milling industry, like many other historical industries and activities, is situated within this context and exhibits many of the characteristics central to the above national themes.

**Integrated Industry**

The investigation into the archaeological and historical record of the New Zealand flax milling industry has highlighted examples of flax mill sites with dual industrial purposes. Additionally, some flax mills were found to have been established at sites previously used for other industrial ventures. This shows technological diversification within flax milling and reiterates the opportunistic and resourceful nature of the industry. These examples will be discussed below and are summarised in Table 14.

**Table 14.** Table listing all recorded flax mills sites with alternative industries established at the same site.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>NZAA Site No.</th>
<th>Industries Present</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>K29/52</td>
<td></td>
<td>Flax mill/Sawmill</td>
<td>Closed 1920s</td>
</tr>
</tbody>
</table>
| O04/434      |               | Flax mill x2/Cordial factory | Flax mill 1869-?  
|              |               |                    | Flax mill circa. 1900-1910  
|              |               |                    | Cordial factory 1917 |
| Tataraimaka Mill | P13/235      | Flax mill/Flour mill | Flax mill 1869-?  
|              |               |                    | Flour mill 1875-? |
|              |               |                    | Flax mill 1890-1937 |
| Marshlands Mill | P28/161      | Flax mill/Sawmill  | Flax mill 1888-1964  
|              |               |                    | Sawmill 1924-? |
| Gibbon’s Mill | Q11/376       | Flax mill/Sawmill  |                                               |
| R13/153      |               | Flax mill/Sawmill  |                                               |
| Milburn Mill | R22/450       | Flour mill/Flax mill/Rendering plant | Established 1862 |
| Pokeno Mill  | S12/360       | Flour mill/Flax mill | Flour mill pre-1858-1863  
|              |               |                    | Flax mill 1870s-? |
| Wairere Mill | W15/96        | Flour mill/Flax mill | Flour mill 1891-?  
|              |               |                    | Flax mill 1907-? |
| Lamb's Mill  | N/A           | Flour mill/Flax mill | Flour mill 1871-?  
|              |               |                    | Flax mill 1888-1915  
|              |               |                    | HNZ Site No.734 |
The Marshlands Flax Mill provides a prime example of integrated industry within the flax milling industry. The flax mill was established in 1888 and continued to operate successfully through until 1924 when sawmilling machinery recovered from a derelict sawmill in Crail Bay, Pelorus Sound was recovered was installed at the site (Woods 1982). The establishment of the sawmill provided additional work for employees in Winter and when flax milling was slowed by periods of poor weather. Additionally, this diversification of industry likely helped the mill survive through the depression era and the onset of yellow leaf disease, when many flax mills were forced to close. While the interior of the mill was unable to be surveyed and the extent of machinery remains is uncertain it is likely that most of it is still intact at the site. The buildings which housed both the flax milling and sawmilling machinery have survived at the site and provide an excellent archaeological example of integrated industry within the New Zealand flax milling context. In addition, other flax mill sites with attached sawmills were identified through ArchSite, however, the extent of their physical remains and associated histories is limited and requires further investigation. Other historical sources, such as photographs, highlight unrecorded sites that undertook both flax milling and saw milling (Figure 112). This indicates that the combination of flax mills and sawmills was somewhat common and reiterates the opportunistic and flexible nature of the industry.

Figure 112. Simpson’s Flax Mill/Sawmill and farm, Karamea, circa 1900. (Available: https://westcoast.recollect.co.nz/nodes/view/20804).
Another example of integrated industry can be observed at Vercoes Flax Mill, Blenheim (P28/160). The site was originally established as a brickworks in 1888, before converting to a flax mill by 1890. While the two enterprises were not in operation at the same time for long, the conversion of the site to accommodate flax milling highlights the technological diversification of the site, in addition to the integration of materials already established. While the archaeological remains at the site are limited to foundations, these likely relate to both the flax milling and brickworks venture.

