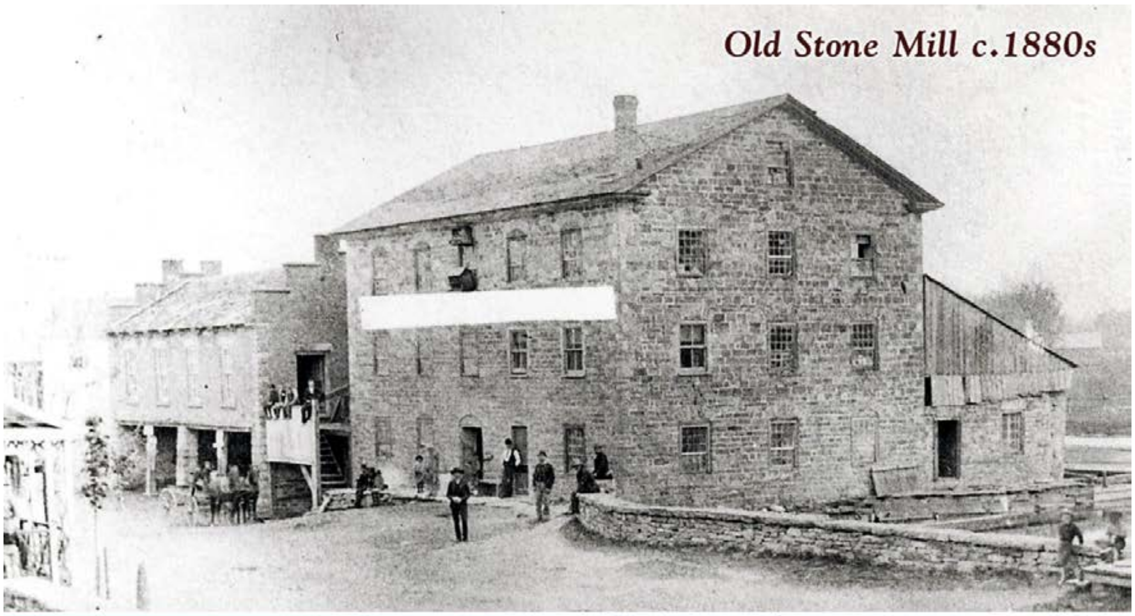
Building the 1810 Old Stone Mill in Delta, Ontario

by

Ken W. Watson



Version 1.0 – May 2018 – the most recent version (in colour) of this document can be found as a PDF download from the history page of our website: www.deltamill.org/history.html

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Cover Photos: The top photo is the earliest photo we have showing the entire mill (the white bar is in the original photo, something such as tape placed on the negative, perhaps for a caption area). The bottom photo is the mill today, restored to its full glory in 1999-2003, with many of its original features still intact. Top: DMS digital archives, bottom: Ken W. Watson.

Contemporary Photos: all photos in this document are by Ken W. Watson unless otherwise credited.

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Introduction

This article will to go back to 1810 Delta and look at how the mill was built. There are many mysteries surrounding the building of the Old Stone Mill. There are no surviving construction records for the mill – everything we know today is inferred from the building itself, archaeological investigations, land deeds, assessment rolls and a general knowledge of how mills were built and operated in the early 1800s.

This is not an architectural article, rather it is a look at why this large stone mill was built in Delta, its placement on the landscape, its innovative flood control features, and how it implemented the Oliver Evans' design for an automatic gristmill. You'll find lots of information about the mill's geographic placement (lots of maps), how it harnessed and used water power and how it implemented the Oliver Evans' automatic mill design, but very little about what type of windows were used for the mill or other architectural details. The interested reader is referred to the 1996 Conservation Report for the mill by André Scheinman (available as a PDF) which discusses the mill's architecture in more detail.

The heritage importance of the Old Stone Mill to Canada, both in its original role in the pioneer development of Eastern Ontario and the fact that it still exists today as a tangible reminder of that pioneer past, with most of its original features still intact, cannot be overstated. The Old Stone Mill it is the only surviving pre-1812 stone gristmill in Ontario. It also has international significance as one of the earliest surviving example of an Oliver Evans' automatic mill in Canada.

The mill is owned and operated by a volunteer, self-funded, non-profit organization, the Delta Mill Society (DMS). The Delta Mill Society takes great pains to ensure that the mill remains in a state of Commemorative Integrity, maintaining the building and presenting its rich heritage to the public. To get the most out of this article you should plan to visit the mill (open daily from Victoria Day to Labour Day) to see, first-hand, the various features that are discussed in this article.

The 1810 Mill

Today's mill represents several time periods. The largest physical change to the mill was the c.1860 addition of the turbine shed (aka turbine hall) to the west side of the mill. This change was a separate addition, it left the original 1810 mill intact. What used to be the west wall of the original mill, is now the dividing wall between the 1810 mill and the c.1860 turbine shed.

This article focuses on the original waterwheel powered mill, a 50 foot by 35 foot rectangular structure, 3 ½ storeys high, that was modelled on the Oliver Evans' 1795 design for an automatic mill.

Author’s Note

Your author is not a trained historian, but rather a keen amateur with a background in geology. My goal, as with all the heritage work I do (primarily with the Rideau Canal), is to present interesting aspects of Canadian history to the general public. I enjoy trying to solve heritage mysteries, particularly questions relating to heritage landscapes such as “why was the landscape modified in this way?” and “why is this object (building, road, etc.) where it is?” I’ve answered those questions for the lockstations on the Rideau Canal and I am now shifting my attention to the many mysteries surrounding the Old Stone Mill National Historic Site.

My interest in the Old Stone Mill started shortly after I moved to this region (late 1995). I was starting to build websites and I put out an offer to some local heritage organizations to build websites for them (on a volunteer basis), since most heritage organizations didn’t have the technical capacity to do their own. Delta Mill Society (DMS) board member Peggy Fry contacted me in 1997 and by July of that year I had the first Old Stone Mill website up and running. A couple of years later, Anna Greenhorn convinced me to join the board of the DMS. That got me directly involved with a very dedicated group of volunteers. This volunteer group is one of the joys of working with the DMS, while we all have different backgrounds and focus, we are bound by a common love of the Old Stone Mill.

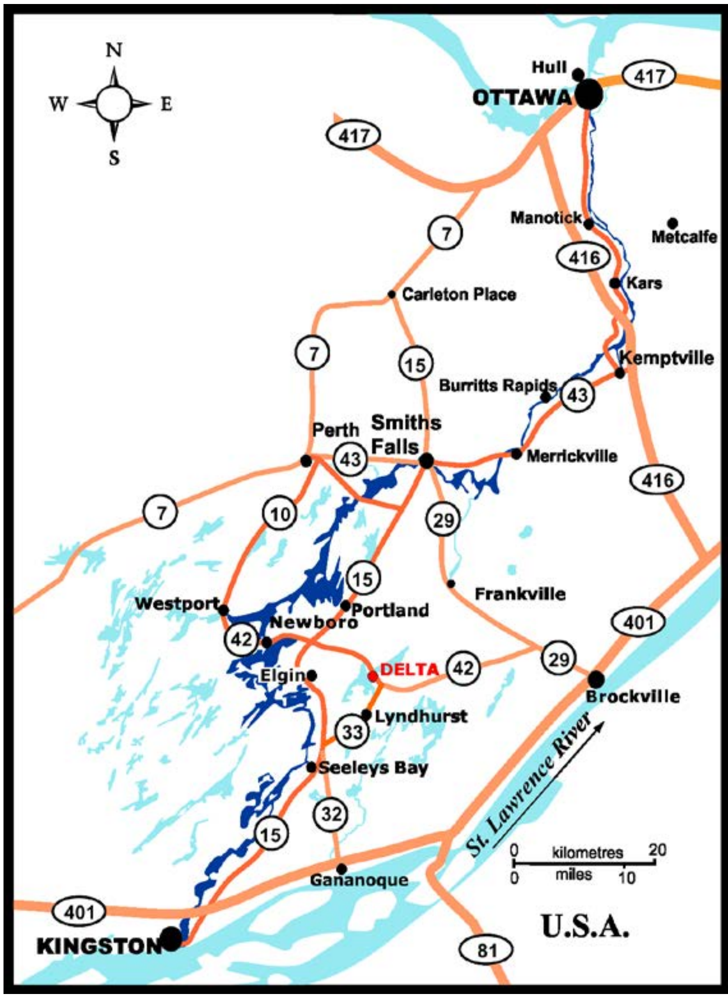
The mill presented (and continues to present) many mysteries. I could see that the mill was built on an artificial channel, not the original stream course. But the exact reasons for that weren’t clear. Anna would wax poetic about how the mill implemented the Oliver Evans’ design for an automatic mill (and about the amazing five sided ridgepole of the roof structure), and after going “Oliver who?” I started to realize the incredible technical aspects of this early implementation of the design. Many of those aspects are still visible in the mill today if you know where to look.

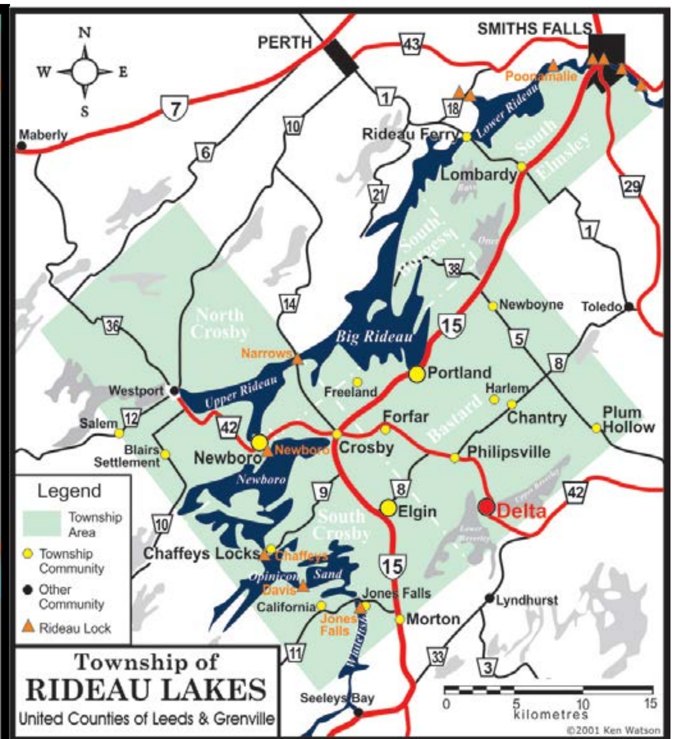
My goal with this article is to go back in time to 1810 Delta and try to visualize the hows and whys of building the mill. Much is still supposition since we have limited facts but I generally use the rule “it has to make sense” in terms of decisions made back then. Likely not all is correct, there is still much more to discover, more mysteries to be solved, but I hope that this document will help advance the DMS’s, and the general public’s understanding of the Old Stone Mill National Historic Site.

I am indebted to previous high quality research which provided some of the factual foundations for this article. These include the 1996 *Delta Mill Conservation Report* by André Scheinman, the 1999 *Archaeology at the Delta Mill National Historic Site* by Jonathan Moore, and the 2006 book, *A History of Grist Milling in Delta* by Wade Ranford. As a public article I have not done foot or endnotes, but I have included my main sources of specific facts (dates and such) in the Selected Bibliography. The interpretation of those, plus new ideas (right or wrong), are my own.

Ken W. Watson, May 2018

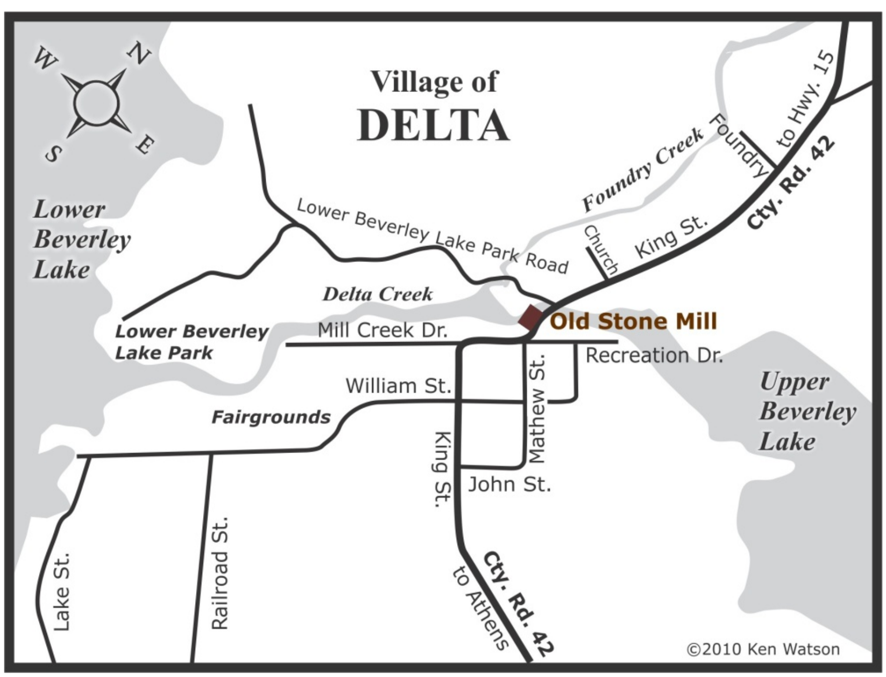
Location Maps



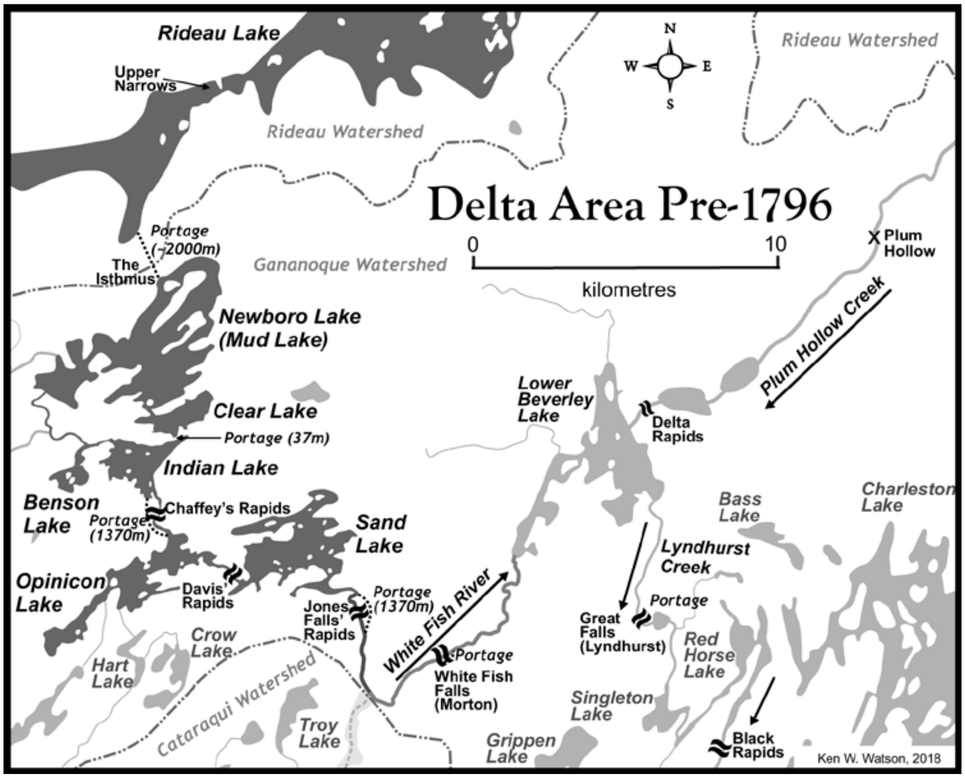


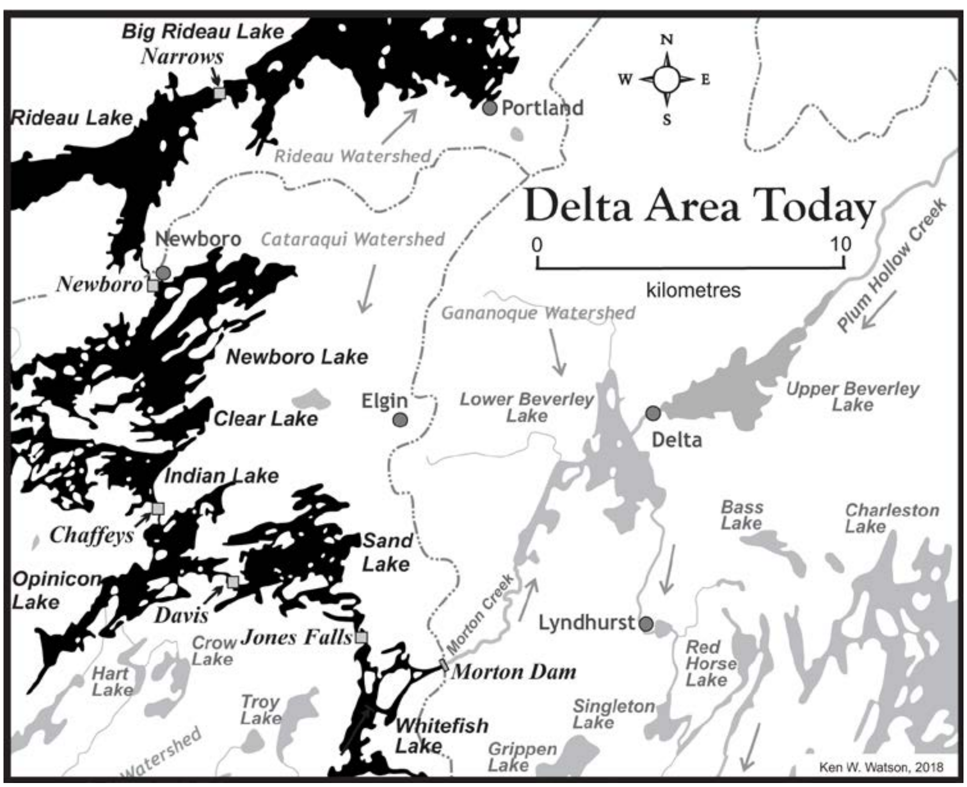
Where Is Delta?

Delta is located in the Township of Rideau Lakes, in Ontario, Canada. Prior to 1998 it was in Bastard Township, which is now a ward of the Township of Rideau Lakes. It sits between Upper and Lower Beverley lakes, near (but not on) the location of the original rapids between those lakes (see maps on next page).



Water Flow Maps





Water Flow

The water flow in the Delta area is a bit confusing, in part because of significant changes brought about by damming some of that flow, not at Delta, but at Morton, in the early 1800s.

The pre-1796 map is how Abel Stevens, founder of Delta, found the area in his 1793 explorations. This is before any man-made alterations to the flow. Lower Beverley Lake had two sources of water, Plum Hollow Creek from the east and the White Fish River from the west. Lakes that are today part of the Rideau Canal (Newboro, Clear, Indian, Opinicon, Sand) flowed into Lower Beverley Lake via the White Fish River and from there to Gananoque.

The first alteration of the geography was in 1796 when Abel Stevens had a dam built at the head of the Delta rapids and a second dam between the two Upper Beverley lakes, slightly raising both lakes.

Damming (c.1803) of White Fish Falls (Morton) changed the water flow, backing up the water so that it now flowed south, to the Cataraqui River and Kingston. That man-made watershed change was made permanent with the building of a Rideau Canal dam at White Fish Falls (1831), today's Morton Dam.

This didn't affect the Old Stone Mill since the flow of Plum Hollow Creek remained unchanged. The mill, acting as its own dam, expanded the size of the original two smaller Upper Beverley lakes in 1810-11, almost to the level they are today.

Background

In 1960, the Old Stone Mill closed its doors. The building was 150 years old and in rough shape. Few people knew the historical importance of this building and its role in the pioneer development of eastern Ontario. The story of the Old Stone Mill had been lost to history – it was now just an old dilapidated building and some were advocating for its demolition.

The last owner of the mill, Hastings Steele, who purchased the mill in 1913, knew the heritage it represented to the region and so, in 1963, he sold it for the sum of $1 to four trustees; Mildred Sweet, Albert Frye, Elizabeth Robinson, and Robert Tuck, people who were keen on the heritage the mill represented. Steele deeded the building to them with the understanding that it be opened to the public as a museum. This was the goal the trustees pursued.

Rescue Restoration – Fall 1972

The mill was in very rough shape when it closed its doors in 1960. Within days of the mill being deeded in September 1972 to the newly incorporated Delta Mill Society, work started on rescue restoration, to stabilize the building and prevent further deterioration. (photo from DMS Archives).

At the time, little was known about the true history of the building. It was believed to have been built in about 1800 and also believed to either have been originally built by Abel Stevens (the founder of Delta), or that it was a rebuild of Abel Stevens' gristmill. Those assumptions, and several others about the history of the mill, turned out to be incorrect.

The trustees formed the core of the Delta Mill Society (DMS). One of the early accomplishments of this group of volunteers was to get the building designated as a National Historic Site of Canada in 1970. The DMS was incorporated in 1972 and, within days of incorporation, work started on rescue restoration of the building, stabilizing it, preventing further deterioration. It was first opened to the public in 1983 as a museum of milling technology and industrial heritage.

It wasn't until the 1990s that more factual details of the mill's history came to light. In 1986, Parks Canada announced a new funding program, their Cost Sharing Program for privately owned National Historic Sites of Canada. The Delta Mill Society jumped on this opportunity and started the fundraising and research required to take advantage of this shared funding program. Part of the requirement was to do archaeology and conservation research to determine how exactly the restore the mill in a heritage appropriate manner. It is from this research, two archaeology reports and a conservation report (see bibliography), that a much more complete story of the mill started to emerge.

In the early 2000s, more research was done, including a detailed look at the chronology of the mill by Wade Ranford, who produced a book, *A History of Grist Milling in Delta*, published by the Delta Mill Society in 2006. Wade produced the first clear look at the mill over time, the various owners and what they did in terms of changes to the mill.

This article steps back in time to before the mill was built, looking at the hows and whys of the building of the mill. The mill and its history are remarkable in many ways and the closer one looks the more remarkable it is. There are many unique features of the mill, found nowhere else in North America. So, while it is the only surviving stone gristmill from the pre-1812 period in Canada, it is in fact much more than that, from its placement on the landscape to how it implemented the Oliver Evans' design for an automatic mill.

Part of the Mission of the Delta Mill Society is that "we research and interpret its history, design, and evolution as it pertains to the early development of Eastern Ontario." As with any history, for each question that is answered at least one more pops up. This article is just an addition to our understanding of the mill, building on previous research.

Unlike many other aspects of Canadian history, the mill is still here. Much of the information presented in this article can still be seen today in the mill and surrounding landscape. It is not theoretical history, it is tangible history, you can (and should) visit the mill to have a first hand look at the history presented by this article.

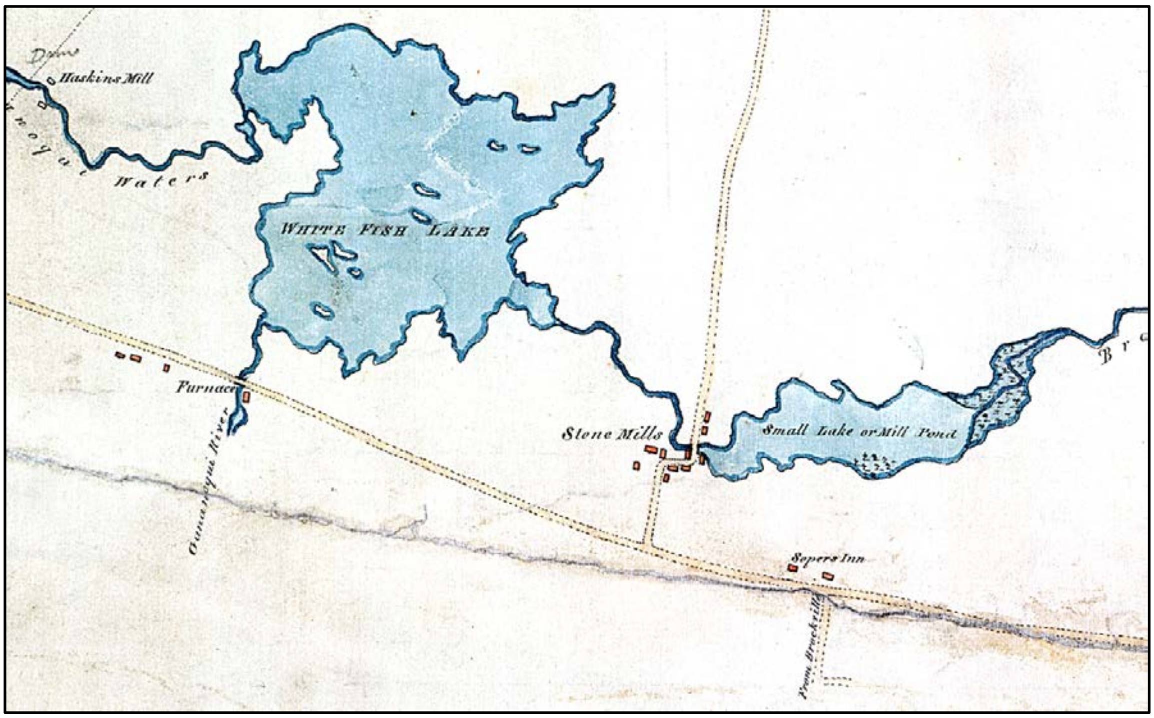
Welcome to the Old Stone Mill NHS

Open each year from Victoria Day to Labour Day weekend, the Delta Mill Society maintains free admission to the Old Stone Mill to encourage public access. Volunteer and student interpreters provide a rich heritage experience for any visitor to the mill.

Why Delta?

Before we look at the details of how the mill was built, we have to answer the question, why build such a large and expensive gristmill, a mill purposely designed as a merchant mill, in 1810 Delta? The mill is one of the earliest stone mills built in Ontario. Today it is the only surviving pre-1812 stone gristmill in Ontario.

In 1810, Delta was a tiny frontier village, an 1816 map shows the village consisted of 10 buildings, including the mill. There were no other inland communities in the area with the exception of a few people at the foundry operations at Furnace Falls (Lyndhurst). The answer to “why Delta” relates to water power, roads and early pioneer development of this region.



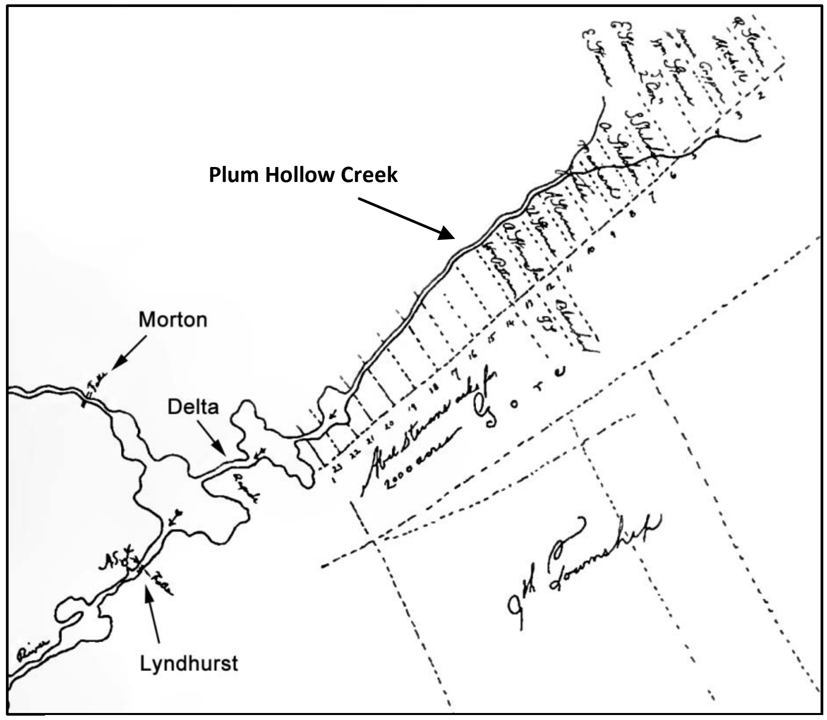
Delta in July 1816

This is the first detailed view we have of early Delta. This map shows 10 buildings in Delta, then called Stone Mills. The Haskins brothers’ mill at White Fish Falls (Morton) can be seen on the far left of the map. The original two Upper Beverley lakes are now shown as one lake (Jebb’s “Small Lake or Mill Pond”) with the flooding from the Old Stone Mill and the dam in front of the mill’s bywash. Today’s County Road 42 is shown going through Delta, the dogleg through town still present today, the road crossing the new stream channel exactly where today’s bridge is located. Sopers Inn, today’s Soperton, is where the southern road from Brockville met the east-west road that led to the farming areas in the Plum Hollow area. The road west, through Furnace, today’s Lyndhurst, goes to Kingston Mills. Today this is County Road 33 and part of Highway 15. Water from White Fish Lake (Lower Beverley Lake), drains through Furnace (Lyndhurst), on its way to Gananoque.

The surveyor for this map, Lt. Joshua Jebb of the Royal Engineers, advocated using this area as a shortcut for the Rideau Canal. His plan was to take the canal up Irish Creek (south of Merrickville), through Irish Lake, over the height of land near Plum Hollow and then down Plum Hollow Creek, through Upper Beverley Lake to Lower Beverley Lake (shown on the map as White Fish Lake) and then up Morton Creek (then the lower part of the White Fish River) to meet up with a dam-created water connection to the Cataraqui River. Jebb also advocated re-opening the ironworks at Lyndhurst, which had burned down in 1811, to produce iron for carts to be used on his proposed railroad over the height of land between Irish Lake and Upper Beverley Lake. If Jebb had his way, we might have a Rideau Canal lockstation in Delta, in addition to, or instead of, the Old Stone Mill.

