St. Peter’s Dynevor Windmill

A Graphic Recreation of an Early Nineteenth Century Industrial Landmark

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Dado

Heritage Manitoba

St. Peter's Dynevor Windmill: A Graphic Recreation of a Mid-Nineteenth Century Manitoba Landmark has been developed by Dado Projects, a Manitoba heritage research initiative of Maureen Devanik and David Butterfield. These projects are supported by Heritage Manitoba, an informal coalition of municipal heritage associations dedicated to the appreciation and preservation of Manitoba's history. The project is part of a series focusing on Manitoba's early industrial development, especially in small-town or rural situations. Other projects in the series include:

The Former Manitou Gas Company Plant
The James White Sash and Door Factory of Carberry
The Leary Brick Factory
John Gunn's Water Mill

Introduction

For about 50 years, from 1833 to the mid 1880s, a remarkable community was developed on the banks of the Red River just north of present-day Selkirk. Known at the time as the Indian Settlement, or the Indian Village, this very first Aboriginal agricultural settlement in what would become Manitoba was undertaken by a band of Saulteaux and Cree peoples under the leadership of Chief Peguis.

Over the course of these 50 years these pioneering Aboriginal people broke the land, planted crops and sold their surpluses. They built a school and with help from Anglican missionaries educated their children. They constructed sturdy little log houses, erected first a log and then a fine stone church and put up two windmills to grind their grain for flour production. At the community's height, in the 1850s and 60s, there were approximately 87 families comprising the village, totaling about 500 people.

There is nothing left of the community, more than 130 years later – no houses, no school, certainly no windmills. St. Peter's Dynevor Anglican Church (built beginning in 1852) still stands, but the Aboriginal community is long gone. (There is more on this important aspect of the history of St. Peter's Indian Settlement in the next section.)

Certainly St. Peter's Dynevor Church is an important Manitoba site – in fact it is a designated Provincial Heritage Site. And a great deal has been written about it, as well as all of the other extant churches of the Red River Settlement era – St. Andrew's Anglican, Little Britain Presbyterian, St. Boniface Roman Catholic, St. John's Anglican, St. Clements Anglican. Their various and interesting histories—architecture, construction, designers, builders—are all well documented and have been thoroughly explored and explained.

What is not so well known are buildings like the two windmills at the Indian Settlement. There has been some general research, which is featured in a later section here. But the actual construction and operation of these vital buildings has been little studied.

The two windmills at the Indian Settlement, as well as the 18 others that are presumed to have been built in the early days of the province's history, might have been less architecturally impressive, and un-imbued with the weighty spiritual attributes of the churches, but they were arguably the most important buildings of the Red River Settlement. For it was them (and the nine water mills of the same period) that ensured that the agricultural production of the farming communities—wheat mostly—was ground into flour for bread and other edibles.

This report is mainly an attempt to "recreate" one of the St. Peter's Indian Settlement windmills – to suggest what it looked like, how it operated.

We are fortunate to have a wealth of information as starting points for this work: general histories of windmills and an excellent overview of Manitoba's nineteenth-century mills by Professor Barry Kaye. There are also a number of contemporary images—drawings and photographs—that help in their details to determine certain aspects of early windmill forms and operations.

Imagining the thought that went into the creation of the St. Peter's windmills, then the actual back-breaking work attending its construction, and finally the impressive vitality of its daily operation (at least during the spring and summer months), is to encounter the kind of robust can-do character that continues to inspire respect and admiration. Such an imagining also recalls the ingenuity and sophistication that attended this and other early Manitoba industrial works.

A view from around 1880 looking east from the west bank of the Red River towards St. Peter's Dynevor Anglican Church, suggesting the topography of the Indian Settlement. (Image Courtesy Archives of Manitoba)

St. Peter’s Indian Settlement

While the main purpose of this project is an exploration and proposed graphic reproduction of an early nineteenth century Manitoba windmill, the choice of the preferred example requires a brief digression to put that mill into its fascinating socio-cultural and physical context.

The site of our windmill was the Red River Settlement’s first Aboriginal agricultural colony, north of present-day Selkirk. And the leader of the combined Saulteaux-Cree band that undertook this pioneering work was Chief Peguis, a revered name in Manitoba history.

Chief Peguis was born around 1774 near what is now Sault Ste. Marie, in present-day Ontario. As a young man he led a band of his tribe westward to the Red River area, where they established themselves at Netley Creek, an area within the marshy southern extent of Lake Winnipeg – a superb location for fishing, hunting and trapping. Peguis’s people had traded with French fur-traders in the Sault Ste. Marie area, and at their new home formed trade relations with the Hudson’s Bay Company (HBC) post at Pembina (in present-day North Dakota).

A significant, and ultimately troubling, change in the Peguis band’s lifestyle began between 1812 and 1815, when a group of European settlers from Scotland and Ireland, known as the Selkirk Settlers, arrived in the Red River area. This was a colonization project set up by Thomas Douglas, 5th Earl of Selkirk, who in 1811 had been granted 300,000 square kilometres (120,000 square miles) of land by the Hudson's Bay Company. Selkirk had become interested in the idea of settling the Red River area after reading Alexander Mackenzie's 1801 book on his adventures in what is today the Canadian West.

Chief Peguis later in his life. When he began his work with Reverend Cockran he would have been about 58 years old. (Image Courtesy Archives of Manitoba)

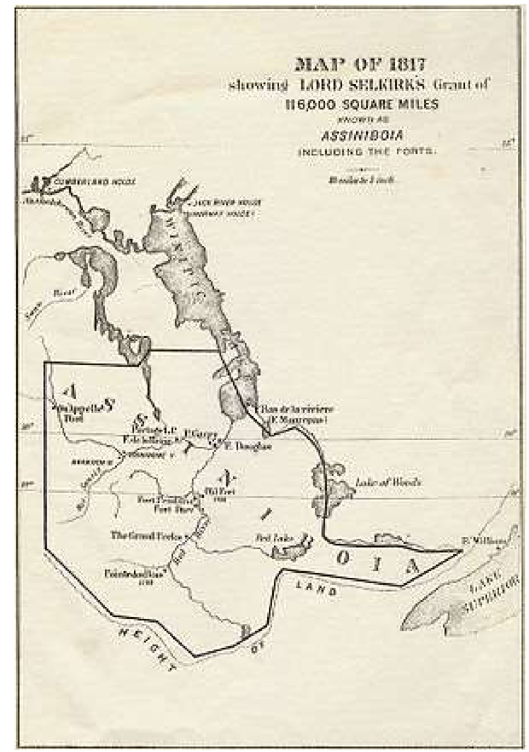
At the time, social upheaval in Scotland due to the introduction of sheep farming and the ensuing Highland and Lowland Clearances had left a number of Scots destitute. Selkirk was interested in giving them a chance at a better life in this proposed colony, which he called Assiniboia.

The early years of the Selkirk colony were extremely challenging—crop failures, disease, and even settler deaths from battles with hostile North West Company fur-traders and their Métis allies—and many of the original settlers left, returning to Great Britain or decamping south or east to more hospitable situations.

For those who remained, it was Peguis and his people who brought the little colony hope and real sustenance. Peguis reached out to them, hunting for them and guiding them to the HBC post at Pembina for shelter when they first arrived. Peguis also developed a personal relationship with Lord Selkirk, with whom the chief signed a treaty in 1817 providing his people with a land settlement, from Sugar Point (near Selkirk) north to Lake Winnipeg.

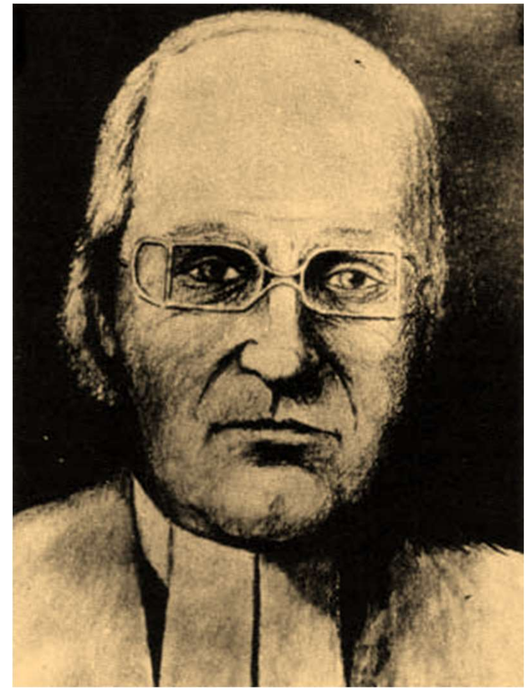
Shortly after the arrival of the Selkirk Settlers, Roman Catholic and Anglican missionaries began to arrive at Red River. They were tasked with providing local inhabitants—English, Scottish and Métis farmers and traders with Christian services. But an important aspect of their work was the conversion of local Aboriginal peoples to Christianity.

In 1818 a French missionary, Father Joseph Provencher, arrived in the Red River Settlement, in what today is known as St. Boniface, and quickly made his way to visit the Peguis band at their Sugar Point encampment. Two years later a Protestant English missionary named John West arrived, and he too spent time at the Peguis camp. It was the arrival at Red River of Reverend William Cockran, in 1825, that would have truly momentous effects on the Peguis band.



The extent of Lord Selkirk's holding, which comprised parts of present day Manitoba, Saskatchewan and parts of the United States.

William Cockran, about 20 years Chief Peguis's junior, was a major force in the Red River area, providing religious and spiritual instruction at various parishes: first at Upper Church (later St John's), then the Middle Church (later St Paul's) and then at the Lower Church (later St Andrew's). But he was also adamant about providing the practical application of farming and animal husbandry techniques that he realized were essential for all people coming to the area—retired fur traders, Métis, and Aboriginals—that would encourage the kind of sedentary situation that would allow for sustained education and religious instruction.



Reverend William Cockran (c.1796-1865) was a driving force in the development of the St. Peter's Indian Settlement. (Image Courtesy Archives of Manitoba)

So it was that in 1832 Cockran persuaded Peguis and a few of his people, who were nearby the Lower Church at St. Andrew's, to settle in a community just north of present-day Selkirk. This site, which came to be called the Indian Settlement or the Indian Village, was the first attempt by local Aboriginal people to develop a farming community.

Some interesting and useful information about the evolution of this settlement is provided via adapted extracts from *Peguis. A Noble Friend*, by Donna Sutherland (self published in 2003, supported by Chief Peguis Heritage Park, Inc.; pages 102-132), slightly abridged here for effect and mostly focused on buildings and context:

By 18 April 1832, most of the snow had thawed and the Red River was clear of ice as far as Netley Creek. Cockran journeyed down (north) the Red in a birch rind canoe with two men towards Sugar Point. From there they continued on to the Saulteaux encampment a little north of the point to discover the most eligible spot to commence the new settlement. They traveled about 10 miles when then came to Peguis's tent. Peguis welcomed them but explained that he would not accompany them further down the river – the waters were too high and the day too cold for traveling. After a short stay, Cockran continued on with the two men. They stopped at the Indians' summer camp and found it to be the only dry piece of ground, consisting of fifteen to twenty acres of arable land.

In the spring of 1832 Peguis, Cockran and six Saulteaux families began breaking the land near Netley Creek. Cockran noted that 70 bushels of potatoes, 10 bushels of barley and three bushels of wheat were planted. Although the initial crops began with promise, the final results were not auspicious. The barley matured to the harvesting stage but the wheat had been damaged by frost and the potatoes were blighted.

By October of 1832 the first house at the settlement, Peguis's naturally, was finished except for mudding the floor. The three Saulteaux men who built the house were known as The Wind, Houlup and The Cannibal. A second house was built for Cockran's local man. This house was about 100 yards farther up (south) the river. A third man, named Red Deer, got a house built with the help of The Cannibal.

By the fall of 1832 nine cottages had been completed for the Netley Creek Saulteaux band, and the small village came to be known as the Indian Farm. All the houses were built from logs with wall seams as well as the chimneys plastered with mud. The roofs were thatched with reeds in addition to being covered with earth [presumably to add weight in windy situations]. The men used a saw to plane the floorboards, doors and beds. The windows were made of parchment from the skins of fish. The little houses were equipped with a trap door in the centre of the floor that lead to the cellar – a place to store their seed and vegetables.

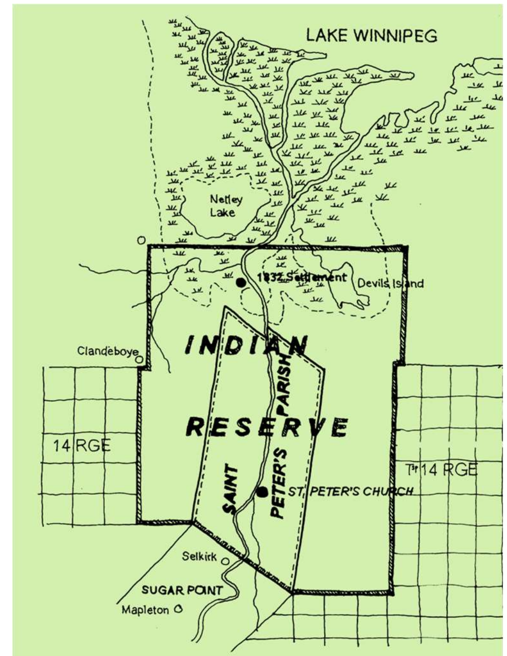
The Netley Creek settlement ultimately proved unsuitable, and in June of 1833 Cockran decided to scout out a location for a new village. He set out on the early morning of 12 June 1833 to survey the river banks for a preferred location, and found a suitable spot on the east bank of the Red River about 12 miles below the Rapids (approximately where the church of St. Peter's Dynevor now stands).

Lord Selkirk's sketch of buildings at the Red River Settlement, done in the summer of 1817 when Selkirk visited the settlement. (Image Courtesy Archives of Manitoba)

Photograph by H.L Hime of Ojibway tipis at Red River, ca. 1858. (Image Courtesy Archives of Manitoba)

Cockran recorded the plan he apparently presented to Peguis: “There the land is of good quality, the large timber has been all destroyed by fire, the bush wood could easily be cut down and the roots dug out with the hoe. The swampy parts could be dried by digging open drains to the creek, to carry off the water. Large fields might be fenced and divided amongst a certain number of families, according to their industry. Each family being obliged to sow, weed, and reap annually the number of acres appointed to their share. . . . The children living with their parents or relatives in the village ought to be assembled every day and taught to read and write. . . . No one ought to be allowed to build in the village who would not send his children to this place of instruction. In the spring the children who are receiving instruction ought to be made to work a certain number of hours upon the farm of their respective parents or relatives to enable them to raise a sufficiency of grain and potatoes to support their families throughout the years. . . . Timber might be rafted down in the summer from the Sugar Point, to build the village and to serve it for fuel. . . . The people living in this village might by and by get some cattle, the cattle by being fed in a band would not be assailable to an attack from the wolves or dogs.”

Peguis was positive about the new plan, apparently, and asked Cockran about the disposition of his house at the Netley Creek site; Cockran replied that he would carry it up the river and place it where the new village would be formed, or he might exchange it for a man who would provide the labour to build a new house for Peguis. And so it was agreed.



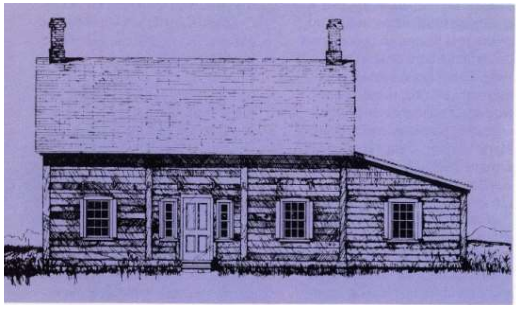
Sketch map showing the immediate vicinity of the Indian Village, here showing the so-called Indian Reserve, Saint Peter’s (Anglican) Parish and St. Peter’s Church. (Map redrawn from the original courtesy Gary Still, redriverancestry.ca)

Cockran commenced the building program immediately. By August 1833 a house that measured 20 feet in breadth and 40 feet in length had been built. It was used as a school room and store with the upper floor holding seed grain. In addition, a large cellar was dug to store seed potatoes. Reverend Jones (Cockrans' superior) donated £10 for the buildings. Cockran expected six families to settle at the village in the fall of 1833 if enough houses could be built to accommodate them.

Sketch of the original early 1800s Grey Nuns' Convent at St. Boniface, a typical log building roofed with thatch. (Image Courtesy Archives of Manitoba)

By the fall of 1833 the small Saulteaux/Cree village had nine small log houses. They were all about the same size – 24 feet in length by 16 feet in breadth. Each home contained a cellar in the centre of the building to store potatoes.

Building the school room was a challenge, as Cockran and his builders were always deficient in proper tools. While engaged in their project they had only one hand saw, one grooving pick, four chisels, two axes, one cross-cut saw, three augers, a few planes. They persevered however and by November 1833 the school room was nearly ready to admit children.



The Pierre Delorme House of 1857 shows the essentials of Red River frame construction – vertical logs infilled with short log members. (Image Courtesy Historic Resources Branch)

The first school master was Joseph Cook. He lived at the settlement for the first year by himself until his wife Catherine Sinclair Cook and their children joined him in the summer of 1834. The children were taught to read and write the English language, with an emphasis on learning agricultural trades for the boys and weaving for the girls.

In the spring of 1835 six more log houses were built at the village. That same year saw the school house enlarged to provide more space for Joseph Cook's large family. It is around this time that Cockran provides some useful diary observations about construction practices: "The roof is to be thatched with clay and straw and log walls pegged with wooden pegs and plastered with clay. On the outside above the clay we will put a thin coat of sand and lime, which will turn the rain and prevent the clay being washed off the lags. We also are going to have glass windows."

Farming continued to increase at the Saulteaux/Cree village, and by 1835 the settlement had 35 acres under cultivation. Cockran decided a grist mill was needed for the people to grind their grain into flour without having to travel to The Rapids to this task. He had trouble finding a carpenter in the Upper Settlement to build the mill, and looked to hire a young Saulteaux man to dig the ground for the 22-foot diameter foundation. It was then to the men of the village that he looked to build the grist mill. Supplies for the construction project were purchased at the Upper Settlement, which meant numerous trips were made up and down the river with supplies.

“Indian Settlement at Red River,” from G. J. Mountain’s journal of 1846. An idealized view of the Indian settlement. (Image Courtesy Archives of Manitoba)

By the spring of 1836 the Saulteaux/Cree settlement continued to grow and prosper. Peguis was still not persuaded of the merits of Christianity, but he was involved with Cockran in the Christian aspect of the settlement, including the decision to build a church.