In addition to the above examples, there are several instances of flax mills being established in closed flour mills (Table 14). There are also examples of recorded flax mill sites being repurposed for other business and industrial ventures, with there being many more in the historical record (Table 14). It is likely that sites were established in order to take advantage of all available natural resources and may have been employed when clearing land. Whereas the establishment of flax mills at sites with other industrial origins suggests the opportunistic adoption and adaptation of sites with available buildings, power sources, and other features. Many of these sites were established in relation to different boom periods in trade, further indicating they were opportunistic (Table 14).

The Human Experience
The first half of this chapter considered technological changes, causes, and themes observed in the archaeological and historical record of the flax milling industry. This has developed a thorough understanding of the physical aspects of the historical industry but lacks insight into the role of people. Therefore, the remainder of this chapter will turn its attention to the human experience in the flax milling industry, considering working conditions, living conditions, the workforce and associated community. This will address the second research question outlined in this thesis, considering broader socio-economic changes observed in the record, and provide a more well-rounded insight in the industry.
Working Conditions

The working conditions of New Zealand flax mills were like those of many other historical industries, poor and dangerous. Hours were long, pay was meagre, and the work included both heavy manual labour and the operation of unguarded machinery. Employees working outside the mill were exposed to the elements and were often cold, damp, and vulnerable to illness. For example, James Cox, who worked as a labourer at a flax mill in the Manawatū region between 1888 and 1890 described working in the outdoor wash station as “very unpleasant” (Fairburn 1995:53). The exposure to the extreme cold and wet caused his health to deteriorate and he experienced chronic pain, sores, respiratory infections, coughs, and “cold on cold” that were slow to improve (Fairburn 1995:53). In contrast, those working inside the mill were unprotected from exposed machinery, noise, and dust. Most injuries and deaths at flax mills were a result of workers coming into contact with open machinery, especially strippers and scutchers. As these machines rotated at high speeds workers were easily pulled into them, especially when loose clothing became caught. This caused a multitude of grisly injuries including broken or crushed bones and defleshing, which often resulted in the amputation of fingers, hands, and complete arms (Star 16 January 1883:3, Waikato Times 13 February 1904:3). Furthermore, in some cases these accidents resulted in death, especially at more isolated rural sites where immediate medical attention was unavailable (Nelson Evening Mail 4 September 1911:5, Star 7 December 1915:5). In addition, the noise produced by the milling equipment was very loud, causing hearing damage, and impeding communication. One newspaper account describes the stripping machine as making a “wild beast-like snarling noise” that could be heard miles away (Bay of Plenty Times 20 February 1890:4). Another hazard workers faced was the large quantities of dust produced by the scutching process. The “fearful dust” both blinded and choked those working inside the mill, particularly those operating the scutchers (Lyttleton Times 22 August 1903:8). Flax dust was also extremely flammable and was a common cause of fire in flax mills.

In response to these unsafe working conditions there were some attempts at making the milling process and environment safer, and some examples can be observed in the archaeological record. As previously discussed, flax mills become more spacious and well thought-out over time which led to a safer working environment. Some sites, such
as the Marshlands Flax Mill, were deliberately dismantled and re-erected to increase space, ventilation, and natural light in order to improve safety (Marlborough Express 31 October 1906:3). Additionally, changes were made to many mechanical components inside the mill to reduce harm. For example, safety guards were fitted to stripping machines, covering the exposed drums to reduce the possibility of accidents (Manawatu Standard June 1910:5). The surviving examples of flax strippers at sites surveyed have this feature (Figure 69). Other processes, such as scutching and washing, became automated which removed workers from immediate exposure to moving parts, reducing the potential harm to workers. These changes can also be observed at sites surveyed as both Otanomomo Flax Mill and Templeton Flax Mill originally had automated machines (Figures 75-77).