Section from “Plan of the Water Communication from Kingston to the Grand River” by Lt. J. Jebb, July 8, 1816, Library and Archives of Canada, NMC 21941

Water power, a set of rapids or a waterfall to provide a hydraulic head to a waterwheel, was a pre-requisite for any mill of that era. The Delta region had three such sources of good water power: the Great Falls at Lyndhurst, White Fish Falls (today's Morton), and the rapids at Delta. However, the first set, the falls at Lyndhurst were, in 1808, being used to power a furnace, foundry and sawmill (1802-1811). The power of White Fish Falls was being used for a sawmill (c.1803), but there were no economics for a gristmill in that location at that time since it was a distance away from good farmland. Delta had the best of both worlds, it lay on the boundary of the hard rocks of the Frontenac Axis, rocks that provided resistant units that created rapids, and younger, more topographically moderate, sedimentary rocks that had rich soil cover, ideal for farming (see Soil and Geology maps on the following pages).

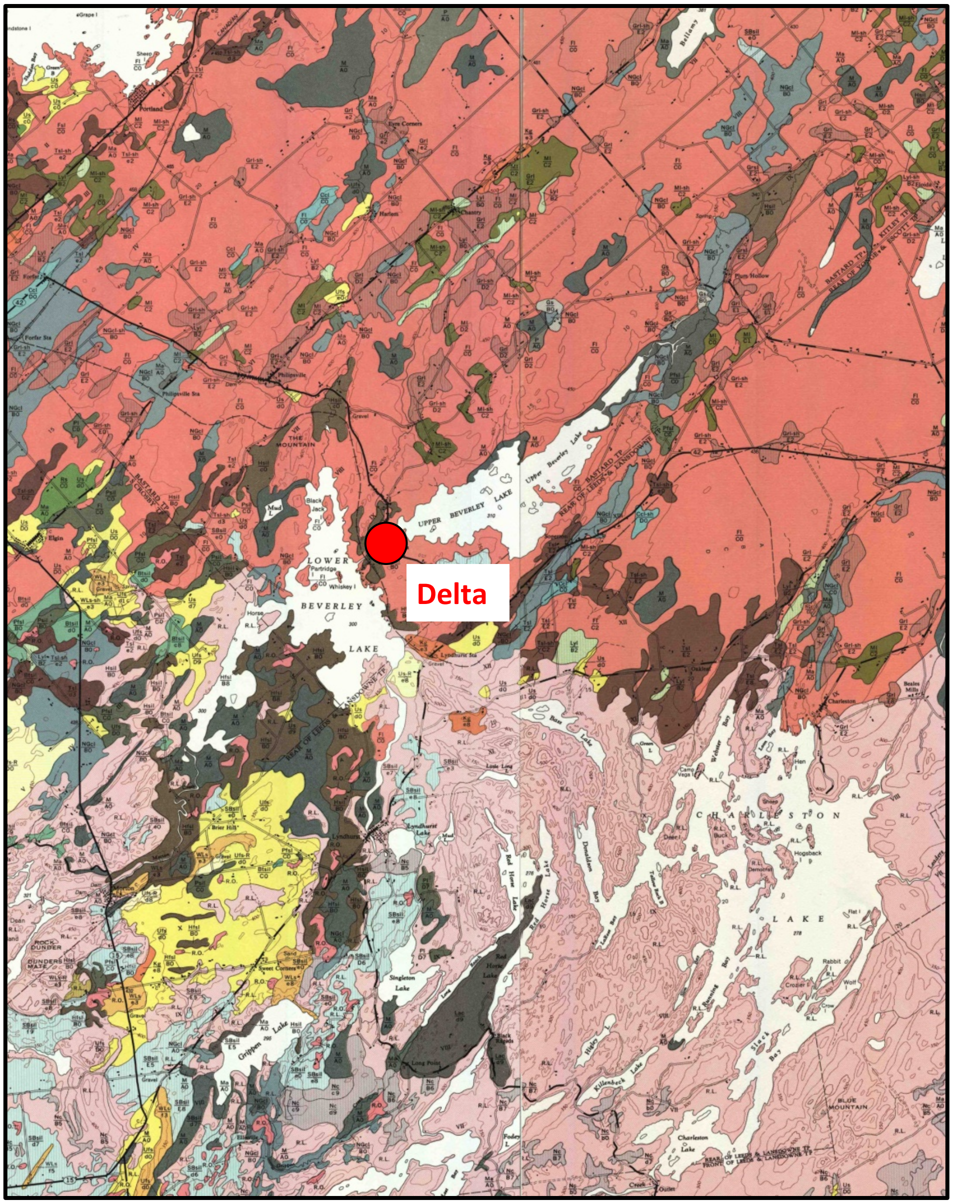


Pre-Delta, c.1795

On this annotated c.1795 map by surveyor Lewis Grant, we see the set of rapids located between the Upper Beverley lakes and Lower Beverley Lake, the location of today's Delta. Also shown on this map are White Fish Falls (Morton) and the Great Falls at Lyndhurst. Abel Stevens' name is shown on the map with a note that he was asking for a 2000 acre land grant on the lower reaches of Plum Hollow Creek and also for the Great Falls at Lyndhurst (his initials, AS, appear beside the Lyndhurst falls on this map). We can also see the lots (200 acres each) of the original Stevens' settlers on the upper reaches of Plum Hollow Creek. Archives of Ontario, RG1-A-1-7.

Abel Stevens Sr. explored this area in 1793, following in the footsteps of his brother Roger who, in 1790, settled on the Rideau River and built the first mill by the falls at Merrickville. Abel had his sights set on the iron deposits, water power, and timber resources at Lyndhurst, discovered in about 1783. But that site was also claimed by a prominent local family, the Sherwoods. Stevens, in his 1793 explorations, also came across the smaller set of rapids at Delta. In February 1794, Stevens and five other families journeyed from the U.S. to Brockville. They built a rough road from Brockville for the oxen drawn wagons of the families and settled in the then unsurveyed area of upper Plum Hollow Creek (just northeast of Delta). This was the creek that fed the Upper Beverley lakes and the rapids between those lakes and Lower Beverley Lake. It was an area with fertile soil and hence good farmland potential. Stevens knew that settlement was key to laying claim to the land, those settlers would lend support to his petitions for the water and mining rights at Lyndhurst.

(text continues on page 13 after four pages of maps)



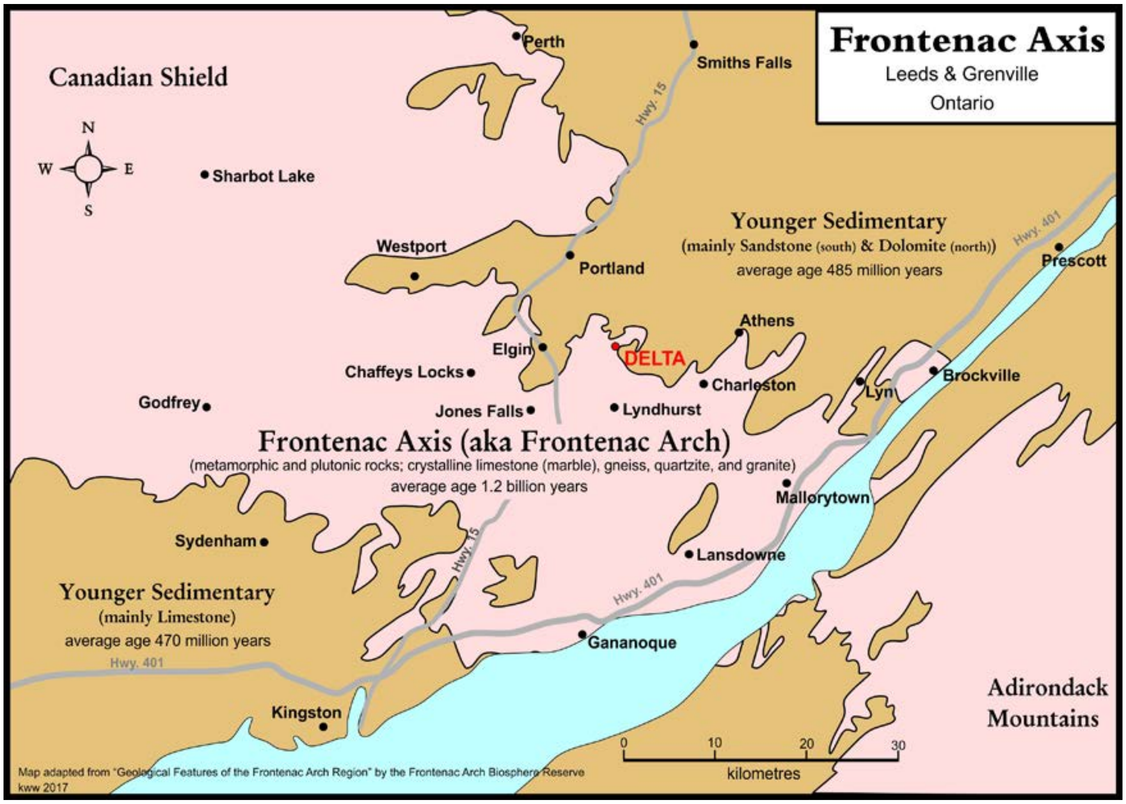
Soil Cover in the Delta Area

Delta sits of the margin of good and poor soil development. The deep pink (top/northern half of the map) is good well drained loam. The light pink (a unit appropriately called "Rockland") and other colours below are poor, generally thin soils with rough topography and many bedrock exposures. This soil development directly reflects the underlying geology, the soil boundary is a close match to the boundary of the Frontenac Axis (see Geology Map on next page).

Delta is ideally situated on this boundary. The topography of the Frontenac Axis provided good water power (rapids) while the sedimentary rocks to the north, with their moderate topography, produced good soils, ideal farmland. This is why the original Stevens' settlers set up their farms on the upper reaches of Plum Hollow Creek, this is an area of good soil development.

By the time of the building of the Old Stone Mill, farming in the good soil areas had expanded beyond simple sustenance farming. Farmers were producing more wheat than they could personally use, helping to provide a business case for the building of a large stone merchant mill in Delta.

From Soil Map of Leeds County, Ontario – parts of the east and west sheets – soil survey report 41, Canada Department of Agriculture, Ottawa, 1968 (published by Department of Energy, Mines and Resources).

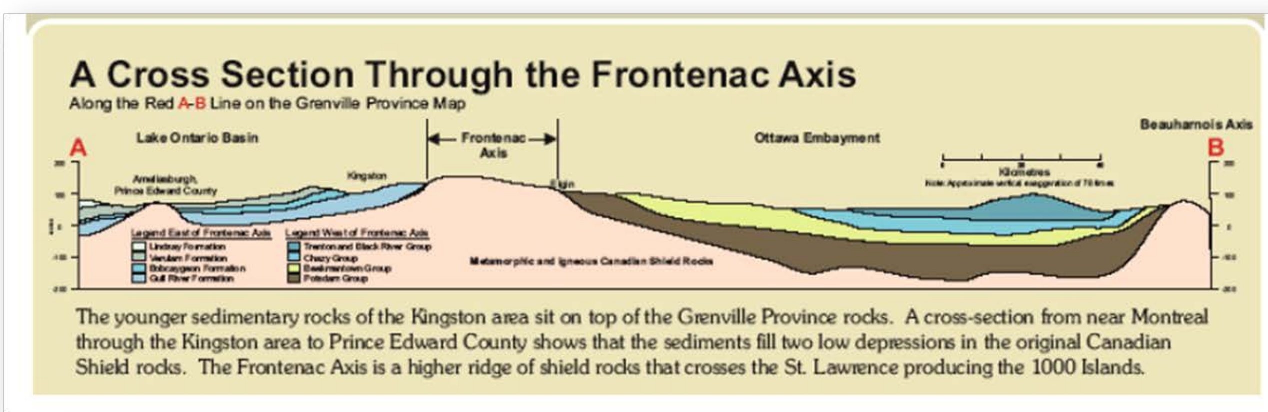


The Frontenac Axis

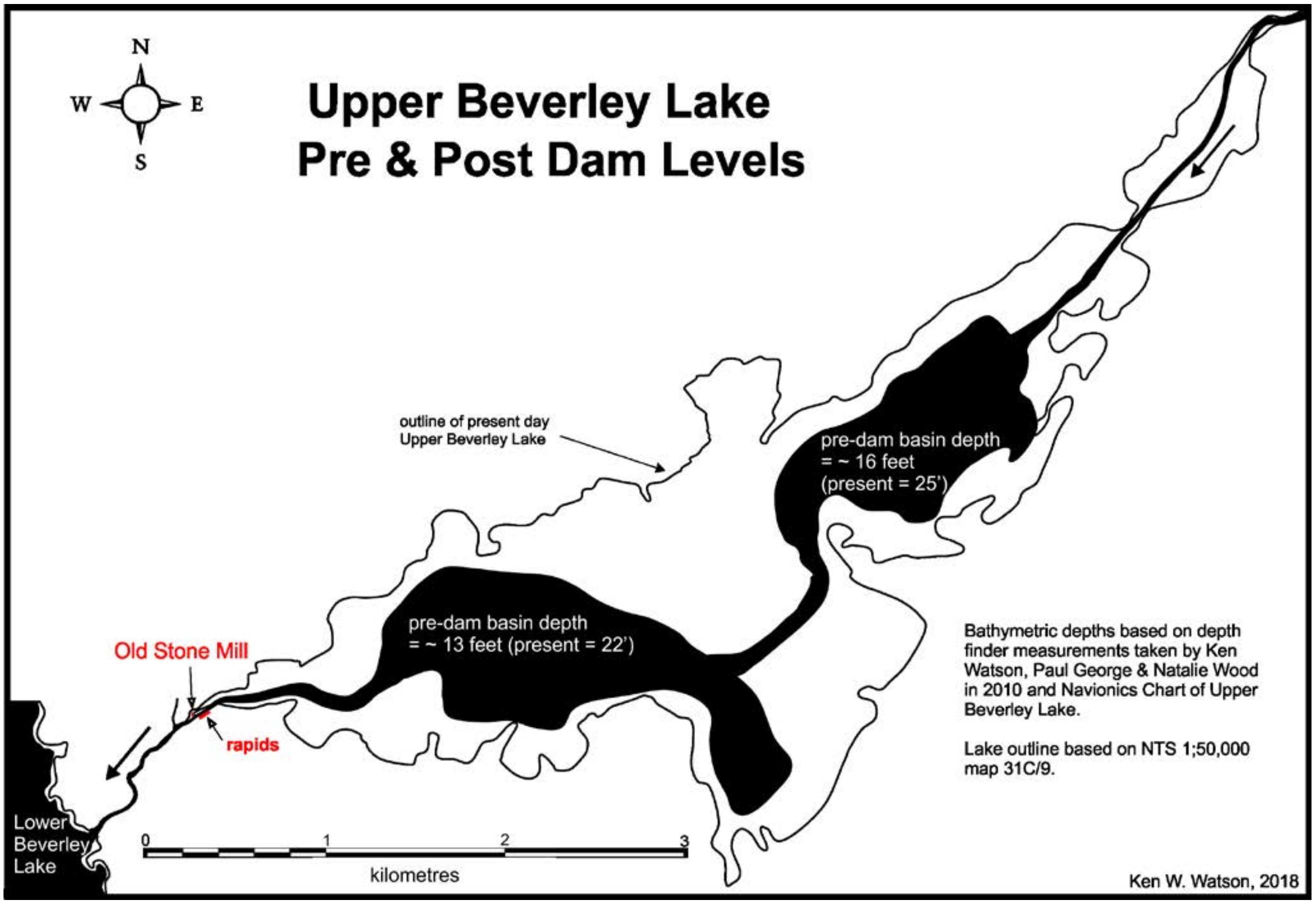
Delta sits on the margin of the Frontenac Axis, the remnants of a very old mountain range, eroded down over hundreds of millions of years. Sediments were deposited on top of the worn down mountain at a time when this part of the continent was located near the equator, warm shallow sea waters laying down sands that turned into sandstone and later calcium (coral reefs) that turned into limestone (or dolomite when mixed with sand). A detailed geology map of the Delta area can be found later in this document.

As shown on the soil map (previous page) the hard rocks of the Frontenac Axis have shallow soil cover and lots of topography (ups and downs). This provides opportunities for mills (rapids) but not for farmland. The relatively flat lying sandstones and dolomites created a thicker, richer soil cover, ideal for farming.

Note: a detailed geology map of Delta can be found on page 24



This cross section shows the root of the old mountain (pink). Elgin is marked on the east (right) margin, essentially the same as Delta. You can see the younger sedimentary rocks that were deposited on top of the old mountain range. From "Field Trip Guide: Geology of the Kingston Area", Queen's University, 2008 (artwork by Mark Badham, Queen's University).



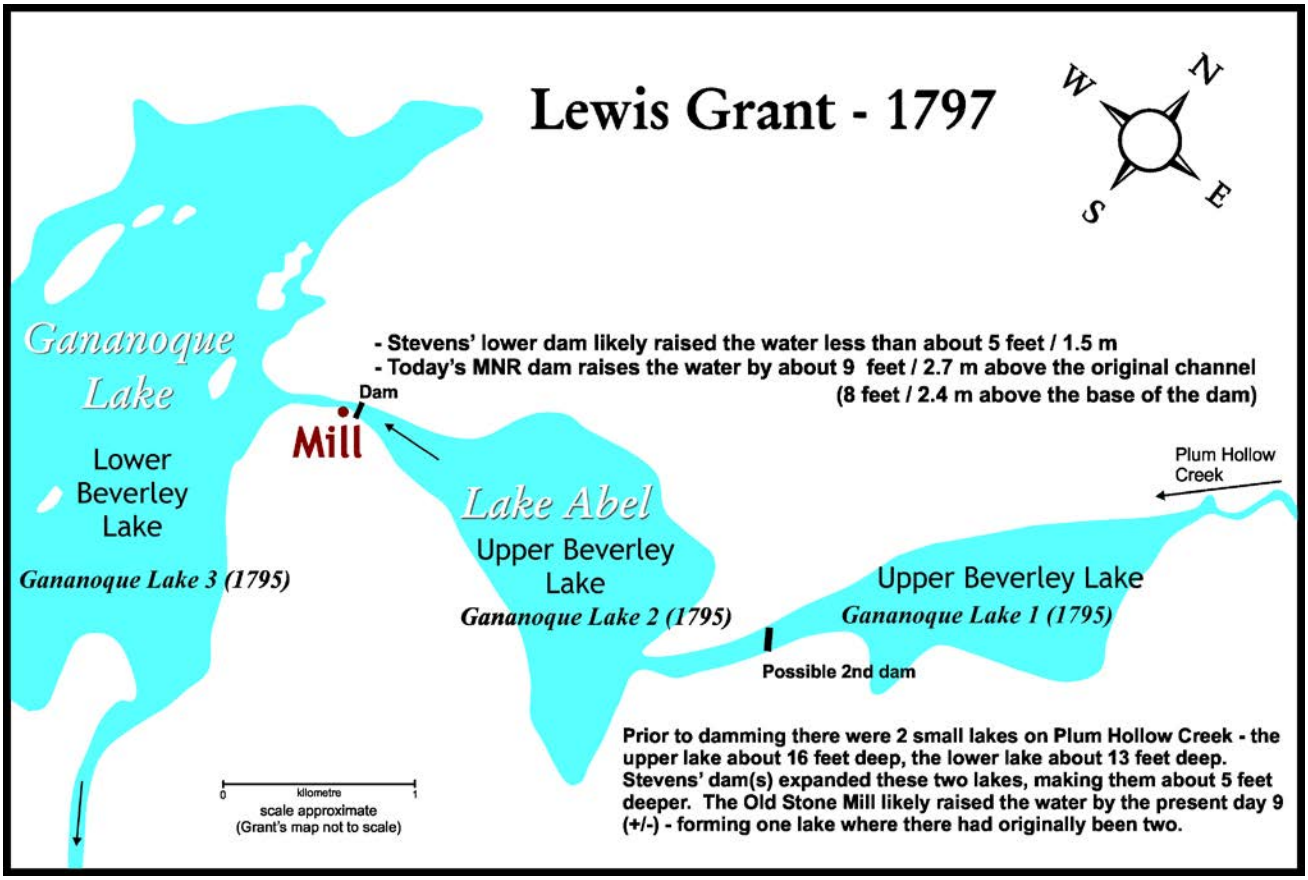
Original Upper Beverley Lakes

The black areas show the lakes as they would have looked to Abel Stevens when he explored this area in 1793. The open outline is the present day extent of Upper Beverley Lake.

Plum Hollow Creek flowed into two small lakes. These lakes were about 9 feet lower than the present day elevation of Upper Beverley Lake (lake level raised by a dam at Delta). Lower Beverley Lake at the time was about 4.7 feet lower than it is today (raised by a dam at Lyndhurst). The water level difference in 1793 between the Upper Beverley lakes and Lower Beverley Lake was therefore a little less than 5 feet. The main part of that difference was the rapids at Delta, the area that Abel Stevens received a land grant to in June 1796. The area of the rapids has seen much cultural disturbance, it's impossible to tell what the exact length and drop of the rapids were. An estimate is they were less than 200 feet (60m) long. The drop was some number less than total elevation difference between Upper and Lower Beverley, so less than 5 feet.

Based on the shape of the lakes in Grant's 1797 map of Bastard Township (see next page), compared to the bathymetry of Upper Beverley Lake, Stevens' mill dam raised the water less than 5 feet. He used a second dam between the two lakes to impound more water in the upper lake.

The original two lakes occupied about 400 acres in area and were about 13 feet deep for the lower lake and 16 feet for the upper Lake. Stevens' c.1796 dams expanded the surface size of the Upper Beverley lakes to about 700 acres. The water raised in 1810-11 with the building of the Old Stone Mill, made the two lakes into one, as shown on Lt. Joshua Jebb's 1816 map. The lower basin was now about 22 feet deep, the upper about 25 feet deep, close to the level they are today (today's level held by the MNR dam may be a bit higher (~ 6 inches) than the historic level raised by the mill. The total expanse of the lake today is 1,350 acres (550 Ha). The level of the lake, which was the millpond for the Old Stone Mill, would fluctuate with the season as the miller fed water into the mill.

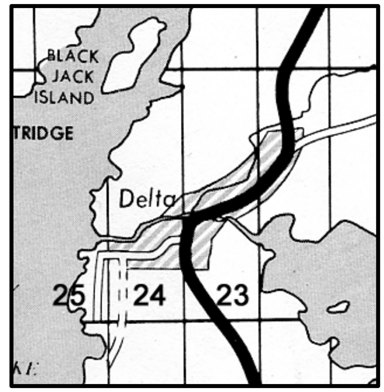


Delta Area, Bastard Township, 1797

A simplified version of Lewis Grant's 1797 survey map of Bastard Township. On that map he marked Stevens' c.1796 mill (which Grant, in his survey notes, attributed to Abel's cousin William Stevens) on the south side of the stream that drained the Upper Beverley lakes into Lower Beverley Lake. Stevens used a 2nd dam (mentioned in Grant's survey notes) between the two lakes to impound more water (exact location not know, the map shows a postulated position of the dam) Comparing the shape of the lakes shown on Grant's map with present day bathymetry of Upper Beverley Lake indicates that Stevens' dams raised the water in the lakes less than 5 feet.

In 1795, Grant named the upper lake Gananoque Lake 1, the lower lake as Gananoque Lake 2, Lower Beverley Lake as Gananoque Lake 3 and Lyndhurst Lake as Gananoque Lake 4. On his 1797 map of Bastard Township he named the lower dam raised Upper Beverley Lake as Lake Abel and Lower Beverley Lake as Gananoque Lake. By 1816 Lower Beverley had become known as White Fish Lake, the White Fish River which flowed from Sand Lake through Jones Falls, fed into it. Sometime after the re-naming of Stone Mills as Beverley in 1826-27, the lakes took on the name Upper Beverley Lake (now one lake) and Lower Beverley Lake.

Stevens received his first land grant in June 1796, five lots, including three lots over what is today Delta. Each lot was 200 acres in size, however those five lots netted Stevens 700 acres of land since portions of his lots were covered by water. This ownership of the land and rapids allowed Stevens to dam the head of the rapids and build his first mill, a sawmill. That mill is shown on the south side of the millstream on surveyor Lewis Grant's 1797 map of Bastard Township (see map on previous page). Grant attributes the sawmill to Steven's cousin, William Stevens – the arrangement between the two is not known (perhaps a lease?). At some later point a wooden gristmill was added, the first known assessment of his gristmill was in 1803, showing 2 runs of millstones. In 1798, Stevens had a road built from Lyndhurst to Kingston Mills to help support his claim for Lyndhurst. This completed a road connection between Brockville and Kingston, the first such road connection. A road along the St. Lawrence didn't exist at that time, that road wouldn't be built until the early 1800s and a bridge at Gananoque wasn't built until 1806. The route passing near Delta would later become known as the Kingston Back Road (see map on next page). As farming expanded, local roads were built to connect farms in Bastard and Kitley townships with the gristmill (Stevens) in Delta. Early maps (1815-18) show good road development into the farming areas of Bastard and Kitley townships.



Stevens' 3 Lots in Delta

Abel Stevens was granted Lots 23, 24 and 25 in the 9th concession of Bastard Township (most of present day Delta) as well as lots 11 and 12 in the 10th concession, in June 1796.

There is no documentation of the business case for why Jones and Schofield would go to the very large expense of building a stone merchant mill in Delta. But, by 1808, there was a relatively good (for the day) regional road system and lots of farming, now moving well beyond simple sustenance farming. Farmers had a surplus of wheat beyond what they needed to feed their family. There was a ready market for flour in the growing town of Kingston, accessible from Delta by road. The port in Kingston also provided the opportunity for the export of flour to the U.S or even to Britain via Montreal.

An Oliver Evans automatic mill is purpose designed as a merchant mill, that is, it can produce fine sorted flour suitable for sale or export. Early gristmills were custom (aka barter) mills, returning whole flour to the farmer in exchange for a percentage (1/12) of the grain. That may be how the Stevens' gristmill initially operated. But the Old Stone Mill was built as a merchant mill and while it would have done some custom milling, merchant milling would have been its main source of revenue. It was reported for a miller near Ancaster in 1804 that "he considers grinding for Toll (1/12) not worth the expense"

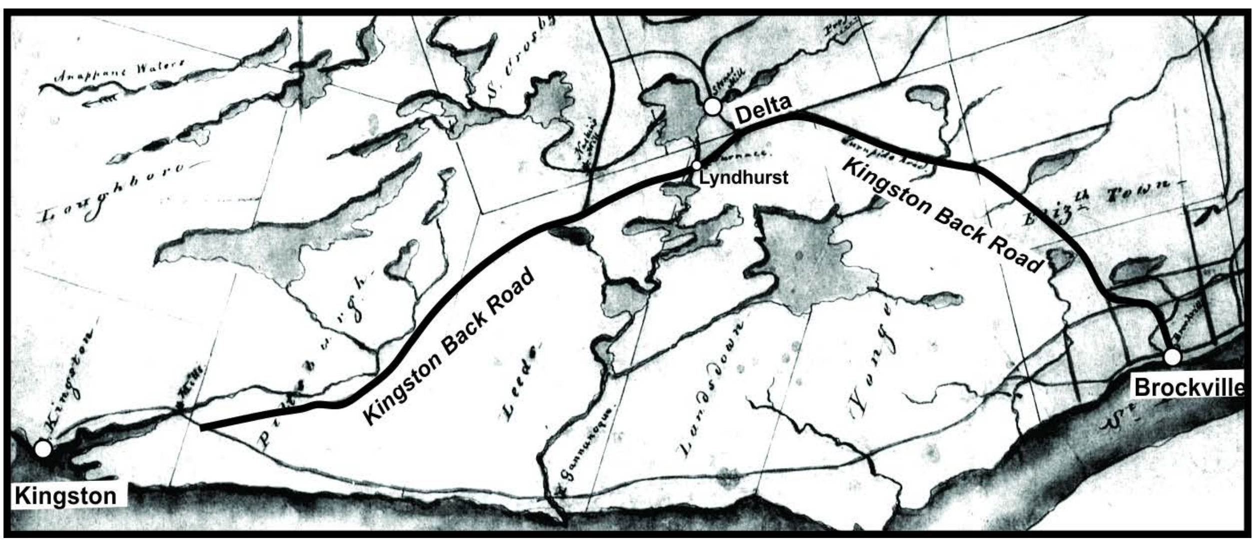
This c.1815 map identifies the mill as Jones & Schofield, but that doesn't clarify ownership vs business partnership. We also see some of the roads from the farming areas leading to Delta. No. 37 [Trent] & Rideau Communications" by unknown, [1815], Library and Archives of Canada, NMC 44765.

(Leung). The Delta region (Bastard and Kitley townships) now had a surplus of grain plus a road system that allowed easy farmer access to the mill and access from the mill to external markets (Kingston, the U.S., Britain). It is assumed that it was these factors that played into the decision to build a merchant mill of the Old Stone Mill's magnitude in Delta.

The mill spurred the growth of the region. Having a local merchant gristmill encouraged farmers to expand their wheat fields, that wheat could now provide a good source of income. With farmers from the region traveling to Delta, the village became a regional service centre with blacksmiths, merchant shops and taverns developing to serve local community needs. Jebb's 1816 map shows 10 buildings in "downtown" Delta. An 1828 map (Walpole, 1828) notes "Beverly is composed of abt. 30 houses." By 1851 the population had grown to 250.

Delta in 1828

This 1828 road map shows that Delta has grown from the 10 building shown in Jebb's 1816 map. Road map of the Rideau region by J. Walpole, Royal Engineer, 22 June 1828. Library and Archives Canada, NMC 11230.



The Kingston Back Road in March 1816

This is the earliest detailed "road map" of the area. On this annotated map, the Kingston Back Road is highlighted. This road pre-dated the front road along the St. Lawrence. A bridge wasn't erected at Gananoque until 1806. In the early 1800s the back road was in better condition and more travelled than the front route. It directly connected Delta to Kingston, the large market for flour there and the port for any flour that was to be exported to the U.S. or Britain.

In October 1800 the road from Brockville to Kingston, passing near Delta was described as being "now generally used, & in winter altogether, by Travellers." Roads back then were much better when frozen in winter than the muddy mess in spring. Map from Upper Canada Sundries, RG 5, A1 vol. 27, p.12288.