The ground upon which the church would sit was chosen in the warm and sunny month of June. The site was on the east bank of the river, north of the present stone church. It was nestled among high trees whose leaves gave shady protection against raging summer sun but prevented any refreshing breezes from reaching the workers, thus creating a sweltering environment to toil in. The church was made of log, hand-sawn and measured 54 feet long by 24 feet wide. The rafters were one foot higher than the log church at The Rapids (St. Andrews), as well as a little longer – a source of some local pride. The building was positioned east and west with the entrance facing west, overlooking the Red. The hand-sawn wood pulpit and reading desk were at the east end on a nine-inch elevated floor. Cockran noted that the new building was equipped with a wood-burning stove, whose heat pipes were placed in a similar pattern to those at the Rapids Church.

An Ojibway farmer with his team of oxen, likely at St. Peter’s. (Image Courtesy Archives of Manitoba)

By early December 1835 the carpenters were making the pews, while others were whitewashing the walls and painting the ceiling. It was at this time that Cockran built for himself a small house at the settlement, where he could sleep while visiting.

With the arrival of the new year the little log church was ready for service, and on 4 January 1837, Cockran recorded the exciting event: "Today our new church was opened. Mr Jones performed Divine Service. Though the weather was exceedingly stormy, the wind blowing strong in our faces, and the snow falling so thick as to render the track invisible, yet all the HBC officers who were in the settlement at the time, and a large number of the respectable settlers accompanied us. The pews were full and many sat in the alley." Peguis, along with some members of his family, attended the initial service.

In the summer of 1841 the Indian Settlement was flourishing. The crops were producing large yields with each individual site separated by a wooden fence. By 1843 the settlement was producing a surplus from their crops. This enabled them to send 130 bushels of wheat and 10 bushels of barley to Cumberland House. In that same year the settlement school had a total of 74 children attending – 39 boys and 35 girls.

By 1844 many of the early log houses had deteriorated to the point that they had become uninhabitable. They were demolished and replaced with new ones. Much of the settlement was now growing on the west bank of the Red River across from the church site. The farms consisted of cows, oxen, pigs, sheep and horses. The women of the settlement spun their own wool, as well as made all the clothing for the community. Two years later, in 1846, the people undertook the building of a new grist mill.

The population of the settlement in 1851 was approximately 87 families – totaling about 500 souls. The colony was clearly a success – just 18 years after it had been established. So it was not surprising that at a meeting of the people requested by Cockran on 8 December 1851, that he expressed the idea of building a new church, made of stone and lime: It would be of the same size as the Bishop's Church viz. 76' by 46.'"Cockran was referring to the church of St. John at the Upper Settlement.

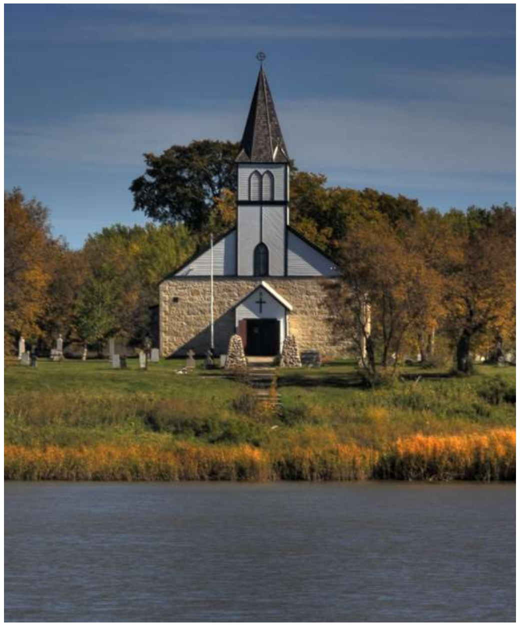
Several parishioners promised to provide the 2,800 boards and planks deemed necessary for construction. Others offered their oxen for hauling timber as well as their backs in labour. Some residents, mainly the older ones, offered to supply the workers with fish while they worked.

Construction on the new stone church began in the fall of 1852. Throughout the cool autumn months of October and November the men quarried more than 80 cords of stone from the banks of the Red River (a cord is 12 feet long, 6 feet wide and 3 feet high). Beginning in the early part of January 1853 they began hauling the stone to the building site – a distance of about eight miles. They also hauled 1,680 bushels of lime and an equal quantity of sand.

The first service in the church was held on 19 November 1854. The building was not complete but the old church was in such a bad state that the newly appointed minister, Abraham Cowley, decided the new church would have to be used for the service.

The new church, called St. Peter's Dynevor Anglican, was finally finished in 1857, six years after Cockran had made his original case for the new building. The church was a handsome thing, based on English parish churches. With its impressive limestone walls and elegant wooden spire and steeple, the church is a landmark. A later addition gave the structure a formal chancel, a unique feature among the four pre-1870 Anglican churches that stand along the Red River.

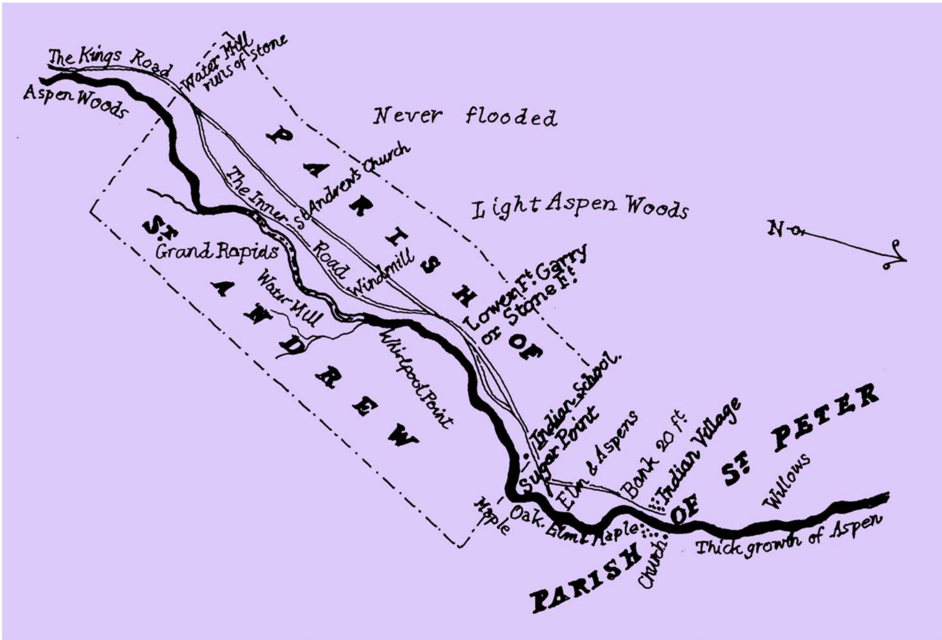
This adapted account from Ms Sutherland continues through another chapter to Chief Peguis's death on September 25, 1864 – he was buried four days later in the cemetery of St. Peter's on a "calm, pretty day," wrote local stonemason Samuel Taylor. Reverend Cockran died one year later on 1 October 1865 in Portage la Prairie. But the essential information for this project—regarding buildings mostly—essentially ends here.



The Parish of St. Peter, Dynevor Old Stone Church.

Some additional context about the demise of the settlement is found in a Historic Resources Branch report:

“In 1857, when [Reverend] Cockran left the Indian settlement and moved to St. Mary’s Church at Portage la Prairie, St. Peter’s was well-established. Within a short time after Cockran’s departure, however, changes began to occur. The Reverend Abraham Cowley, Cockran’s assistant at the Indian settlement, was placed in charge of the church and mission. After Chief Peguis’s death, tensions between the Saulteaux and Cree, and between Christian and non-Christian Aboriginals, grew and caused divisions at the settlement. [More significantly], Canadian settlers who came out to Red River in the 1860s and 1870s in search of rich farmland often bought out the Aboriginal farmers. As the white and Métis presence increased in the area, the native population dispersed. [And] in short time what was once called the “Indian settlement” came to be known as the parish of St. Peter’s.



Sketch map showing the immediate vicinity of the Indian Village, with a number of buildings and sites shown, along with roadways and vegetation. The Indian Village and related sites and topography descriptions are situated at the right. (Map redrawn from the original courtesy Gary Still, redriverancestry.ca)

“In 1871 an [Aboriginal] treaty designated St. Peter’s as a reserve, but this did not halt the sale of land or prolong the life of the settlement. By 1875 half of the population of the area were non-treaty and eventually much of the missionary’s painstaking work was undone. Farming became a subsidiary occupation for remaining Aboriginals, who readily re-adapted to hunting and fishing.

“In 1908 St. Peter’s was closed as a reserve. A number of those who still held land in the area sold out and moved north to the newly-opened Peguis Reserve. The old river lots merged into larger farms and the overall population of St. Peter’s parish decreased.”

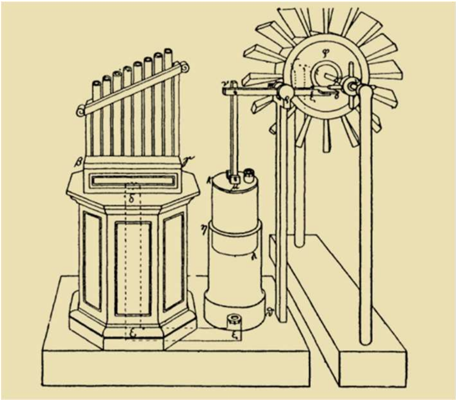
Brief History of Windmills

A wind wheel designed by the Greek engineer Heron of Alexandria in the first century AD is thought to be the earliest known instance of the use of a wind-driven wheel to power a machine – interestingly for a musical device (shown at right). Indeed, for centuries it was the more obvious activity of rushing water that was exploited for conversion to usable power – for grain-grinding, saw-milling and a multitude of other functions.

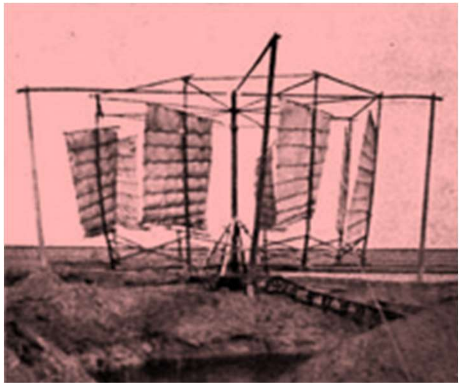
The first practical windmills had sails that rotated in a horizontal plane, around a vertical axis (lower right). According to Ahmad Y. al-Hassan, these “panemone” windmills were invented in eastern Persia as recorded by the Persian geographer Estakhri in the ninth century AD. Made of six to 12 sails covered in reed matting or cloth material, these windmills were used to grind grain or draw up water.

In northwestern Europe, the much more familiar horizontal-axis or vertical windmill (so called due to the plane of the movement of its sails) is believed to date from the last quarter of the twelfth century, and was mainly concentrated in the triangle of northern France, eastern England and Flanders. The first English windmill was at Bury St. Edmonds in Suffolk, dating from 1191, followed into the next century by as many as 4,000 in England.

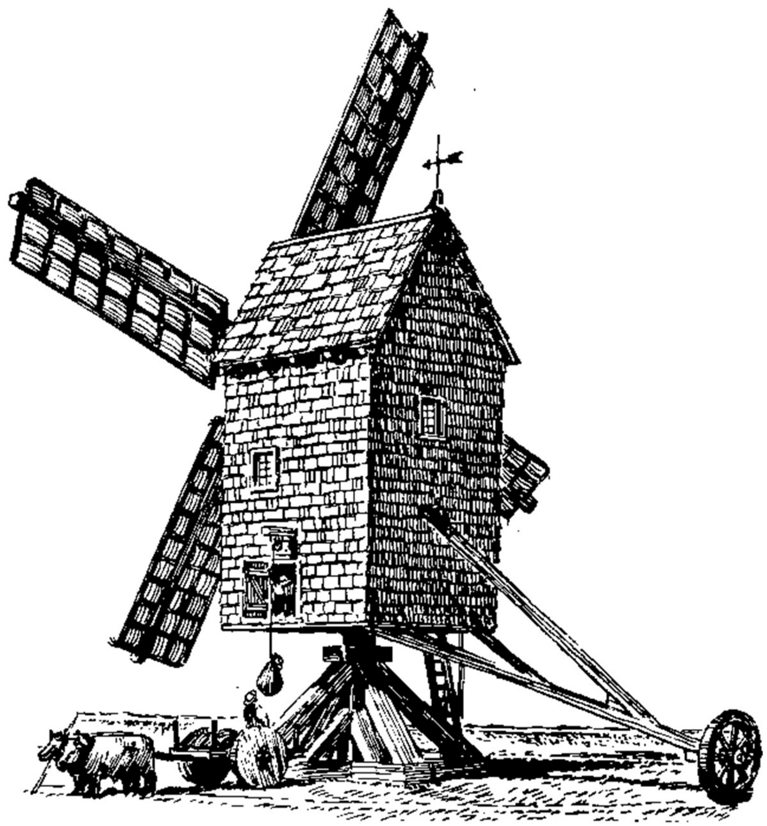
Current evidence suggests that the earliest type of European windmill was the post mill, so named because of the large upright post on which the mill's main structure—the "body" or "buck"—was balanced. By mounting the body this way, the mill was capable of rotating to face the wind direction, an essential requirement for windmills to operate economically in north-western Europe, where wind directions are variable.



Speculative drawing by W. Schmidt from 1899 showing Heron of Alexandria’s wind organ and wind wheel (right side of drawing) (From *Herons von Alexandria Druckwerke und Automatentheater*, Reprint 1971).



A Chinese example of a horizontal windmill, in which the sails are arranged around vertical members.



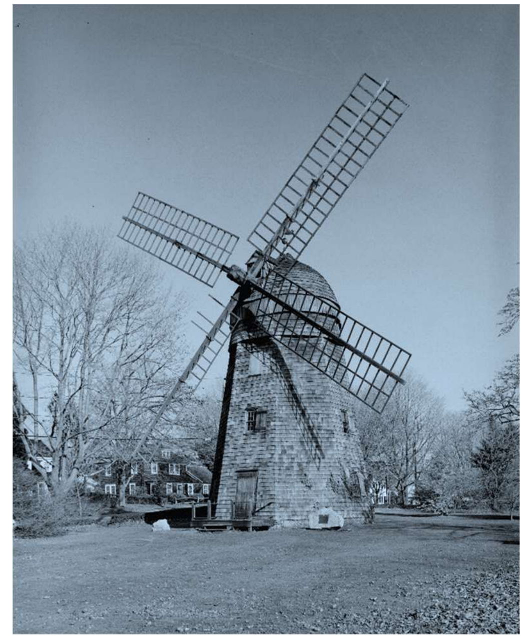
Sketch of a typical post windmill. This amazing little building (also called the buck) rests on a heavy timber framework, with the post that forms the main structural feature of the mill just visible as it enters the bottom of the buck. The stout form was turned into the wind by pushing on the long poles at the back of the mill – in this case fastened to a wheel to make this process slightly easier. The body contained all the milling machinery.

The value of windmills, compared with water mills, gradually gained them even greater popularity: they were cheaper to construct than water mills; and in spite of the vagaries of wind the comparative "portability" of a windmill meant that there were many more siting opportunities.

By the end of the thirteenth century in Europe the tower mill had been introduced, and gradually replaced the post mill. The revolutionary innovation of the tower mill involved the turning apparatus – instead of the whole building rotating, only the cap atop the tower needed to be turned into the wind. This meant that the main structure could be much taller, allowing the sails to be made longer, which in turn enabled them to produce more useful work even in low winds. The spread of tower mills throughout Europe came with growing national economies that called for larger and more stable sources of power. (The tower mill, of which our St. Peter's example is a type, is discussed in more detail in the next section.)

The tower mill's cap could be turned either by winches or gearing inside the cap or from a winch on a long tail pole outside the mill, as seen above in the illustration of a post mill. A method of keeping the cap and sails facing into the wind automatically came with the invention in 1745 by Edmund Lee of the fantail, a miniature windmill mounted at right angles to the sails, at the rear of the cap.

The sails that are the key aspect of any windmill—post or tower—typically consisted of a lattice framework on which a canvas sailcloth was spread. The miller could adjust the amount of cloth spread according to the amount of wind available and power needed. In medieval mills, the sailcloth was wound in and out of a ladder type arrangement. Post-medieval mill sails had a lattice framework over which the sailcloth was spread and fastened, while in colder climates the cloth was often replaced by wooden slats, which were easier to handle in freezing conditions.

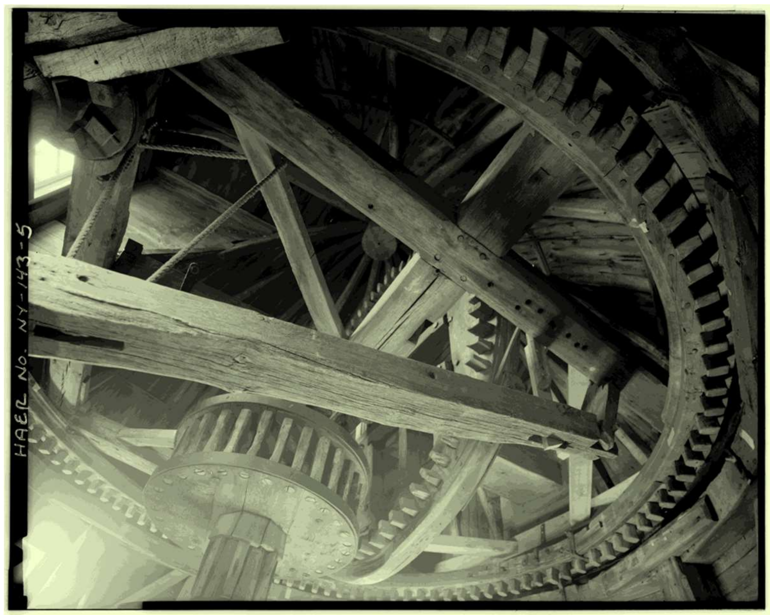


A modest tower mill in England. showing the basic shape, turning cap and sails.

In all cases, the mill needed to be stopped to adjust the sails. Inventions in Great Britain in the late eighteenth and early nineteenth centuries led to sails that automatically adjusted to the wind speed without the need for the miller to intervene, culminating in patent sails invented by William Cubitt in 1813. In these sails, the cloth was replaced by a mechanism of connected shutters.

Lines of windmills in Holland, essential to ensure ongoing drainage of low-lying land for agriculture. Holland boasts the largest number of windmills in Europe – at least 9,000 have been counted over the centuries of their presence in the country.

Clearly, the evolution over the course of several hundred years of the main external elements of the European windmill—from post to tower type, from stretched sail cloth to intricate wooden shutters, from manual to automated operations—is a story of enormous creativity. Within the mill itself, however, the kinds of mechanical apparatus required for specific functions—usually grain grinding or water displacement—relied on a range of intricate wheels and gears that may have become more complex over many years, but were essentially as they had been since the late medieval period.