**Living Conditions**

Due to many flax mills being established in isolated rural areas it was necessary for workers accommodations, and other basic amenities such as cookhouses, dining rooms, and ablution blocks, to be located on or near the mill site to ensure a reliable workforce. However, the standard of the amenities provided varied greatly between mills, especially prior to the passing of the Agricultural Labourer’s Accommodation Act of 1907 and later amendments. In many early cases workers accommodations were temporary or poorly constructed out of basic materials (Figure 113). Tents and simple huts were common, often without any flooring, insulation, heating, lighting, or furnishings (Manawatu Herald 19 October 1912:2). Workers were often expected to provide their own fixtures, and the manufacture of mattresses out of tow or other waste fibres became a common practice (Fairburn 1995:42). Additionally, in some instance’s mills did not supply accommodation and workers instead had to provide or build their own. The simple and transient nature of these early workers accommodations is likely why there are no surviving examples from this period in the archaeological record today.
In addition to being rudimentary, workers' accommodations and camps at flax mill sites were often unsanitary. One account published in the *Manawatu Herald* describes the living conditions at an unnamed mill as “not in the least healthy” and notes the considerable number of cockroaches and fleas in the living and dining quarters (*Manawatu Herald* 19 October 1912:2). It also criticises the lack of bathroom and lavatory facilities, and deficiency of clean water for drinking, cooking, and washing, due to the pollution of local rivers by flax mills and workers themselves (*Manawatu Herald* 19 October 1912:2). These conditions often led to outbreaks of colds, flus, infections, and other diseases or illnesses. For example, in 1912 an outbreak of typhoid occurred amongst flax mill workers in the Manawatū region because of these substandard conditions (*New Zealand Herald* 8 October 1912:7). The outbreak resulted in the hospitalising of some workers and one death (*Dominion* 14 October 1912:6). In response, the *Pure Water Supply to Flax Mills Bill* was presented to parliament in October 1912, however, the Bill was not passed due to the Public Health Act covering the same provisions (*Grey River Argus* 9 October 1912:5).
The passing of The Agricultural Labourer’s Accommodation Act of 1907 was the first legal attempt to remedy the poor quality of living conditions faced by rural workers, however while this included flax mills the regulations were not actively enforced and little improvements were initially made (Burnett 2012:67). The continued poor conditions caused discontent amongst flax mill workers and saw employees and union groups advocate for improved conditions (Fitzgerald 1970:19). This in part led to the passing of The Shearers’ and Agricultural Labourers’ Accommodation Amendment Act which highlighted the need for the regulation and regular inspection of workers accommodations and living conditions at flax mills (Burnett 2012:68). The newly detailed regulations were not officially gazetted until June 1913, but they promised greatly improved living conditions and facilities (Fitzgerald 1970:22). While some mills were still slow to adopt these new regulations and many found loopholes within the legislation, this marked an important turning point for the standard of living conditions at flax mills. This change can be observed in the archaeological and historical record.

The Redan and Otanomomo flax mill sites both have surviving examples of workers accommodations dating to the period after the introduction of the accommodation Acts of 1907 and 1912. The facilities provided at these sites are of a higher standard than those at earlier sites prior to the introduction of the accommodation Acts, and highlight a socio-economic change represented by the surviving archaeology. The single men’s quarters at the Redan Flax Mill accommodated four single workers in separate bedrooms. Each bedroom was sizeable, furnished, well ventilated, and had an open fireplace as a source of heating (Figure 63). Workers also had access to an ablution block with appropriate plumbing and drainage (Figure 32). Larger houses were also bought and relocated to mill site to accommodate workers with families, however, no examples of these survive today (Figure 32). The Otanomomo Flax Mill originally had similar workers accommodations, and provided a manager’s residence, family houses, and “army style” workers huts for single men (Costain n.d.). A worker’s lounge, dining hall, and washroom were also established on site, however, all that survives at the site are two of the single men’s huts (Figures 65 and 66) (Costain n.d.).
These changes to workers accommodations and living conditions are also well represented in the historical record and are particularly noticeable at the larger mill sites. For example, the Miranui Flax Mill provided bunk rooms that were comfortable, furnished, and well-constructed, at the cost of 15s and 6d per week, inclusive of meals (Figure 114) (Ayson 1977:1). Workers also had access to a large dining room with multiple fireplaces, a reading room, and two billiard tables (Figure 114) (Ayson 1977:1). Therefore, both historical and archaeological examples of workers accommodations show the movement from rudimentary campsites to more permanent structures and associated facilities.