The Design of the Mill

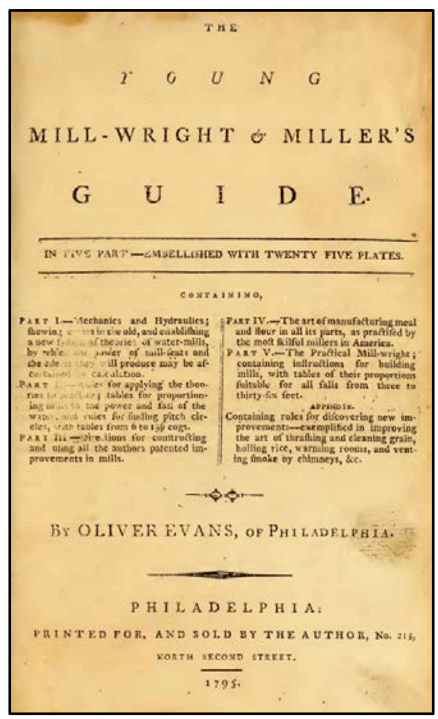
In 1810, construction started on a new mill in Delta, a stone gristmill located a short distance (~50m) away from existing wooden mills that had earlier been built for Abel Stevens Sr. But it wasn't Stevens building this new stone mill, it was William Jones, likely in partnership with Ira Schofield. On June 10, 1808, Stevens sold the northern part of his property, including his two wooden mills – a sawmill (timber) and a gristmill (flour), to William Jones for the sum of £375. Ira Schofield was a signed witness to this sale. While the initial result of this was Jones and Schofield taking over the operation of Stevens' mills, it seems likely that the planning for a new mill would have started at about this time.

Jones and Schofield came from well off families in the region. Both were entrepreneurs, William Jones first shows up in the records in Delta in 1807 when he's assessed for a 150 gallon still. In 1808 he's assessed for a 168 gallon still which was located in the gristmill previously owned by Abel Stevens, now owned by Jones. In 1809, Ira Schofield was assessed for operating Steven's old mill, now Jones' mill, and in 1810 Jones and Schofield are assessed for a general store, storehouse, and a sawmill (presumably Stevens' old sawmill) in Delta. Jones retained sole ownership of the land until his death in 1831.

At some point after the land was purchased in 1808, Jones and Schofield started planning for a new mill. The type of mill they envisaged, an Oliver Evans automatic gristmill, would be a mammoth project. In 1795, American inventor Oliver Evans published a book, *"The Young Mill-Wright & Miller's Guide,"* which laid out the details for how to build an automatic gristmill, which needed less than half the labour force of previous gristmills, to run it. Evans' design relied on elevators (wooden or tin buckets attached to a moving leather belt), conveyors (horizontal auger screws) and gravity to replace much of the manual labour.

We have no evidence that either Jones or Schofield were millwrights familiar with the complex Evans design – they would have hired such a millwright, likely from the U.S., to design and construct the mill. That millwright, in addition to his personal experience with an automatic gristmill, would also likely have had Evans' original 1795 guide or the 1807 second edition of the guide as a reference.

Prior to the Old Stone Mill, most mills in Canada, automatic or otherwise, were made of wood (often on a stone foundation), they were less expensive to build. But Jones and Schofield clearly wanted something more substantial; they decided to build the entire mill using stone. So a design, for a 50 foot long, 35 foot wide, 3 ½ storey high stone gristmill was laid out. It followed most, but not all, of Oliver Evans' design recommendations for an automatic mill. The first divergence from the Evans' design was due to the required positioning of the Old Stone Mill on the local landscape.


THE
YOUNG
MILL-WRIGHT & MILLER'S
GUIDE.

IN FIVE PART—EMBELLISHED WITH TWENTY FIVE PLATES.

CONTAINING,

PART I.—Mechanics and Hydraulics; shewing [illegible] the old, and establishing a new [illegible] of theories of water-mills, by which the power of mill-seats and the [illegible] they will produce may be ascertained [illegible] calculation.

PART [illegible] for applying the theories [illegible] tables for proportioning mills to the power and fall of the water, and rules for finding pitch circles, with tables from 6 to 136 cogs.

PART III.—Directions for constructing and using all the authors patented improvements in mills.

PART IV.—The art of manufacturing meal and flour in all its parts, as practised by the most skilful millers in America.

PART V.—The Practical Mill-wright; containing instructions for building mills, with tables of their proportions suitable for all falls from three to thirty-six feet.

APPENDIX.

Containing rules for discovering new improvements—exemplified in improving the art of thrashing and cleaning grain, hulling rice, warming rooms, and venting smoke by chimneys, &c.

BY OLIVER EVANS, OF PHILADELPHIA.

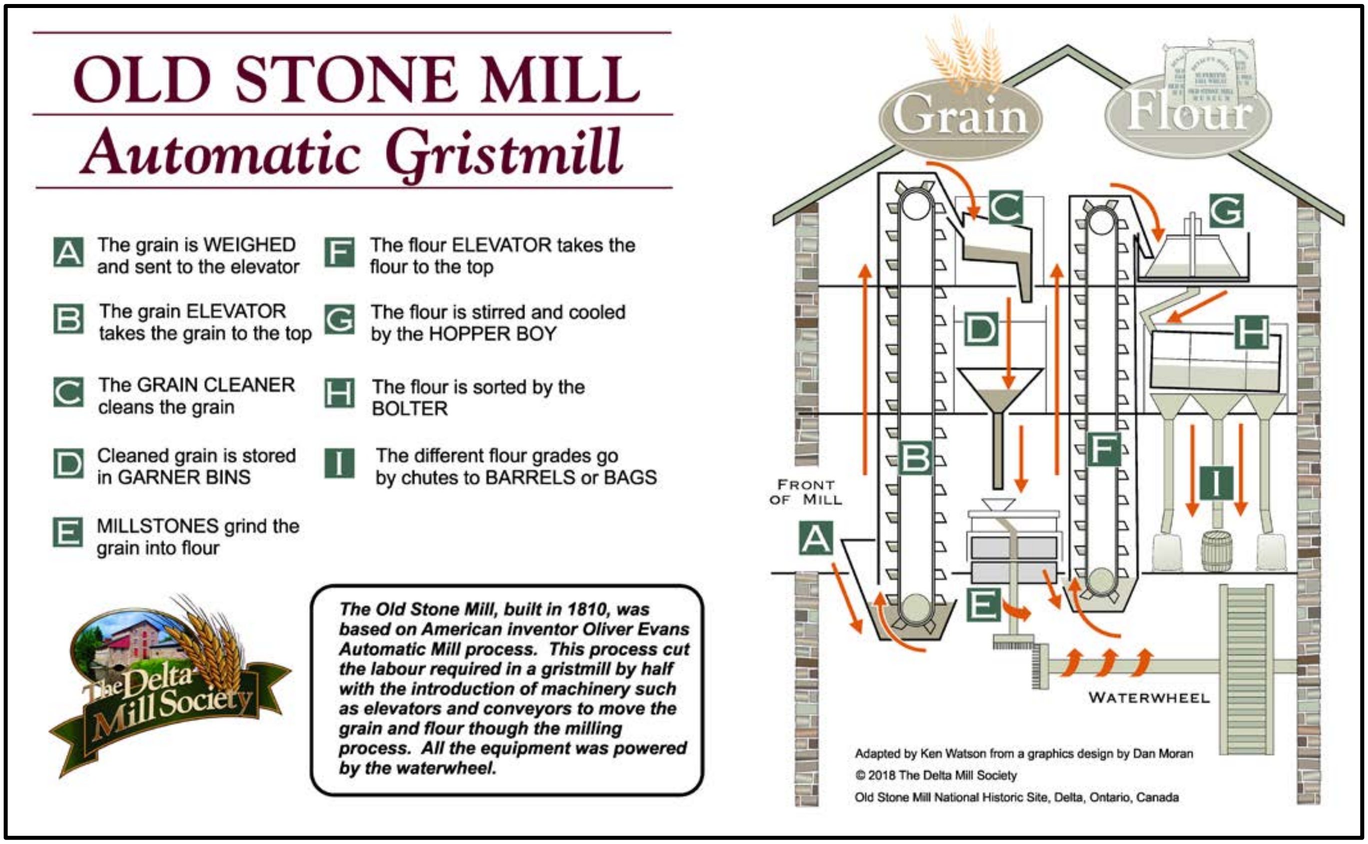
PHILADELPHIA:

PRINTED FOR, AND SOLD BY THE AUTHOR, No. 215, NORTH SECOND STREET.

1795.

Oliver Evans' 1795 Guide

American inventor Oliver Evans detailed the building of a gristmill that only required one or two people to operate it in his 1795 guide.



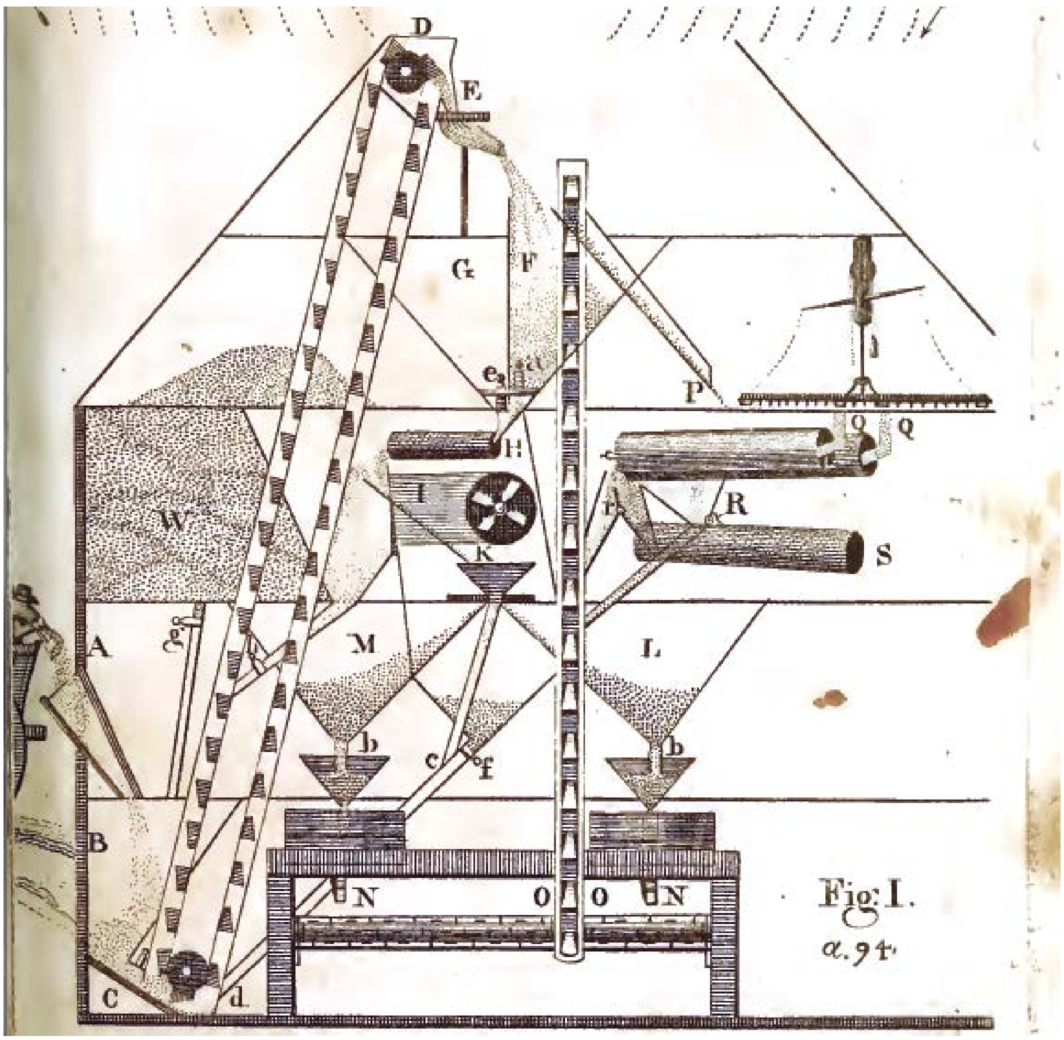
The Automatic Mill – a Brief Description

The automatic gristmill, while very complex to build, is actually quite simple in concept. The process starts with the raw grain loaded into a elevator (wooden or tin buckets on a moving leather belt), the elevator taking the grain up to the attic. From there it falls by gravity to grain cleaners. The cleaned grain is put in bins for storage or directly sent by chutes (gravity) to the feed hoppers over the millstones (two sets in the mill). The millstones were located on a robust timber foundation called the husk, elevated above the level of the first floor. The millstones then ground the grain into flour.

The newly ground flour fell by gravity down to an elevator boot in the basement and the elevator transported it back up to the attic where it then fell into a hopper boy on the third floor. The hopper boy raked the flour, cooling it and keeping it separated. The cooled flour then fell via chutes to bolters on the 2nd floor which sorted the flour into different grades (degrees of fineness: superfine/ fine, middlings, shorts and bran) and the sorted flour then fell by chutes to barrels or bags on the first floor.

More detailed descriptions of the process can be found later in this article

Due to the weight of the stone building, a solid bedrock foundation was needed. This presented the first problem for the designer since the only near surface bedrock, in the area below the rapids that flowed from the Upper Beverley lakes (then two smaller lakes), was located to the north of the original stream channel. Stevens' old mills were conventionally positioned at the base of those rapids, with a small dam at the head of the rapids and a sluice or a wooden flume directing water to the waterwheel for the mills. But those wooden buildings were sitting on sedimentary deposits of the stream valley, not on bedrock. With the only bedrock located to the north of the stream channel, a new water/mill configuration was needed.



Evans' Improved Gristmill

Part of Plate IX from Evans' 1795 guide showing the same process described on the previous page. Evans noted that his improvements only required half the labour previously used in a mill. In his book he writes: "Formerly one hand was required for every 10 barrels of flour that the mill made daily, now one for every 20 barrels is sufficient. A mill that made 40 barrels a day required four men and a boy, two men are now sufficient." Evans calculated the savings using his improvements for a 40 barrel a day mill to be 298 dollars per year, based on a man's wage rate of 7 dollars a month plus 51 dollars per year to board the two men. The boy cost 68 dollars a year for board and clothing.

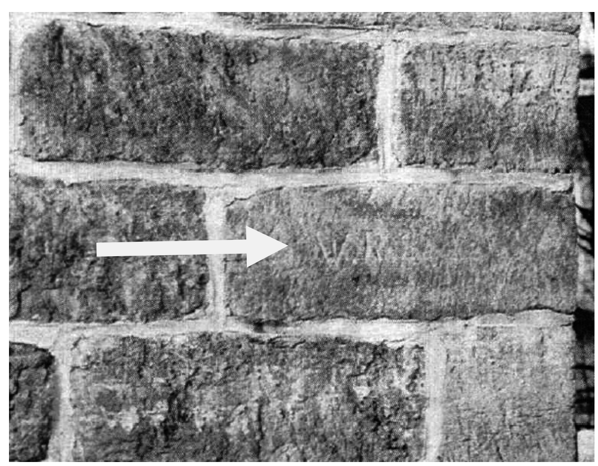
Building the Mill – People & Materials

The owner of the land on which the mill was built was William Jones (1782-1832), born in Burton, Ontario (his father, Ephraim, moved from Connecticut, U.S.A. to Canada in the late-1770s). His business partner, Ira Schofield (1776 to 1864) was born in Connecticut, U.S.A. He moved to Canada in the early 1800s (a son was born in 1800 in the U.S., a daughter was born in 1803 in Canada). They both end up in the Delta area by the mid-1800s – Jones is shown operating a still in Delta in 1807 and Schofield is a signed witness to the June 1808 sale of the land the mill sits on to William Jones from Abel Stevens. So they were in Delta on or before those dates.

In terms of "who actually built the mill" we've seen that an expert millwright, familiar with the Oliver Evans design, must have been involved. According to Evans a millwright "could handle the axe, hammer, and plane, with equal skill and precision; he could turn, bore, or forge ... He could calculate the velocities, strength, and power of machines, he could ... construct buildings, conduits and water courses." (quote from "Engines of change : the American industrial revolution, 1790-1860" by Brooke Hindle & Steven D Lubar,1986). A millwright of that era was essentially a combination of skilled carpenter and engineer. Most were self-taught, sometimes apprenticed to a working millwright. The millwright who designed and built the mill was clearly an expert, implementing several innovative features due to the mill's placement on the landscape.

While the millwright most likely did much of the carpentry work, other skilled trades would have been masons and blacksmith (masonry could have been a skill set of the millwright, if not, a skilled mason would be required). The masons would have chosen and laid the stones and created the mortar for the walls. The millwright may have had other carpenters helping him do the exacting work of building the waterwheel, the power transfer shafts and gearing, the internal timber structure, the husk, the floors, and all the chutes needed to transfer grain and flour. The millwright would have also built most of the internal equipment. A blacksmith would be required to create and shape many of the metal parts, including making nails. And of course a number of general labourers would have been required to do much of the grunt work.

A few names have shown up in anecdotal stories. One is that two local men, Isaac Whaley and Jasper Russel, worked on the mill. In support of that, a tantalizing clue is a cornerstone on the north-east corner of the mill that has the initials 'W.R' and possibly an ' S ' or ' J ' carved into the stone. Does the W.R. stand for Whaley and Russel, or for some other name entirely? Was it carved into the stone when the mill was originally built, or scratched into the stone later? A problem with this story is that Isaac Whaley was born in 1809/10 (in NY, U.S.A.) and Jasper Russel was born in 1817 (in the U.S.), so they couldn't have worked on the mill. Another name is the "great-grandfather of L. Hill" who is credited by a "Miss Allyn" in a 20th century



Initials in an Old Stone Mill wall stone

The initials W and R can just be seen in this photo. Do they relate to the original masons or are just later graffiti? Photo by André Scheinman.

remembrance: "Mr. Hill' s great grandfather worked as a mason in the building of the present gristmill". That remembrance is perhaps credible but again we have a problem, there are 4 possibilities (4 great-grandfathers). On his paternal side, Leonard Hill's grandfather was was Ephraim Hill, who emigrated to this area from England in the 1830s, so Ephraim's father can be ruled out (as can the father of Ephraim's wife, Louise Galloway). But his maternal grandfather was Isaac Whaley. Could it be that it was Isaac Whaley's father (name presently unknown) who worked on the mill as a mason? Perhaps coming up from the US to do so and his son Isaac later returning to this area? Or the father of Isaac's wife? The Whaley and Russel names do show up again in the history of the area – see the Bridge section.

William Jones and Ira Schofield would of course have been directly involved. Schofield shows up as the first miller in the Old Stone Mill in 1812. That year also marked the outbreak of war with the United States. Jones got married that year and also joined the militia, becoming a Captain in the Leeds Militia. Ira Schofield also signed up, becoming a Captain of the 2nd Regiment of the Leeds Militia.

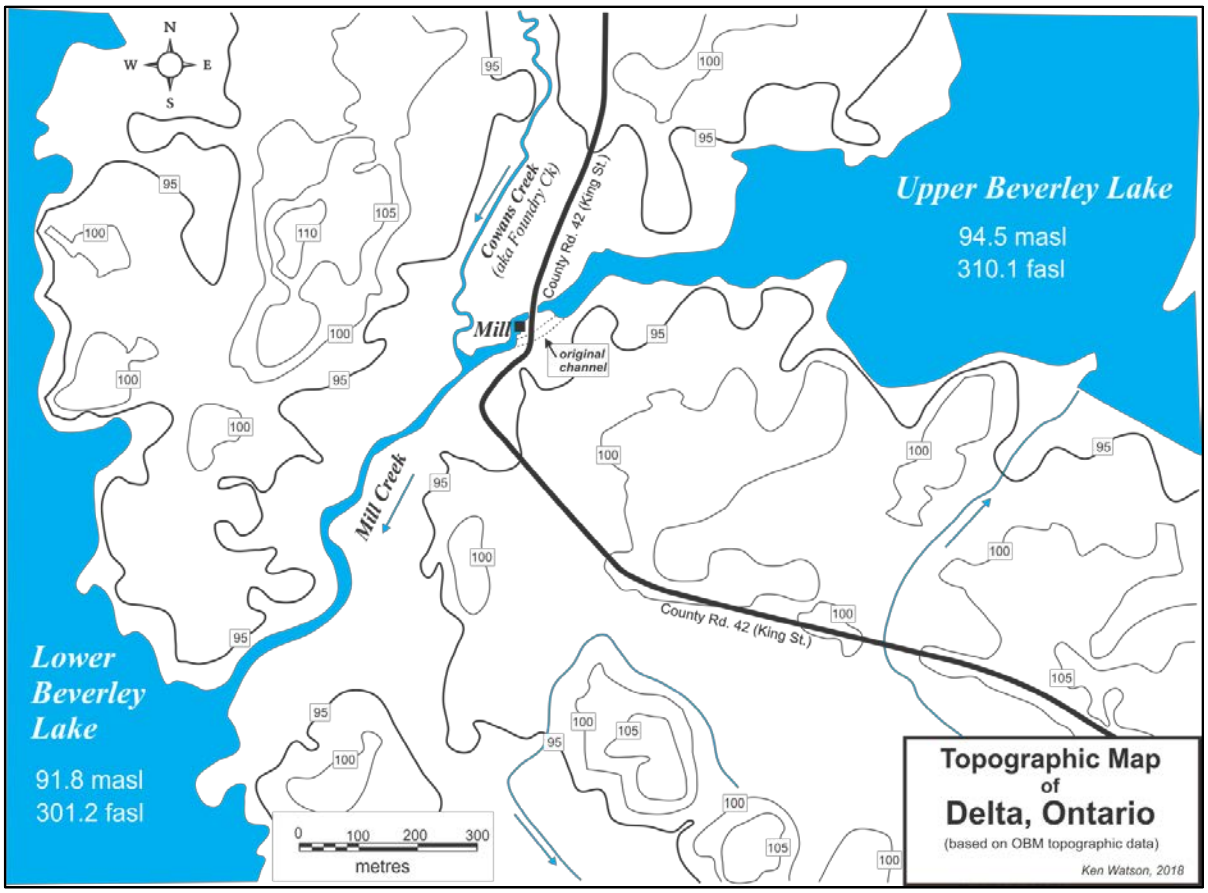
Most of the materials for the mill were locally sourced; we'll look at that in more detail later. In that time period bringing in pre-made items was difficult (poor roads) and expensive. Almost everything was made by hand and they made do with what was available locally except for some specialized items. In a nutshell, local white pine was used for much of the woodwork (support timbers, floors, chutes and much of the machinery), local white oak used for any wet applications such as the waterwheel, flume and waterhouse, and perhaps a hardwood such as maple for some of the wooden gearing. The stone walls were built using local Potsdam sandstone and some marble (crystalline limestone) for the corner stones. Local crystalline limestone was also used to create the lime for the mortar. Local iron, from the Lyndhurst Ironworks, which was still in operation in 1810, may have been used in the mill. The millstones and bolting cloths were imported, but much, if not all of the other equipment was built on-site.

The geologic and geographic location of the mill was advantageous to construction of a large stone mill. The Frontenac Axis supports the growth of large white Pine trees as well as white oak, maple, beech and cedar, all materials that may have been used for the mill. Any of those trees around the margins of Lower Beverley Lake and the lower reaches of the White Fish River (today's Morton Creek) could have been cut down and floated to the mill construction site. Teams of oxen from local farmers could have hauled timber in from the surrounding region. The rocks of the Frontenac Axis, except for some sections of marble, aren't suitable for building stone, but the Potsdam sandstone units located near Delta do have sections with competent enough rock to be used as building stone.

It's unlikely that much, other than some metal parts and perhaps the millstones (likely granite), could have been repurposed from the old Stevens' gristmill. Anecdotal stories have Stevens' mill burning down twice, the last time perhaps in late 1809 since Ira Schofield is shown as being the miller that year, but neither Jones or Schofield are assessed for milling in 1810, an indication perhaps that something happened to Stevens' gristmill between 1809 and 1810. Stevens' millstones, which may have survived a fire, were likely not the quality required for the Old Stone Mill (more about this later).

Building the Mill – Situating the Mill

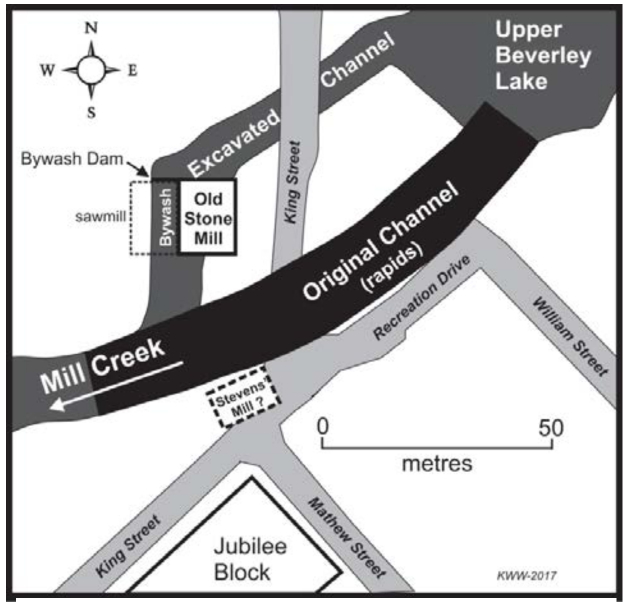
The design of the mill would have been completed before the first foundation stone was laid, that planning likely took place in 1808 and 1809. It's unknown if Jones originally planned to simply expand or rebuild Stevens' gristmill or whether he intended from the beginning to build a new mill. However any thought of building a stone mill at the location of the original gristmill would have been quickly quashed by the designer who would have said that "it needs to be put on bedrock." The geology and geography of Delta now dictated the position of the new mill, to the north of the original stream channel, the only exposure of bedrock near the downstream end of the rapids.



Topography of Delta

The 95 m contour, a height slightly above the present dam-raised level of Upper Beverley Lake, has been highlighted. That contour line essentially defines the Mill Creek valley which was carved by the lower part of Plum Hollow Creek. The original stream channel shown on the map was the site of the original rapids, likely cause by a resistant bedrock unit at the head of the rapids. Upper Beverley Lake was originally about 9 feet lower than it is today. Lower Beverley Lake was a bit less than 5 feet lower than it is today. The level of Upper Beverley Lake today dates to the building of the Old Stone Mill. Lower Beverley Lake levels are less certain. We know, based on turbine placement in the mill, that they were at present dam raised levels by c.1860, likely due to a dam built for the mills at Lyndhurst in the 1820s. The level of Lower Beverley Lake prior to that is presently uncertain (there likely was a dam of some sort used for the 1802-1811 forge and foundry at Lyndhurst, but we have no direct evidence of this). The pre-dam level of Lower Beverley Lake was ~90.4 masl (bedrock elevation at the head of the Lyndhurst falls). Delta starts to flood when Upper Beverley Lake reaches 94.7 masl, and water floods past (& through) the mill drive shed when the water reaches 94.9 masl (a partial fix for this, a small barrier dam, is likely to be constructed in 2018/19).

The original Stevens' wooden mills were not on bedrock, they were built on stream sediments, part of the stream valley below the rapids from the Lower Beverley lakes (see topographic map on previous page). A bedrock profile of Delta has not been done, but we know that today we see visible bedrock to the north of the original stream channel (under the mill and the channel leading to the mill), but not to the south. Bedrock also exists near surface at the head of the rapids, it is likely that a resistant unit of skarn or marble is the reason for those rapids. But the waterwheel for a mill has to be placed at the lowest topographic point below the rapids to obtain maximum water power. That left the bedrock exposure north of the Stevens' mills as the only choice for the stone mill's location.

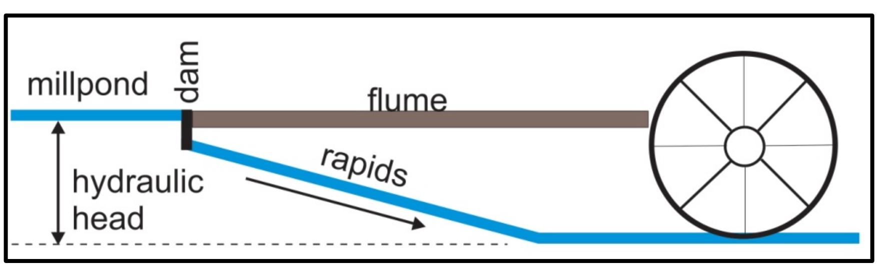


Old and New Channels and Mills

The exact location of the original Stevens' mills are unknown, but as an educated guess, would be about where shown on this map, on the south side of the original channel, at or below the base of the rapids. That original channel was filled in with material excavated for the new channel, foundation and bywash for the Stone Mill.

That location provided a number of advantages and disadvantages. The biggest advantage is that it would allow the mill, which was to act as its own dam, to be built "in the dry" – all the foundation work could be done without the many problems that flowing or standing water brings with it. A secondary advantage is that it didn't disturb the old Stevens', now Jones', wooden mills located on the creek, allowing those mills to continue to operate as the Old Stone Mill was being built. That advantage was taken away to a degree with the possible burning down of the Stevens gristmill in the latter part of 1809. However, the Stevens' sawmill either survived, or was rebuilt, since it appears to have been in operation, with Ira Schofield as the operator, in 1810.

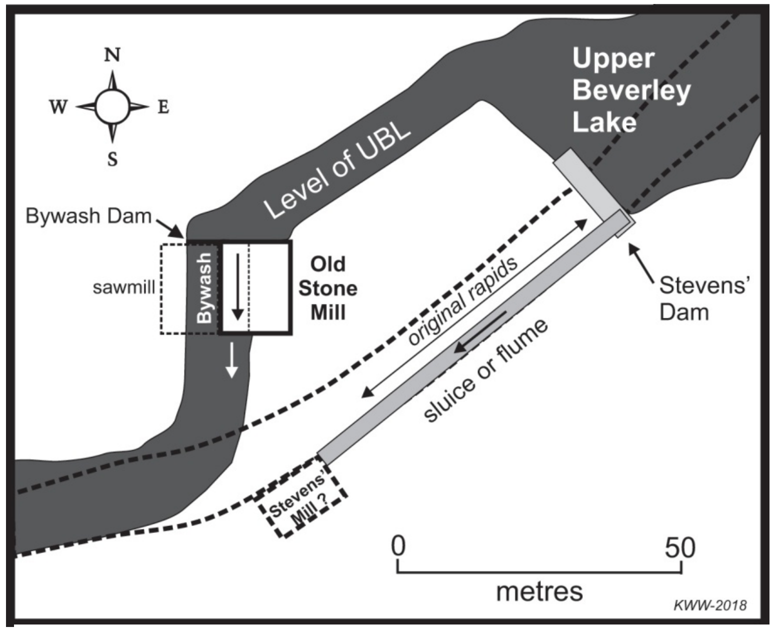
There were also disadvantages of the location, the greatest of those was that it placed the mill in a position where the conventional method of getting water to a mill, a sluice or a flume from a dam located at the head of the rapids (see diagrams below and on next page), could not be used. But the designer of the mill had a solution for that problem.