This interior view, of the upper gearings of the Pantigo windmill in New York State, suggests the complexity inherent in the construction and placement of the gearing apparatus required in a windmill. (Image courtesy East Hampton, New York Historic American Buildings Survey)

For many Manitobans the most familiar wind-powered structure is known as the American windmill. Also called a wind engine, the device was invented in 1854 by Daniel Halladay and was used mostly for lifting water from wells. Larger versions were also used for tasks such as sawing wood, chopping hay and shelling and grinding grain. During the late nineteenth century steel blades and steel towers replaced wooden construction. At their peak, in the 1930s, an estimated 600,000 units were in use throughout the United States, with many also appearing on western Canadian farms and ranches. Firms such as U.S. Wind Engine and Pump Company, Challenge Wind and Feed Mill Company, Appleton Manufacturing Company, Star, Eclipse, Fairbanks-Morse, and Aermotor became the main suppliers in North and South America.

These wind engines featured a large number of blades, so they turned slowly with considerable torque in low winds and were self-regulating in high winds. A tower-top gearbox and crankshaft converted the rotary motion into reciprocating strokes carried downward through a rod to the pump cylinder below.

Illustration from The Aerometer Pneumatic Water Supply Company of its galvanized metal wind tower. The company still produces windmills today.

Operation of a Tower Windmill

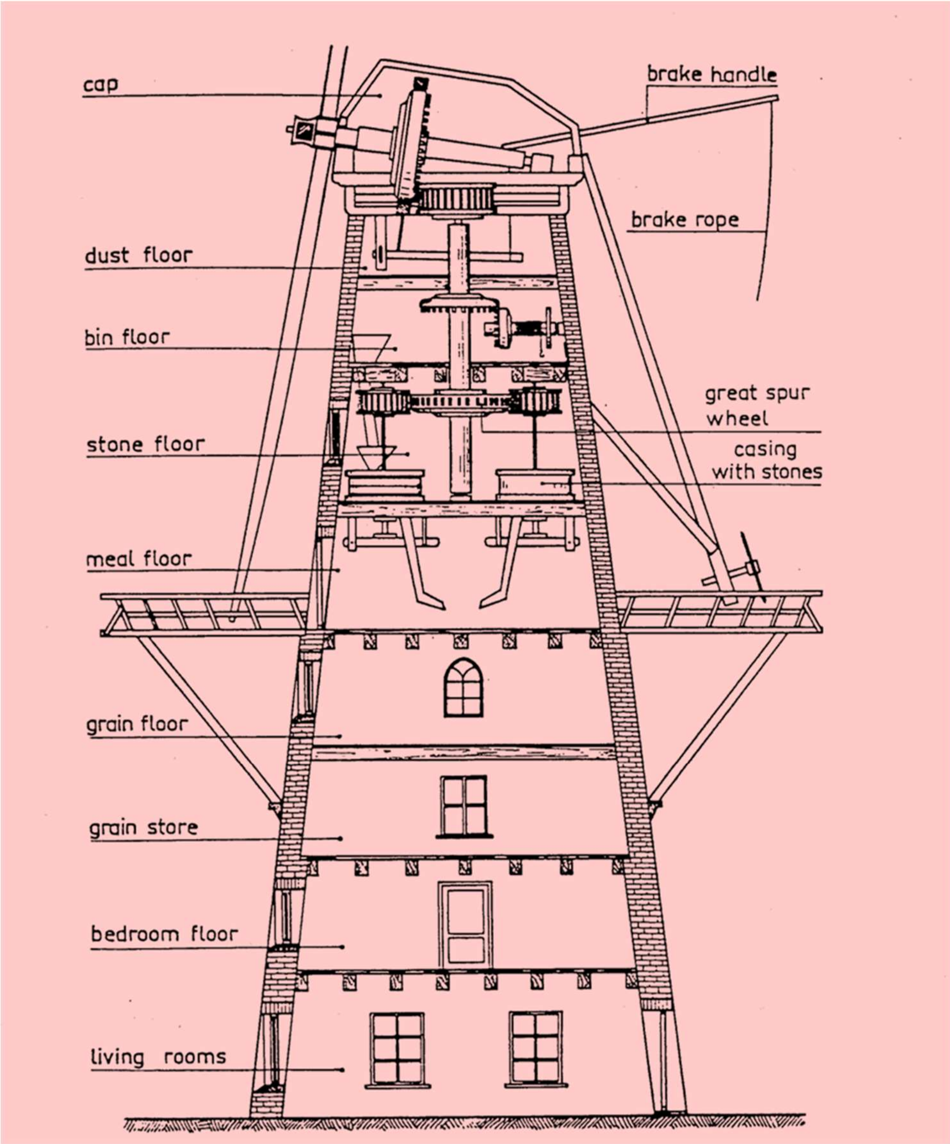
The tower windmill, having been the subject over several centuries of close and keen attention, experiment, revisions and improvements, was by the early 1800s a well known and familiar combination of formal and mechanical elements and features – at least to windmill builders. And while the Red River examples from the 1830s were modest and even rudimentary, they were still of this type, and presumably as sophisticated at least in terms of general mechanics and operations as their thousands of cousins throughout Europe and eastern North America.

This section of the report has been included not only for general interest, to explore the levels of ingeniousness and complexity these Victorian-era manufacturing operations attained, but also to gain an understanding for the imaginative recreation of the 1835 St. Peter's mill – in its various details and operations.

The following entries have relied greatly on two sources: "Historical Development of the Windmill" by Professor Dennis G. Shepherd of Cornell University (1990, carried out for the National Aeronautics and Space Administration/NASA) and a website devoted to an understanding of tower mill mechanics and operations by English engineer John Hearfield (2007).

It is useful to begin this section with an observation by Professor Shepherd in his NASA article: "Throughout history, windmill technology represented the highest levels of development in those technical fields we now refer to as mechanical engineering, civil engineering and aerodynamics. The best technical minds of their day were constantly seeking to improve the design and operation of windmills. A continuous series of modest changes introduced and tested by builders and millers must have occurred that finally resulted in the refinement and advancement of windmill technology." It is within this context that the following information needs to be understood. But before the necessary details of operation are discussed, a general sense of tower mill forms and mechanics is presented.

A large and sophisticated tower mill in cross section (next page) shows some key features and details that will find their way to the much more rudimentary mills of the Red River Settlement in the 1830s and 1840s. At the top of this drawing we see the cap, which holds a large wheel and axle which in turn are joined to the large sails and connecting features shown on the outside left of the cap. It is notable that the axle (known as the windshaft) and thus the sails and large wheel are placed at an angle to the horizontal – it was discovered fairly early on in the evolution of the windmill that this angle (about 15 degrees) was necessary for the efficient functioning of the sails. In this drawing there is a long shaft labelled "brake handle" – this feature was not present on many mills, but is a reminder of the need for a braking mechanism in this section of the windmill that could slow and stop the sails. The brake—usually a smaller wooden element—was more typically adjacent to the large wheel. We can see that this wheel also served another purpose – to turn and thus via its toothed gears drive a smaller wheel directly below the cap. The concatenation of additional axles and smaller gear wheels, shown in the "bin floor" and "stone floor," were the typical features and arrangements in any mill—wind or water—that was used for grinding grain. The ultimate destination for all of this mechanical activity, and the gradual transition of power, is seen in the "stone floor," where two "casing[s] with stones" mark the place where grain was deposited and in this case two large grinding stones did their work. In an area here called the "meal floor" one can see two long chutes that emerge below the grinding casings, and where the resulting flour would fall via gravity – there would be bags situated under these chutes when the mill was in operation. In this drawing there are two additional floors below the "meal floor" labelled "grain floor" and "grain store," where grain waiting for grinding would be housed. The two lower stages, "bedroom floor" and "living rooms" were only



Cross section of a large Dutch tower windmill (Shepherd). This mill, featuring walls of masonry construction, was about 60-65 feet high and about 25-30 feet wide at the base. The St. Peters windmill was 37 feet tall and 21.5 feet at its base. The largest known tower mill was built in East Anglia, England, in 1812 and measured 121 feet (37 metres) high and 40 feet (12 metres) at its base; it was destroyed by a storm in 1905.

developed in the most sophisticated of windmill operations. One final feature shown in this drawing is seen at the "meal floor" stage, where a fenced platform encircles the building – this was very common on tower windmills, the area where a miller could more easily get at the sails, for repairs and adjustments, and in this case at the rope that was attached to the brake handle.

When Professor Shepherd makes the point that "throughout history, windmill technology represented the highest levels of development in those technical fields we now refer to as mechanical engineering, civil engineering and aerodynamics," he is mostly referring to the specific mechanical features that define a windmill's operation: the sails, the adjustable cap (in a tower mill) and the power train within the cap. He is generally not referring to the basic formal and structural aspects of a windmill that are actually based on common and straightforward building techniques that attend any historic structure.

At the same time, Professor Shepherd includes in his article some contextual information about form and construction aspects that are specific to windmills, and thus useful for this present exploration of Manitoba windmills:

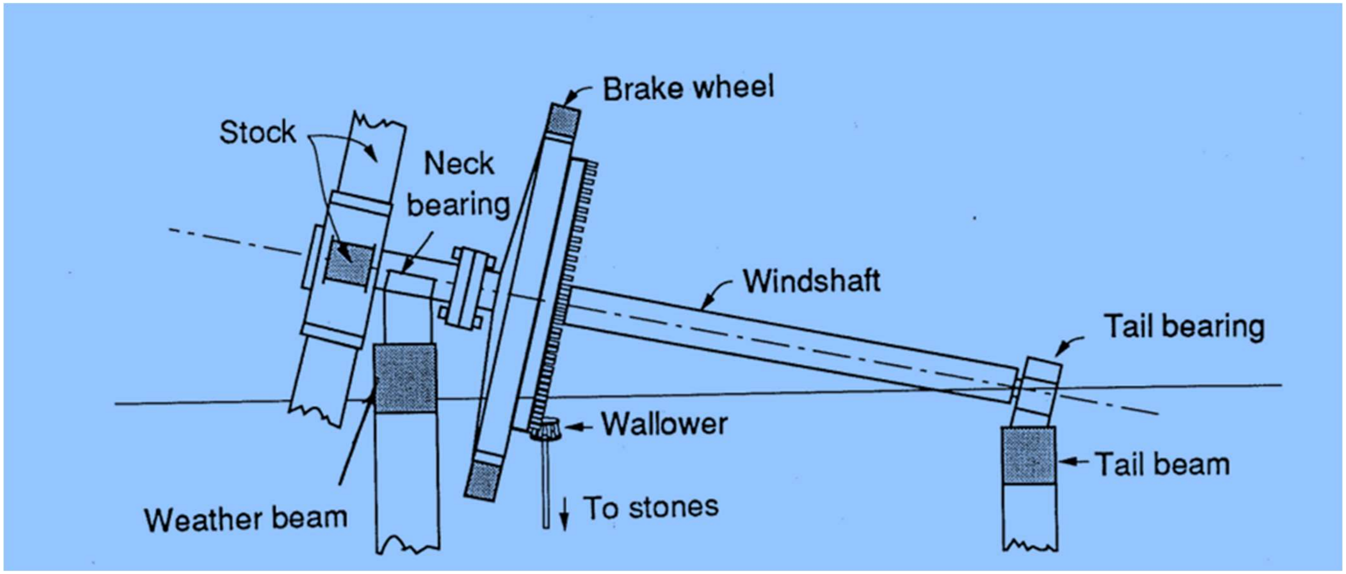
"Tower mills were often made of brick with a circular cross section or of wood in an octagonal shape. The mills made of timber were covered with clapboarding in England and often painted white, so that they came to be called smock mills, from their supposed likeness to the rural smock or frock [garments]. Many Dutch tower mills had a brick base and a rush-thatched body. There was little difference in the machines and sails of either type [brick or wood], except for those engaged in specialized applications, such as sawmills, which did require some special design considerations."

"A tower [mill] constructed of bricks could be very sturdy and resistant to weather, but it was not easy to repair if splits appeared as a result of a shift in the foundation or because of the constant vibrations. Thus the usual practice of placing windows in a linearly symmetrical pattern was sometimes changed to a spiral pattern to avoid lines of structural weakness. Wooden smock towers, on the other hand, were subject to joint opening and subsequent rotting from water seepage. Their multi-sided design included walls with slanted corner posts and beams with beveled ends, all of which required expert craftsmanship and constant maintenance to make them secure and leak-resistant."

Returning to those technologies so esteemed by Professor Shepherd will see a focus on three essential aspects of a windmill—post or tower type—that are key to its highly particular operation: the power train/windshaft, the cap and the sails. The logical presentation of these features would start with the sails, the initial point of power generation, move to the power train/windshaft and conclude with the cap. However, the following review will instead reorganize this logic based on the complexity of each feature; and thus begin with the simplest, the power train/windshaft, and conclude with the most complex, the sails. A concluding short summary piece will re-present this information in the logical progression.

The Power Train/Windshaft

In his article, Professor Shepherd provides a labelled diagram, below, to show a windmill's essential power train, from sails (left of the image and not shown in full), through the windshaft and via its various support and component pieces to the wallower and grinding stones below.



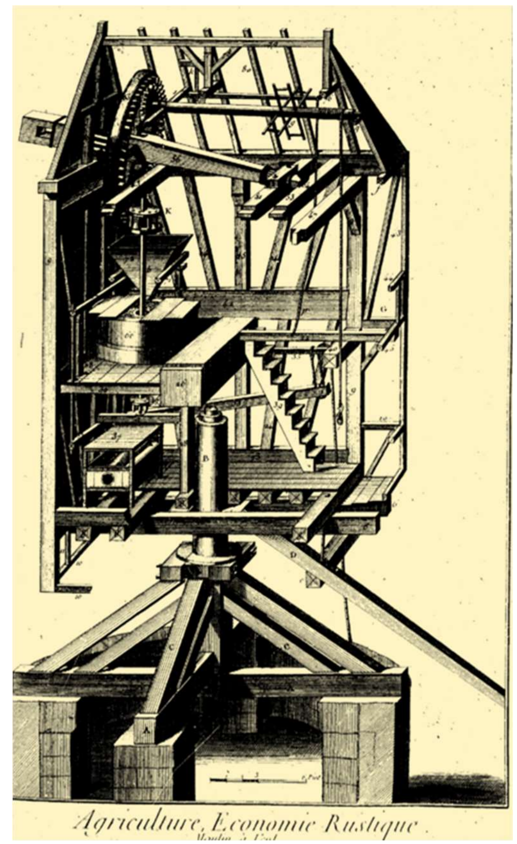
This elevational detail shows the essential power train features that take wind to sail and then into the building via a range of wheels and bearings.

Professor Shepherd provides more detail about this feature's operation: "The sails . . . were carried on the windshaft, which was supported at its forward or breast end by the large breast beam or weather beam and at its rear or tail by the tail beam. The weather beam supported the neck bearing and thus the weight of the sail assembly, which was considerable. The tail bearing took the axial thrust which again was considerable . . . ."

“The power take-off from the windshaft was made by a large brake wheel, so called because it also carried the brake on its rim. It was fitted originally with hardwood pegs that transmitted the torque to the wallower, or lantern pinion, the vertical shaft of which either directly or via intermediate gears powered the millstones or other devices below. As time went on, the wooden pegs or staves became shaped cogs. Iron parts replaced some of the wood, and eventually the brake wheel and wallower developed into iron cross-helical gears. The wooden pegs were lubricated and lasted a surprisingly long time; some are in use to this day.”

“The brake was simply a friction band around the circumference of the brake wheel, made of a number of curved wooden blocks banded together, with one end of the band anchored to a timber of the [cap], and the other to a brake lever, itself pivoted at a fixed point on the structure. The active end of the brake lever could be pulled up or down by a rope. The brake lever had an iron pin that could engage with a notch in a catch plate, free to swing from a pin in its head. The brake lever was very heavy, and when it has unsupported by the rope or the catch plate, it pulled the brake blocks sufficiently hard against the rim of the brake wheel to hold the wind shaft at rest.”

“It was advantageous to have the brake be capable of operation at a distance, with the miller on the lower working floor. Application of the brake in a high wind or with full sail, either by design or accident, could start a fire from sparks of metal or ignition of wood because of the heavy friction effect. The miller must have had to keep a sharp eye for sudden storms that might catch him, with sails up, so to speak.”



This cutaway drawing of a post mill, from Denis Diderot and Jean le Rond d'Alembert’s 1772 *Encylopedie*, shows the interior features and arrangements of a post mill – including the large geared wheel at top left that transmitted the rotating power of the sails to other geared mechanisms within.

The Cap

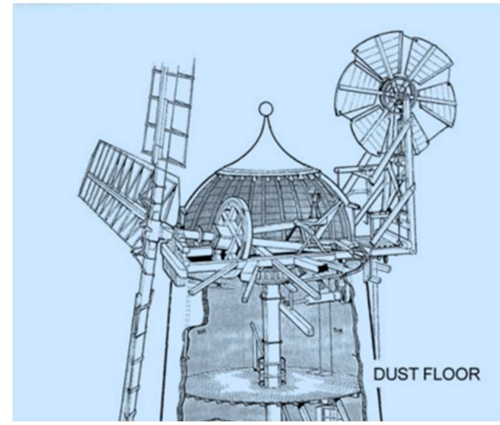
The cap in which the windshaft assembly was situated was a major aspect of a tower windmill's appearance and operation.

As noted by Professor Shepherd: "The cap of tower mills was kept small, and its external design was varied according to the degree that the effect of its shape had on the wind flow behind the sails was recognized, and perhaps according to the aesthetic sense of the miller or builder." This last point will be considered with regards to our Manitoba mills, which have a definite English Tudor architectural character.