![Workers' quarters Miranui Flax Mill circa 1907. Dining hall and lounge in foreground, bunk rooms in background. (Digitisation ID: 2007P_Fx15_FLA_0613, Manawatu Heritage, Palmerston Libraries and Community Services).](image)
The Workforce and Associated Community

The New Zealand flax milling industry employed thousands of men over the course of its history (Figure 115). Women and boys were also employed in the industry, however, women accounted for a much smaller percentage of the overall workforce and statistical data relating to their employment is incomplete (Figure 116). These workers, referred to as flaxies, were susceptible to unemployment due to the turbulent nature of the flax milling industry, especially during the pre-1900 era. Historical statistics clearly show a drastic decrease in hands employed following the end of the first (1869-1973), second (1888-1893), and third boom (1898-1907) periods (Figure 115). However, the flax milling industry became increasingly stable during the early 20th century and workers experienced more consistent employment (Figure 115). The change in consistency of employment caused the workforce to move from being largely transient to more permanent. This movement towards a more a permanent workforce at flax mills saw the increase in married couples and families residing at these sites, as opposed to strictly single male workers. The establishment of houses specifically for families at later flax mills such as Otanomomo, Redan, and Templeton demonstrate this change.

![Total Number of Hands employed in Flax Mills 1871-1942](chart.png)

**Figure 115.** Total number of hands employed in flax mills 1871-1942. (Census of New Zealand 1871-1911, New Zealand Official Yearbook 1916-1942, www.archive.stats.govt.nz).
The geographic isolation of many flax mills meant that workers, relied heavily on each other for support, solace, and leisure (Burnett 2012:87). This led to tight-knit communities within individual flax mills and a distinctive culture of ‘mateship’ and comradery within the flax workforce (Figure 117) (Burnett 2012:87). In many circumstances these communities became known for their notorious gambling and drinking. For example, in 1902 the workers of the Tane Flax Mill were operating a ‘two-up’ ring, an illegal game played by betting heads or tails on a flipped coin (Matheson 2003:18). The group operating the gambling ring were subsequently arrested by undercover police and the game was eventually banned by mill owners, despite already being illegal (Matheson 2003:18). However, many of the activities undertaken by flaxies were more respectable, with many flax mills having their own sports teams and hosting regular musical events such as concerts and dances (Burnett 2012:84). For example, the Templeton Flax Mill had their own rugby team that played in the local competition (Templeton 1997: 101). These activities, regardless of their notoriety or respectability, highlight the strong sense of community within the flax workforce. Further investigation specifically into the ‘mateship’ culture and demographic profiles of the New Zealand flax milling workforce is well covered by

![Figure 117. Prouse & Saunders Flaxmill Workers (The Nelson Provincial Museum, Tyree Studio Collection: 177643).](image)

**Summary**

As the above discussion has shown, the archaeological evidence of the New Zealand flax milling industry demonstrates technological changes over time in relation to mill size and durability, machinery, and power sources. Following the establishment of the fully mechanised flax fibre production industry in New Zealand in 1860, small and often ramshackle mills became established nationwide. These early opportunistic, resourceful, and expedient mills provide a typical example of ‘cottage industry’ which is to be expected in early settler societies, such as New Zealand in the mid to late 19th century. However, the increase in size and durability, the automation of mechanical processes, and the ultimate standardisation of New Zealand flax mills following the turn of the 20th century highlights the movement towards a permanent and larger
industrial-scale flax milling operation. Like many other historical industries, flax milling is situated within the context of New Zealand’s movement towards a fully industrialised society and provides a unique case study within this broader societal change.