Conventional Layout for Dam, Flume & Waterwheel

A conventional mill used the configuration of a dam at the head of the rapids, the mill with waterwheel at or below the base of the rapids and a sluice or flume directing the water to the waterwheel. In the Old Stone Mill this configuration was compressed to inside the mill (this diagram shows a breastshot waterwheel).

Building the Mill – Excavation & Foundation



Water Power at Delta – 1796 and 1810

The original rapids at Delta were buried in 1810-11 with the building of the Old Stone Mill. We can only speculate on the configuration of the original Stevens' mills, but conventional design would have a dam at the head of the rapids with a sluice or flume directing the water to a mill located at or below the base of the rapids. When the Old Stone Mill was built, the mill acted as its own dam, bringing the full height of water up against the mill, the water then going through a flume in the raceway to power the waterwheel.

Oliver Evans recommended that a mill never be used as its own dam, uncontrolled water is potentially very damaging. The conventional design was a dam placed at the head of the rapids with the mill placed at or below the base of the rapids. A headgate was built into the dam with a sluice or a wooden flume taking the water from the dam to the waterwheel of the mill. This allowed for a controlled water flow to the mill. Excess water in times of flood would flow over the top of the dam into the original channel of the rapids. This was the likely configuration of Stevens' original mills. But the Old Stone Mill was built contrary to Evans' recommendation; it did act as its own dam. The reasons for that are due to the geology/geography of the area and a decision by the designer to orient the mill exactly north-south.

The first work, likely in early 1810, was to clear the site for the foundation. That site was the exposure of bedrock to the north of the stream channel. The mill is built close (2 metres) to the southern edge of that bedrock, before it drops off (eroded) into the original stream channel. Ideally the mill would have been oriented with the headrace (upper end of the water channel leading to the waterwheel) facing the top of the rapids. But that's not how the mill is oriented, the headrace faces due north, almost 90 degrees to the natural water flow.

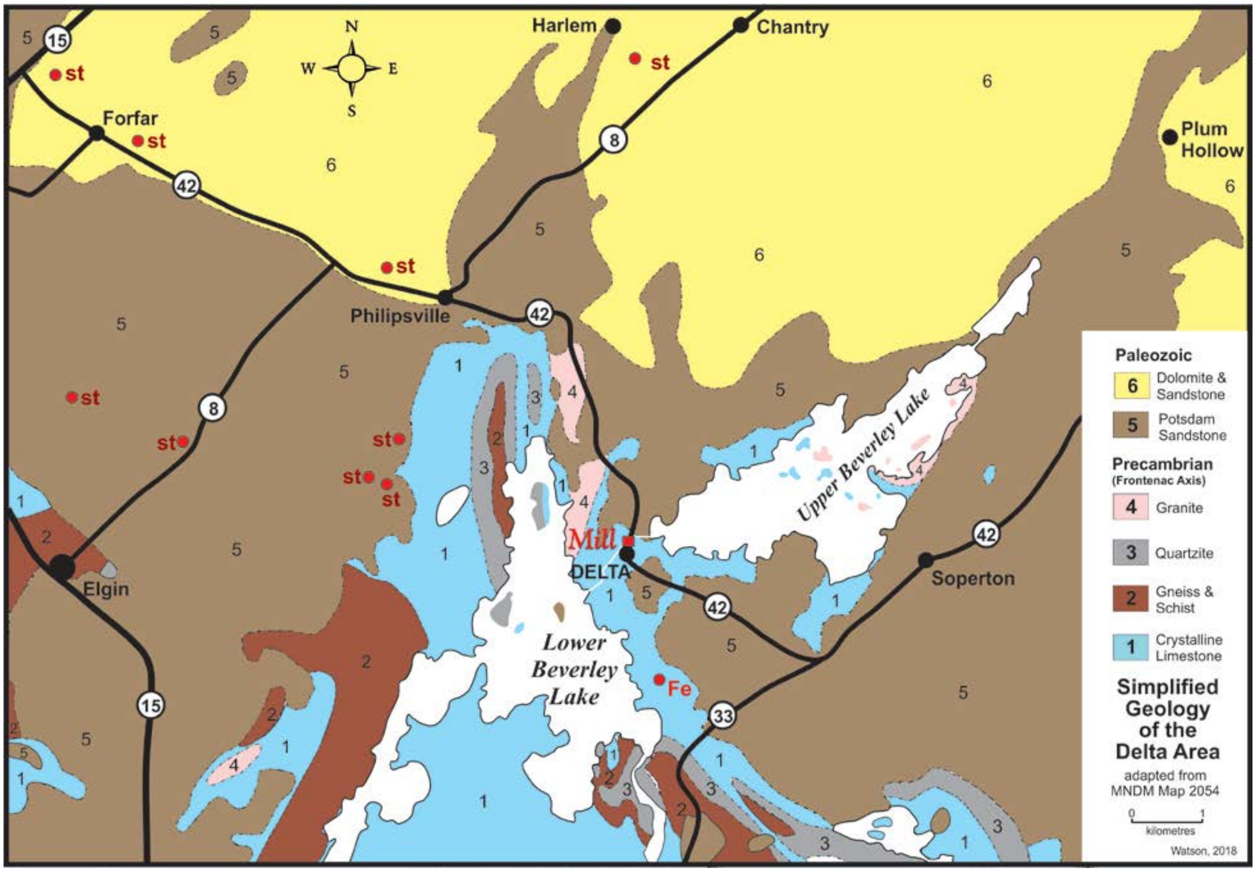
The reasons for this odd orientation may be twofold. One is the local topography which may have made it difficult to construct a tailrace (the water exit channel behind the waterwheel), in line with the headwater flow, leading back to the stream. In that era, rock excavation was manually intensive and difficult; the only assistance to human muscles for levering a pry bar or swinging a pick axe was the use of black powder blasting. The second reason is a deliberate decision by the designer to orient the building north-south, positioning it so that the entrance door faces due east. We know that exact orientation of the mill is deliberate since the walls of the mill don't line up with the walls of the waterwheel raceway, they were re-oriented to line up exactly north-south-east-west. This may be a freemasonry idea tied to the belief that the only entrance door of the tabernacle (which housed the Ark of the Covenant) faced due east.

With its location on the landscape and its north-south orientation, there was little choice but to bring the water from the stream to the head (north wall) of the mill, where it could then flow directly to the waterwheel. To do that, a new stream channel had to be excavated, bringing the water from Upper Beverley Lake directly to the head of the mill. This is where the ingenuity of the millwright comes in; three external water damage mitigating features may have been used; a bywash (water bypass channel) with a stop-log dam at its head, a buffer wall built against the stone wall of the mill, and a bridge upstream of the mill that also served to control water flow to the mill. The fact that the mill is still standing today is partial testament to those three design features. Details about flood control can be found in the section "Building the Mill – Flood Control – the Buffer Wall, Bywash & Bridge."

In 1810, the sound of black powder blasting would have been heard in Delta as the new water channel, bywash and foundation area for the mill were excavated. The rock on which the mill sits is a dog's breakfast mixture of crystalline limestone (marble), dolomite and skarn, most fractured and steeply dipping (angled). These are some of the billion year-old rocks of the Frontenac Axis, the eroded remnant of a large mountain range that once extended from Newfoundland to California. Much of the excavation would have been done by men using pry-bars and pick axes who would have removed any loose material or fractured rock. They didn't have to move it far, the excavated rock was piled up on the edge of the original stream channel, ready to fill it in when the flow from Upper Beverley Lake was switched from the original stream channel to the newly constructed channel.

Where the bedrock proved too competent to be moved by human power, black powder was used. A hole would be drilled using a hand drill, a piece of steel with a wedge shaped end, essentially a very large chisel (cross bits (square) wouldn't be developed until later). The drill steel would be held in place by one man while one or two others whacked the top with a sledge hammer. The drill would jump on each hit, the driller turning the steel before the next hit, creating a slightly irregular shaped hole. When deemed deep enough, the hole would have a fuse inserted, then be filled with black powder, the top sealed and then the fuse lit. In those days the rate of a fuse burning was highly variable, the person lighting the fuse had to be quick on his feet. Evidence of boreholes was found in the 1999 archaeology supporting "local lore" that black powder blasting was used. The boreholes were all 4 cm in diameter and appear to have been made with a jumper drill (hand held drill steel with a chisel bit).

The artificial water channel leading to the mill is about 1.5 feet above the original channel. That elevation difference and whether they left a section of bedrock as a barrier, or used a coffer dam at the head of the new channel, meant that the mill could be built "in the dry" – without the problems water would bring during construction of a mill that was to act as its own dam.



Geology of the Delta Area

On this simplified geology map, Delta sits on the blue unit 1 (crystalline limestone (aka marble), lime silicate rocks, skarn) which are very old Precambrian rocks. The medium brown unit 5 is Potsdam sandstone, much younger Lower Ordovician or Cambrian rocks. It is Potsdam sandstone that makes up the majority of the stone in the walls of the Old Stone Mill. The layers of sandstone in the region are highly variable in their competency for use as building stone (some suitable, much is not). The “st” dots on the map are known quarries – most, if not all, shown on this map post-date the building of the Old Stone Mill (the one north of Elgin on County Road 8 is the Halladay Quarry used for the Rideau Canal). The Fe dot south of Delta is an iron deposit in Potsdam sandstone (outcrops surrounded by marble). It’s uncertain if this deposit was used for Lyndhurst, it may be the deposit that Ira Schofield claimed to have found – he stated in 1815 that he had gone “to considerable expence for the Discovery of (in all probability) a valuable mine of Iron Ore, situate on a water Communication to the falls on the Gananoque River." This small deposit of iron fits that description since it is on a “water communication” with Lyndhurst. There are several other areas near Lyndhurst (in Lansdowne Township) that the historic records indicate were used to obtain iron for the foundry. The deposit on Lower Beverley Lake was mined in the 20th century (1918-1919) and four carloads of ore (68% iron) were shipped.

The excavated channel adjacent to the mill

This early 1960s photo, showing the dewatered millpond, is looking east at the old stone bridge. The mill is located just to the right of this photo. Bedrock is visible both to the right (the tree near the bridge is growing on bedrock) and left (the building foundation is sitting on solid bedrock). The centre channel is not natural, it's been excavated. The MNR dam was built just upstream of the bridge in 1962 and the stone bridge was demolished and replaced by a concrete bridge in 1963 (more info about the bridge in the flood control section). Photo by MNR.

In the end they would have had an area excavated to competent bedrock large enough to site both the mill and the adjacent bywash (water bypass channel). They didn't make it flat, they didn't have to, the foundation walls of the mill follow the topography of the bedrock. The main goal was to ensure that the rocks the foundations stones laid on were competent (non-weathered) bedrock and that a channel was available for the water to flow to the mill and through (raceway) or past (bywash) the mill.

Mill East Wall Foundation (looking north)

In this photo taken under the mill we see the foundation of the east (front) wall of the mill on the right. Its base follows the topographic line of the underlying bedrock. You can see that same slope by looking at the front of the mill.

On the left we see two stone piers that help hold up the robust first floor support beams.

With the excavations done, the first thing to be built was the raceway for the waterwheel, two stone walls that formed a containment structure for the flume. The waterwheel raceway is a self contained structure, built by laying two walls defining the raceway onto the excavated bedrock. It also had its own wooden ceiling, isolating it from the rest of the building, presumably to prevent a flooded raceway from flooding the interior of the mill. It is with the orientation of the two raceway walls that we see a problem, the waterwheel raceway is skewed about 5 degrees from a north-south orientation. That wouldn't be a problem if the foundation walls, built later, had been built parallel to the raceway (which they should have been), but those walls are in an exact north-south orientation. This made the raceway skewed to the waterwheel since the waterhouse (the area housing the waterwheel) is built to the orientation of the mill (see the foundation diagram at the end of this section).

Inside the Waterwheel Raceway

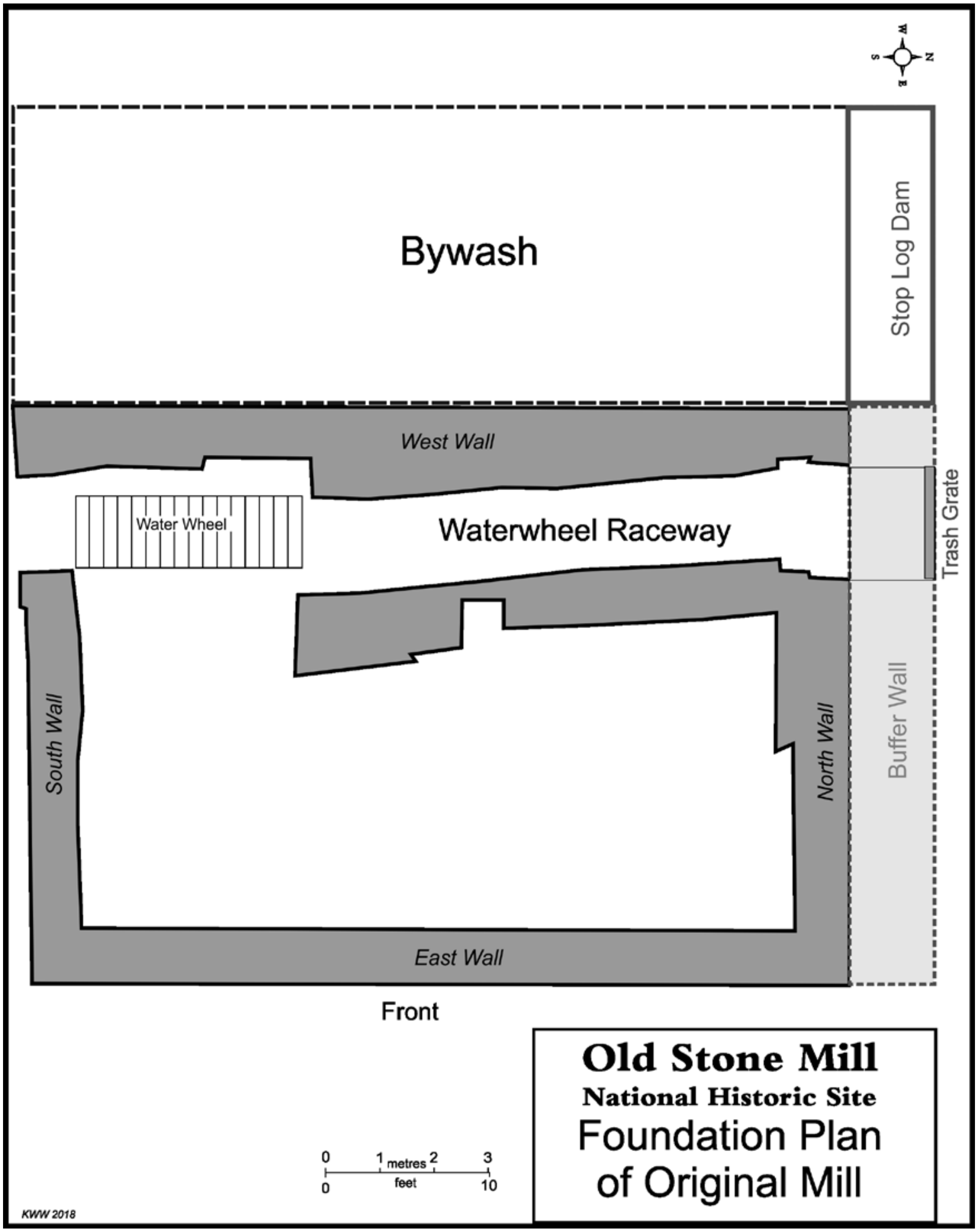
This photo taken in 2017, with Delta Mill Society volunteer Moel Benoit, is looking north towards the headrace. Moel is standing on the original bedrock of the raceway. The raceway is defined by two stone walls and a wooden roof. Missing is the original wooden flume that was likely inside this structure.

It is assumed that a compass/survey error was made when the raceway walls were built. Rather than tear down and rebuild those walls the millwright ignored that problem, likely because he knew he could fix it with an internal wooden flume. That flume was planned all along, putting in one smaller than the width of the stone raceway could correct that 5 degree orientation error. A wooden flume to the waterwheel is part of the Evans' design, and archaeological features, such as a horizontal wooden timber built into the raceway wall, and timber supports in the raceway at the head of the waterhouse, are indications that a wooden flume was used.

The bedrock excavation included room for a bywash (bypass channel), likely about the size of the current bywash (which was built c.1860). The original bywash was later used as the raceway for the turbines, the turbine shed is built on top of it. Up until 1962, the head of the later c.1860 bywash was a stop-log dam, likely similar, if not identical, to the dam built at the head of the original 1810 bywash. The idea of a stop-log dam is to stack squared timbers on top of each other to barricade the water, the water flowing over the top of the upper log. In times of high water flow, some of the stacked timbers are removed to allow more water flow, allowing the water to bypass the mill, preventing it from flooding. It's a technology that hasn't changed much, the current Ontario MNR dam, built in 1962 (repaired in 2017-18), just upstream from the bridge, is a stop-log dam.

Waterwheel Raceway (looking north)

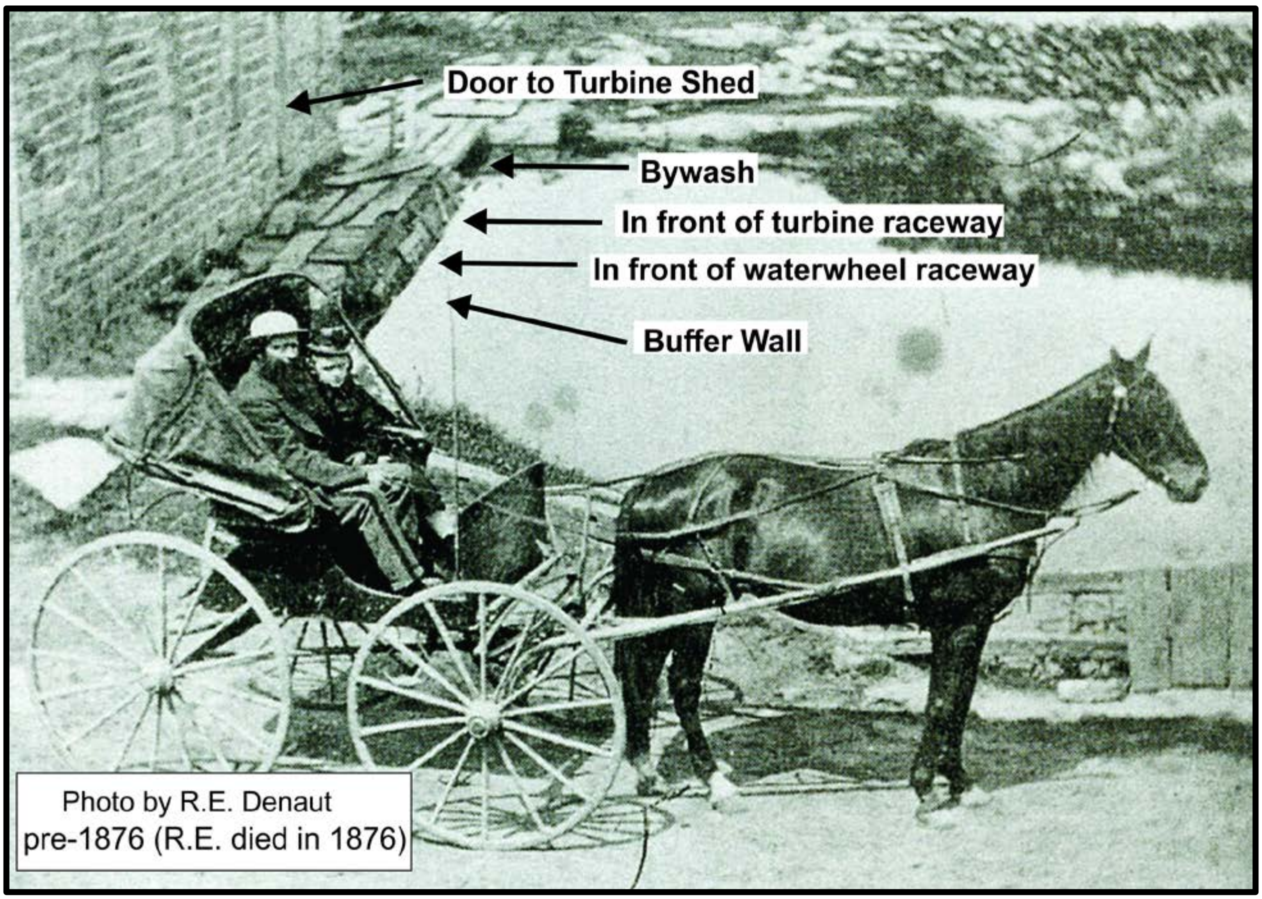
Looking north to the entrance (headrace) of the waterwheel raceway. In this 2017 photo we can see part of the original ceiling for the raceway that sealed it from the first floor of the mill. There are also the remains of a horizontal wooden plank in the east wall of the raceway. There was likely also one in the west wall, now either gone or obscured by later stonework and repointing. The cement plug at the head of the raceway, which incorporates a control valve, was added during 1999-2003 restoration of the mill.



The difference in orientation between the waterwheel raceway and the mill building is clearly evident in this foundation plan of the mill. A wooden flume inside the raceway would have directed the water flow in a straight line to the waterwheel. The open area between the east wall of the raceway and the south wall of the mill would have been filled in with wood, part of the waterhouse. Diagram adapted by Ken Watson from "Restoration of the Delta Mill and Turbine Shed – Phase II-R", Stantec Consulting Ltd, 2000.

Building the Mill – Flood Control – the Buffer Wall, Bywash & Bridge

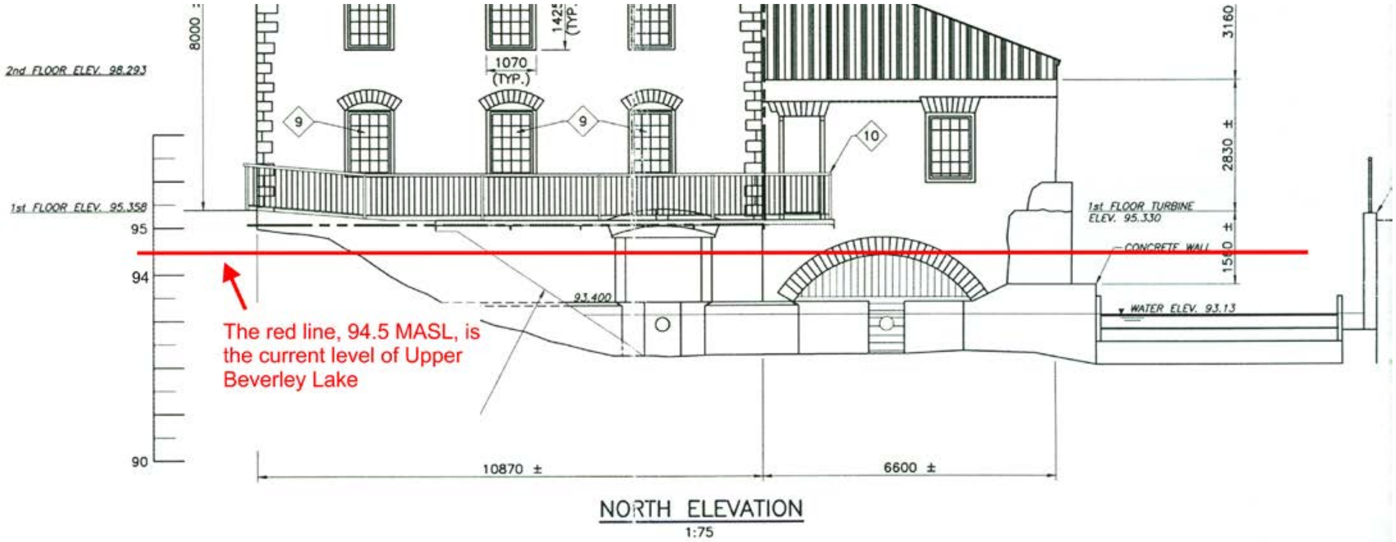
It's been noted that the mill acted as its own dam contrary to Oliver Evans' recommendation. In Evans' guide he states *"Let the dam and mill be a sufficient distance apart; so that the dam will not raise the water on the mill, in time of high flood."* The designer of the mill came up with a few solutions to the problem of flood water against the mill: the buffer wall, the bywash and possibly the bridge. It's unclear if the buffer wall feature had been used before with mills but it was a solution to "don't let uncontrolled water against your mill." The mill was vulnerable to anything Plum Hollow Creek and Upper Beverley Lake could throw at it including uprooted trees and other debris, as well as chunks of ice during spring (or even mid-winter) breakup. Those would eventually take a toll on the north wall of the mill, making for very expensive repairs.

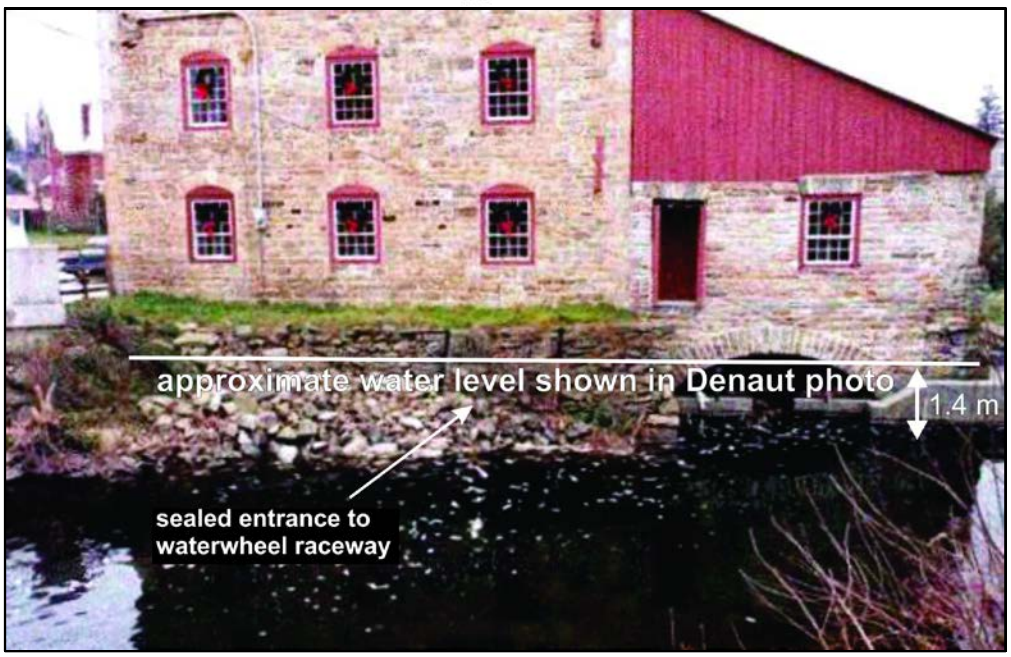


North side of the mill and the millpond c.early 1870s

This is the earliest photo we have of the Old Stone Mill. It shows the north side of the mill and the buffer wall that was positioned against the mill. The water in front of the mill is a bit below the current level of Upper Beverley Lake today (see diagram on next page), that height maintained by the stop-log dam in front of the bywash. On the upper right you can see stacked timber for the sawmill.

The people in the photo are unknown. The photo was taken by Walter Denaut's son Roderick who died in 1876 which dates the photo to sometime prior to 1876. Photo from "A History of the Old Stone Mill, Delta, Ontario", by Paul S. Fritz, The Delta Mill Society, 2000.





Water Level Against the North Wall of the Mill

In the top drawing, which is looking at the north (upstream) side of the mill, the vertical scale on the left is in metres above sea level (MASL). The red line is the current level of Upper Beverley Lake, which is 94.5 MASL. The bottom photo show a line positioned on a 1999 photo at the water level shown in c.early 1870s photo on the previous page. Note the two lines in relation to the headrace arch of the turbine raceway. It implies that the high water level caused by the mill was likely a just bit below the present day level of Upper Beverley Lake.