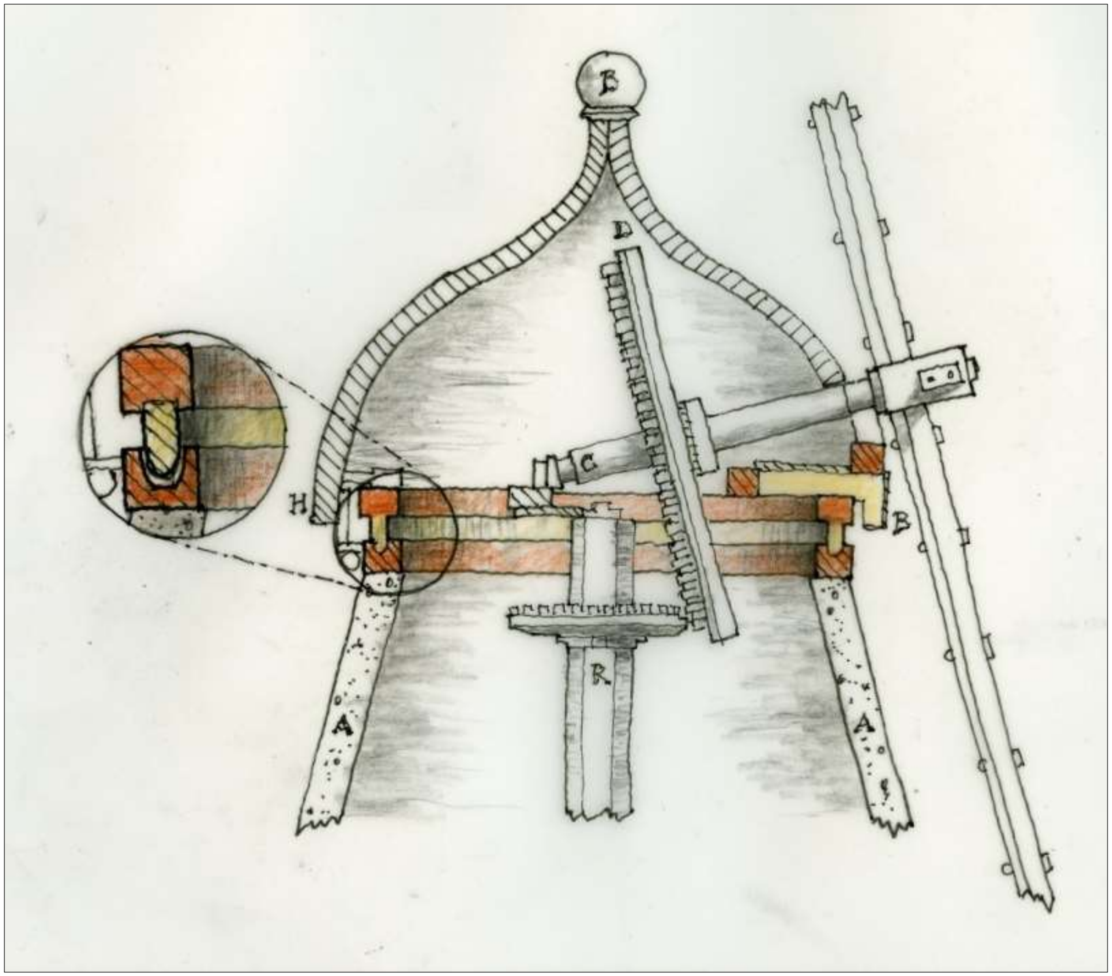
Again to Professor Shepherd: "The top of the tower had to be of stout construction and had to have two essential features. The first was the provision of a fixed curb, [track] or rail on which the cap could turn with a minimum of friction between the horizontal surfaces through which the gravity load was transmitted." Turning the cap was absolutely essential to a windmill's operation, ensuring that the sail assembly could be positioned in just the right place to correctly catch and use the force of the wind.

Professor Shepherd adds: "The second feature was a means of keeping the cap truly centred, again with a minimum of friction between vertical fixed and moving surfaces through which thrust loads were carried. The horizontal bearing was initially wood blocks sliding on a curb, well greased, or with iron plates fixed below the cap frame. Later, iron trolley wheels were mounted on a cap ring, and finally iron rollers were placed between special iron tracks attached to both tower curb and cap ring, so that a roller-bearing was effectively formed."

While the fixed curb, track or rail is clearly a major aspect of a tower windmill's design, it is physically a very small feature (compared with other parts) and also rather difficult to illustrate. The examples at right and on the following page aim for a clearer explanation.



A cutaway drawing of a tower mill showing the interior arrangements of upper sections, including the cap.



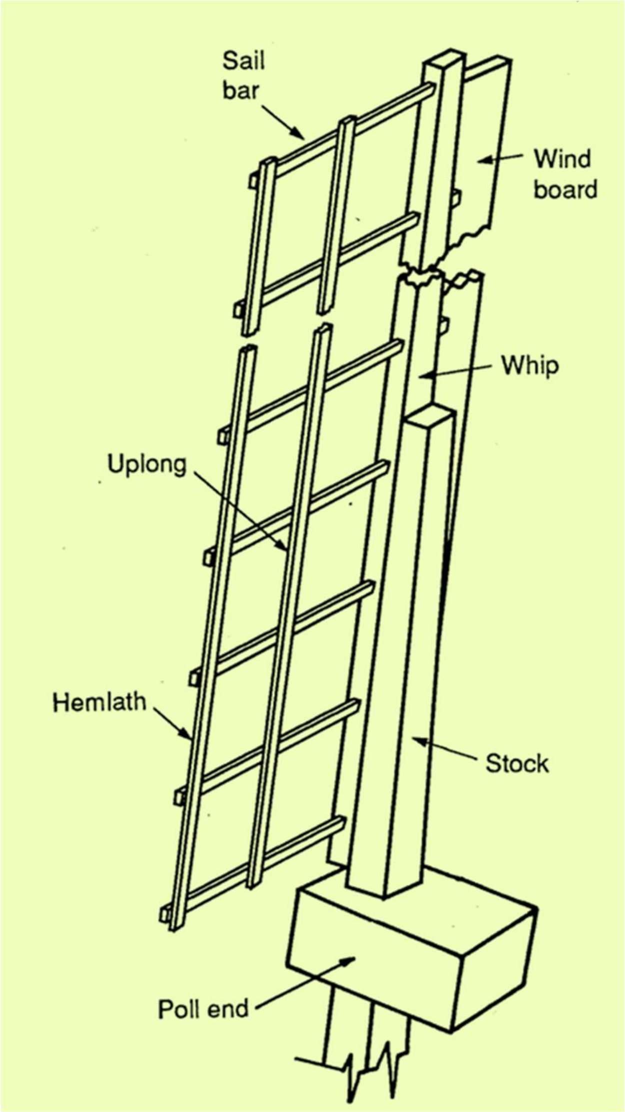
This sectional detail of a tower cap shows via coloured highlighting the key components of the turning apparatus – built up rings (of wood or metal) that allowed the cap to turn. The enlarged section at the far left shows how the upper ring was inset with a narrower ring that fitted into the continuous groove of the curb below it. As was noted by Professor Shepherd, the lower curb and presumably the narrow infill ring would have to be regularly greased for effective operation.

The Sails

As noted above, a discussion of the sails of a windmill has been presented last, given that these apparently simple and obvious parts of a windmill are actually the most complex and the most difficult to describe – certainly in their actual mechanical and aerodynamic aspects, the qualities that actually made the windmill work so well.

First, some basic history and obvious facts, from Professor Shepherd: “It is likely that the first [windmill] sails [of the fourteenth century] were flat boards, but these were soon replaced by a cloth-covered wooden lattice on a central spar, forming two “ladders” through which the sail cloth was laced over and under alternate transverse battens. These early sails were inclined to the plane of rotation at an angle of about 20 degrees along their whole length.”

“The figure [right] shows the structure of the common sail diagramatically. The main structural element was the stock, which either was mortised right through the windshaft or was fitted into the iron canister or poll end. It could be as long as 27 metres [nearly 90 feet], although anything longer might have led to structural problems; it was most likely limited to this length by availability of the right kind of lumber. Along the length of the stock were fastened narrower timbers called whips, through which transverse sail bars were mortised at intervals. To the sail bars were nailed longitudinal laths, the outside ones called hemlaths and any intermediate ones called uplongs. In this way, a lattice was formed on which cloth could be attached. The sail bars were initially placed symmetrically on either side of the whip, but in later times the common sail had the stock positioned as shown in the figure.



Structural components of the common windmill sail. The stock is a heavy wooden element, likely oak, forming the primary base for the lattice work of uplongs, hemlaths and sail bars that make up the wooden parts of the sail structure.

“The forward end of the sail bars supported a leading edge wind board that directed the wind onto the sail and helped to hold the cloth firmly against the frame. At the poll end there was a transverse iron bar onto which the end of the sail was attached by rings and eyelets in the fashion of a present-day curtain. Ropes were attached along both lengthwise edges of the sail so that it could be drawn radially outwards and fastened at the tip. Note that the tip had to be within reach of the miller, standing on or near the ground, or on the tower stage, for those mills that had one. Furling of the common sail acted to control power and rotor speed. When the mill was not operating, the sail was unfastened at the top, twisted into a roll, and cleated to the whip.”

This reconstructed medieval windmill clearly shows the early sail form and structure described in Professor Shepherd’s article and obviously well known even in the 1500s and 1600s: the lattice frame twisted slightly to gain power, the symmetrical positioning of the lattice on the spars, and the sail cloth attached to the lattice.

This useful overview of sail construction, design and operation is probably sufficient for a basic understanding of this key component of a windmill's operation. But Professor Shepherd and Mr. Hearfield both have developed much more technical observations about windmill-sail design, some of which is presented here for those interested in the depth of engineering thought that attended the evolution of these features.

Beginning with Professor Shepherd: "[While the ancient idea of rotating] a right-angle gear mechanism allowed the rotor axis to be transposed from vertical to horizontal, the action of the sails also had to be turned through 90 degrees. This was revolutionary, because it meant that the simple, straightforward push of the wind on the face of the sails was replaced by the action of the wind flowing smoothly around the sail, providing a force normal to the direction of the wind. As a concept, it was indeed a sophisticated one that was not fully developed until the advent of the airplane at the turn of the nineteenth century and the engineering science of aerodynamics."

"In fact, although they were not aware of it, the first builders of the vertical windmill had discovered aerodynamic *lift* and had used it to achieve a greatly improved design over that of *drag*, which is the force that powered the Persian [horizontal] windmills [of the early medieval period]."

"The earliest sails were inclined at a constant angle to the plane of rotation, whereas the common sail was given a twist from root to tip to vary the inclination continuously along its length. This was called weathering the sail, and it was done by mortising the sail bars through the whip at different angles, which might vary from 22.5 degrees at the root to less than zero at the tip. This was undoubtedly an empirical discovery, because it is unlikely that the millwrights were aware of the concepts of *relative velocity* and *angle of attack*. Perhaps weathering was prompted by observations of the behaviour of the stretched cloth along its length "catching the wind" or "filling the sail."

It is now to Mr. Hearfield that we turn for an additional, albeit rigorously complicated, review of windmill sail technologies – essential for an appreciation of the evolution and results of all of this attention and experimentation. He includes in his article some interesting editorial thoughts that are included here for context:

View of the sails on a rare five-sailed tower windmill built in the early nineteenth century.

"This article looks at how old wooden windmills and particularly their sails, have come to be the shape they are. It tries to explain how the sails start rotating, why they don't self-destruct in a gale, and why a windmill sail looks like a piece of garden trellis."

"There's something beautiful about a well-designed machine, whether it be a steam locomotive or a fighter aircraft, a clock or a racing car. Every component, large and small, is there for a reason. Each has been made in a particular way, from the most appropriate materials available, to interact with the other components in just the way their designer intended."

"For me at least, part of the pleasure I get from machines comes from trying to understand how they work. Windmills are not just pleasing to look at. They are machines, and like all machines they have been engineered to do a useful job at minimum cost. Every single component has been thought about, and designed, and optimized."

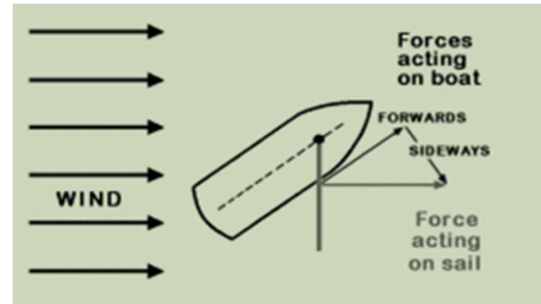
Mr. Hearfield then gets to the heart of the matter regarding windmill sails:

"It's a much more challenging task to extract energy from moving air than from moving water [as in a water mill]. The amount of water flowing through a waterwheel can be controlled quite closely by using artificial millponds and sluices, but the strength and direction of the wind can change dramatically during a day, or even in the course of a few minutes. So the problem faced by an aspiring windmill designer is this: how can the energy in an erratically-moving mass of air be harnessed, and then used to drive a shaft at ground level which needs to rotate at more or less constant speed?"

"At first glance, it seems obvious how windmills work. They have huge flat sails that face the wind, so when the sails are rotating they cut through the air just like the wings of an aircraft. But then I asked myself, if the wind is blowing directly at the sails, why should they ever begin to rotate? And whilst an aircraft's wing is a smooth solid surface, a windmill's sails seem to be mostly empty space. The wind would blow straight through the holes."

View of the kind of lattice-work that defined many windmill sail compositions.

"I tried to find out the answers to these questions. My usual sources of information—books, the internet, local library, county library—had practically nothing of any use. This was disappointing, but not really surprising – nobody builds windmills like this anymore, so there's little point in writing books on how to do it. So I decided to spend a little time thinking about the principles that guided these early millwrights, to see if I could understand why they built windmills in the way they did. The key question seems to be: *How does the wind make the sails revolve*? Once I understood that, it should be easier to see why the sails have the shape they do."



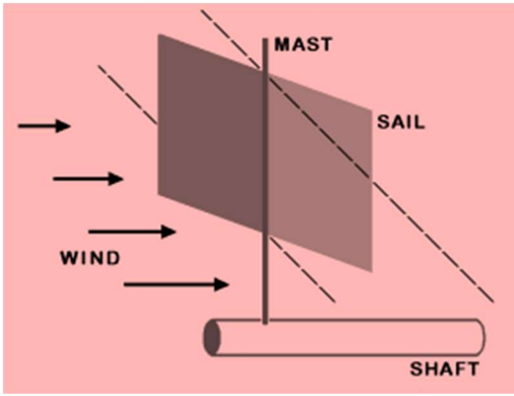
This diagram in Mr Hearfield's article shows how an angled sail on a ship captures the force of wind to move in a preferred direction. The diagram also shows a key aspect of wind force on the sail – driving the ship both forward and sideways.

Mr. Hearfield's following 10-page dissection and compelling illustrated analysis of windmill sail technology is necessarily dense, complex, and frankly excessive for the present purposes of this project. The following is a summary of the key points of the article.

Mr. Hearfield begins by noting the obvious comparison of a windmill's sails with those of a sailing ship, looking for similarities of design and function: "Sailing ships capture wind energy and convert it into forward motion, so an obvious starting point in designing a windmill's sails would be to think about a sailing boat. Boats have been around for a very long time, and to be useful they must have some means of changing the direction of the force supplied by the wind into the direction the captain wishes to steer. With care, they can even sail into the wind."

"The force of the wind acts on the sail, of course [see diagram right and another on the next page]. That's what the sail is for. But the sail is attached to the boat, and it's the boat that moves. If it were a raft, it would move in whatever direction the wind was blowing, but a sailing boat is designed to go in just one direction – forwards." In the diagram, Mr. Hearfield identifies two forces that act on the sail – one forwards and one sideways. There is considerable analysis following that shows how these forces are captured and controlled, especially in a windmill, with the conclusion that the sideways motion noted here is actually the force that is used for the effective operation of a windmill's sails.

Mr. Hearfield then makes this key observation about the force of the wind and the sails, noting that this sideways, or turning, force occurs at right angles to the axis (or centre) of the sail assembly, which is at some distance from the windshaft, and so its effect is to make the mast—and hence the shaft—rotate. He adds: "The size of the turning force evidently depends on the angle between the sail and the wind."



This diagram shows how an angled sail on a ship is set to exploit wind power for movement. A similar action happens with a windmill when its sails are set at a similar angle.

Through this comparative analysis, Mr. Hearfield appears to have answered his basic question: *How does the wind make the sails revolve*? with the answer that the sails in a windmill must be set at an angle to initiate motion. But he actually wants more clarity – thus not just how the rotation begins, but also: "What should be the [optimal] angle between the sails and the wind?"

He begins this query with this observation: "The logical conclusion of this [that sails need to be set at an angle to the direction of the wind] is that windmills should be built with their sails edge-on to the wind, to use all the available turning force, with the wind flowing over the sails as it does over the wings of an aircraft. In fact, aircraft designers know this turning force as 'lift', and it's what makes aircraft fly. Windmill sails were actually called 'wings' in Anglesey (and 'sweeps' in Kent, and 'arms' in Yorkshire)."

"But if the sails were mounted edge-on to the wind, when they went round they would flail wildly at the air like giant cricket bats, instead of slicing though it smoothly like swords. The resulting turbulence and air resistance would be enormous, and would seriously limit how fast the sails could rotate. This wouldn't do at all, since it was already known that the windmill's power output increases greatly as the speed of rotation rises. On the other hand, if the sails were mounted square-on to the wind, there would be no turning force at all. So it's essential to set the sails at a compromise angle that will persuade them to start moving in slow-moving air, yet still give a reasonable power."

“The optimum angle turned out to be about 15 degrees. As it happened, the first engineer to analyse this properly (in 1759) was one of my heroes – a Yorkshireman called John Smeaton. He pioneered the approach that engineering is an applied science and not just a collection of rules-of-thumb. His achievements included making waterwheels more efficient and building the first Eddystone lighthouse that didn't fall down. Scientists may live in ivory towers, but engineers design them.”

Zierikzee windmill in the Netherlands, showing the placement of sail cloth that allows the mill to attain ongoing productivity even in low winds.

Mr. Hearfield adds some additional information on sail design: “Power output depends not only on the wind speed, but also on the area swept by the sails. Long sails generate more power than short ones, and a typical sail might be 10 metres long and 2 metres wide [about 35 x 6 feet].

“Ideally, the sails should rotate at a constant speed whatever the wind conditions, and in practice this means that additional braking must be applied when the wind speed is high. The most elegant solution would be if the moving sail could itself somehow supply a braking force which increased with speed, and it turns out that this happens if the sail is constructed as an open lattice instead of with a smooth continuous surface. The holes generate turbulence, which act as a brake (and also reduces lift).”

“But whilst increased drag is an advantage when the sails are actually rotating, the reduced lift makes the system more difficult to start. The wind speed has to be higher before the sails can generate enough lift (turning force) to get them moving. So the mill needs solid sails when the wind speed is low, but open lattice sails when the wind is blowing more strongly. How can this dilemma be resolved? The answer is, by using open lattice sails, and covering them with cloth when the wind is light, [as seen in a mill, right] in the middle of the small town of Zierikzee in the Netherlands. It was a cloudy and showery day with hardly any wind when we were there in 2005, but the mill was working. The photograph also illustrates that although the inner edges of the sails (near the hub) do meet the air at about 15 degrees, the angle at the tips of the sails is very much less. This gradual change in angle was another of Smeaton's ideas.”

Windmills in Manitoba

As was suggested in a previous section focusing on the development of the so-called Indian Settlement at St. Peter's Dynevor, windmills were an essential service ensuring the economic security of the fledgling Red River Settlement. For about 40 years—from about 1825 to the mid 1860s—windmills especially (but also water mills) were the necessary quasi-industrial infrastructure that ensured the cereal crops being harvested by farmers were converted into useful foodstuffs – flour specifically.

It is important that the two windmills at the Indian Settlement (one from 1835 and the other from 1846) be situated in this context – to better understand the whole history of these long-forgotten landmarks, but especially to appreciate the skills that attended the construction and operation of the windmills at St. Peter's.

In his very useful 1981 article in *Manitoba History*, "Flour Milling at Red River: Wind, Water and Steam," Professor Barry Kaye (Department of Geography, University of Manitoba) provides important background context for the exploration of the St. Peter's Dynevor windmills. Professor Kaye's article focuses on both water mills and windmills; it is the section on wind-powered mills that is reprinted here:

Before the transfer of Rupert's Land to the Dominion of Canada in 1869-70, the colony founded on Red River by Lord Selkirk in 1812 was the major centre of population and agriculture in the Canadian Northwest. As such, it was also the preeminent centre for the primary processing of the agricultural products necessary for day-to-day life at Red River and for the operations of the fur trade.