The surviving archaeology of the New Zealand flax milling industry also provides a combination of evidence relating to the working life of the individuals operating the mill and their living conditions. By modern health and safety standards the historical flax mills of New Zealand created a harsh and dangerous working environment. Workers were subjected to cold and damp conditions when working outside, and those inside the mill were vulnerable to exposed machinery, noise, and dust. Living conditions were highly variable and accommodations were often poor, although they improved over time. However, despite all the hazardous and meagre conditions faced by those in the industry, flax milling provided their living, and their livelihoods depended on the success of the industry.
Chapter Seven: Conclusion

Flax has always been a vital resource in New Zealand’s human history. The indigenous plant was an important natural material in traditional Māori society and following the arrival of early European explorers, traders, and settlers in the early 19th century it became one of New Zealand’s earliest exported goods. The later development of specialist machinery that mechanized flax fibre production in 1860 marked the beginning of the New Zealand specific industry that persisted for over 100 years. Over the course of the industry’s history hundreds of flax mills were established nationwide, providing employment for thousands of people. However, by the mid-20th century less than 20 flax mills remained operational and the rise of cheaper synthetic fibres saw the demise of the New Zealand flax milling industry. By the early 1970s nearly all the remaining independent flax mills had closed, and in 1985 the final commercial flax stripper in operation fell silent, marking the cessation of the New Zealand flax milling industry. Today the surviving archaeological remains of these mills provide an insight into one of New Zealand’s most unique historical industries.

The central aim of this thesis has been to research the history and surviving archaeology of New Zealand flax mills in order to understand the development of the historical industry. The research aims of this thesis focused specifically on investigating and interpreting technological and broader socio-economic changes observed in the industry through the use of both historical and archaeological evidence. This focus sought to investigate why and how changes occurred within the historical industry, rather than simply describing them, to provide a deeper level of understanding. Industrial archaeology is all too often labelled as sterile, descriptive, and lacking in human perspective. However, as observed during this thesis, the investigation into these processes of industrialisation can shed light on social conditions, material culture change, innovation and technological change, and broader cultural meanings and values of historical industries and their industrial landscapes. Furthermore, the application of industrial archaeology in 19th and early 20th century New Zealand offers an interesting insight into our movement from an early frontier nation through to a fully industrialised society.
Technological Change

The invention of the first patented New Zealand flax stripper in 1860 not only exhibited a significant technological development for the flax milling industry, but also signified an important moment in New Zealand’s industrial history. The invention of the Purchas and Ninnis flax stripper marked the beginning of mechanized flax fibre production, as well as the allocation of New Zealand’s first official patent. From this point onwards the New Zealand flax milling industry continued to grow and develop, surviving numerous highs and lows in trade. Historical and archaeological data show technological changes over time relating to size, layout, durability, power sources, and machinery components of flax mills. As the industry became increasingly established, mills increased in size, layouts became more planned, and the building materials became more durable. Ultimately, flax mills moved from being opportunistic and haphazardly assembled towards being well-planned and more standardised. The mechanical components of flax mills also experienced technological change over time, with many milling processes becoming automated, and power sources being upgraded as technology advanced. These changes show the New Zealand flax milling industry’s development from smaller, individual, opportunistic, 'cottage' or 'backyard' industries, through to a firmly established and increasingly regulated, centralised, and purpose-built means of mass production.

In addition to highlighting the movement of the New Zealand flax milling industry from a 'backyard' industry to a fully industrialised mass production process, this research has drawn attention to the innovative nature of early industries within early New Zealand society. As to be expected in an early settler or frontier context, the lack of available resources requires a certain level of ingenuity, creativity, and innovation. This industrial resourcefulness is expressed and well represented within the flax milling industry, with many early mills being haphazardly constructed out of recycled or borrowed materials. Additionally, there were numerous inventions specific to the flax milling industry, as highlighted through New Zealand’s historical patent registry. Together this shows the ability of early settlers to problem solve and make do with the materials at hand. Retrospectively, these expedient and opportunistic approaches undertaken by early settlers embodies the can-do attitude that has since become an
integral quality in our national sense of self. It is from these early contexts that national themes of ‘kiwi ingenuity’ and the ‘No. 8 wire approach’ have since formed.