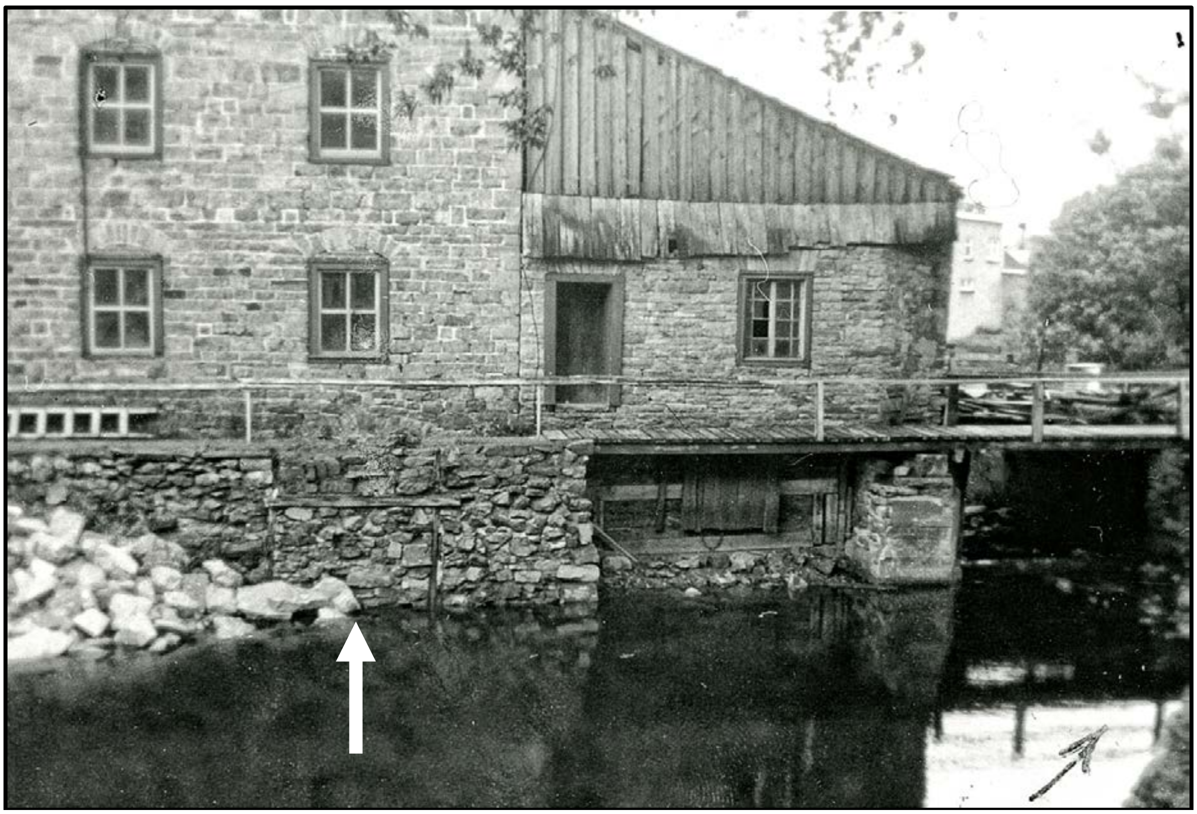
Information from MNR (Dale McLenaghan, 2009) stated that the water level of Upper Beverley Lake, controlled by the present MNR dam (built in 1962) was raised in the early 1990s by 6 inches. So the original level of the millpond (Upper Beverley Lake) was perhaps near the original dam level of 95.4 MASL. That's based on an assumption that MNR would have built their dam in 1962 to match the historic level (the Old Stone Mill dam raised level) of Upper Beverley Lake.

It's to be noted that the millpond level would fluctuate during the season. The miller would do his best, through the use of the stop-log dam at the head of the bywash, to hold the water level as high as he could without flooding the mill.

Diagram from "Restoration of the Delta Mill and Turbine Shed – Phase II-R", Stantec Consulting Ltd, 2000. Bottom photo was taken in 1999 at the start of restoration (DMS photo archives)

The Buffer Wall

One solution to preventing flood damage of the mill was the buffer wall, a stone wall extending out from the north side of the mill. We know exactly what the buffer wall looked like, the earliest photo we have of the mill (early 1870s – shown two pages previous) shows the north wall of the mill with the buffer wall. The wall was still in place when the mill shut down in 1960. The chronology of the buffer wall isn't certain, was the wall built in response to water/debris damage, or was it an original design feature? Archaeology in 1999 pointed to the latter, with evidence that a stone shelf that formed the base of the buffer wall was keyed to the mill's foundation (it was also mortared to bedrock). In addition, the buffer wall had an entrance to the waterwheel raceway, indicating it likely pre-dated the turbine shed. So it appears to be either an original feature, or a feature added early on when problems with water against the north wall were encountered, but its exact chronology remains uncertain.



North side of mill in mid-1960s

This is a view of the mill shortly after MNR built a dam upstream of the mill (in 1962). The stop log dam in front of the bywash (far right) and the portion of the buffer wall in front of the turbine headrace have both been removed. The rest of the buffer wall is intact, you can see the wooden boards in buffer wall outlining the entrance to the waterwheel headrace (the arrow is pointing to the location), this is the location of the original trash grate and likely wooden chute leading to a headgate and flume inside the waterwheel raceway. It was presumably sealed with stone sometime after the turbine shed was built and the waterwheel raceway no longer needed. The sawmill, which was located beside the turbine shed, no longer exists in this photo, it was torn down in the 1960s (just part of its floor remains in this photo).

This photo shows the present day level of the stream in front of the mill. Prior to the MNR dam, the water sat at level about a foot down from the top of the buffer wall (as shown in early 1870s Denaut photo). Photo by MNR (DMS digital archives).

The buffer wall was 2.2 m /7.2 ft thick, we know that exact number since archaeology in 1999 found the foundation base of a trash grate sitting 2.2 metres out from the north wall of the mill. A trash grate is a series of vertical posts to prevent any debris from entering the raceway of the mill. The trash grate sat at the front (north) face of the buffer wall (they are visible in both the 1870s photo and the c.1880 photo on the next page). While a headgate could have been in the buffer wall behind the trash grate, it is much more likely that the headgate was inside the headrace entrance of the mill, with a wooden chute though the buffer wall directing the water from the trash grate to the headgate and into to the wooden flume leading to the waterwheel. The headrace was blocked with concrete at some point (that plug was removed in 1999). There are some archaeological indications (mortise in a horizontal beam) that a headgate might have been positioned at the entrance to the millrace.

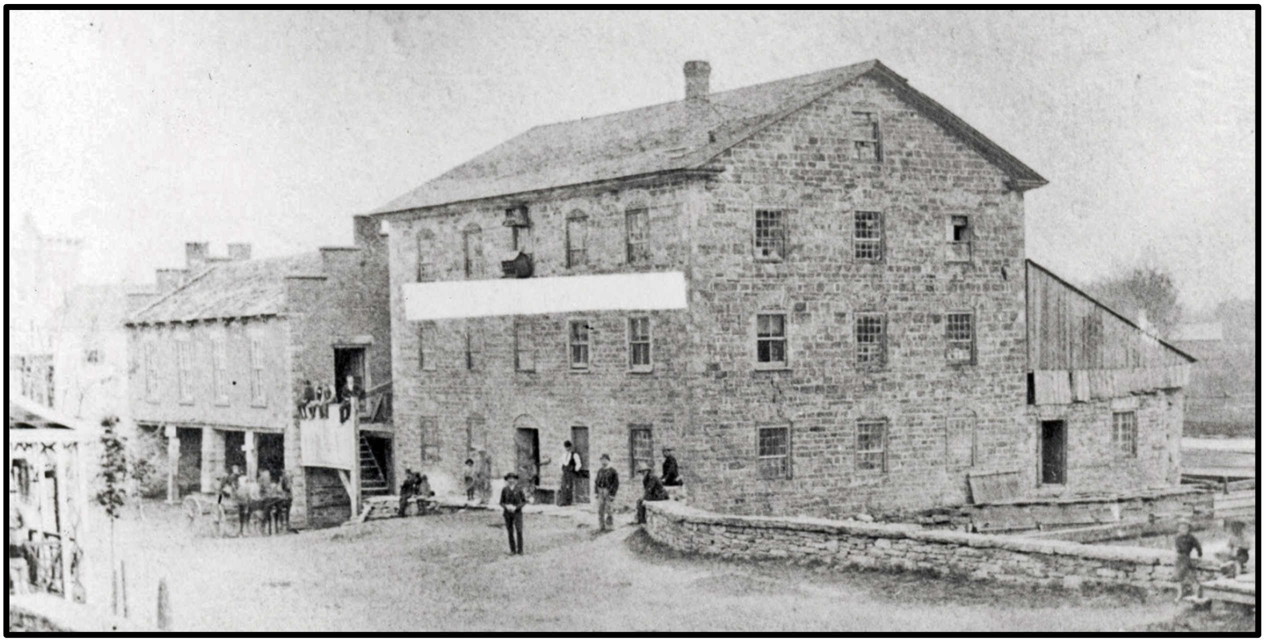
The depth of water in the 1870s photo is a bit below today's level of Upper Beverley Lake and evidence from the buffer wall and the height of the waterwheel headrace points to that also being the case for the mill/dam raised level of Upper Beverley Lake when the mill went into operation in 1812. When the later (c.1860) turbine shed with associated turbine raceway was built, the buffer wall was simply extended to cover the front of the turbine raceway.

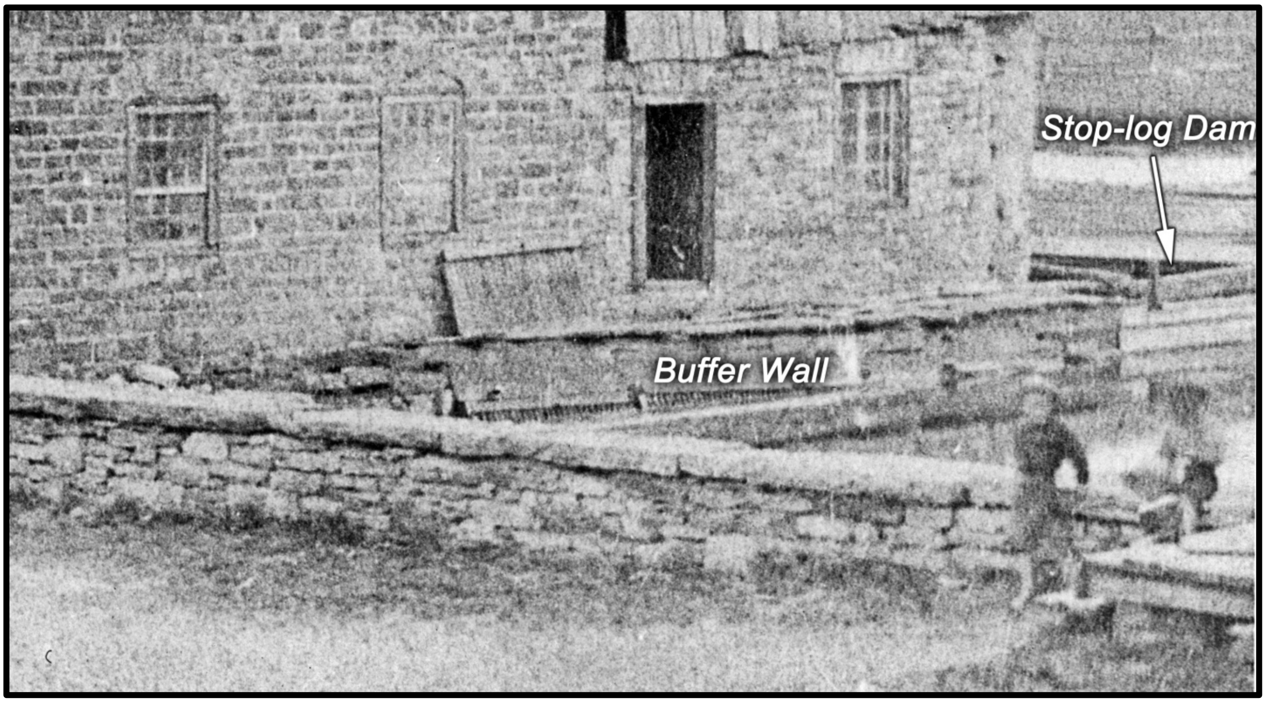
Today only a remnant of the buffer wall foundation remains. The buffer wall had to be removed for the 1999-2003 restoration and it was decided, in order to be able to see the waterwheel and turbine headraces, and for maintenance of the north wall, that it would not be replaced. It was a significant feature to the Old Stone Mill, speaking to the mill's place on the landscape and how a problem related to that was overcome.

The Bywash

Another water damage control feature was the bywash, the water bypass channel on the west side of the mill. Today's bywash is immediately adjacent to the turbine shed, the original bywash would likely have had the same configuration against the west wall of the mill. The turbine shed was likely built over the original bywash and a new bywash excavated in the early 1860s. The dimensions for the original bywash are likely very similar to the bywash today which is about 16 feet wide. The turbine raceway is about 13 feet wide, but the full original width may be obscured by the stone walls of the turbine shed (uncertain). Walter Denaut, when he built the turbine shed and new bywash, would have known how well the old bywash worked in terms of its capacity to control water levels against the mill.

At the front (head) of the bywash would have been a robust stop-log dam (aka weir), likely similar, if not identical, to the c.1860 stop log dam at the head of the new bywash built adjacent to the turbine shed. A mill always needs lots of water, but there are times when there was too much of a good thing. If the waterwheel raceway flooded it would, at the very least, damage the waterwheel and wreck some of the gearing. So the idea was to channel all excess water around the mill. Normally the top log would be set to the desired elevation of the mill pond, the excess water simply flowing over the top, into the bywash. In times of the spring freshet, or after a major rain event, more logs could be removed to increase the flow through the bywash and prevent the mill from flooding.





The Buffer Wall and Stop Log Dam

This photo, taken c.1880, is the second oldest image we have of the mill, known at the time as "Denaut's Mills" after owner Walter Denaut (who owned the mill from 1850 until his death in 1889). The photo, likely taken in mid-late summer, shows that the mill isn't operating, the water in the millpond is too low. The stop log dam in front of the bywash is sealed, trying to stop any water from escaping (Denaut was likely praying for rain to provide enough water to power his turbines). The lower photo is an enlargement of the lower right corner of the upper photo.

To the left of the mill in the top photo is the carriage shed and hall (brick upper storey) built by Denaut (likely in the 1850s). The brick upper storey was removed in the early 1960s. Photo from DMS digital archives.

The Bywash

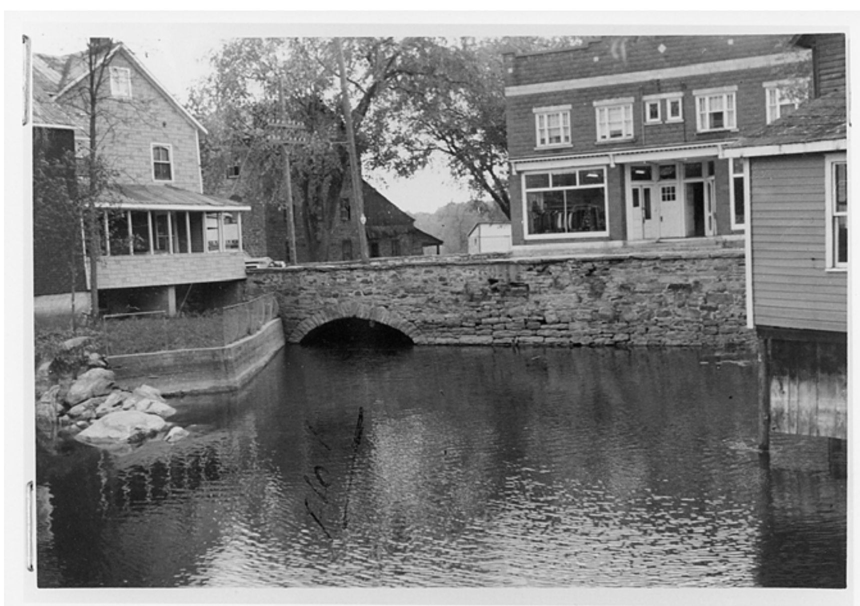
The top photo, taken in the early 1960s, shows part of the frame for the stop log dam (mostly dismantled at this point) that was located at the head of the bywash. The full height of Upper Beverley Lake was up against the mill at that time (see the previous 1870s photo). The stop-log dam at the head of the bywash controlled the level of Upper Beverley Lake, meaning the miller controlled the level of the lake since it was his millpond. With the mill no longer operating (closed in 1960), MNR took over water control, building a stop-log dam just upstream of the bridge in 1962. The original bedrock floor of the bywash (which can be seen in the top photo) was sealed with concrete in 1974-75. Photo by MNR (DMS digital archives).

The lower photo, taken on April 6, 2017, shows the effect of spring runoff and the reason for having a bywash, you don't want that much roaring water going through the mill. The miller would be aware of rising waters and remove logs in the stop-log dam to allow more water through the bywash, preventing the mill from flooding. The turbine shed, built c.1860, sits on top of the original 1810 bywash for the mill. The water level in this photo is a bit below the original operating level of the millpond (Upper Beverley Lake) which was to the top of the turbine archway entrance.

The Old Stone Bridge

An interesting feature related to the mill is the old stone bridge that used to cross the channel above the mill (replaced by the current bridge in 1963). A feature of that bridge was its very small opening. A normal bridge has large openings designed not to restrict water flow. A local example is the Lyndhurst stone bridge (photo on following pages), the three arch openings in that bridge are each over twice as large as the opening in the Delta stone bridge. A photo of the Delta stone bridge with the channel dewatered (shown on the following pages) shows the size of the opening, approximately 12 feet wide at the base, with the top of the arch about 6 feet above the bed of the channel. The current bywash (c.1860) for the mill is about 16 feet wide and this would likely have been about the width of the original bywash. The width of the bywash and the width of the bridge opening are close and that's likely not a coincidence.

The chronology of the stone bridge is uncertain. According to a memoir by a "Miss Allyn" (n.d.) *"I remember when the present bridge was built, taking the place of a narrower bridge with a wooden deck."* No date is given, but she was a child in the 1860s (she was "learning to write" in 1870) so that places the earliest date of that bridge to the 1860s or 1870s. Did the original 1810 bridge have this same water control function? The first "road map" of Delta, Joshua Jebb's 1816 map (shown on page 7), shows the present day dogleg configuration of the main road with a bridge in its current location. But that's not the early (pre-1810) road alignment through Delta, the original (Stevens' era) wooden bridge was located just a bit downstream of Able Stevens' mills (just upstream (east) of the confluence with Cowan's Creek) and this provided a straighter road alignment than we see today. Today's dogleg road through Delta is due to a new bridge being built upstream of the mill in 1810-11.



Old Stone Bridge, early 1960s

In this photo, likely taken in 1961 or 1962 just before the channel was dewatered (see following pages), it shows the channel filled with water, the mill (visible in the background) acting as a dam. The normal operating level of the mill (which is shut down at this point) was higher than this water level, staining on the bridge and adjacent structures shows the original "mill pond" operating level, just a bit below the top of the arch opening of the bridge. Photo by MNR (DMS digital archives).

When the mill was built, the downstream bridge was abandoned and replaced with an upstream bridge. Why? One obvious reason was to take the road around the front of the mill for ease of access by farmer's wagons and other customers of the mill, the bridge allowing road access from both north and south. But that doesn't explain the small opening in the stone bridge. That bridge, in times of flood, would have acted as both a dam and as a water flow regulator, only allowing as much water flow as the mill's bywash could handle. That appears to be a deliberate design feature.

The top of the arch was near the present level of Upper Beverley Lake, 94.5 MASL (310 FASL). The top of the bridge was about 6 feet about the arch, approximately 316 FASL (deck level of bridge about 313 FASL). Today, Delta starts to flood when the level of Upper Beverley Lake reaches 94.7 MASL (310.7 FASL) and extreme flooding starts at 94.9 MASL (311.4 FALS). So the top or even the deck of the bridge were never at risk of being flooded since water could never reach those levels, long before that it would start to flood Delta (but not the mill), following its old channel down Recreation Drive (as it has done several times in Delta's history, most recently in 2005).

Did the original bridge, perhaps a wooden bridge (it had a wooden deck, but that doesn't necessarily mean the entire bridge was wood) serve this same function? Whether built from wood or stone, or a perhaps a combination, stone abutments with a short wooden span over the channel, it could have served the same function as the later stone bridge, as a dam and a water flow regulator. We can't say for sure, the later stone bridge (1860s/1870s) might have been built in response to water problems. Or it might have simply followed the design of the original bridge, with a small opening to regulate water flow.

It's an ingenious idea, one necessitated by the fact that the mill was acting as its own dam. It's unfortunate that the bridge was demolished; Delta and the mill lost a significant part of their history when the bridge was torn down in 1963 and replaced by the current concrete bridge. There is no known archaeology that was done on the bridge prior to demolition, so we can only infer information based on maps and a few photos.

As a bit of an aside, in the "Building the Mill – People & Materials" section, the names Isaac Whaley (b.1810) and Jasper Russel (b.1817) appear, with local lore crediting them as working on the 1810 mill. The source for that is a 1960 newspaper article (Athens Reporter) which credits these fellows as working on both the mill and the old stone bridge. It is possible that Whaley and Russel did work on the c.1860s/1870s bridge. The author of the newspaper article may have made an assumption that the stone bridge dated to the mill, but we now know that the stone bridge (the one torn down in 1963) was built in the 1860s or later.

As noted in Building the Mill – People & Materials, it is speculated that perhaps Isaac Walley's father (name presently unknown) may have come up from the US to work on the mill as a mason (to fit the story that L. Hill's great-grandfather worked on the mill – his maternal grandfather was Isaac Whaley). But we have no concrete evidence of that. Jasper Russel was a local brick maker and it was his bricks that were used in the building of the Old Town Hall (1880), a building which is now owned by the Delta Mill Society.

Delta Stone Bridge & Lyndhurst Stone Bridge

The small opening of the old stone bridge in Delta (top photo) is in contrast to the three large openings (each about twice the width of the Delta bridge opening) in the Lyndhurst Stone Bridge (built 1856-57) which was designed not to restrict water flow. The Lyndhurst bridge sits on the dam raised level of Lyndhurst Creek (level of Lower Beverley Lake). In 1986 the Lyndhurst bridge was retrofitted with load bearing concrete slabs for the deck, the stone arches no longer provide a supporting function. Top photo MNR, bottom Ken W. Watson.

The Old Stone Bridge and Dewatered Channel in 1962

In these photos, taken in 1962, the channel has been dewatered (coffer dammed) in preparation for building a new dam (pretty much where the fellow in the middle of the channel in the lower photo is located).

The difference in stone colour marks the high water level held by the mill – the stones above are mortared, the stones below have no mortar. They may originally have been and the lack of mortar simply represents 100 years of erosion (as opposed to dry laid stone), while the above water portion was re-pointed over the years.

In the top photo which is the mill side of the bridge (photo is looking east), you can see bedrock on the left (north) and a stone pier beside the arch opening on the right (south) – an erosion control feature which prevented backwater eddies from eroding the base of the arch in that location.

In times of flood the arch opening would have been completely underwater, the bridge then acting as a water control dam. There is about 5 feet of flood guard above the arch. The bridge deck couldn't be flooded since before the water reached that level, it would be flooding Delta (we have examples of that over the years including a major flood in 1935), the water from Upper Beverley Lake reverting back to its original course (along Recreation Drive).

The small opening in the bridge would also have prevented large sheets of ice or large flood-eroded trees from coming through the bridge and up against the mill. This bridge was built in the 1860s/70s, replacing the original, narrower bridge (construction details unknown). Did the original bridge in this location serve the same function? We don't know. (photos by MNR, DMS Digital Archives)

Building the Mill – The Waterwheel

Everything in the mill revolves around the waterwheel. The wheel provides rotational power which, in 1810-11, was transferred to all the machinery in the mill by direct connection using shafts and gears (all wooden). Belt technology for the mechanical transfer of power wouldn't be invented until the 1820s and may not have appeared in the mill until the 1850s or 60s.

The waterwheel is the most important feature of any mill. Its size and location determines where the millstones have to be located. Those stones sit on a separate internal foundation known as a husk. Under the husk is the gearing that makes each set of stones turn, that gearing is powered by the main axle shaft from the waterwheel (this will be discussed later).

Demonstration Waterwheel

The waterwheel we have in the mill today is a bit smaller than the original and it's powered by the water pumped up by a sump pump. Our waterwheel has a thin metal axle, the original wheel had a thick (~16 inch) wooden axle which extended towards the millstones to power all the equipment in the mill. Turbines replaced the waterwheel in about 1860 and what used to be the west wall of the mill then became a wall between the mill and the turbine shed.

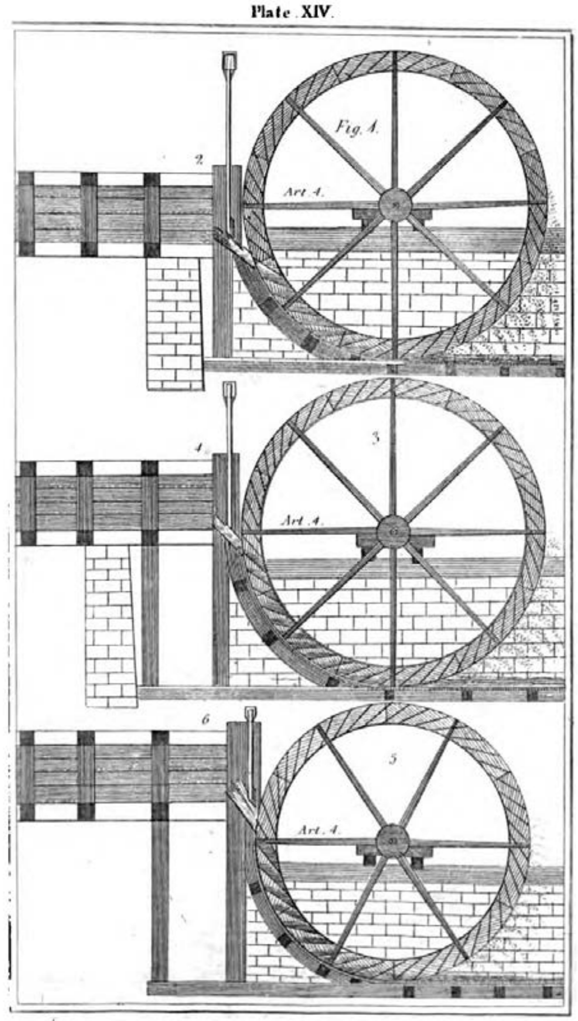
While the original waterwheel is long gone and the original husk moved, we do have images of what those would have looked in 1810-11 from Oliver Evans' book. Before we get into that, we need to look at the waterwheel itself. There are three general types of waterwheels; an overshot wheel where the water flows to the top of the wheel, a breastshot wheel, where the water is introduced about mid-level to the wheel and an undershot wheel where the water hits the bottom of the wheel. The best is the overshot which can capture about 60% of the water's energy. The available hydraulic head of water determines what type of wheel can be used. In general, if 10 feet or more of head is available, an overshot wheel can be used. If between 6 and 10 feet of head, then a breastshot wheel is used and if the head is under 6 feet, then an undershot wheel is used.

The energy of water is defined by its volume and head, the latter being the difference between the level of water at the top of the falls or rapids, and the level into which that water flows. In Delta, the maximum head for a dam-raised Upper Beverley Lake was about 9 feet. That number though is clouded a bit by the uncertainty regarding the level of Lower Beverley

Lake, which today is dam raised (at Lyndhurst) by about 4.75 feet. The c.1860 installation of the turbines is consistent with that dam-raised level of Lower Beverley Lake, but the level of the lake in 1810 in a bit uncertain. We do however know the exact elevation of the tailrace bedrock and that, together with the type of waterwheel, gives us some clues.

A breastshot waterwheel, such as the one used in the Old Stone Mill, while somewhat tolerant of backwater due its direction of rotation, is ideally placed above the low water level of the receiving water. Having the bottom of the wheel in standing water slows it down and too much standing water will stop it. We know the bedrock elevation of the waterwheel tailrace, the exit for the water. It sits at 91.3 metres above sea level (MASL) or 299.5 feet above sea level (FASL). This is 3 feet higher than the bedrock elevation at the head of the falls in Lyndhurst (90.4 MASL / 296.5 FASL), indicating a partially dam raised lake in 1810, otherwise they would have likely excavated the tailrace to a lower level, presumably to or near the bedrock elevation of the head of the falls at Lyndhurst, the exit of Lower Beverley Lake. The level of Lower Beverley Lake would fluctuate with the season, in times of drought it would be close to the level of the physical barrier at Lyndhurst, either the natural barrier (bedrock) or a man-made barrier (dam). The designer of the mill would have been familiar with the seasonal levels of both Upper and Lower Beverley lakes.

The other number we have to play with is the length of space available for a waterwheel inside the waterhouse, which is 13.2 feet, the distance from wooden supports near the head of the waterhouse area (assumed to be the downstream end of the flume) to the southern wall. A large waterwheel can produce more "momentum" rotational power. So, with the same head, a large breastshot wheel can provide more power than an overshot wheel half the size (both using the same head of water). In general, a minimum diameter of 10 feet for a waterwheel was desired. Putting all that together with the various water levels indicates an original waterwheel of about 12 feet in diameter (today's demonstration wheel is a bit smaller at



Breastshot Waterwheels

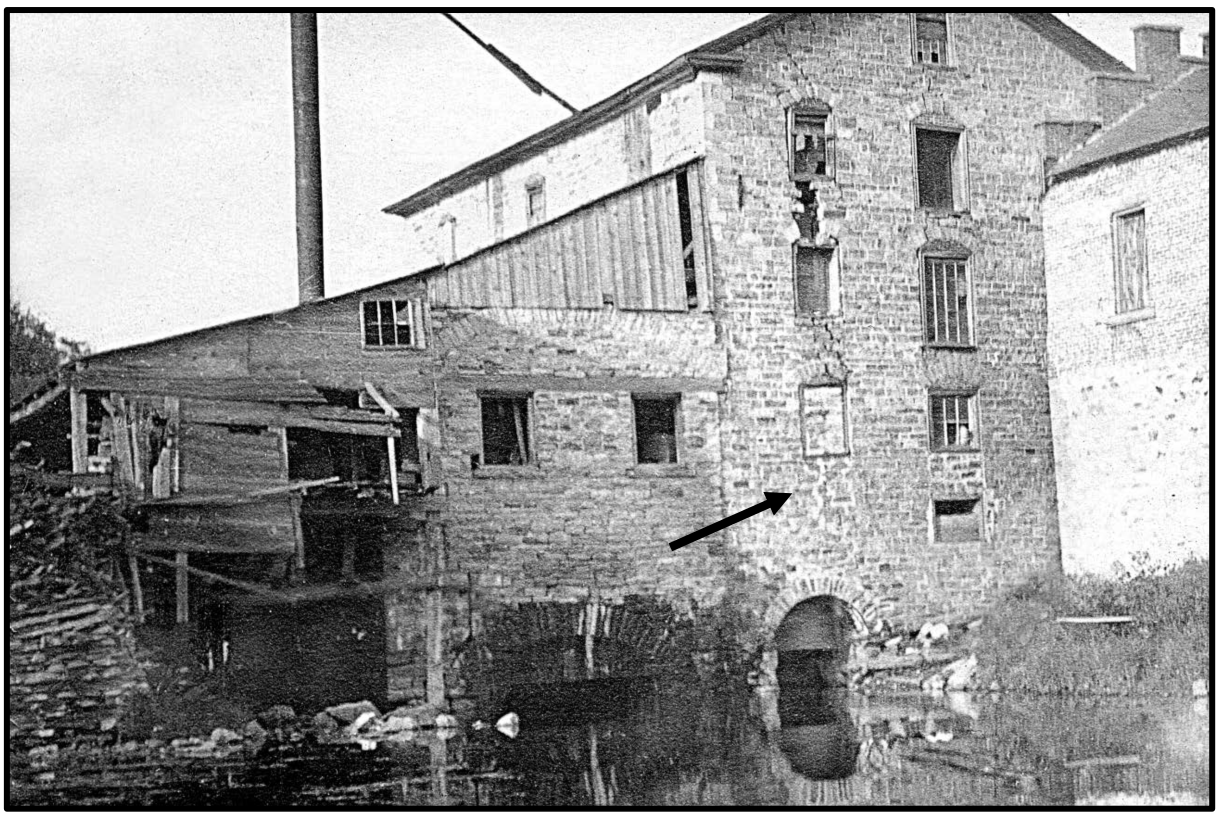
Oliver Evans' diagram showing various types of breastshot wheels. They show a wooden flume leading to the wheel, the water arriving at different levels. The bottom of the wheel rotates in the direction of the water flow unlike an overshot wheel where the bottom of the wheel rotates against the direction of water flow. Hence while an overshot wheel cannot be in any depth of standing water (it would slow down or stop the wheel), a breastshot wheel, while ideally placed above the level of the receiving water, is a bit tolerant of backwater which can be caused by fluctuating levels of the receiving water.