Selkirk's main intention in establishing a colony at Red River was to provide a home on British territory for dispossessed Scottish and Irish peasants, thereby reducing both social stresses in Britain and the flow of emigrants to the United States. Selkirk's plan for an interior colony became a reality only through the cooperation of the Hudson's Bay Company, on whose chartered lands it was to be planted. For its part the Company judged that an agricultural colony might serve as a reliable and convenient source of agricultural foodstuffs and labour for its growing number of Northwest fur posts. Such a settlement, the Company hoped, would allow significant reductions in the expense of importing the English provisions needed to supplement the local food supplies of its overseas settlements and thus increase its competitiveness in the ongoing struggle with the Northwest Company for commercial supremacy in the fur trade.

Foremost among the secondary industries at the Red River Colony was grist milling, which produced the flour used in Red River households and at the fur posts. From the onset of colonization, plans were made for the installation of a gristmill to meet the needs of the first settlers. In a letter dated 12 June 1813 [Lord] Selkirk advised Miles Macdonell, the first governor of the colony, that "I have no doubt of your finding good mill stones on the east coast of Winipic [Lake Winnipeg] among the granitic rocks." Writing shortly afterwards, Macdonell informed Selkirk that "A wheel-wright and a constructor of windmills would be great acquisitions to us." As a result of these exchanges Samuel Lamont, a millwright about whom Selkirk had heard good reports, accompanied the party of Kildonan Scots settlers that journeyed to Red River in 1814.

The colony's first powered mill was erected in the spring and early summer of the following year. This was a horse-powered treadmill constructed out of local timber and using grindstones transported from the Lake Winnipeg area the previous year by the incoming Scots settlers. Unfortunately this first mill was never able to demonstrate its value to the settlers, as all the colony buildings, including the recently erected mill, were burnt to the ground by the Métis in 1815.

A second horse-mill, able to grind from 12 to 15 bushels of grain per day and employing millstones of four feet in diameter "found pretty near at hand," was erected at considerable expense during the winter of 1820-1821 for the use of the settlement. The mill worked well enough in the cold season, but during the spring thaw part of the foundations gave way and by May 1822 the mill was not working. Another mill, built by the Hudson's Bay Company and intended primarily for Company needs, but also used by the settlers when the colony mill was out of order, was working by November 1822. Earlier in the same year the lack of flour milling capacity at Red River forced the Company to ship grain as far as the mouth of the Winnipeg River for grinding into flour by the mill at Fort Alexander.

It is not known what proportion of the colony's grain was processed by these first mills. What is known is that throughout the colony's early years the settlers ground much of their grain in simple handmills or querns. The quern was a hand-operated rotary mill that was still widely used for grinding in the Highlands of Scotland during the early nineteenth century. Many of the Kildonan settlers brought querns with them and [George] Simpson [Governor of the Hudson's Bay Company during the period of its greatest power, 1820-1860], writing in 1824, claimed that every second or third settler owned one of them. In 1822 the colony also acquired a handmill and two flour sieves from Fort Alexander. For the periods of time when there was no animal-powered mill, most of the colony's wheat must have been ground in handmills. The quern consisted of "two flat stones (the upper and the nether)—the upper having a handle which turned it upon the wheat and brought the grain into some semblance of flour, not over white, but in the best degree a health-producing and dyspepsia—obliterating substance." Small amounts of wheat may also have been ground by similarly hand-operated steel mills.

In 1821 the Hudson's Bay Company sent out to York Factory on Hudson Bay the machinery required for the erection of a wind-powered gristmill. Governor Simpson came across this machinery at York during his 1821 visit to the Northern Department. He reported to Andrew Colvile, [Lord] Selkirk's brother-in-law and one of the principals of the Hudson's Bay Company, that "the Iron Mill now lays here and is likely to remain in our stores. One piece of machinery alone weighs 10 cwts. and unless boats are constructed purposely and handymen sent from England for the purpose of transporting it, here it must continue." Simpson recommended that the weighty mill machinery be shipped back to England and "returned to the tradesmen who furnished it even at a reduction in price as here it is totally useless."

The machinery remained, however, at York Factory and in August 1822 selected parts of it were forwarded to the colony. The selection was made by James Mitchell, a Scottish millwright who had arrived that year in the Company ship from England to supervise the erection of a gristmill at Red River.

Two years later, in 1824, Mitchell was reported by Simpson to be constructing not a windmill but an animal-powered corn mill at Red River, able to grind 17 to 18 bushels of grain per day. The equipment transported from York Factory in 1822 turned out to be machinery for a sawmill, not a corn mill, and led Simpson to doubt whether Mitchell had the skill and knowledge to set about erecting a windmill.

Despite Simpson's apprehensions, Mitchell, aided by Captain F. Matthey, an officer of the De Meuron mercenaries, completed the erection of a windmill at Red River. It was located on the southern edge of Point Douglas about a mile north of Upper Fort Garry. The windmill began to grind on October 1, 1825 and was said by a Fort Garry journalist to work "well," whilst those best able to judge thought the workmanship "solid and complete." The flour it produced was considered "fine and fully answerable to all demands" by Donald McKenzie, the governor of the colony. Simpson was also favourably impressed by the new mill which seemed to him to answer the needs of both the Company and the settlers at Red River.

The expense of the mill's construction, which amounted to £1,500, was borne by the Estate of Lord Selkirk. When it was finished, the mill, plus one hundred acres of adjoining land which included the site of old Fort Douglas, was sold [almost immediately] for £400 by an agreement of June 11, 1825 to Robert Logan, a retired trader who had worked for both the Northwest and Hudson's Bay Companies. Payment was fixed at one tenth of the grain ground. The mill fortunately escaped serious damage from the 1826 flood and served as a place of refuge for settlers and livestock during the worst periods of that disaster. Logan's daughter remembered that the mill was a "big round building like a tower—broader at the bottom than at the top, and it had great sails that flapped around and around when there was a good wind and there was grinding to be done."

The first windmill in the Red River Settlement, was built in 1825 for the Hudson's Bay Company by James Mitchell, a Scottish millwright, and Captain F. Matthey, an officer of the De Meuron mercenaries who had accompanied Lord Selkirk on his visit in 1817. In this engraving the mill, which was located on the southern edge of Winnipeg's Point Douglas area, is shown as part of Robert Logan's farm; Logan took over ownership of the mill almost as soon as it was completed. (Image Courtesy Archives of Manitoba)

The mill erected by Mitchell and Matthey on Point Douglas was the first of several to be erected along the banks of the Red, and to a lesser extent the Assiniboine, during the next 40 years. Lack of relief and fairly regular high winds seemed to ensure a successful future for the wind-powered flour mill at Red River.

Logan's windmill was for a few years the only one at the colony and was still in active use when Alexander Ross wrote his history of the Red River settlement in the 1850s. As might be expected, the expansion of the settled area and the growth of wheat production was paralleled by increasing numbers of grist-mills at the colony. By 1830 a second windmill was in operation and three others were under construction. In 1831 the first mill was under construction at the Grand Rapids (later St. Andrew's Parish) to meet the needs of the retired fur company servants who settled in large numbers along that stretch of the Red River.

According to Ross, who was himself a mill owner in the early 1830s, the windmills at Red River "were made with the materials of the country, iron only excepted, and finished by the workmen of the settlement, at an average cost, everything included, of £150 sterling." In addition to the iron work, many of the millstones were also imported. Visiting the colony in 1857, Hind was informed that, although millstones had occasionally been obtained from the Lake Winnipeg area, "they could not compete commercially with these imported by the Hudson's Bay Company, which, for a time, were sold for a little above cost, even after their long and expensive journey."

In the 1850s there were two millwrights amongst the few tradesmen at Red River. One of the two was Hugh Polson of Kildonan, who had learnt his trade by helping his fellow Scotsman James Mitchell erect Logan's mill in 1825. Polson built a windmill for himself in the 1830s and later erected "several others at different points in the settlement."

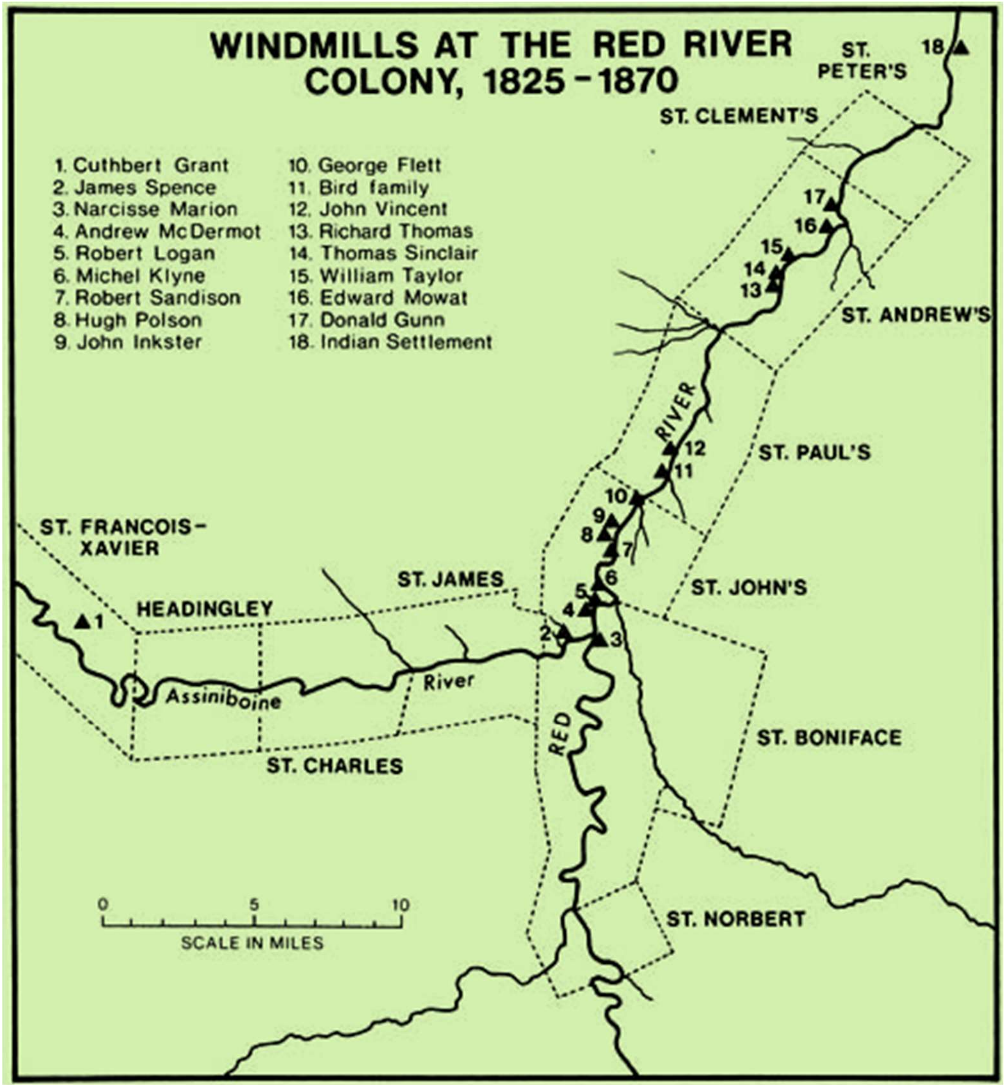
By the time of the 1838 census, the first to record the colony's millers, there were fourteen windmills at Red River. The number of windmills increased only slowly over the next 20 years and no more than 18 were counted in any census year. They were numerous enough, however, to stand out as prominent features in the flat Red River Valley. In the words of an 1848 visitor from the United States: "The grain is ground by windmills, which form picturesque and conspicuous objects in the landscape of the plains surrounding the settlement." For Hind, the windmills were the only visible evidence of any manufacturing activity at Red River.

In this early photograph, ca. 1870, of the landscape around Middlechurch, the site of St. Paul's Anglican Church, and today a northern suburb of Winnipeg, one can easily discern the two landmark forms of windmills on the right-hand horizon line. ((Image Courtesy Archives of Manitoba)

North of the Forks along the west bank of the Red River, in what was generally called the Lower Settlement, windmills occurred at fairly regular intervals along the river front (see map next page). The Lower Settlement included the predominantly English-speaking Protestant parishes of St. John, St. Paul and St. Andrew. In 1856, 13 of the colony's 18 windmills were located in these three parishes. The reasons for the concentration of mills in that quarter of the colony are fairly obvious. It was the longest settled and most densely peopled part of the colony and also the part where agriculture was most important and most advanced in the years prior to 1870. The relative dominance of agriculture along the lower Red was not the result of any environmental advantages but of the cultural prejudice of the Scottish Highlanders, who formed a significant portion of the parochial population only in St. John's and St. Paul's. It was the Scots at Red River, and to a lesser degree the Orkneymen and English-speaking mixed-bloods [now more commonly identified as Métis], who were most completely dependent upon agriculture as the main source of their livelihood. The distribution of mills at Red River mirrored this fact.

Even at the centre of the colony windmills were far fewer on the east bank of the Red River. Until the 1850s only one mill sufficed to grind the wheat grown by the Canadian and Métis farmers of St. Boniface. This was the windmill built south of the St. Boniface mission church, sometime between 1840 and 1843, by the Canadian Narcisse Marion.

Outside the agricultural core of the colony the commitment of settlers to farming was weak or nonexistent and mills were consequently fewer. This was particularly the case in the peripheral parishes of St. Francois-Xavier and St. Norbert where the population comprised a mixture of Métis and Canadians, and that of St. Peter which was wholly Aboriginal. Almost all the residents of these parishes lacked any significant agricultural background, and although a few adopted the life of the farmer with some enthusiasm and energy once they settled at Red River, this was not general. Grain production was, therefore, small and the needs of the population could be met by a small number of mills.



This map created for Professor Kaye's article shows the concentration of windmills along the Red River, especially in the area above (north) of the forks of the Red and Assiniboine rivers and then along the stretch near St. Andrew's. The windmills at the Indian Settlement are shown as number 18, top right.

For many years one windmill, erected sometime during the early 1830s by the settlement's founder, Cuthbert Grant, ground flour for the Métis settlement of Grantown (St. Francois-Xavier). Grant's mill remained the most westerly one in the Red River country until the early 1850s. At that time English-speaking mixed-bloods from St. Andrew's and St. Paul's began to migrate westwards along the Assiniboine and settle at Portage la Prairie, where a windmill was erected by John Hudson soon after the commencement of farm settlement. Hudson's mill continued to grind until 1873, when it was pulled down and its timber used in the construction of a blacksmith's shop.

The most northerly windmill in the colony, that in the Church Missionary Society's station at St. Peter's, differed from the others at Red River in that it was built as a result of encouragement by missionaries. The Church of England missionary, the Reverend William Cockran, encouraged the building of a mill at the mission he had established in the early 1830s amongst the Saulteaux and Swampy Cree living in the vicinity of Netley Creek and the Red River delta. Cockran actively urged the Aboriginals to settle down and become agriculturalists as a step in their conversion to "civilization" and Christianity. He saw mill building as a part of this process. In his journal for 11 February 1835 Cockran wrote that "the Indians began to complain of the inconvenience they were subjected to from not having a gristmill. The poor fellows are obliged to live principally upon parched corn, when they are unsuccessful in taking fish. This is not agreeable when the settlers above are enjoying their wheaten bread. I reminded them of their former state, and likewise the present state of the Catholic population, that had not one mill amongst them, but at the same time assured them if I saw them enlarge their farms and raise as much grain as was worth incurring the expence [sic] of building a mill, I would certainly set about as soon as possible. A mill to us here would be of great service."

Six months later Cockran reported his intention to go ahead with the erection of a mill at the Indian Settlement so that he "might be able to give the children a larger quantity of flour, and likewise to grind the grain of the parents upon the spot, to see if they will not be more attached to the habits of civilized life." The mill was completed later that year or early in 1836, several months before the mission church was finished. Cockran referred to it as "the most conspicuous mark of civilization that we have planted in this rude waste."

The windmill built at the Indian Settlement in 1835 is the only one at Red River whose precise dimensions are known. The pillar of the mill was 21 and a half feet in diameter at its base, while its height from the foundations to the top of the dome was 37 feet. The mill stones were three feet six and a half inches in diameter and the sails, each of which contained 76 yards of canvas, were 17 feet six inches long and six feet wide.

The Indian Settlement mill gradually fell into disrepair and in 1845 had been out of operation for three years. It was rebuilt in that year under the supervision of the Reverend John Smithurst, at a cost of one hundred pounds. Once the mill was back in working order the Aboriginals "made considerable efforts towards enlarging their farms." In 1852 the mill at St. Peter's was sold on twelve months' credit to an Aboriginal settler. Thomas Cameron. In the same year a second mill was built at the Indian Settlement. Cockran informed his superiors that this second mill "may be said to be entirely Indian property—It does a great deal of good. & we get a regular supply of flour, & the two mills give a certain portion of employment to needy individuals and sell flour to others who have anything to represent it. This gives an additional spur to industry and will no doubt induce the Indians to enlarge their farms & look more to the soil for the supply of their wants."

Throughout its long history as a source of mechanical power the major shortcoming of the windmill has been its failure to provide power during periods of calm weather. One settler at Red River remembered that "The north and northwest winds were the best for the mills. The south and east winds were not so strong and steady." There were also occasions when "there would be a breeze strong enough to give them power to grind, but not to bolt." At such times the settlers had to do the bolting themselves. for which was used "a sieve of brass wire which we would hang from a beam and spread a white cloth under it on a table, then by pouring in the ground but unbolted grist we had brought from the mill and shaking the sieve we would get flour." Prolonged calms sometimes caused or accentuated flour shortages at Red River. The windmills did "fair work," according to Macbeth, "but when a long calm prevailed there was always danger of a flour famine, unless by borrowing from one another the supply could be eked out until the wind arose." The Reverend John Black wrote from Kildonan in February 1856 that "The people have almost been out of flour the whole winter on account of the very calm weather." Against such contingencies as this many households continued to keep a handmill even after windmills were erected at the colony. Such calms occasionally posed problems for the Hudson's Bay Company in making up its requisitions of flour from the colony. In 1828, when Logan's windmill was still the only flour mill at Red River, Donald Mckenzie informed Simpson that "With the settlers the harvest has been pretty liberal; in consequence your requisition of flour bids fair to be put up unless the calms present a hinderance [sic] as last year at the mill."