The Human Experience
The New Zealand flax mill, like many other historical industries of the 19th and early 20th centuries, was an extremely dangerous working environment. At all points along the fibre production process workers were exposed to hazardous and uncomfortable working conditions. Flax cutters and those who worked in the swamps were exposed to the elements, while those who worked within the mill were unprotected from unguarded machinery. Additionally, workers responsible for washing stripped flax fibre were constantly damp and all of those to work inside the mill were exposed to the high-pitched shriek of machinery and the copious amounts of dust produced by scutching the flax. The historical record indicates that accidents were all too common in flax mills, and although much less frequent, deaths did occur. Additionally, living conditions at many mills, especially those from earlier periods, were of a poor quality. They were often basic and unhygienic, resulting in numerous outbreaks of disease and localised pollution. By modern standards these conditions seem barbaric and unacceptable, however, despite the risk associated with flax milling, the industry represented paid work for thousands of people in an era prior to the establishment of the Welfare State. When the industry experienced slumps or collapses in trade many mills closed or went bankrupt leaving many unemployed and their families destitute. Therefore, the shrieking and unguarded machinery of the New Zealand flax mill ultimately represented and ensured many people’s livelihoods.

Despite these somewhat dire circumstances, the archaeological and historical records show evidence of change over time for the better. Technological improvements made, such as the automation of milling processes, decreased the exposure of workers to dangerous machinery. Additionally, as flax mills increased in size and standardisation, they became increasingly well lit, ventilated, and spacious, contributing to a safer work environment. The passing of different legislation also led to the improvement of living and working conditions among flax mills, and other industries, in New Zealand. The passing of The Agricultural Labourer’s Accommodation Act of 1907 marked a significant turning point for workers’ rights to comfortable, hygienic, and reasonable
accommodations. Mills went from providing basic tents or huts, to more comfortable, warm, and larger houses or living quarters, which we can observe in the surviving archaeological examples of workers accommodations at Redan and Otanomomo.

**Future Research**

To date archaeological research into flax mills, and industrial sites in general, are limited in the New Zealand context. While this thesis has provided an initial investigation into the archaeology of New Zealand flax mills there are still several avenues of research that would be beneficial to pursue.

Due to unavoidable limitations this thesis was only able to physically survey nine flax mill sites from four regions of New Zealand. Therefore, it would be useful to examine the material remains of more flax mill sites, especially in regions which have not yet been investigated. This would provide further archaeological data relating to the flax milling industry and may highlight further temporal and technological changes, as well as regional differences. Additionally, as many recorded flax mill sites have not been recently revisited it would be beneficial to re-examine and update the sites to determine the extent of surviving remains. Furthermore, there have been no excavations undertaken at flax mill sites in New Zealand. The excavation of a mill site may provide further information on the layout and construction of mills and give insight into the living conditions and lives of workers themselves.

Finally, this thesis has offered a unique insight into a historical industry specific to the New Zealand context. However, there are several other historical industries of New Zealand yet to be investigated from an archaeological perspective. In particular Kauri gum digging and sawmilling have been paid little attention, especially when compared to the likes of gold and coal mining. Additionally, cottage and town-based industries that were crucial for early European settlements such as flour milling, brickmaking, and even farming, in many cases have not been thoroughly investigated. Whether small scale operations, large business ventures, or fully industrialised landscapes, investigating these historical industries is important for understanding New Zealand’s past and development towards a fully industrialised society as we know it to be today.
References


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## Appendix One: Recorded Flax Mill Sites

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