From *The Young Mill-Wright and Miller's Guide* by Oliver Evans.

10 feet). With a net head in the order of 7 feet, it would have been a breastshot water wheel, the water arriving near the centerline of the wheel, the bottom of the wheel spinning in the direction of the water flow. This would have captured about 45% of the power of the water.

Oliver Evan's recommended that the waterwheel be put in an enclosed room inside the mill called a waterhouse. One of the reasons for this was to be able to more easily keep the wheel ice free in winter since the enclosure could be heated (the rest of the mill, outside of the enclosed office, was not). Its other purpose was flood control – water would be contained in the raceway and waterhouse and not flood into the mill. Most direct evidence for a waterhouse is now long gone, but there are some features, including a doorway on the south wall behind the waterwheel (later filled in to become a window, then taken back to a door during 1999-2003 restoration), that are consistent with the Evans design for a waterhouse. It has been assumed (Scheinman) that there likely was a waterhouse in the original mill.

The type of wheel, its elevation and placement now set the stage for everything else in the mill.



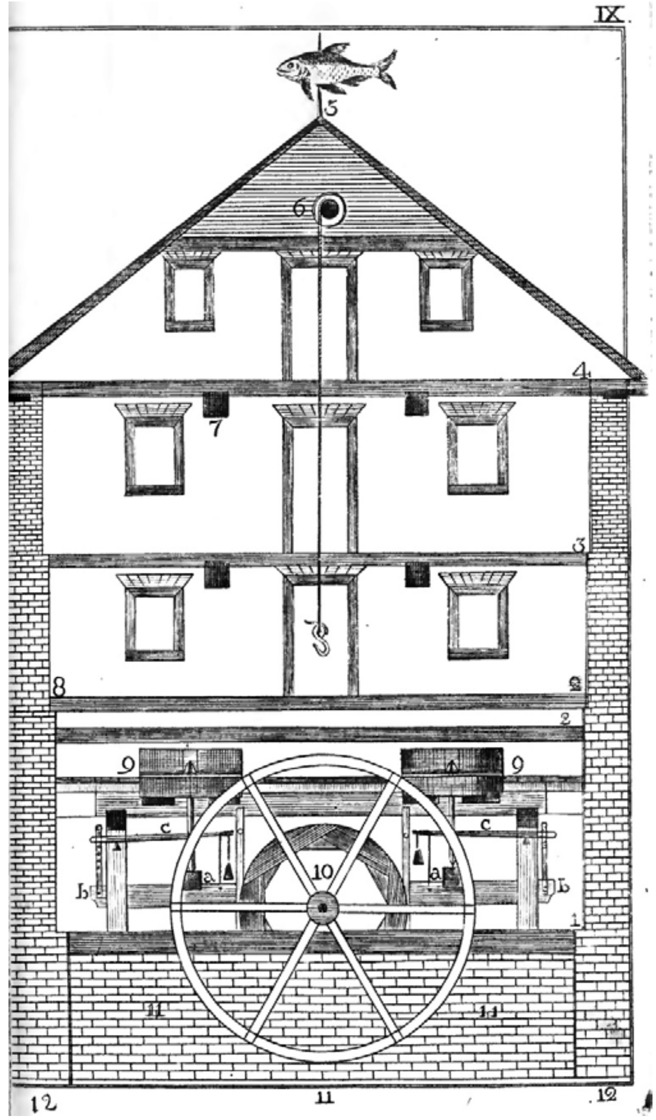
Old Stone Mill c.1900

In this c.1900 photo of the south side of the mill, the original first floor door (likely into the waterhouse) above the waterwheel tailrace has been converted to a window (arrow is pointing to that location), likely done when the turbine shed was built (c.1860) and the waterhouse removed. Two original doors to the right (1^{st} & 2^{nd} floor doors) have also been converted to windows. Those three original doors were restored during the 1999-2003 restoration of the Old Stone Mill. To the left is the sawmill, a wooden structure built up against the turbine shed and sharing the same roofline. Photo from DMS digital archives.

Building the Mill – The Foundation Walls

With the area excavated down to competent bedrock and the walls of the raceway built, the cornerstones for the foundation were laid. Those stones were laid to give the mill an exact north-south-east-west alignment even though it skewed the mill from the alignment of the waterwheel raceway. It's unclear why that is, other than a supposition that it may, as previously noted, be tied to a freemasonry belief to have the entrance door face due east. It was clearly a deliberate decision on the part of the millwright and/or Jones and Schofield. In a memoriam after his death in 1864, Ira Schofield was described as a "most zealous Freemason." Jones likely was as well (most men of status were Freemasons in that period).

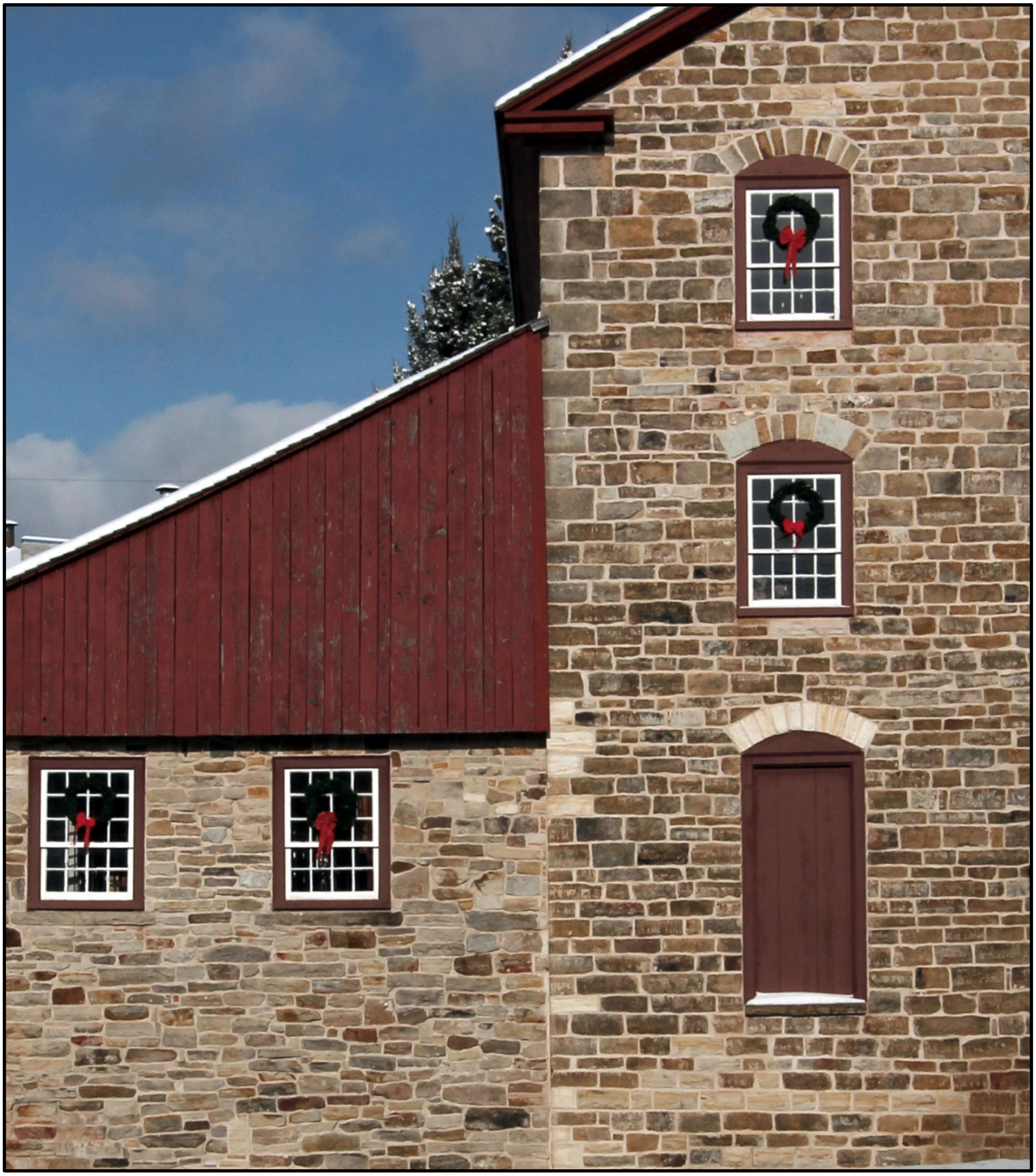
The stones excavated for the new stream channel and for the bywash and raceway weren't suitable as building stone, they were generally fractured and irregular in shape, not features you want in building stone. That excavated stone didn't move far, initially to the edge of the original stream channel, and then later into that stream channel to block it off and fill it in when the water flow was switched to the new channel leading to the mill. Only a few pieces of flat stone from that excavation remain, stacked against the inner south wall of the mill.



Oliver Evans' Automatic Mill

This image from Evans' book is very similar to the south face of the Old Stone Mill, doors in the centre allowing heavy equipment to be lifted up to each floor of the mill. Our waterwheel is 90 degrees to the one shown in this diagram but the concept is the similar. Two millstones are shown sitting on an elevated wooden foundation, the husk, with its foundation separate from that of the mill.

Most of the stone used for building the walls of the mill are Potsdam sandstone which was likely quarried within 5 km of the mill (see the detailed Geology Map on pg.25). Several of the sandstone blocks used for the mill have a unique assemblage of fossil traces (vertical tubes known as Skolithus and U-shaped burrows known as Diplocraterion) and this clue may eventually lead to the location of at least some of the original quarries. Given the variations in the stone, several quarries may have been used. These may not have been quarries in the conventional sense, a deep hole in the ground, but rather the removal of a layer or two of competent sandstone from several areas. There is a lot of sandstone available nearby, but only limited amounts that would be competent enough for use as building stone.



Detail of South Side of Old Stone Mill

We can see the contrast in stonework between the 1810-11 mill (right) and the c.1860 turbine shed (left) – the mill exhibits more consistency in stone size and, on average, more iron rich sandstone (rust coloured). Both walls exhibit the use of natural stone, minimally worked. The lower door (1^{st} floor) of the mill was restored during 1999-2003 restoration, the arch over the door not made from the original stones. A few of the stones on the south mill wall (lighter coloured) are replacement stones added during 1999-2003 restoration. Photo by Ken W. Watson

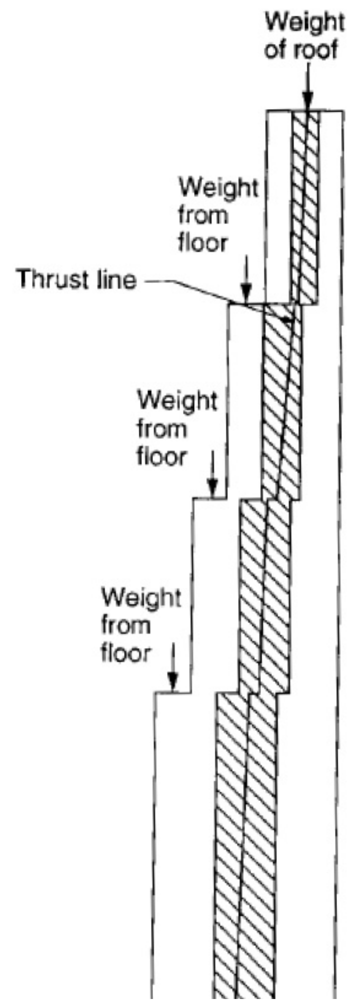
If the model for the Rideau Canal (1826-1831) was used, rough quarried stone (not finished in any way) would be brought to the building site. Once there, the mason would choose which stones he wanted to use for each layer of stone in the building, ideally achieving a consistency of height for each of those layers. While Georgian architecture specifies a regularity of stonework, this wasn't an option for the Old Stone Mill, the mason had to make do with what was locally available. The mill walls exhibit an irregularity of stone size characteristic of natural stone, minimally finished. We don't know the location of the quarries. Some have suggested the Philipville area, a road may have gone through that area (heading to Rideau Lake) at that time (it existed in 1816, the original road date is unknown). They may not even have even been quarries in the usually sense, local farmers may have been involved, bringing in stone from their lands and being paid for any stones that were used in the construction of the mill. This would have been the least expensive and most efficient way to obtain building stone for the mill in that time period. But purpose quarries could also have been used.

The mill walls are thick (2 to 3 feet) and were built using stacked layers of minimally shaped stone with rubble fill in between. This is known as "two wythe construction," a standard stone building technique with essentially a separate outer wall and inner wall. We can look to Oliver Evans' recommendation to see how it may have been done:

1. To lay the foundations with large, good stones, so deep as to be out of danger of being undermined, in case of such an accident as the water breaking through at the mill.
2. Set the centre of gravity, or weight of the wall, on the centre of its foundation.
3. Use good mortar, and it will, in time, become as hard as stone.
4. Arch over all the windows, doors, &c
5. Tie them well together by the timbers of the floors.

With his first recommendation, the foundation stones are on excavated bedrock to provide an erosion resistant foundation. The base of the walls follow the shape of the underlying bedrock, this is very evident in the east wall of the mill where the wall follows the topography of the bedrock as it rises to the north.

The outer wall leans in just a bit (a battered profile) and the inner wall is stepped back (so thicker at the bottom than the top), providing ledges at each floor level for the floor support beams. This serves to ensure that the thrust line (line of compressive forces) of the wall is inside the wall, not outside (which would cause the wall to eventually fall).



Cross section of a stone wall showing two wythe construction. From Lecture Plan CE 479 Fall 2012 ▫ Design of Building Components and Systems by J. Liu, Purdue

The mortar was made using local crystalline limestone. A lime kiln would have been built in Delta to produce the lime. The quality of the local crystalline limestone in the region of the mill is very good (few impurities), it would have produced a good quality lime.

The arches over the doors and windows, as noted in Oliver's recommendation, are for structural strength. Oliver's recommendation number five notes the structural purpose of the large timber floor beams (in addition to their job of supporting the floor). The weight of those beams (with the floor & equipment) also helps keep the thrust line inside the wall (see diagram on previous page).

At the west end of the south wall is an opening behind the waterwheel to allow the free flow of water back into the mill stream (the tailrace arch). It has an arched top to help throw the weight of the building above it to stones that are founded in bedrock on either side. Today, fill from the rubble foundation of the drive shed, material from the removal of the brick second storey of the drive shed (1960s), and rip rap, now obscures the original exit channel (outside the mill) for the water from the waterwheel raceway.

The Waterwheel Tailrace Arch

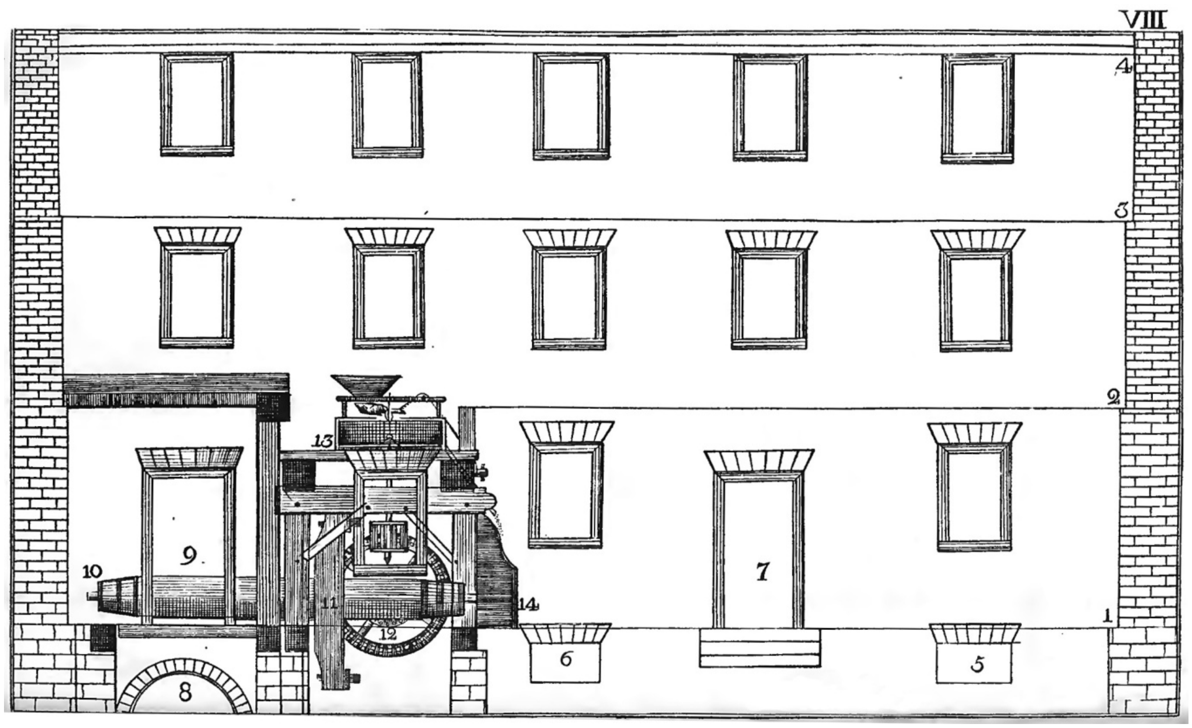
This is the exit opening for the water behind the waterwheel. You can see bedrock on the left (east) side which has been excavated down to form part of the east wall of the tailrace. The tailrace was excavated into that bedrock, the right side is the original 1810 west wall of the mill which is sitting on excavated bedrock.

Building the Mill – The Husk

Note: this section focuses on the foundation for the millstones – more detailed discussion about the millstones and how they work can be found in the "Building the Mill – The Equipment" section.

The husk is an independent foundation for the millstones built out of robust timber. It helps to solve two problems. One is that stone walls and vibrating machinery don't mix well, in that contest the stone wall inevitably come out the loser. A partial solution is to remove the greatest source of that vibration, the millstones and the gearing associated with them. The husk, with its timbers founded in bedrock, help to isolate those vibrations. Vibrations induced by the millstones and gearing into the husk are channelled to bedrock, not into the walls of the mill. The second problem is keeping the millstones perfectly level. The horizontal level of the husk can be adjusted independent of any settling of the building.

The husk, when the mill shut down in 1960, was located at first floor level, but that was due to a move in the early 20th century (c.1922). The original husk was likely elevated by 6 or 7 feet above the level of the first floor as shown in Evans' guide. There would have been an open space, no second floor, above it. Evidence for this still exists in the fact that the main first true floor beam for the second floor level is 17 feet from the south wall, the space between that and



Oliver Evans' Automatic Mill

Another image from Evans' book. On the lower left is the waterhouse, housing the waterwheel. The large axle shaft (below the number 9), in the order of 16 inches in diameter for a 12 foot waterwheel, is visible extending to connect to gearing below the millstones. Those stones sit on a husk which in this diagram is just below the level of the second floor. The reason for elevating the husk is to provide room for all the required gearing connecting the waterwheel to the millstones. It is believed that the original Old Stone Mill had a very similar configuration to this, although our waterwheel is 90 degrees to the one shown in this diagram (see foundation plan for the mill on page 30).

the south wall originally had no 2nd floor (it was the open space above the husk area). Also one of the support columns in that same area is two floors high, indicating there was no second floor in that location. The main reason for the elevation of the husk is to provide room for all the gearing below the millstones. The mill was originally built with two sets of millstones on the husk, although at one point, in 1837-39*, it had three sets in operation.

The husk sat directly on bedrock, thick timber posts supporting the weight of the floor and millstones. The bedstone, which doesn't rotate, was set almost flush with the floor of the husk, the rotating runner stone sitting above it, supported by a spindle.

Millstones, Waterwheel and Husk

In this 2010 photo our French burrstones sit on our new husk (the wooden collar for the bedstone has yet to be installed – see photo two pages down for finished configuration). In operation these stones aren't visible since a wooden vat with hopper on top is in place over the stones to feed the grain to the stones and to capture the ground flour, which then falls down to an elevator that carries the flour up to the attic of the mill. The top millstone, the runner stone, sits on a spindle, the gap between the upper and lower stone controlled by the tentering wheel shown just ahead of the stones. The main foundation posts for the husk sit on bedrock. Originally the large axle of the waterwheel would transfer the rotational power of the wheel to the millstones. Today we power our millstones with an electric motor since we don't have the water rights. Today only a small amount of water gets let into the waterwheel raceway. However it is enough to rotate our wheel (with the aid of a sump pump) so that visitors can see how a waterwheel works.

* the source of the dates, "A History of Grist Mill in Delta" states that the mill re-opened in 1837 with 3 sets of stones. But the listed assessment in that book shows only 1 additional run in 1837 (2 sets) with 2 additional runs shown for 1838 & 1839 (3 runs).

Today's Husk, viewed from below

Our new husk was built in 2010. In this 2017 photo we're under the mill looking north, the waterwheel and raceway are to the left (you can see a person standing in the raceway), the husk and the electric motor that turns our millstones on the right. The large timber posts that support the floor of the husk are themselves supported by a steel I-beam that sits on a stone pier foundation (north) and bedrock (just out of sight on the right side of the photo). The original husk was of course an all wooden structure. The white just visible over the motor assembly is the bottom of the bedstone which is inset into the floor of the husk (see photo on previous page).

French Burr Millstones on the Husk

In this 2012 photo our French burrstones are being dressed (sharpened). Chris Wooding is using a millbill (a specialized pick) to sharpen the grooves. Art Shaw is in the background. Both were being instructed in millstone dressing by expert miller, Roland Tetrault.

The static (unmoving) bedstone sits in the floor of the husk. The top stone (left), the runner stone, has been lifted from the top of the bedstone so that it too can be dressed. The stone is constructed from several pieces of burrstone (a quartz rich rock), tightly fit and bound around the outside with an iron band. The base of the stones is cemented into plaster. We have a second set of French burrstones on display which show these features. The runner stone sits on a rotating spindle, originally powered by the waterwheel, then later a turbine and today powered by an electric motor. In the foreground you can see a hole in the wooden collar of the bedstone (the white arrow points to that location). The freshly round flour falls through this hole to the flour elevator.

The original husk was 6 to 7 feet higher, almost to the level of the second floor. It accommodated two sets of millstones. It was modified in 1836 to allow for a third set of stones. That only lasted from 1837 to 1839 before returning to two sets of stones. When the turbine shed was built c.1860, the husk remained at the same elevation but was likely extended to the original west wall of the mill (over the former waterwheel area) to shorten the distance for the power transfer belts from the turbines. Slits in the wall between the turbine shed and original mill show where those belts were located. In 1922 the husk was lowered to the level of the first floor to make it easier to use the mill for animal feed production (chopper mills).

As the husk was built, so were the first floor foundation walls and the first floor itself. The floor is supported by three large transverse beams (squared timber) which are themselves supported by the stone wall of the mills, the stone walls of the raceway, and stone piers located where required to support the weight of the floor and much of the interior building above it.

The timber for the husk and other wooden elements in the mill was sourced locally. The assemblage of trees was similar to what is available today, pine, oak, and maple predominating. White pine was preferred for areas that would stay dry; it had straight grain and was more easily worked using period tools than either oak or maple. Large old growth white pine would have been easily available, any on or near Lower Beverley Lake and the lower portion of the White Fish River (today's Morton Creek) could have been floated up the creek (today's Mill Creek/Delta Creek) to the mill's construction site. The timbers in the mill are tight-grained white pine. For wet areas, Evans' recommended the use "of good white oak or other timber that will last in damp places" for the waterwheel and waterhouse, but those wooden structures are long gone, so the type of wood used for their construction is unknown. Other "wet" items such as the flume may have been made out of white oak. Items such a wooden gearing that needed extra strength may have been made with a hardwood such as maple or beech.

Trees were felled by axes (saws for tree felling didn't come into use until much later). Axes were also used to create squared timber, in fact the "square timber trade" as it was known continued until the late 1800s. Adzes were used for timbers, such as support columns, where a better quality of finish was desired. Planks for the floor of the husk and the floors of mill may have been cut at the local sawmill. Ira Schofield was assessed for a sawmill in 1810, likely Stevens' old sawmill, it could have been producing material for the construction of the mill. In fact if the idea for the Old Stone Mill was the reason for Jones' purchase of the land and mills from Stevens in 1808, the sawmill could have started producing materials at that time, giving a bit of time for the wood to season. Acquisition of large timbers (axe shaped) could also have started as early as 1808.

At the same time the waterwheel and husk were being positioned, the outer walls up to the level of the first floor were being built. The tailrace opening has been mentioned, but there also was a headrace entry, a rectangular opening with an arched stone top. The waterwheel raceway was not intended to be filled with water, rather it would have contained a wooden flume that directed water to the waterwheel. There would have been a headgate, a water control gate to moderate the flow of water to the waterwheel. It was most likely positioned inside the mill at the head of the raceway.

In the early archaeology reports there is a bit of debate about the raceway since so little wooden evidence remains. Remains of what appeared to be wooden support posts where the raceway enters the waterhouse were originally interpreted to be a headgate in an open raceway (no flume). However later interpretation, based on more knowledge of Oliver Evans' design, suggested both a waterhouse and flume. It is now fairly conclusive that a flume must have existed, not only does it match the Evans' design, it also makes the most logical sense.

Building the Mill – The Rest of the Building

The building itself uses a Georgian style of architecture adapted to an industrial purpose. It is described as having "five-bay façades with three-bay end elevations" a fancy way of saying that it has five sets of windows along the front side with three sets along the end sides. The south end features doors in the middle instead of windows, facilitating the addition and removal of heavy equipment from each floor. These features are all part of the Evans' automatic mill design (see the illustration from Evans' guide in the Foundation section).

South Wall of Mill

This photo shows the doors on the first, second and third floor levels of the mill. A shaft supporting a block and tackle would have been used from the attic, going out the attic window. There are some indications that the top opening was not originally a window, but rather a circular opening, purpose designed for such as shaft, as shown in Oliver Evans' diagram (see page 43).

The Georgian style incorporated architectural features to add decorative elements to the building. While the likely desired regularity of stonework was not achieved (due to the nature of the local stones), the twelve-over eight pane windows and the stone voussoirs (shaped stones that make up the arches over doors and windows) speak to a desire to make the building as attractive as it was functional (the arches themselves are functional, how those arches are constructed adds to the attractiveness of the building). Other architectural elements include the low-pitched, gabled roof covered with wood shingles, the projecting eaves and verges along the roofline, wood trim around the windows and doors, the recessed doorway in the centre of the front façade and the segmental structural opening on the doorways on the front façade.

The internal frame of the building was raised, floor by floor until the roof support structure, which incorporates some of the most interesting architecture in the mill, was built. In addition to large axe-hewn beams and timbers (the characteristic chatter marks of the axe shaped timbers still visible on the beams today), support columns were placed at intervals to support beams on the second and third floors. The original columns were aligned with (sat on top of) stone piers in the basement that helped to support the first floor beams. We see greater finishing work on the columns than the beams, adzes likely used to provide the finished shape.

It is presumed that the floor planking was one of the final things to be done and that the mechanical gearing for power from the waterwheel, plus the elevators and conveyors, were put in place without floors to get in the way. Although we describe the mill as being 3 ½ storeys tall, there were actually four floors since the "attic" was originally floored. During restoration most of that floor was not restored in order to provide a better view of the roof structure. It is in the roof support structure that we see some very interesting features.

The most obvious is the single piece ridgepole (aka spine beam) that runs the length of the building. It is 50 feet long, five sided, 14" x 8" in dimension, made from a single tree. The five sides all have functions, the top two sides match the angle of the roofline, the next two sides are for the rafters to butt into (mortised into) and the fifth side (the bottom) provides a flat face for support columns. In addition, the ridgepole and rafters are supported at each end by a set of wind braces, which provide diagonal bracing, keeping the roof from swaying, even in high winds (photos on following pages).