In his discussion of the Red River Settlement, John Palliser included a section on the "Trade and Occupation of Inhabitants." According to Palliser, "There can be said to be no distinct trades practised at Red River, every man being his own carpenter, smith, mason, etc., and the women taking the clothing department." Henry Youle Hind was similarly informed by Mr. W. R. Smith, the clerk of the Council of Assiniboia, and the Superintendent of the Red River census, that "no kind of industry or a distinct trade or occupation existed in the settlements. Almost every man was his own wheelwright, carpenter or mason; carpenters, blacksmiths, masons, etc. could be found, but they were also engaged in other occupations, either as small farmers or hunters. Mr. Smith did not think that one man could be found in Assiniboia who pursued any particular trade, or limited his industry to one special branch. Both Palliser and Hind probably suggest a greater degree of self-sufficiency among Red River households than was the case, for to the extent that colonists with a particular craft skill supplemented their incomes by doing odd jobs for their neighbours, there was some specialized activity at the settlement.

“Young’s Mill,” by noted painter Paul Kane, shows a windmill outside the walls of Lower Fort Garry, ca. 1860. ((Image Courtesy Archives of Manitoba)

In general, the millers were settlers of energy and some entrepreneurial ability who were trying to escape the stifling economic restraints imposed upon the colony by the all-pervasive fur trade and the Hudson’s Bay Company monopoly. The milling business was one avenue of economic advancement. Included amongst the settlement’s millers were some of the most eminent citizens at Red River, men who were involved in a variety of vocations other than agriculture. The Orkneyman John Inkster, for example, was a store owner, merchant, free trader and member of the Council of Assiniboia, as well as a miller. Andrew McDermot, the colony’s most prominent miller, was also a leading free trader, a shopkeeper, a freighter and a dealer in cattle. Narcisse Marion of St. Boniface owned “a shop of merchandise” and a blacksmith’s shop as well as a windmill. Robert Sandison and Thomas Sinclair combined carpentry with milling. John Tait was a carpenter and boat builder as well as the owner of a water mill. In addition to Inkster, McDermot and Marion, several other millers owned both a mill and a store. These included Donald Gunn, Thomas Logan, Edward Mowat and John Vincent. Several of the colony's millers also earned part of their livelihood by private freighting. The boats of John Inkster, Andrew McDermot, Edward Mowat and Thomas Sinclair voyaged twice during the summer months to and from York Factory, carrying goods ordered from England by both the Company and the settlers.

It is also worth noting that the majority of the Red River mills were owned and operated by Protestant settlers as might be expected from their interest in agriculture. These included Scots, Orcadians, Englishmen and English-speaking Métis and after 1852-53, an Aboriginal [at St. Peter's]. Of the more than 20 millers identified in the Red River censuses before 1856 only four—Andrew McDermot, Michel Klyne, Narcisse Marion and Cuthbert Grant—were of the Catholic faith.

No account of the early flour milling industry at Red River would be complete without a discussion of the role of the Hudson's Bay Company in that industry. The Company was by far the largest customer of the Red River gristmills and following 1865 was itself directly in the milling industry. The Company started to buy Red River wheat in 1825, the first year in which there was a surplus. In February 1826 Company carts carried its wheat purchases to Logan's newly erected windmill for the first time, "to be ground for exportation in the spring, to Norway House and York Factory, for the ensuing summer's consumption." After the mid-1820s wheat was the most important item in the Company's purchases of colonial farm produce. It was also the only item that had to be processed before it could be shipped out of the colony to provision the fur trade.

There thus began in the 1820s the system, which was to continue until 1870, whereby flour produced by Red River millers was annually boated north to the stores at Norway House. Norway House, in turn, supplied the boat brigades of the various districts that composed the Northern Department as they passed on their journey to and from York Factory during the weeks of open water on the Nelson River system. In this way Red River flour and other colonial farm products were distributed to fur posts scattered throughout the vast distances of the Northern Department.

With the increase of gristmills after 1830, the Company patronized a variety of private millers in the colony. Indeed, the prospect of the Company's business may have been the prime factor in convincing a few settlers that flour milling would provide them with valuable additional income.

After 1850 the Company appears to have reduced the number of mills at which its wheat was ground. McDermot constructed his water-powered gristmill on Sturgeon Creek on the understanding that he would have the right to grind the Company's wheat for the next ten years. From entries in the Fort Garry post journal, it is evident that a large part of the Company's wheat purchases during the 1850s was in fact ground at McDermot's mill on Sturgeon Creek. The flour was boated down the Assiniboine or sent by cart to the flour stores at Upper Fort Garry. McDermot did not, however, have a monopoly of this side of the Company's business. In 1854, the Company loaned Louis Riel Pere one hundred pounds "in the security of his water mill across the Riviere la Seine" and in the late 1850s Riel was grinding Company wheat at his water mill on the Seine to the east of the Red. After 1857 the Company also made use of the St. John's steam mill, and in the autumn of 1858 was sending wheat to "Larjemonier's" mill.

Windmills and water mills were the only sources of mechanical power at the colony until 1856, when the Red River Valley's first steam mill was erected. Amidst an atmosphere of what one colonist described as a "mania" for steam, during the winter of 1855-1856 a number of prominent Red River citizens organized the formation of a joint stock company, "The Red River Steam Mill Co.," that would raise sufficient funds for the purchase of a steam gristmill and saw mill. The desire for a new source of power appears to have been instilled by the shortages of flour resulting from the calm weather that halted the windmills for long periods that winter.

The machinery and boiler for the mill were purchased in St. Paul, Minnesota, and transported north to the colony along the Red River in a scow, a type of flat-bottomed boat. The mill, driven by a 20-horse power engine fueled by wood and designed to saw timber as well as produce flour, was assembled in St. John's parish. It had a two run of stones and began to grind in December 1856. The cost of the machinery and its assembly was £1,600, raised in £50 shares. The major shareholder and president of the steam mill company was John Inkster, an Orkneyman, of St. John's.

The steam mill posed mechanical problems and never turned a profit for the proprietors, but nevertheless it gave valuable service to the colony for several years, particularly during the winter season. The new mill was reported to produce "an excellent article." This venture unfortunately ended in 1860, when the mill was totally destroyed by fire.

At the time of this disaster the ever-enterprising Andrew McDermot was starting to assemble the colony's second steam mill. The mill machinery was purchased by McDermot from the United States government at Fort Abercrombie, Minnesota, in the summer of 1859. The mill was located a few yards back from the Red a mile or so north of Upper Fort Garry, close by McDermot's home of Emerald Grove. It was in operation by November of 1860. The charge for users was eight pence per bushel or one eighth of the grain ground, which rose to one shilling per bushel or the fifth bushel by October 1863. The settlers were heavily dependent on McDermot's steam mill during the dry summers of 1863 and 1864 when the water mills failed to grind and the windmills were unable to meet the extra demand. This mill suffered the same fate as its predecessor, however, and it was destroyed by fire in December 1872.

Later in the 1860s steam mills were constructed in other parts of the colony. In 1863 the first steam mill in St. Andrew's was built at the Rapids on the corner of the parish church lot and was expected to begin grinding early the following year. This appears to be the same mill built by E.H.G.G. Hay, a Yorkshireman who settled at Red River in the early 1860s after a number of years in the United States.

In the mid-1860s the *Nor'Wester* [newspaper] carried advertisements for Hay's "American Steam Mill" and "new store" at the rapids of St. Andrew's, grinding at the eighth bushel in wheat. By 1867 Hay's mill contained a smutting machine and was able to "produce a good article of wholesome flour." Hay's mill served the residents of St. Andrew's until 1877, when it too was destroyed by fire.

In 1868 J. B. Holmes of St. Boniface built a steam grist and saw mill at High Bluff to the east of Portage la Prairie, an area of rapid settlement in the 1860s. Other steam flour mills were erected at Portage la Prairie itself during the early 1870s, the first by William M. Smith, a former resident of Winnipeg who had been that town's "pioneer flat-boatman." Lower down the Assiniboine in the Silver Heights district of St. James, a steam mill was built at Sturgeon Creek by Robert Tait in 1869. Tait's mill was said to produce a "beautiful fine flour." Based on information from 1872, the St. Norbert parish survey map of 1875 locates Joseph Lemay's steam mill, the first in a predominantly French-speaking parish, on the west side of the Red a short distance north of the parish church. The year of its erection is not known.

During the 1860s the Hudson's Bay Company also involved itself in the steam flour milling business at Red River. This involvement stemmed largely from the Company's growing dissatisfaction with its heavy reliance on the inconstant wind and water mills of the colony's private millers. Furthermore, getting the wheat purchased from the settlers to the mills for grinding involved "the Company in a great deal of expensive and time-consuming transportation."

The outcome was that in 1865 the Hudson's Bay Company decided to enter the milling business for itself. In that year a steam mill, doubling for grinding grain and sawing wood, was installed at Lower Fort Garry. Fitted with grindstones brought in by cart from the United States, it was in operation by November 1865. Entries in the post journal reveal that the new steam mill ground the grain of the local settlers in addition to that harvested from the large farm the Company had maintained since the late 1850s at the Lower Fort. The mill used fuel at a prodigious rate and Company servants were kept busy cutting and hauling wood when it was on steam. It continued to grind until 1879, "when in the face of competition from smaller private mills in the area it was finally abandoned."

The royalty that Red River farmers paid to the miller, what was known as the "moulter measure," varied according to the type of mill. The toll on wheat milling in 1869-70 ranged from one sixth of the wheat at the steam-driven to one-ninth at the water-driven mills, with the windmills probably exacting something between those extremes. It was George Henry Gunn's recollection, however, that certain clients of his father's water mill, such as the Hudson's Bay Company and the wealthier local residents, paid in cash.

In the early years of the new Province of Manitoba, which was created in 1870 and embodied the Red River Settlement, flour was turned out by a combination of wind, water and steam mills. During Manitoba's first decade, steam flouring mills were erected in Winnipeg in the parishes along the Red and the Assiniboine, as well as in the new farming communities that sprang up beyond the old riverfront settlements after 1870. At the same time there was a reduced need for the inefficient and unreliable wind and water mills with their one or two run of stones. These primitive gristmills, therefore, eventually fell into disuse. A few windmills were still working in the Winnipeg area, including one at Colony Creek owned by James Spence, at the time of J.C. Hamilton's visit in the mid-1870s. His comment was that "most of them have been dismantled and their machinery taken farther west, steam mills here taking their places."

The proliferation of steam mills did not, however, immediately eliminate the use of windmills in the settlements along the Red and the Assiniboine. In St. Paul's parish, for example, the windmills continued to operate even after Hugh Pritchard built a "fine" steam mill close by the parish church in the 1870s. The older settlers in particular preferred the parish windmills, believing that they turned out a "stronger and better flour."

St. Peter's Dynevor Windmill – A Graphic Recreation

As noted at the outset of this report, the purpose of this project has been to determine what the St Peter's Indian Settlement's 1835 grist mill looked like – that is, how it was put together with native materials at hand (thus without machine power), how those materials gave it a certain form, and how it operated.

Obviously nothing is left of this windmill, or of any of the 18 other windmill sites that once ground grain in early nineteenth-century Manitoba. But all the preceding information developed for the report has lead to this point – the suggested graphic recreation of this important early Manitoba milling operation, which is conveyed by a set of annotated drawings on the following pages.

Before the drawings are presented, it is useful to summarize the key historical, architectural, structural and operational facts drawn from various preceding materials, and to provide some additional salient observations:

The St. Peter's Indian Settlement Windmills

The following contextual facts are drawn from Donna Sutherland's book on Chief Peguis and Professor Kaye's article on Manitoba windmills.

- The second of two "Indian Settlements" was inaugurated in 1833 on the east bank of the Red River, near the present site of St. Peter's Dynevor Church. By 1835 the settlement was well established (35 acres under cultivation) and Reverend Cockran decided a grist mill was required for the community's self-sufficiency. Given that there was the need to cut and season the timber for the mill, it is likely either that Cockran's decision to build occurred in 1834, a year before construction, or that the mill was actually built in 1836.

- Whether it was constructed in 1835 or 1836, the St. Peter's windmill was built at a time when buildings at the Red River Settlement were made with materials at hand—logs, stone, long marsh grass—and with near-Medieval building technologies: thus no light wood frame, no wood siding, no wooden shingles, no brick, no concrete. The rudimentary, but still effective, approaches to building and carpentry will be kept in mind when we imagine the mill's construction.
- Cockran had trouble finding a carpenter in the Upper Settlement to build the mill. He hired a young Saulteaux man to dig the ground for the "foundation" – presumably the deep holes to take the long poles that formed the main structural features (see evidence of this following). It was then to the men of the village that he looked to build the mill.
- This first windmill at the Indian Settlement is the only one at Red River whose precise dimensions are known: 21 and a half feet in diameter at its base, while its height from the foundations to the top of the dome was 37 feet.
- It is noted that supplies for the construction project were purchased at the Upper Settlement (i.e., the thriving community formed by the Selkirk Settlers and others around Point Douglas in present-day Winnipeg and of the Hudson's Bay Company operation at Upper Fort Garry), which meant numerous trips were made up and down the river with supplies. This is a key fact, and while the absence of details in the record is unfortunate, the entry may actually go a long way to suggest a great deal about the windmill's construction. "Numerous trips" implies a fair number of pieces of apparatus and specialty materials that were required, perhaps even some components that were manufactured (and paid for) and assembled at the site – like the intricate cap railing and guide, or the brake wheel, or the various geared wheels.
- The mill stones were three feet six and a half inches in diameter and the sails, each of which contained 76 yards of canvas, were 17 feet six inches long and six feet wide.
- In 1852 this mill was sold on 12 month's credit to an Aboriginal settler named Thomas Cameron.

- The windmill was rebuilt in 1845 under the supervision of the Reverend John Smithurst, at a cost of £100; it is difficult to convert that sum into a comparative modern value – one online inflation calculator suggests more than £60,000 (Canadian dollar value today of $114,000!); more conservative sources suggest a value of $10,000 Canadian. Any way you look at it, this was a major investment. And of course the sum raises questions about what was being paid for – labour, technical skills, specialty materials, transport, apparatus?
- In the same year a second mill was built at the Indian Settlement, with Cockran observing that this second mill "may be said to be entirely Indian property—It does a great deal of good & we get a regular supply of flour, & the two mills give a certain portion of employment to needy individuals and sell flour to others who have anything to represent it." Note that Professor Kaye notes a construction date of 1852 for this new mill.

General Information about Red River Settlement Windmills

The following information is drawn from Professor Kaye's article on Manitoba windmills.

- The first windmill in the Red River Settlement began to grind on October 1, 1825.
- It was built by trained wheelwright James Mitchell, aided by Captain F. Matthey, an officer of the De Meuron mercenaries who had accompanied Lord Selkirk to the settlement in 1817. The mill was almost immediately sold to Robert Logan for £400 by an agreement of June 11, 1825. Using a similar estimate for contemporary values as suggested above, this might be the equivalent of about $40,000.
- Robert Logan's daughter remembered that the mill was a "big round building like a tower—broader at the bottom than at the top, and it had great sails that flapped around and around when there was a good wind and there was grinding to be done."

- According to Alexander Ross, who was himself a mill owner in the early 1830s, the windmills at Red River "were made with the materials of the country, iron only excepted, and finished by the workmen of the settlement, at an average cost, everything included, of £150 sterling." As noted above – this would be the equivalent of about $15,000 Canadian today.
- In addition to the iron work, many of the millstones were also imported. Visiting the colony in 1857, surveyor, geologist and explorer Henry Youle Hind was informed that, although millstones had occasionally been obtained from the Lake Winnipeg area, "they could not compete commercially with these imported by the Hudson's Bay Company, which, for a time, were sold for a little above cost, even after their long and expensive journey."
- In the 1850s there were two millwrights amongst the few tradesmen at Red River. One of the two was Hugh Polson of Kildonan, who had learnt his trade by helping his fellow Scotsman James Mitchell erect Logan's mill in 1825. Polson built a windmill for himself in the 1830s and later erected "several others at different points in the settlement."

General Information Tower Windmills

The following brief overview of the operation of a tower windmill is drawn from the extensive and detailed analyses developed by Professor Shepherd and Mr. Hearfield; an illustration is included for clarity. There are three key features of a tower mill that need to be clearly understood for a recreation of the St. Peter's windmill: the sails, the powertrain/windshaft and the cap. A fourth aspect, the grain grinding apparatus, though not specific to the tower mill, also needs to be briefly explained.

The essential point here is that by the time of the St. Peter's mill's construction, in 1835 (or 1836), all of the following aspects of windmill construction and technology would have been well-known and understood by anyone undertaking this kind of major project.

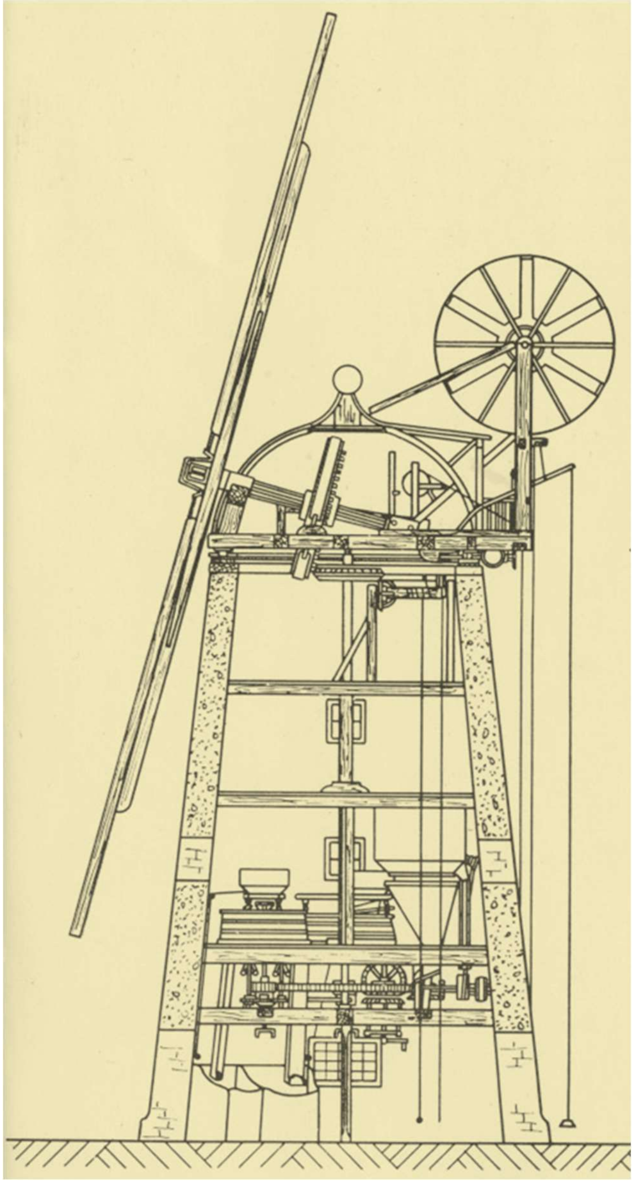
- **<u>The Sails</u>** – There are three key facts that will inform the following drawings: the lattice of the sails will be set at an angle of 15 degrees to the plane of the main stocks, and angled inwards to the mill; the lattice frame will be attached to the stocks along one edge (rather than along the middle); and the sails will be made of cloth – likely canvas. It is presumed that the main wooden elements of the sails would have been local oak.

- **<u>The Powertrain/Windshaft</u>** – The timber that forms the main element of the powertrain—the windshaft—is invariably at a 15 degree angle to the horizontal, defined by the angle of the main sail feature that is set at this angle to better catch the wind. It also will need to be large –at least a foot square, and presumably of a stout material, oak probably. It may also have been tapered and lathed at certain key points along its length to fit or accommodate other features – like the neck bearing, brakewheel, tail bearing or tail beam. The brake wheel, which is invariably quite large—most images of this feature show it at least six feet across—will have been built up of various cut and formed members and assembled into a perfect circle, with a central cavity to allow it to fit over the windshaft. The perimeter of the main wheel will be covered with notched features (likely wooden shingle shapes) to ensure effective braking. A secondary attached wheel will be studded with small wooden teeth that will ensure its mechanical engagement with the wallower gear, which itself will also need to be carefully shaped and detailed.

- **<u>The Cap</u>** – The cap atop the tower must be capable of turning – this is a prerequisite of the successful operation of a tower mill, ensuring that the sails are placed in good positions to catch and exploit the wind, and also that the brake wheel and wallower gear are constantly aligned so as to engage with lower level axles and gears and of course finally with the grinding stones. This is a key point to note and remember – the St. Peter’s mill, and likely other Red River windmills, may have been rudimentary in their construction, but they still had to be sufficiently sophisticated so that their various pieces of machinery ran smoothly.

As noted earlier in the report, the feature that facilitated the cap's revolution is not highlighted nor fully explored in any sources: Professor Shepherd only provides this basic observation: the cap "required a fixed curb or rail on which the cap could turn with a minimum of friction." To extrapolate from this essential but vague presumption – the rail or curb, presumably attached to the top level of the tower, would need to be nearly perfectly circular (and level), while a similarly configured feature that rested on it (and presumably overlapped it on one edge for stability) would likewise have been nearly perfectly round and level. And each of these large features would have to be rendered smooth, to ensure ease of turning. We know that this level of craftsmanship would have been available at the Upper Settlement – where various millwrights experienced with windmill construction had already proved their worth with several windmills. And so it is assumed that there must have been considerable sharing or knowledge, and perhaps even paid service, in the production of this part of the St. Peter's windmill. As noted above, there were many trips taken to the Upper Settlement for various supplies required for the project, so it is assumed that some of the most complex features of the mill—the windshaft, brake wheel, gears—might also have been procured there and that other features were manufactured there.

- **<u>The Grain-grinding Machinery</u>** – The various wheels, gears and axles that define nearly every grist mill operation (powered by water or wind) will naturally have been developed for the St. Peter's mill. In a windmill, the process and the apparatus start at the engagement between the wallower gear and the brake wheel and continue down until power is transmitted to the primary turning feature – the upper grinding stone; the lower stone was always stationary. The stones were sheltered in a metal or wooden box, through which raw grain was poured, and upon grinding fed by the design of the stones and gravity to a spout that directed the flour to a lower level for bagging.



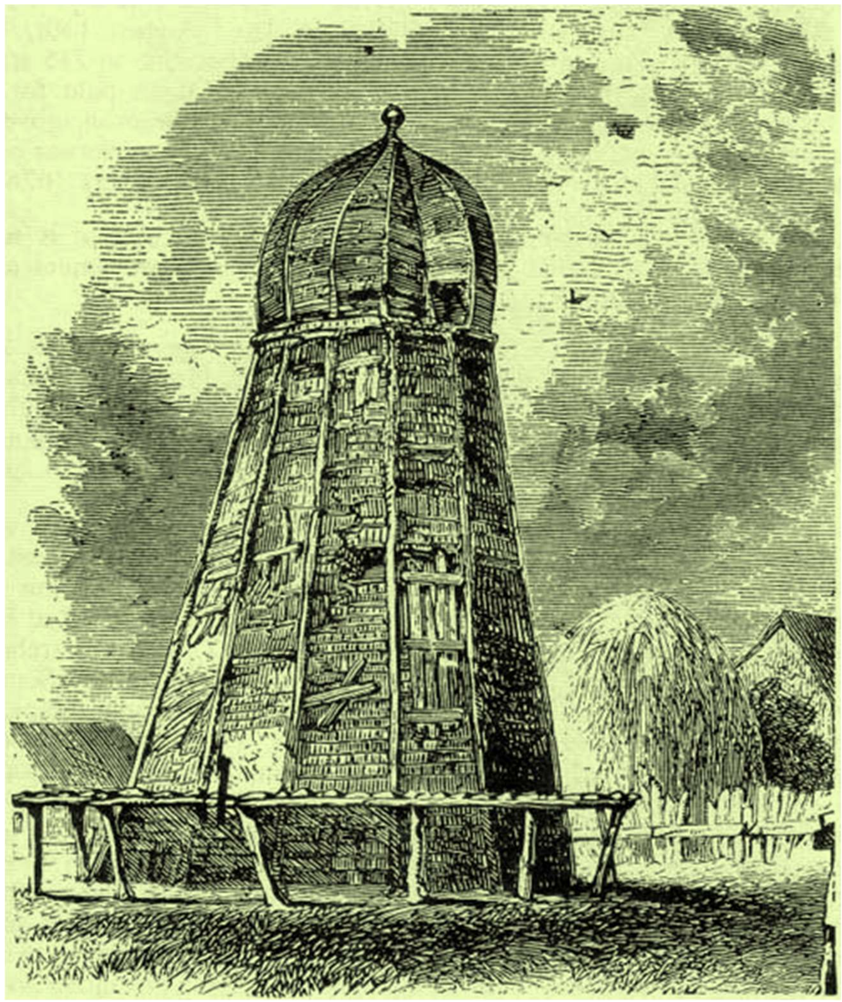
A cross section of a tower mill used for grinding grain. As per the summary entries above, notice the angle of the sails and windshaft, the details at the joint of the tower body and cap (allowing for cap turning) and the various axles, wheels and gears required for grain grinding that are all aligned below the cap.

Available Images of Red River Windmills

There are four archival images that are very useful for this present project, discussed below. It is assumed that the St. Peter's mills would have looked very much like these.

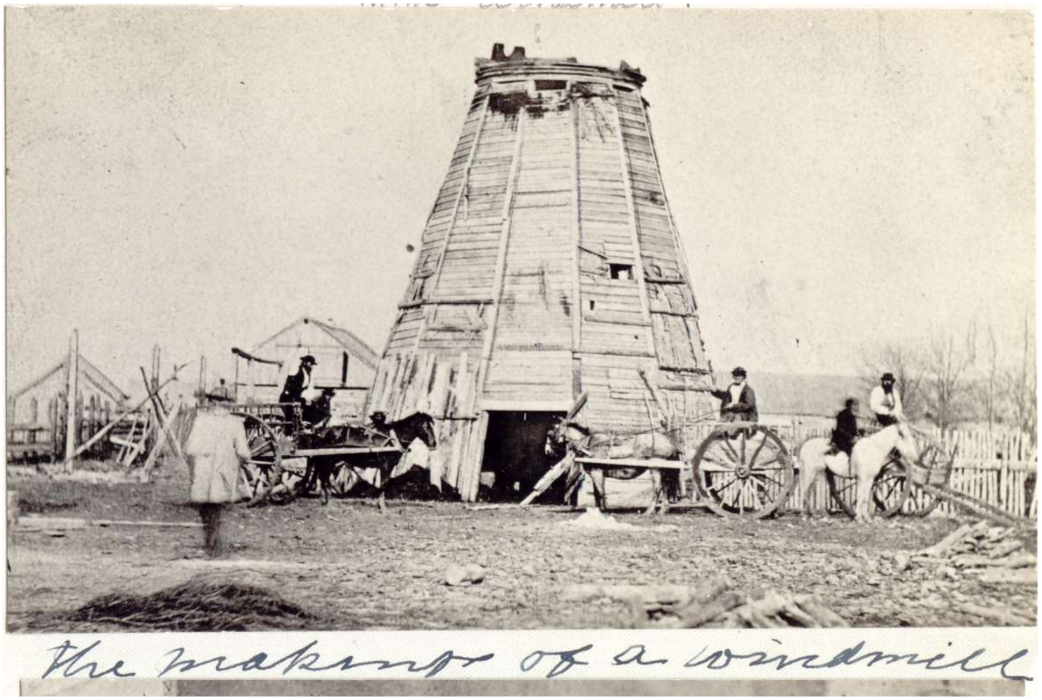
- **View of Robert Logan's House and Mill, Fort Douglas, 1860** (Image Courtesy Archives of Manitoba) – This image clearly shows a tower mill with a distinctive Tudor-esque cap (symmetrically sloped and finished at a point). A raised platform encircles the lower section, with a door opening into the mill at this level. The four sails, with offset lattices, appear too short for likely operation. Ropes shown here presumably provided stability to the whole sail assembly.

- **View of Robert Logan's Mill, ca. 1875** (Image Courtesy Archives of Manitoba) – This image shows Mr. Logan's mill in a nearly ruined state, long past its active life. But the details in this image are extremely valuable for insights into a Red River tower mill.



- First we can see six long poles forming the structural frame of the main tower element – so we assume there would be 10 poles in total. We also see that the poles are visible – thus not covered with siding – the interstices between poles is where the sheathing material is situated – it looks like shingles but must have been thatch. They are not clear, but there must have been windows in the upper levels – perhaps here covered with boards. We can vaguely discern the connection between the tower and the cap – clearly the feature that allows the cap to turn, but not rendered in detail. We see the platform around the tower and the door that would require a few steps up to gain entry. We can see that the cap was formed of curved wooden pieces and also infilled – apparently with boards rather than the thatch used on the tower body. The draftsperson has rendered the cap so that one section is inset – presumably where the sail / windshaft feature was positioned.

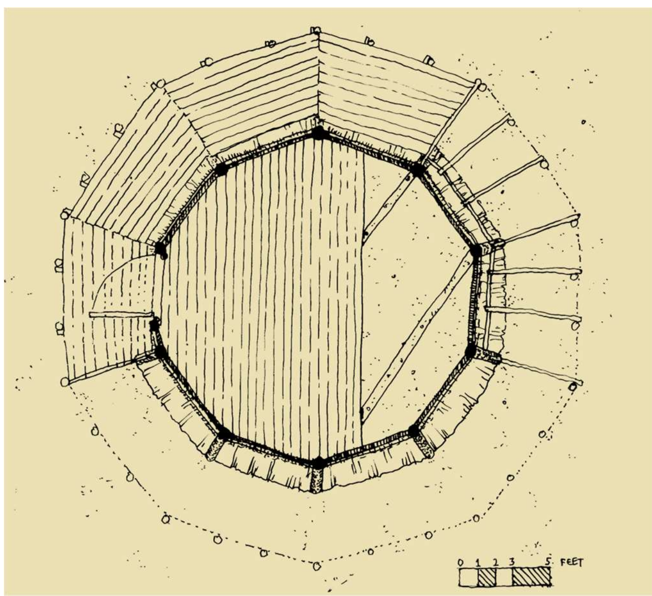
- **<u>Young's Mill</u>** (Image Courtesy Archives of Manitoba) – This rendering by artist Paul Kane (an Irish-born Canadian painter, 1810-1871, famous for his paintings of western landscapes and Aboriginal people) showing a windmill near what appears to be Lower Fort Garry. The sketch reprises key features from the Logan images – a tall tower, long sails offset from the stocks, and what appears to be a thatched body. The cap has the distinctive Tudor form that suggests its English architectural heritage. There is no raised platform in this image, with the door several feet above ground level and here set a few feet back of the sail line. It is interesting to note that the poles forming the tower's structural framework are visible at the bottom of the tower where it touches the ground – perhaps to reduce rot in the thatch. Barely discerned at the left of the main tower is a thin line – presumably the long pole that would have been used to turn the cap.



- **<u>The making of a windmill</u>** (Image Courtesy Archives of Manitoba), date and place unknown – this image clearly shows some of the key parts of a typical Red River tower windmill, with the long poles forming the structural frame and the interstices between poles infilled, here with boards. The top of the tower shows the built up wooden bands that ultimately would form the turnable base of the cap in which the sail feature and windhaft would be housed.

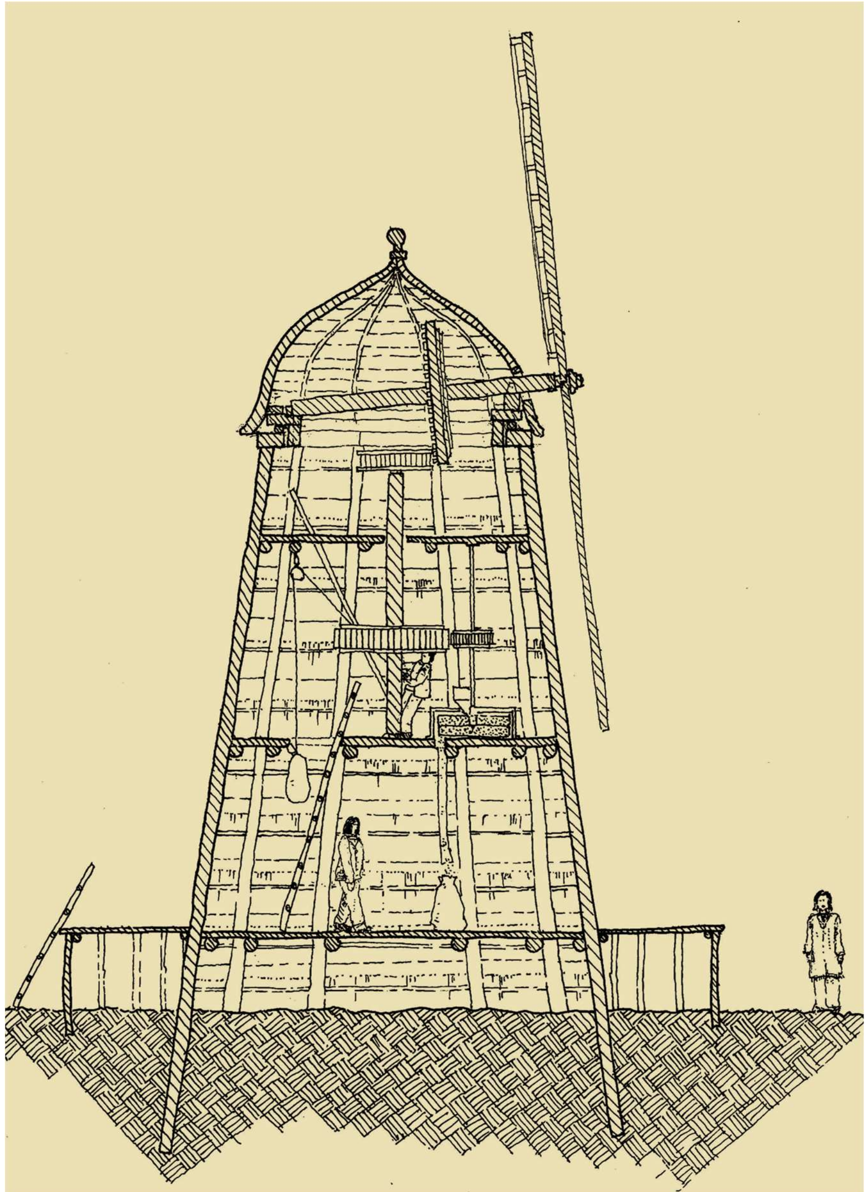
St. Peter’s Indian Settlement 1835 Windmill, Plan

A floor plan is a common graphic expression of a building as if seen from above, via a horizontal cut that allows walls and room arrangements, as well as some structural details, to be clearly presented. Most plans employ the cut at ground level, but given that the windmill’s main floor was about four feet above grade this plan shows the cut at that point. The plan shows the main floor area, entrance and some construction features. The dark shaded lines define the ten-sided form, interrupted at their interstices by the main structural poles (which are also shown extending down to ground level). The dark lines also express the top edge of the thatch sheathing in between the poles, cut at this point for the drawing. The thatch itself flares out slightly to extend to the ground level. The pole supports are shown as much as they would be visible in this plan view. The floor planks are set atop logs attached at key juncture points of the main timber supports – some of the planks have been removed at the right side of the drawing to show this situation. The ‘stage’ area that enlarges the whole plan, shown encircling the main floor area (and with planks only on the top and left side), allowed the miller access to the sails. Thin posts are continued around the whole drawing to show the full extent of this feature.