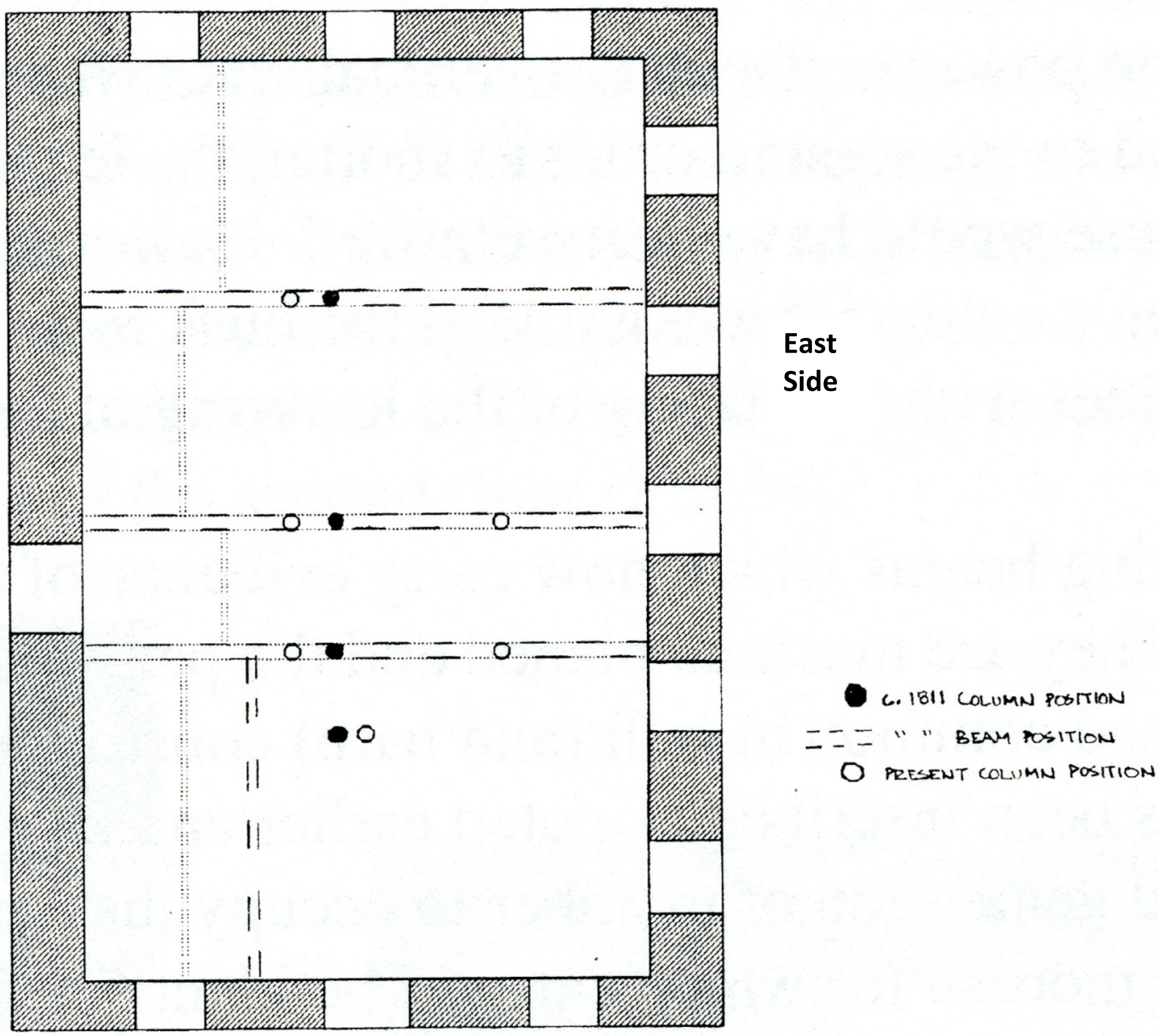
The robust timber purlins (large timbers running lengthways halfway between the ridgepole and upper wall) are themselves supported by queen post trusses (aka queen beams) sitting on some of the joists. This is another structural feature that helps to lock in the roof. These various large beams are doweled into place, all of those along the ridgepole using tree nails, a wooden dowel with a pointed end.

These features attest to the carpentry skill of the millwright. The five-sided ridgepole is a Dutch design feature, the wind braces are an English design feature and the queen post trusses are of German design. All work in harmony and have helped keep the roof intact for over 200 years.

Left: Wind supports (diagonal bracing) on either side of the ridgepole. **Right:** Queen beam (angled post support of the purlin (horizontal roof support beam).

West Side

East Side



FIRST FLOOR PLAN (2ND FLR. FRAMING) c. 1811
1:50

FIG. 26

Support Columns and beams

This sketch from the 1996 conservation report shows the location of the original 1810-11 support columns (black dots) and the present column positions (open circles). Those columns helped to hold up the massive support beams under each floor. Stone piers founded on bedrock sit below the location of the columns. Column positions were moved during renovations done by Walter Denaut in the 1850s and 1860s. The front of the building (east side) is to the right. The left side, the original west wall of the 1810-11 mill, is now the wall between the original mill and the turbine shed addition (c.1860). Sketch by André Scheinman.

Axe squared timbers on the 3rd Floor of the Mill

The large square timbers of the mill were shaped using axes, the "chatter marks" of those axes still evident on the timbers today. The creation of large squared timber using axes prevailed until the late 1800s.

Treenails in the Ridgepole

On the left in this photo we can see the pointed ends of treenails sticking out of the centre ridgepole. The diagonal timber is a wind brace. All the roofing timbers are held to the ridgepole using mortising and treenails (wooden dowels with a pointed end). You can see four more (ends broken off) on the right. The roof planking was then nailed onto the support timbers.

On the third floor is another interesting feature, likely original to the mill, a section with a ceiling done in accordion lath with hand wrought lathing nails. Split accordion lath was an early lathing technique (sawn lath didn't come into use until after 1830), in which a wide green piece of hemlock board is split on alternate sides into lath widths until you can open it up like an accordion and nail it up between two studs. The cracks in the board are then plastered which seals up the openings. Once dry a finishing smooth coat of plaster was put over the ceiling. The purpose was likely to create a vermin proof area for grain storage. Insets in the floor planking in this area are similar to those used for movable walls to create different sizes of bins in barns. That same purpose was likely the reason for this feature, grain storage bins that could easily be varied in size.

There are also some tapered floorboards in this area, a technique that cut planks following the tapering width of the tree (to minimize wastage). The boards were then placed edge to edge to form a rectangular surface.

Accordion Lath

Portions of the original plastered accordion lath ceiling still exist in the mill today, part of the ceiling in the northern part of the third floor.

These may have been quarter-sawn boards (unverified), a technique used in that time period to prevent the boards from warping. The large white pine trees with tight grain available at that time would have lent themselves to this technique.

All of these features can still be seen in the mill today. While some timbers and many floor boards had to be replaced during the 1999-2003 restoration (due to rot and insect damage), as much of the original fabric of the mill as possible was retained during the restoration process.

Building the Mill – The Equipment

We don't know exactly how the mill was originally equipped, that original machinery is long since gone from the mill. What we do have is what Oliver Evans has in his guide and this gives us insights into what would have been installed in the 1810 mill. His Chapter II deals with "APPLICATION OF THE MACHINES, IN THE PROCESS OF MANUFACTURING WHEAT INTO SUPERFINE FLOUR." There are diagrams and descriptions of how to build the various pieces of equipment, later editions of his guide provide even more details. A millwright familiar with the Evans' design would have been able, with the assistance of a blacksmith, to build all the machinery in the mill. Only some specialized equipment, such as bolting cloths and French burrstones, would then need to be imported. Interestingly, when Oliver Evans' moved to Philadelphia in 1793, he opened a store selling milling supplies. The main items in the store were millstones and bolting cloths, two things that couldn't be built on site.

Evans' 1795 innovations were to add five machines to the existing milling equipment of the era. Those five innovations were the **Elevator**, wood or tin buckets on a leather belt moving vertically; the **Conveyor**, a wooden auger moving material horizontally; the **Hopper Boy**, a device for stirring and cooling the newly ground flour; the **Drill**, a horizontal elevator with flaps instead of buckets (similar to the use of a conveyor but easier to build); and the **Descender,** an endless strap (leather or flannel) in a trough that is angled downward, the strap helps to move the ground flour in the trough.

These devices, designed to cut the manual labour requirement in half, were in addition to regular merchant gristmill equipment such as millstones, grain cleaners and bolters.

The process, in a nutshell (details on following pages), is as follows (see diagram in the Design of the Mill section, pg.17): Raw grain was weighed and then loaded into an elevator which took the grain to the attic. From there it was moved to grain cleaners and the cleaned grain then put in bins for storage or directly sent by chutes (gravity) to the feed hoppers over the millstones (two sets in the mill). For grain not immediately ground, conveyors would be used to move the grain from the garner bins to the feed hoppers. The millstones were located on a robust timber foundation called the husk. The millstones ground the grain into flour which fell by gravity down to an elevator boot in the basement. The elevator transported it back up to the attic where it then fell into a hopper boy on the third floor. The hopper boy raked the flour, cooling it and keeping it from clumping. The cooled flour then fell via chutes to bolters on the 2nd floor which sorted the flour into different grades (degrees of fineness: superfine/fine, middlings, shorts, bran) and the sorted flour then fell by chutes to barrels (superfine/fine) or bags on the first floor. Sometimes the middlings were captured separately, elevated and ground a second time to create more fine flour. Shorts and bran were used for animal feed.

We can follow the path of the grain and flour to see what machinery was required.

Weighing the Grain

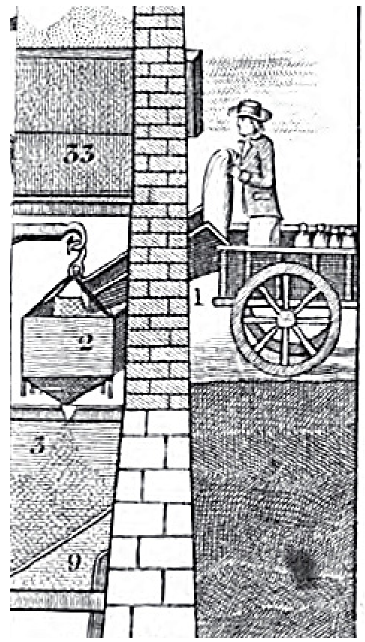
The grain starts its journey at the weighing scales. Grain was measured in bushels, which is measure of weight, 60 pounds, not volume. Originally a bushel meant 8 imperial gallons but at some point the U.S. standardized on it being 60 pounds for grains of wheat (an American bushel) which was loosely based on the English Winchester bushel (8 gallons). A scale for weighing wheat could have easily been manufactured on site. Evans describes a type of equal arm scale, with a box for receiving the grain attached to one arm and a box on the other arm for holding the weights that would determine the weight of grain.

Chap. II. APPLICATION OF THE MACHINES.

The grain is emptied from the waggon into the ſpout 1, which is ſet in the wall, and conveys it into the ſcale 2, that is made to hold 10, 20, 30, or 60 buſhels, at pleaſure.

There ſhould, for convenience of counting, be weights of 60lbs. each; divided into 30, 15 and 7 1-2lbs. then each weight would ſhew a buſhel of wheat, and the ſmaller ones halves, pecks, &c. which any one could count with eaſe.

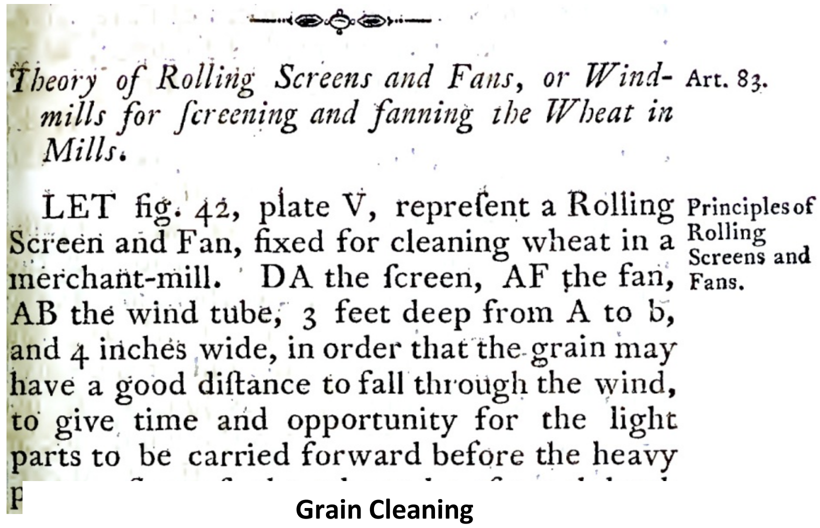
When the wheat is weighed, draw the gate at the bottom of the ſcale, and let it run into the garner 3; at the bottom of which there is a gate to let it into the elevator 4—5, which raiſes it to 5, and the crane ſpout being turned over the great ſtore garner 6, which com-



In this excerpt from Evans' 1795 guide he describes how the wheat coming into the mill is weighed. His diagram only shows half of what appears to be an equal arm balance scale.

Cleaning the Grain

The weighed grain was then introduced into the elevator which took it up to the "attic". From there it fell by gravity through a series of grain cleaners. These consisted of screens and fans – the idea was to blow off any remaining chaff and other impurities (i.e. dirt and smut) from the grain. Evans describes a few varieties of these grain cleaners. The grain likely went through two or more stages of cleaning before being sent to bins (garners), ready to be milled.



Theory of Rolling Screens and Fans, or Wind-mills for ſcreening and fanning the Wheat in Mills. Art. 83.

Principles of Rolling Screens and Fans.

LET fig. 42, plate V, repreſent a Rolling Screen and Fan, fixed for cleaning wheat in a merchant-mill. DA the ſcreen, AF the fan, AB the wind tube, 3 feet deep from A to b, and 4 inches wide, in order that the grain may have a good diſtance to fall through the wind, to give time and opportunity for the light parts to be carried forward before the heavy

Grain Cleaning

Part of Oliver Evans' 1795 description of grain cleaning.

Milling the Grain

Note: additional information and photos can be found in the section Building the Mill – The Husk.

The cleaned grain could either be milled directly or stored in bins waiting to be milled. It was introduced into hoppers located above the millstones. The hoppers allowed for the controlled delivery of grain to the centre of the millstones. Given the quality of the Old Stone Mill it is assumed that the best millstones, French burrstones, were likely original to mill. It is doubtful that such stones were in use in the Stevens' gristmill, he was likely using stones made of granite or other "country stone" which would have been cheaper and easier to obtain.

Evan's 1795 guide shows two different types of millstones, a "country stone" and a "bur mill-stone," a French burrstone (see diagrams on next pages). This doesn't clarify what was originally in the Old Stone Mill. Country stones were any locally available stone that could be fashioned into a millstone. In the U.S. this included sandstone, conglomerate, granite, quartzite and gneiss. Many were softer than burrstone and often used for milling soft materials such as corn. A disadvantage of some of these, such as sandstone, is that it can introduce particles of the rock into the flour as it wears down.

Wheat kernels are very hard and the best flour results from milling with a hard burrstone (which cuts rather than crushes the kernels of wheat). At this point in time (1810-11), wheat farming was much more prevalent than animal husbandry in the Delta region. This would change later in the 1800s, resulting in the Old Stone Mill doing more feed milling. But at this time, the primary product from the mill would have been flour.

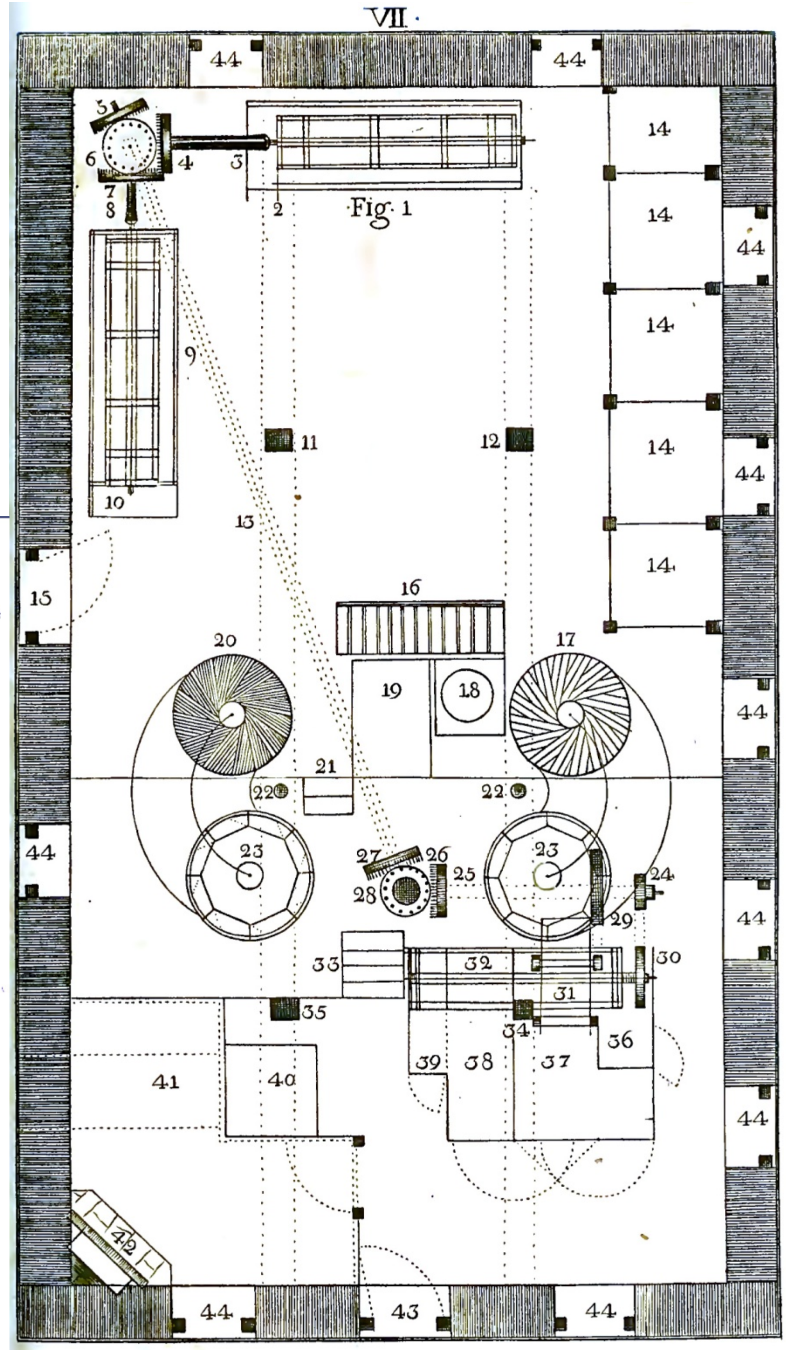
In 1812, Ira Schofield is assessed for a gristmill with 1 additional run of stone (total of 2 runs), a sawmill and a merchant shop. An advantage of having two runs of burrstones is that not only can it double production, but it can also allow continued production while one set of stones is being dressed (sharpened), which had to be done at least once a month.

P L A T E VII.—*Second Floor.*

Fig. 1 and 9 a top view of bolting-cheſts and reels.
2 and 10 places for bran to fall into.
3 and 8 the ſhafts that turn the reels.
4 and 7 wheels that turn the reels.
5 a wheel on the long ſhafts between the uprights.
6 a wheel on the upper end of the upright ſhaft.
11 and 12 two poſts that bear up the girders of the 3rd floor.
13 the long ſhaft between two uprights.
14 five garners to hold tole, &c.
15 a door in the upper ſide of the mill-houſe.
16 a ſtep-ladder from 2nd to 3rd floor.

EXPLANATION OF THE PLATES.

Fig. 17 the running bur mill-ſtone laid off to be dreſſed. Art. 38.
18 the hatchway.
19 ſtair way.
20 the running country ſtone turned up to be dreſſed.
21 a ſmall ſtep-ladder from the huſk to 2nd floor.
22 the places where the cranes ſtand.
24 the pulley-wheel that turns the rolling-ſcreen.
25 and 26, the ſhaft and wheel that turns the rolling-ſcreen and fan.
27 the wheel on the horizontal ſhaft to turn the bolting-reels.
28 the wheel on the upper end of the firſt upright ſhaft.
29 a large pulley that turns the fan.
30 the pulley at the end of the rolling-ſcreen.
31 the fan.
32 The rolling-ſcreen.
33 a ſtep-ladder from the huſk to the floor over the water-houſe.
34 and 35 two poſts that ſupport the girders of the 3rd floor.
36 a ſmall room for the tailings of the rolling-ſcreen.
37 a room for the fannings.
38 do. for the ſcreenings.
39 a ſmall room for the duſt.
40 the penſtock of water.
41 a room for the miller to keep his books in.
42 a fire-place.
43 the upper end door.
44 ten windows in the 2nd ſtory, 12 lights each.



Oliver Evans' The Young Mill-Wright & Miller's Guide – 1795 edition

An example of Evans' original 1795 guide. At the top of the image are the bolters for sorting the flour. He shows two types of millstones, a "country stone" (likely granite or silicified sandstone) on the left and a French burrstone on the right. Both are shown in dressing position, the top runner stones removed from the bedstones. The husk sits slightly below the second floor, item 21 is a small set of steps that lead from the husk to the 2nd floor.

French burrstones are a constructed millstone made from pieces of a siliceous (quartz-flooded) sedimentary rock, locally known as “pierre meulière,” quarried at Ferte-sous-Jouarre near Paris, France. The millstones constructed of this very hard stone were of the highest quality and were being exported to North America. At the time of the building of the Old Stone Mill there was a move to smaller, four-foot diameter stones. These weighed less than larger stones and could be turned faster (up to about 120 rpm, producing more flour per hour). Evans’ 1795 guide generally references 5 foot stones (which he recommended rotating at 97 rpm), common in that era, but smaller 4 foot stones were used in the Old Stone Mill (based on the size of bedstone cut-outs in the original husk).

French burrstones were generally shipped fully manufactured, or as a set of pieces ready to be put together. Pieces of stone were fitted together to form the stone, set in plaster and bound on the outside with an iron band. Part of the skill in stone selection and millstone construction was to have a consistent weight over the entire stone so that they didn’t wobble when rotated. This meant that the stones were either fully or partially assembled by experts in the quarries in France to achieve this perfect balance before being exported. Often lead weights were put inside the rim of the stone to correct any wobble, exactly the same as balancing a car tire today.

The original use of burrstone was because of the small cavities in these particular stones, which, when exposed, provided cutting surfaces. As the stone wore down, new cutting surfaces (cavity edges) were exposed. Then, in the mid-1700s (c.1761), a Franciscan Friar came up with the idea of cutting furrows (grooves) into the stones to create consistent cutting surfaces. This is called dressing and dressed stones, which were much more efficient, became the norm. The furrows are designed so that the top (runner) stone and bottom stone perform a cutting (scissor) action on the grain rather than simply abrading the grain.

Millstones in Dressing Position

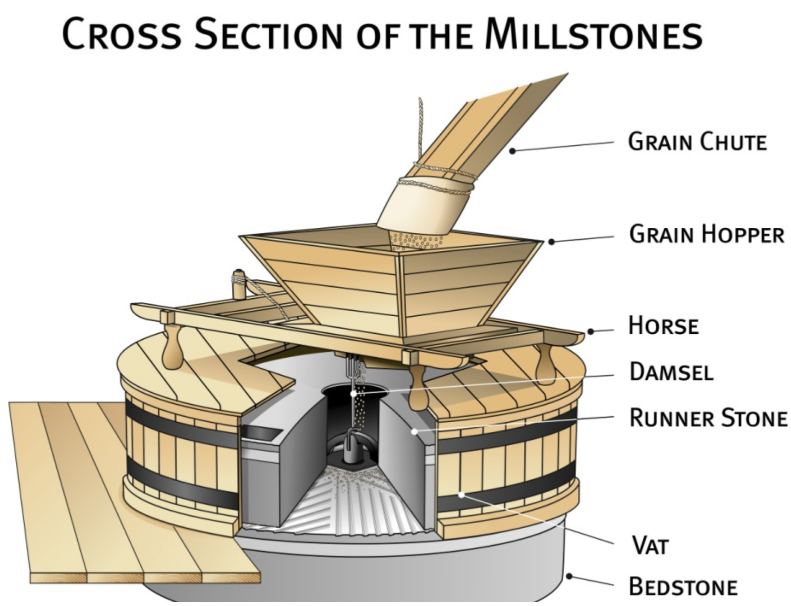
In addition to our working millstones, we have a pair of French Burrstones set up in an interpretive display showing all the features of the stones and explaining in detail how they were dressed.

The building of the husk has already been discussed. The floor of the husk had cut-outs for the bedstones, the non-rotating part of a millstone. The original husk of the Old Stone Mill had 3 such cut-outs, each 54 inches in diameter which is consistent with the placement of 48 inch bedstones with their wooden collars. The husk had 2 sets of millstones on it for most of its operating life, the 3rd cut-out, while possibly related to the third set of stones in use in 1837-39, may have been due to extending the husk over the waterwheel area to move the stones closer to the west wall after the turbines were introduced (c.1860) and the waterwheel removed.

The top stone, the runner stone, is elevated slightly above the bedstone. It is supported by a metal spindle which can be raised or lowered using a tentering gear which is adjusted using a control wheel that sits on the husk (see photo on next page). The miller will adjust this gap between the runner stone and bedstone during operation to make sure the stones are producing the proper grind of flour.

Grain in introduced from the hopper into to the opening in the centre of the runner stone using a shoe, a narrow wooden trough that directs the grain to the centre of the stone. The amount of grain flowing into the stone is automatically controlled by a damsel, a forked iron rod that taps the shoe based on the rotation rate of the stone. The damsel gets it name since its tapping of the shoe was likened to a damsel singing her song (or so goes the story of the name's origin).

The grain is moved to the outer edge of the stone by the rotation of the runner stone as it is being cut by the furrows of the stone and ground into flour by the lands (flat areas) of the stone. The finished flour falls from the outside of the stone and is contained by the wooden vat which sits over the stone. The ground flour is swept by the rotation of the stone to a hole (see photo on next page) leading down to the flour elevator that takes the flour up to the top of the mill and to the hopper boy.



Cutaway View of the vat and millstones

This shows the configuration of the working millstones (the shoe sitting under the vat is not visible in this diagram). Graphic by Dan Moran.

Cleaning the millstones

In this photo showing the stones with the vat removed, the top runner stone is visible. It sits upside down (cutting surface down) on top of the non-rotating bedstone. The miller (DMS volunteer Moel Benoit in this photo) is cleaning up after using the stones, brushing them clean of flour.

Millstones Vat and Hopper on the Husk

These photos show the millstones being operated by our miller, Chris Wooding. In the original mill there would have been a chute leading to the hopper so that cleaned grain, stored on the 3rd floor, could be dropped by gravity to the hopper (the husk was elevated and there was no 2nd floor above the millstones in the original mill). The miller then controlled the flow from the hopper into the millstones, the grain entering in the centre of the stones and ground flour coming out the sides, kept contained by the wooden vat and swept by the runner stone's rotation to the hole leading down to the flour elevator.

As shown on the right, the miller would take off the cover of the hole that leads to the elevator and feel the flour between his thumb and fingers to ensure it was the right grind. If not he would adjust the gap between the runner stone and the bedstone using the tentering wheel which is shown in the foreground of the top photo).

While French burrstones are best for the grinding of wheat, softer stones, those made from granite, were used. These were a single piece stone, dressed with cutting furrows. Granite is softer than the silica flooded rock that makes up a French burrstone and so wears out much faster and doesn't do as good a job making flour. However, granite is easily available locally, the Delta region has a number of granite exposures, including near Lyndhurst (the Lyndhurst pluton) just south of Delta.

Granite and other "country stones" were often used to grind softer material such as oats and corn. This may have been common in the U.S. where agriculture had advanced by Evans' era to include a wider variety of crops. Milling for animals (feed milling – for horses & calves) was also just beginning in that era. The expansion of crops represents an evolution in farming in a region. The first farmers in the Delta area (mainly Bastard & Kitley townships) were cutting down forests to create farmland at a rate of about 3 acres per year (one guy with a felling axe, helped by members of his family). The first crops for a settler were generally potatoes (easy to plant, grow and store) and wheat in order to make flour, initially just for their own use. By 1810, as previously noted, it is assumed that this area had now moved beyond sustenance farming of wheat, that it was now being grown by many farmers as a cash crop. Animal husbandry was increasing, the sawmill that was built adjacent to the stone mill had a carding machine (for wool) inside it, indicating that sheep were being raised in the area.

It is therefore assumed that the original mill may have only had burrstones to start with and that granite stones were introduced later, likely in the mid-1800s, when demand for animal feed started to pick up. Granite stones were also used in early mills that couldn't afford to buy French burrstones, the Stevens' gristmill may well have used granite stones. We have two granite stones on display at the mill (one inside, one outside).

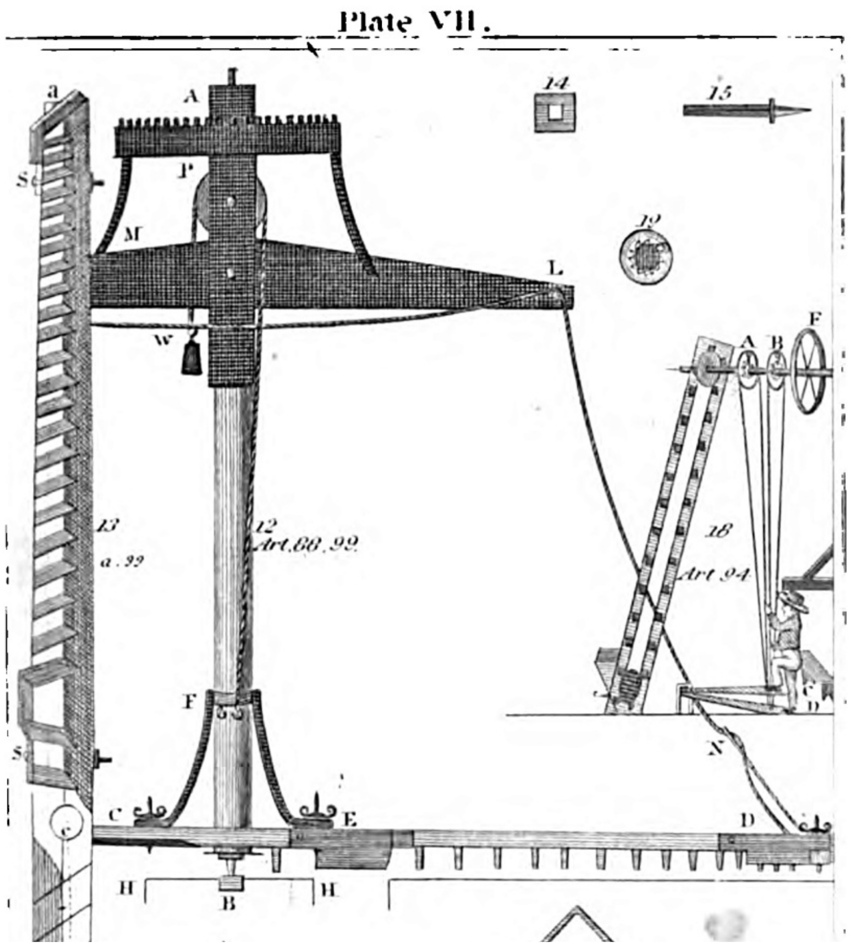
Granite Millstone

A granite millstone sits on display outside the mill. This stone weighs in the order of 1,200 pounds (~550 kg).