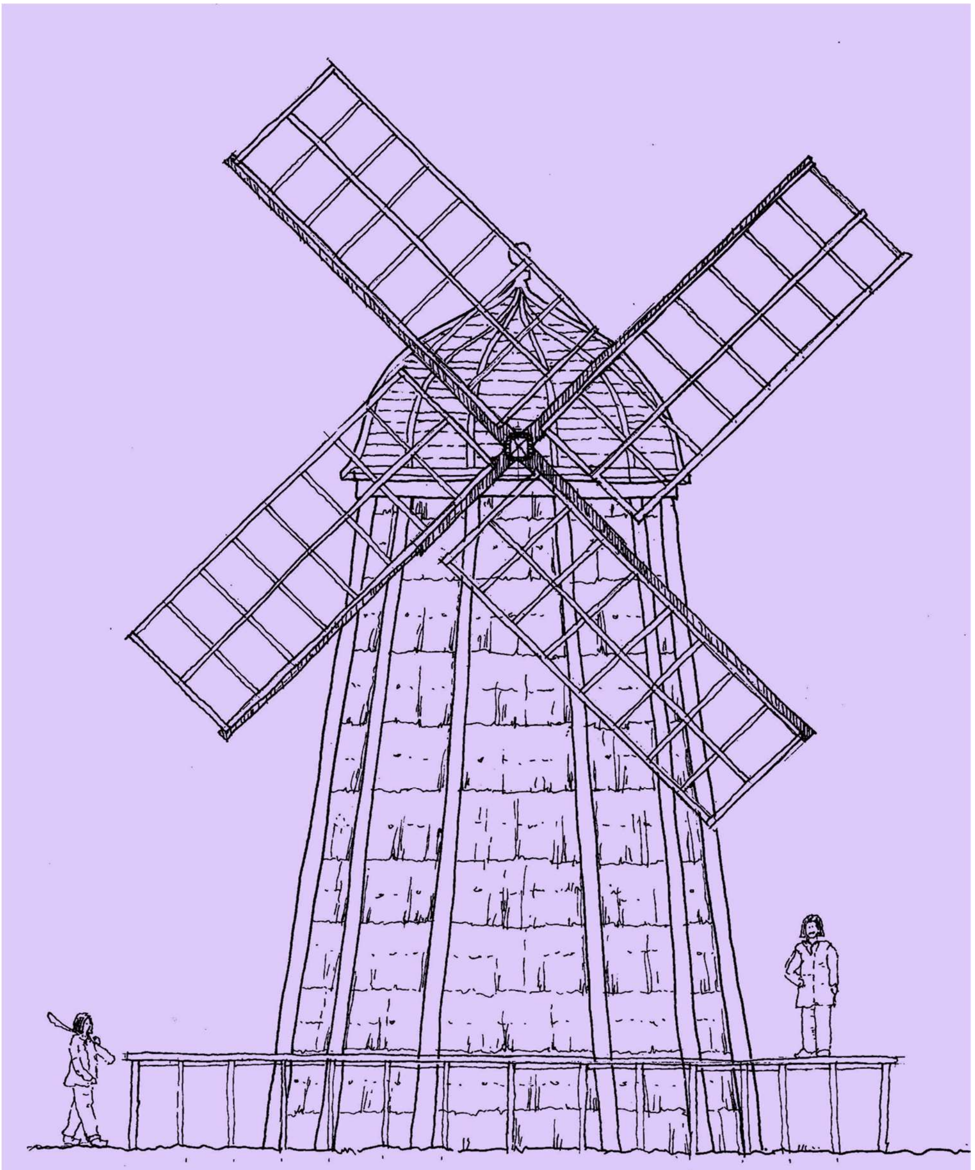
St. Peter’s Indian Settlement 1835 Windmill, Transverse Section

This vertical section, or cut, through the windmill from top to bottom, shows the interior arrangement of key pieces and their placement, as well as a sense of dimensions and scale suggested by the figures. We are essentially looking south, with the sails facing to the west/northwest (right on the drawing). Starting from the top of the drawing: we note a finial at the crest, decorative but with an important functional aspect – to bind in place the thin structural elements of the cap. We notice the opening at the west/front of the cap that allows the windshaft to enter the cap; note that the shaft is at a slight angle to a level position. The large wheel set on the windshaft transfers the power of the wind and sails to another gear feature in this upper level. There is not much headspace in this area – about five feet, but enough to manoeuvre to get at the shaft and wheel and other parts of the cap if they needed attention. The secondary gear, itself a wheel with slats, turns the thick shaft below it to which is attached another large gear wheel in the higher second floor of the windmill. This shaft in turn rotates the smaller gear box connected to the grinding stones, which are shown at the right (front) of the mill. Raw grain would be poured into an attached spout on the millstone housing and once ground (and manoeuvred to the edges by the design of the top stone’s grooves) dropped down a chute to the main floor, where bags would be positioned to collect the resulting flour. Other features to note in this drawing: the stage around the lower floor that allowed easier access to the sails; the basic structural frame of long logs and thatch (with the thatch shown only on the far walls, given that the section cut is through the poles); the ladders that provided access to upper floors; a grain bag being hoisted on the left (east) side. It is also important to note that the drawing has been developed according to the basic dimensions provided in sources presented above: 21.5 feet in diameter at its base, 37 feet high from ground to the top of the dome, mill stones that were 3.5 feet in diameter, and finally sails, each containing 76 yards of canvas, that were each 17.5 feet long and six feet wide. It is presumed that the long log structural posts were dug into the ground – to get past the frost line by about six feet, and thus about 40 feet long. There is of course no way of knowing the wood species used for various features, but the map of the area included in the opening section, “St. Peter’s Indian Settlement,” identifies aspen (likely poplar), willows, elm, oak and maple as nearby tree species, and so there were considerable options for matching wood types to structural and operational requirements – thus perhaps oak for the windshaft, wheels and gears, elm for the main structural frame, maple for support features and sail lattice, and willow for the cap structure.



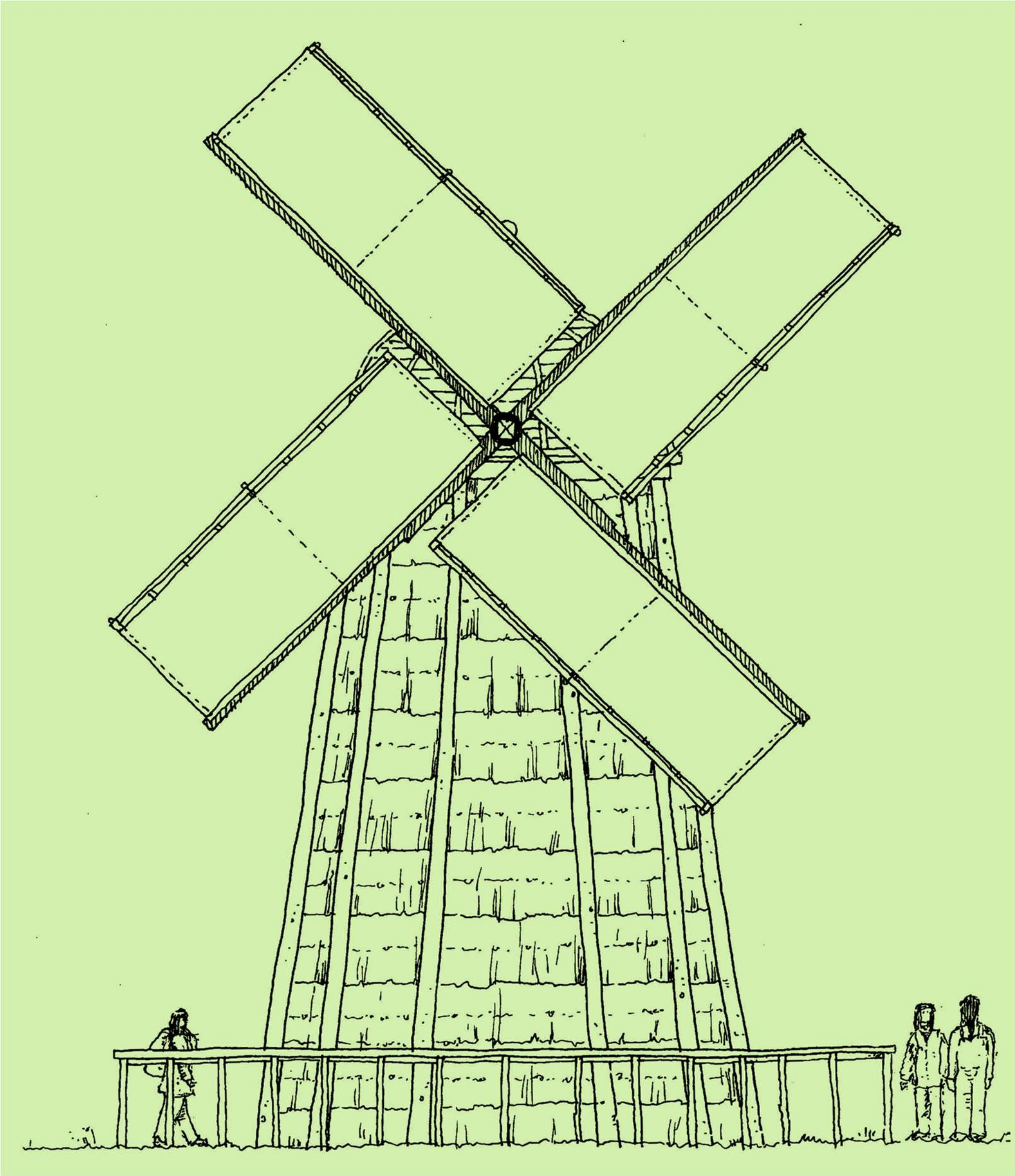
St. Peter’s Indian Settlement 1835 Windmill, Elevation With Sails Unattached

This basic elevational drawing shows the windmill facing west/northwest, and thus viewed looking east/southeast, from the river edge. The drawing shows key external elements, visible with the sail cloth excluded. Thus the elemental tower form, created by the use of tall log framing elements infilled with thatch, is very clear. The ‘stage’ that surrounded the tower at the mill entry level, and which gave the miller easy access to the sails—at least at their lowest point in rotation—is evident in this image. And the sail framework, of stocks and lattice (uplongs, hemlaths and sail bars) is also obvious. Figures, as usual, give a sense of scale.



St. Peter’s Indian Settlement 1835 Windmill, Elevation With Sails Engaged

This elevational drawing, reprises the previous image but in this case with the sail clothes attached. This then gives a sense of how the mill looked face-on to people approaching it when it was in its working stages. It is presumed that given the prevailing wind directions—from the northwest and west—that the sails would have turned clock-wise.

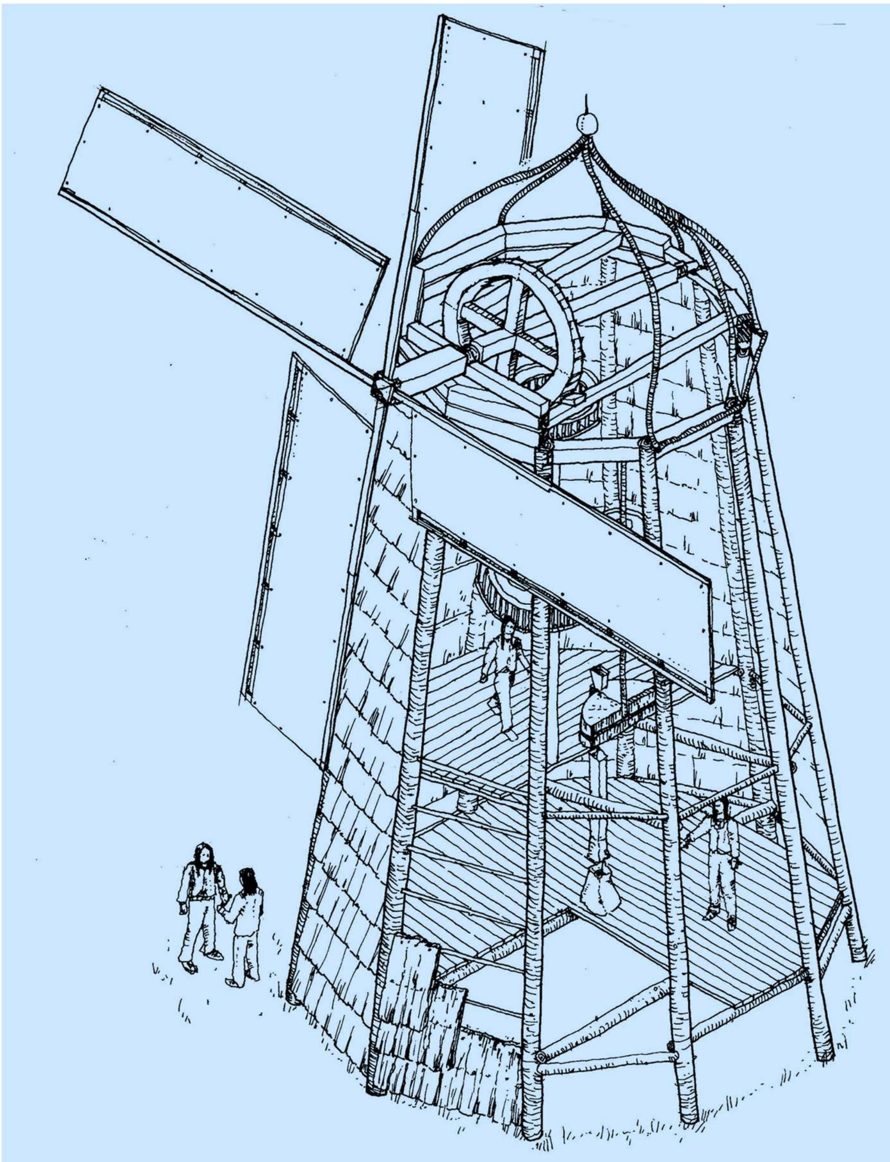


St. Peter’s Indian Settlement 1835 Windmill, Building Isometric ‘A’

This drawing presents the information developed in the four preceding drawings to create a three-dimensional view of the building. Certain parts of the mill have been cut away or excluded (topmost part of the upper sail for example) to better present interior features, arrangements and conditions. And the main floor platform encircling the tower, best seen on the previous elevations, is not featured for a better focus on the mill structure and interior. There is not much more to be said here about the building or its operations that has not been noted in the previous drawings – this image is mainly to be explored and enjoyed.

And because there is not much more to say about the building via this drawing, perhaps it is useful here to recall some of the facts noted earlier, and thus provide at least some modest speculation that will make an exploration of the drawing more engaging.

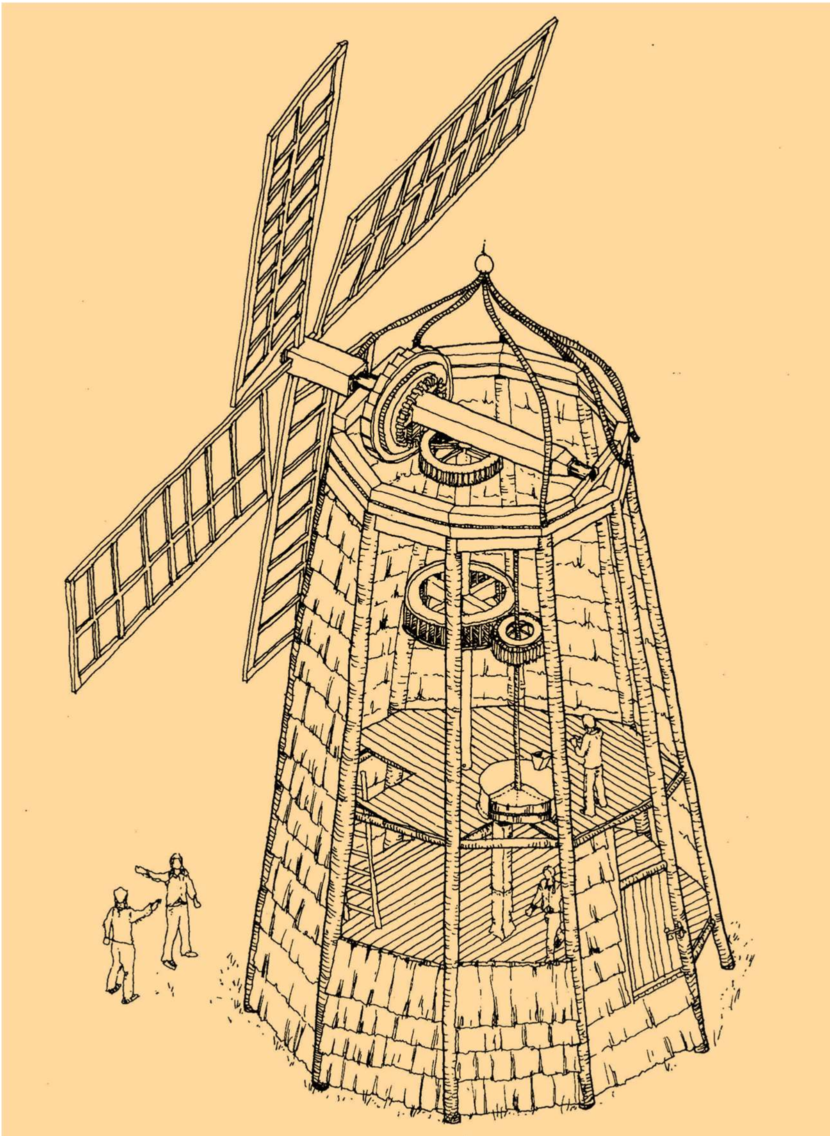
In 1835, when the mill was built, there were about 15 farmsites (with 35 acres under cultivation) and as many houses at the settlement – and so about 75 people. It is possible that the three men who built some of the early houses at the settlement—the Wind, Houlup and The Cannibal—who had building experience, were in charge. One can well imagine all the men of the settlement involved in the construction of the windmill. And then perhaps three to five in its ongoing operation. It is indeed impressive to consider the foresight, ingenuity and determination of this small band of Aboriginal people, dealing with agricultural and building technologies completely foreign to them, and yet within a few short years erecting a windmill – acknowledged by Mr. Hearfield above as the height of engineering of its day. It was an astonishing achievement.



St. Peter's Indian Settlement 1835 Windmill, Building Isometric 'B'

Like the previous isometric drawing, this image presents information developed in the four preceding drawings to create a three-dimensional view of the building. In this image the building has been rotated 45 degrees to allow for a slightly different view into the mill. Certain parts of the building have been cut away to better present interior features, arrangements and conditions. As with the previous isometric, the main floor platform encircling the tower, best seen on the previous elevations, is not featured to ensure a better focus on the mill structure and interior. It should be noted that there would have been an opening in the second storey, likely in the section that also contained the door (but above it), which would have provided light into that area – it is also likely that stretched fish skins were used rather than glass, which was not readily available at this time (see Reverend Cockran's observations on this "technology" in the earlier section, "St. Peter's Indian Settlement"). Again, there is not much more to be said here about the building or its operations – the drawing is mainly to be explored and enjoyed.

Like the previous entry, this view of the windmill might be enlivened through some imaginative thoughts. While this project has focused on the 1835 windmill (given that this mill is the only one with measurements of a Red River Settlement mill), we might also recall that it was repaired in 1845 and then joined by a new mill in 1846 (1852 according to some sources). And both appear to have been operating for several years, including in 1851 when there were 87 families, and nearly 500 people, industriously involved in farming and in grinding their grain at their two windmills. Imagining this mill at that time reminds us that this was no rough pioneer situation – this was a small but busy and industrious community, and the windmills must have been a very visible symbol of their success.



St. Peter’s Indian Settlement 1835 Windmill, Context Isometric

This final drawing shows our windmill in context, with the Red River at lower right and two adjacent farm properties, one likely for the miller. Two details are worth noting: the long pole at the back of the windmill, used to turn the cap into the wind (not shown on earlier drawings); and the presence of fences that divide farmsites, as noted in Reverend Cockran’s descriptions of the settlement.

This view, looking to the northeast, shows just a section of the Indian Settlement, focused on the immediate vicinity of the windmill. We can imagine it’s the summer of 1837, when the mill had been in operation for a few years. A skiff has beached on the river bank and two men make their way up the bank, heading to the mill; a man in another small boat, with a sack of grain in the bow, manoeuvres his way to the same spot. Other figures go about their business – a man on the main road along the river’s edge is carrying his own sack of grain, presumably heading to the mill. The scene is bucolic and inviting – and why not: a “pretty day” as they used to say at the time.

But we should recall that this is the scene of profound pioneer experience. These people, and many others at the Red River Settlement, were struggling to wrest a living from a completely new environment. And in their buildings we can see real evidence of that struggle – of small log buildings with tiny windows and rudimentary construction of logs and grasses.

And we can see those qualities in the windmill, with its body covered with thatch and the long log poles that define its framework, suggestive of the nearly medieval construction practices required when building only with materials at hand. But we can also see in the windmill the deep reservoirs of technical and architectural sophistication that were beginning to define the whole of the Red River Settlement, with fine churches, stone forts and scores of busy little farms.

The first windmill at St. Peter’s Indian Settlement was a grand achievement for all involved – Reverend Cockran, Chief Peguis, the mill builders, the local people. And while every vestige of its existence is long gone , it is hoped that this project has stirred some wonder at its mere existence, as well as a humble recognition of the determination and hard work that must have gone into its creation and operation.