Cooling the Flour

Although stones have a lot of thermal capacity, they eventually warm up and the freshly ground flour at this point is both warm and sticky, neither are attributes that you want in flour. Today we operate our stones for only a few hours at about 92 rpm, which doesn't significantly heat the flour since the stones remain cool. But originally a faster rotation rate would have been used. Evans recommended 97 rpm for 5 foot stones, the smaller 4 foot stones may have been turning at up to 120 rpm. The faster rotation and longer operating time meant that the stones got warm and the flour they were making was heated up.

The freshly ground flour needed to be cooled, stirred (to prevent clumping) and dried. For this Evans' invented a piece of equipment called the "hopper boy," originally located on the third floor of the mill. The name derives from the fact that boys were employed to manually rake the hot flour, this machine replaced them in that job. It was essentially a vat with a rotating rake. The hot and sticky flour would be introduced into the hopper boy where it would be stirred by the rakes, cooling it down and allowing moisture to evaporate. This preventing the flour from sticking. This machine would have been built on site, a blacksmith would have fashioned the required metal parts.



The Hopper Boy – see description on next page

For a Hopper-Boy.

For a hopper-boy. 1 piece of dry, hard, clean pine ſcantling, 4 1-2 by 4 1-2 inches, and 10 feet long, for the upright ſhaft.

1 piece of dry poplar, ſoft pine, or other ſoft light wood, not ſubject to crack and ſplit in working, 8 by 2 1-2 inches, 15 or 16 feet long, for the flight arms.

Some 2 inch plank for wheels to give it motion, and ſcantling 4 1-2 by 4 1-2 inches, for the ſhafts.

So flights 6 inches long, 3 inches wide, and 1-2 inch at one, and 1-4 at the other edge, thinner at the fore than hind end, that they may drive in tight like a dovetail wedge. Theſe may be made out of green hard maple, ſplit from ſap to heart, and ſet to dry.

Half a common bed-cord, for a leading line, and balance rope. Art. 102.

Smith's Bill of Iron.

1 ſtay-iron, C F E, plate VII, fig. 12. The height from the top of the ring F, to the bottom of the feet C E, is 15 inches; diſtance of the points of the feet C E 24 inches; ſize of the legs 1-2 by 3-4 inch; ſize of the ring F 1 by 1-4 inches, round and ſmooth inſide; 4 inches diameter, the inſide corners rounded off, to keep it from cutting the ſhaft; there muſt be two little loops or eyes, one in each quarter, for the balance-rope to be hung to either, that may ſuit beſt.

2 ſcrews (with thumb-burs that are turned by the thumb and fingers) 1-4 of an inch thick, and 3 inches long, for the feet of the ſtay-iron.

2 do. for the end flights, 3 1-2 inches long, rounded 1 1-2 inch next the head, and ſquare 1 1-4 inch next the ſcrew, the round part thickeſt.

2 do. for the end ſweepers, 6 1-4 inches long, rounded 1 inch next the head, 1-4 inch thick.

2 do. for the hopper ſweepers, 8 1-2 inches long and 1-4 inch thick, (long nails with rivet heads will do.)

1 ſtep-gudgeon (fig. 15) 2 1-2 inches long below the ring, and tang 9 inches, 3-4 inch thick.

1 plate 4 by 4, and 1-8 inch thick, for the ſtep-gudgeon to paſs through (fig. 14.)

S

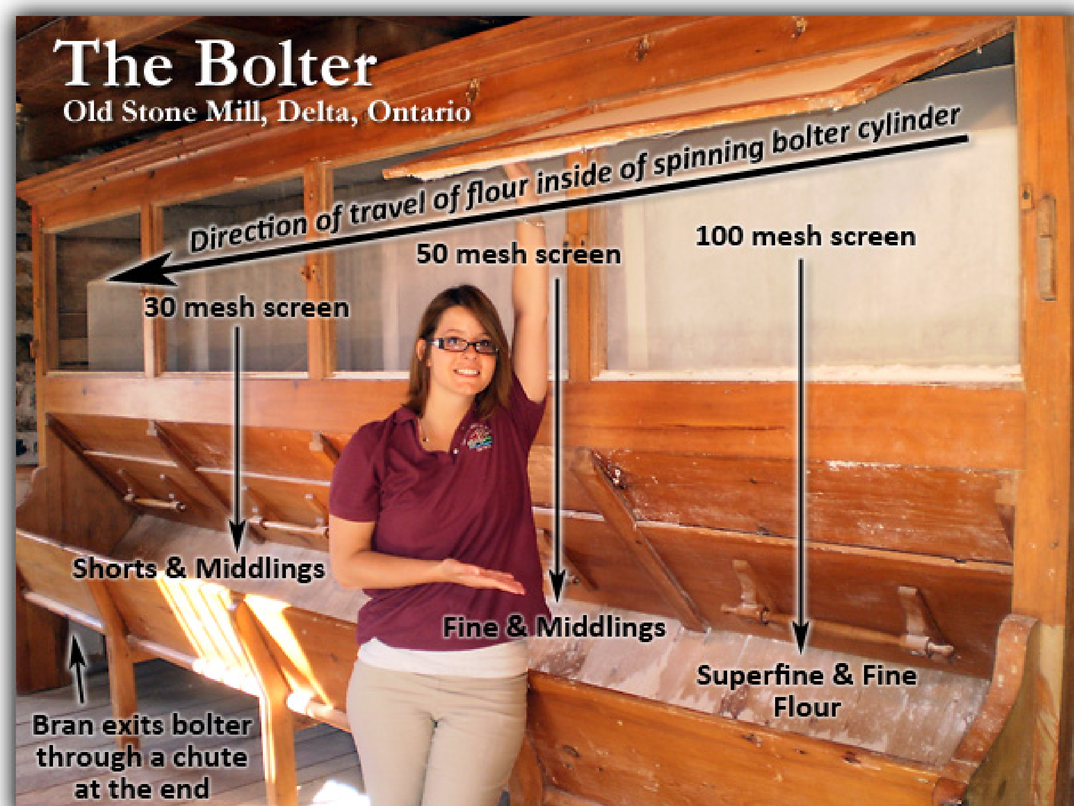
Evans' 1795 Description of a Hopper Boy

A millwright would presumably have to have seen one of these machines to interpret Evan's description, which reads more like a parts list, of how to build a hopper boy. Later editions of his Guide provided more detail on how to construct each piece of equipment.

Bolting the Flour

Today we value whole grain flour, the most nutritious flour, containing all parts of the grain. But it has an Achilles heel, it is not suited for "light" baking purposes such as pastry or light (white) bread. As such, fine flour, which is naturally light in colour, was desired. In fact in that time period, whole wheat was considered an undesirable type of flour. It was against the law to export it, only fine flour could be exported. If you wanted to produce flour for sale, you needed to bolt it. As perhaps a bit of a marketing ploy, all fine flour was referred to as "superfine."

The Oliver Evans' design was for a merchant mill meaning that it included bolters, machines designed to sort flour (see Evans' second floor diagram on previous pages which shows two bolters). The bolter would have been built by hand, the only external item required were the bolting cloths (fabric and metal screens). The bolter in the mill today is an example of a hand made bolter, most of the bolter consists of wood. The working part is a cylinder surrounded by bolting cloth. The finer cloth is at the upper end where the flour is introduced. The fine portions of the flour get sifted out first as the cylinder rotates. Coarser screens further down the cylinder allow the coarser middlings and shorts to fall out and the hard bran gets carried to the end of the bolter.



The Bolter in the Old Stone Mill

This is the bolter we have in the Old Stone Mill. It's not original to the mill, but is from the same time period. The flour enters the bolter at the fine screen end, the screen surrounding an open wooden cylinder (see photo on next page) which spins. These screens sort the flour into degrees of fineness. Our current bolter is self contained, the original bolters would have had chutes leading down to a collection area on the first floor.

Chutes from the bolter would direct the various classes of flour to the first floor. The fine portion would be barrelled and the coarser portion and bran would have been bagged to be used as animal feed. The American standard for a barrel was 196 pounds of "superfine" (fine) flour. Any such barrelled flour could have been sold to markets in Canada or the U.S.

The Bolter in the Old Stone Mill

Curator Paul George and Associate Curator Natalie Wood view our newly (2010) installed bolter. The doors and bolting screens are not installed providing a view of the open wooden cylinder. Grain is introduced into the centre of the cylinder at the top (right end) and the slightly sloping angle of the cylinder together with its rotation moved the flour to the far end, the various grades falling though the screens until only bran remains, which falls out the far end.

Evans preferred method was to separate out the fine and superfine portion, sort out the shorts and bran, and sort and re-grind the middlings. He has a section in his book titled "OF GRINDING OVER THE MIDDLINGS, STUPT & BRAN, OR SHORTS, IF NECESSARY; TO MAKE THE MOST OF THEM. That section reads, in part:

> "ALTHOUGH we grind the grain in the best manner we possibly can, for as to make any reasonable dispatch ; yet there will appear in the bolting, a species of coarse meal, called middlings; and stuff, a quality between superfine and shorts; which will contain a portion of the best part of the grain : but in this coarse state they will make very coarse bread ; consequently, will command but a low price. For which reason it is oftentimes more profitable to the miller to grind and bolt such over again, and make them into superfine flour, and fine middlings ; this may easily be done by proper management."

We still use elevators and chutes to move our flour today. A chute gate on the third floor directs the flour to either the bolter on the 2nd floor or directly to the first floor for bagging of whole wheat flour.

The final product

There are a number of mysteries regarding the mill's production. We don't have any records of the mill's early production. We don't know how many hours in a day or days in a year the mill operated. The latter was dependent on the availability of grain to grind and the available water in the millpond, which could lower at times to the point of the mill not being able to operate. Recorded production shows a peak in 1860 of 6,000 barrels (196 lbs each) of fine flour which required the milling of about 30,000 bushels of wheat. At that time it would have been done using millstones, likely still powered by the waterwheel. Earlier production was likely much less due to available grain (wheat production in Bastard Township peaked in 1861 at 57,787 bushels).

In Evans' 1795 guide he notes "Formerly one hand was required for every 10 barrels of flour that the mill made daily, now one for every 20 barrels is sufficient. A mill that made 40 barrels a day required four men and a boy, two men are now sufficient." If the 1860 production of 6,000 barrels of flour represented say 200 days of milling, that would be 30 barrels per day.

Today, with a single set of millstones turning at 92 rpm, we can mill about 150 lbs of whole wheat flour per hour (we go slow to ensure we preserve the nutrient content of the wheat). Our milling of hard spring Red Fife wheat averages 62.5% fine flour, 25% middlings/shorts and 12.5% bran. So to produce a barrel (196 lbs) of fine flour today, 314 lbs (5.2 bushels) of wheat would have to be milled. Interestingly, this almost exactly matches Oliver Evans who calculated that about five bushels (300 lbs) of wheat was required to produce one barrel (196 lbs) of superfine flour. He also said that a 5 foot stone, turning at 97 rpm, could process 5 bushels (300 lbs) of wheat per hour. Four foot stones turned faster, 120 rpm is often quoted. Period references for 4 foot stones range from 5 to 10 bushels of wheat processed per hour per set of stones. If we assume 7.5 bushels of wheat per hour as an average, that's 1.4 barrels of fine flour per hour, per set of stones. At that rate, with 2 sets of stones and a full 10 hour milling day, almost 30 barrels of fine flour could be produced. But we have no records to know if that figure is correct, if there was only one person in the mill, then Evans' number of 20 barrels is more likely. A certain amount of production would have been sold locally in Delta and also in Kingston (which in 1812 had a permanent population of about 2,000) and the rest exported (to the U.S. or England). The rejects – middling (if not reground), shorts and bran, would have been sold locally as animal feed.

Running the equipment

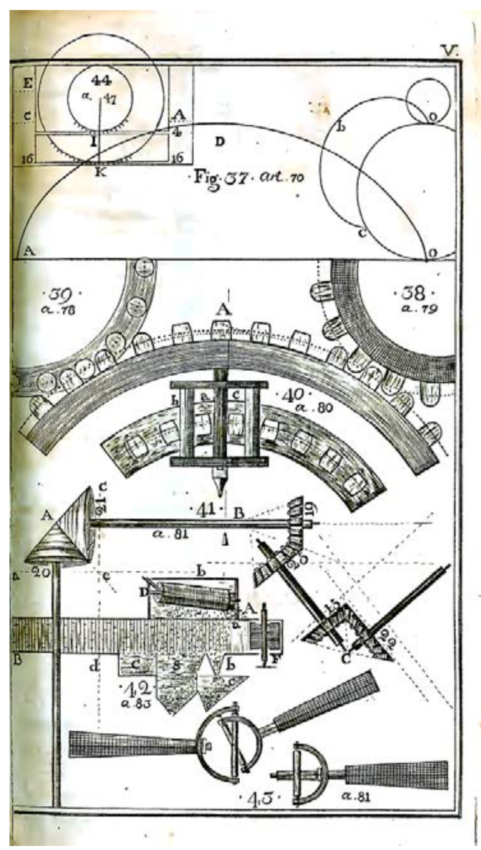
All the equipment was powered by the waterwheel. Direct connections in the forms of shafts and gearing were used, all constructed of wood. Improvements in the form of belts for the transfer of power had yet to be invented. These shafts and gears would have been built on-site. Oliver Evans' guide goes into great detail about designing the required gearing, it was a complex process to have every single piece of equipment in the mill connected to the rotation of the waterwheel. It was detailed work, every shaft and gear had to be aligned perfectly to minimize friction and provide the right amount of power to each piece of equipment.

Some of the bearing surfaces had metal to reduce wear. For wood on wood bearing surfaces, tallow (animal fat) was used for lubrication. The millwright would pick the best type of wood for the application. A hardwood such as maple or beech was used for the gearing to minimize wear. A mill, with wood on wood gearing, was reported to be reasonably quiet. Squeaks and other such sounds indicated that something needed to be fixed, lubricated, or fine tuned.

Later in the life of the mill we see belts, metal shafts and metal gearing introduced. These were more reliable and flexible than direct wooden gearing. But in 1810-11, it was wooden shafts, wooden gears and direct connections.

Model of an Oliver Evans' Automatic Mill

This is a wooden model of an Oliver Evans' Automatic Mill (a representation of aspects of an automatic mill). The main feature to note here is the direct connection to all the equipment with shafts and gearing, all powered from the waterwheel (which is out of sight, on the outside of the building, behind the model). Everything that needed to be powered had a direct connection to the axle of the waterwheel. Photo of a model at the Hagley Museum and Library, Wilmington, Delaware, Photograph by Martin Kane (from fall 1990 edition of American Heritage of Invention and Technology – vol 6, No. 2).



Gearing

The image on the right is a figure from Oliver Evans' guide showing examples of different types of gearing. Building and positioning these shafts and gears was a tricky thing, all were powered from the single waterwheel. Everything had to be perfectly aligned to minimize friction while at the same time applying the appropriate amount of power to each piece of machinery in the mill.

Turning it on

Presumably each piece of equipment was tested as it was installed. An automatic mill allowed all the movement of grain and flour to be done with machines, the miller only had to start them up and turn them off. This required everything to work in perfect synchronization. So at some point, likely in late 1811 or early 1812 it was all complete and ready for the first full run. With everything now in place the headgate of the flume leading to the waterwheel was opened and the waterwheel started to turn*. The gears would start to transfer that rotational power to the millstones, grain cleaners, hopper boys, bolters, elevators and conveyors. The first load of grain started its journey through the mill, lifted to the attic, then down through grain cleaners, down to the millstones and then, as flour, back to the attic, down into the hopper boy and then down to the bolter, with the final product falling in chutes to barrels on the first floor, ready for sale or export.

While it's been noted that wooden gearing, when properly adjusted, is fairly quiet, there would still have been a fair bit of noise and vibration. Even with the husk to isolate vibration from the millstones, the gearing would impart vibration into the building. The Old Stone Mill was now alive.

One can imagine Jones and Schofield and the workers holding their collective breath the first time the entire mill process was tested. They would have watched as raw grain was put into the mill and perfectly ground flour was produced. It likely didn't happen quite as smoothly as that, tweaking by the millwright would have been required to dial it all in.

The first full season of production was 1812 when Ira Schofield was listed on assessments as the miller.

* There is some debate about how a gristmill was best started and stopped. Key to this are the millstones since this is where most of the power was used. One method was to have the runner stone sitting on the bedstone, effectively providing a brake to the waterwheel. The headgate would be opened, allowing water to flow to the waterwheel. The runner stones would be slowly raised, allowing the stones and the waterwheel to start rotation.

Another method is exactly the opposite. The runner stones would be raised prior to the headgate being opened. When the water flowed, the waterwheel and runner stones would both start to rotate.

It appears that both methods were used, whatever the miller's preference. An advantage of the first method is that the miller was at the controls of the millstones when they started to turn and could then adjust them right away. Otherwise he'd have to run back after opening the headgate to adjust his stones. A disadvantage was that it was harder on the millstone gearing since it had to hold the waterwheel stationary until the runner stone was raised.

Stopping a mill was best done by simply closing the headgate. Some millers used the stones to stop the waterwheel, but this caused stress on the gearing. However, this was the method to use in an emergency, a miller would throw a handful of grain into a set of stones, effectively causing it to immediately slow down (choke), and allowing him to then lower the runner onto the bedstone until the waterwheel and all the gearing fully stopped.

The Sawmill

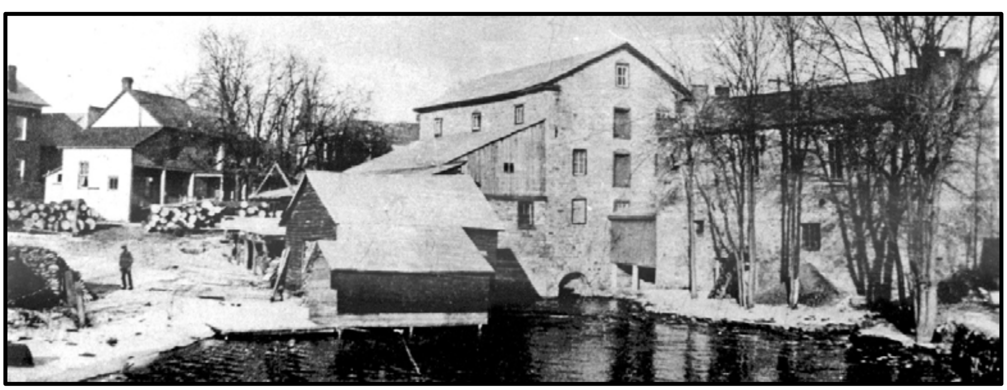
A wooden sawmill was built adjacent to the west wall of the mill, likely original to the construction of the mill. There are no windows on the first floor of the west wall of the mill, the reason for that was the sawmill (no point in having windows if a building is parked right next to it). Oliver Evans 1795 guide details the construction of a sawmill, but we have no evidence whether that design was used for the sawmill built adjacent to the Old Stone Mill.

An 1835 sale ad by Henry Jones for the mill describes the sawmill as “a large wooden building in which there is a Saw Mill, a Mill for cutting and polishing marble, and a Carding Machine;- with Mill Yard and out Buildings.” Since there are windows on the 2nd floor of the west wall of the mill, we can perhaps assume it was a low (1 storey) building.

It was likely positioned over the bywash, just as the later (c.1860) sawmill was located over the c.1860 bywash. It was powered by a shaft running through the west wall from the waterwheel into the sawmill building. The saw would have been a vertical reciprocating saw, circular saw blades didn’t appear until the 1830s. A timber slide and iron bull wheel may have been used to haul up logs floating in from Lower Beverley Lake. The metal parts for the sawmill could have been repurposed from the original Steven’s sawmill.

A carding mill (wool) was likely original to the sawmill. It is mentioned in an 1817 report and also shows up in the 1835 sales ad for the mill and sawmill. Carding mills were a relatively new invention, John and Arthur Schofield (their relation to the Delta Schofields unknown) built the first woollen carding machine in Connecticut in 1794.

Later, c.1830, a marble cutter and polisher was added to the sawmill building. These were likely installed by Christopher Allyn who moved to Delta c.1830 and set up a marble cutting and polishing business.



Photos

The top photo (c.1950s) is the best view of the sawmill. The c.1930s photo left shows two outbuildings that obscure the view of the sawmill. DMS Digital Photo archives.

The Mill Over the Years

In its early years, the mill was run by either Ira Schofield (1812), William Jones (1816) or both (1813-15 & 1817). It was assessed as a gristmill with 1 additional run of stones (total of 2 runs of stones). Also assessed was a sawmill and a merchant shop (which they started in about 1810). Ira Schofield left Delta and moved to London, Ontario in 1818. In 1819 William Jones mortgaged the mill to his brothers, Charles and Jonas Jones, for the sum of £ 1,358. This seems to indicate that the mill was in some financial difficulty at that time.

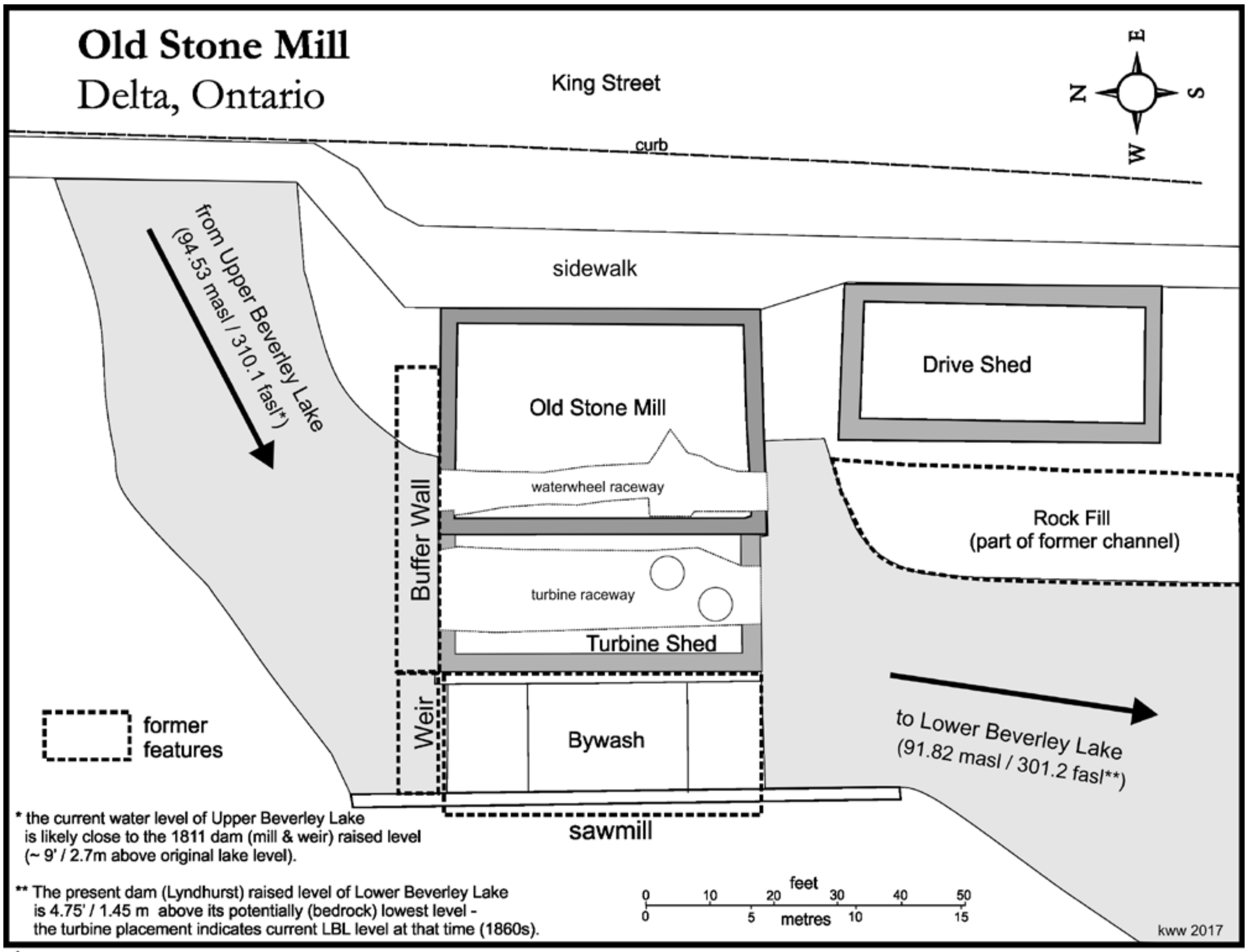
Milling technology was slowly improving. It's to be noted that Oliver Evans guide continued to be published, the final (15th) edition appearing in 1860, long after Evans death (1819). The biggest change in the guide was the introduction of iron to replace wood for gearing and shafts, although information about how to construct wooden gearing remained in the guide. Obviously iron is a lot more durable than wood and as industrial capacity increased in North America, the forging of these iron components became more common and affordable. By the 1850s, iron had generally replaced wood for shafts and gearing. The transfer of power by the use of belts appeared in the 1820s, although that doesn't appear in later editions of the Evan's guide and the introduction of that technology was likely not introduced to the mill until after 1850 when Walter Denaut bought the mill and made major improvements.

Given the financial state of the mill up until 1850, it seems unlikely that any major changes were made, although when the mill was bought by James and Amelia Macdonnel in 1836 (Amelia was the widow of William Jones) it re-opened in 1837 with 3 runs of stones indicating that the husk had been enlarged. The mill was back to 2 runs of stones by 1840. The Macdonnels mortgaged the mill for the purchase price (£ 500) in 1836 and they subsequently took out two more mortgages on the mill. So while some improvements may have been made, there was not a lot of capital available for significant changes. That was to come in 1850 with the next owner of the mill, Walter Denaut.

Denaut brought business acumen and a large amount of capital to the mill. He discharged the three mortgages on the mill and in 1851 did extensive work on the mill, assessment showing the value of that to be £ 2,600. We don't have records of what was done but we know that at some point most of the support columns in the mill were moved (see diagram in Building the Mill – the Rest of the Building) indicating a major change to the configuration of the mill. That may have been part of the biggest change to the mill, the c.1860 installation of a pair of Swain turbines in an addition to the mill, the turbine shed. Turbine technology was in the early stages of development, offering a huge advantage over a waterwheel, delivering more power with much less maintenance.

We are very fortunate that Walter Denaut decided to put the turbines in an addition to the mill, keeping the original 1810 mill essentially intact. We don't know his exact reasoning for this, but it would have allowed the mill to continue full operation while the turbine shed was built and the turbines introduced. His decision to install 2 turbines precluded the use of the existing waterwheel raceway since it was far too small. The turbine shed (aka turbine hall) was a stone addition to the west wall of the mill. The turbine shed was built over the existing bywash, a new bywash created adjacent to the west wall of the turbine shed (today's configuration). The sawmill was also simply shifted west, a low building built over the new bywash.

Two turbines were installed, an upstream turbine located on the east side (mill side) of the turbine shed and a downstream turbine located near the west wall (bywash side) of the turbine shed (see diagram below – the circles show the location of the turbines). Turbines were much more efficient and required less maintenance than a waterwheel. A net head of about 7 feet of water was available, with each turbine capable of producing about 33 hp (calculation by William Trick, 1996 Conservation Report).



Old Stone Mill – 1860s to Present Day Configuration

This diagram shows the changes made by Walter Denaut. A turbine shed was built against the west wall of the Old Stone Mill and two turbines (shown as circles in the diagram) were installed. A new sawmill was built against the turbine shed, sitting over the c.1860 bywash. Diagram by Ken W. Watson, adapted from engineering drawings in "Restoration of the Delta Mill and Turbine Shed – Phase II-R", Stantec Consulting Ltd, 2000

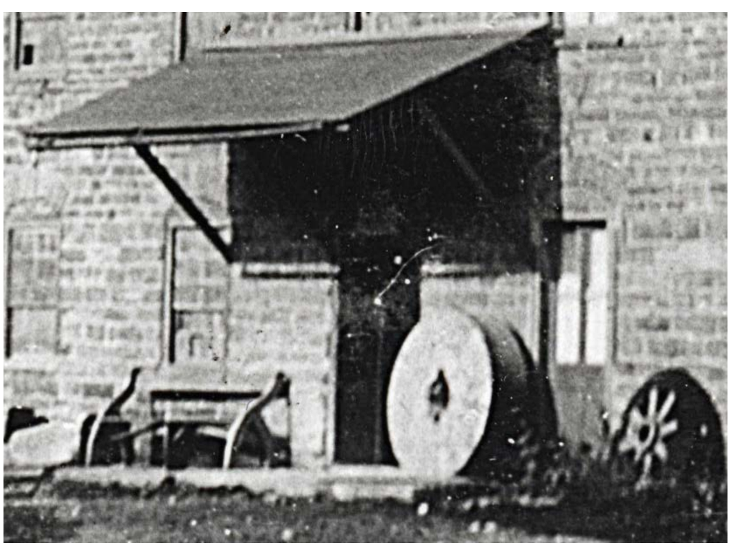
The change in the column positions done by Walter Denaut likely reflects a change in power transfer throughout the mill – belt technology was likely introduced at that time as was iron gearing. By the 1860s the mill was a much changed building. The basic equipment likely stayed the same, the millstones, grain cleaner, hopper boy and bolter – however that was about to change as well.

Notches in Beams

You'll see notches and cut-outs in many of the beams in the Old Stone Mill. These are spots where equipment, chutes and supports used to be positioned. The mill adapted over time, replacing old technology with new. The physical remnants of those changes are still in the woodwork of the mill.

By the Denaut period (1850-1889), purpose built milling equipment was becoming more readily available although the general sequence of milling remained as described by Oliver Evans. It's uncertain what equipment might have been improved/replaced by Denaut. The biggest change in how flour was made wouldn't come until the late 1800s with the introduction of roller mills.

We have a date of 1893 (the year George Haskin purchased the mill) for the introduction of roller mills to the Old Stone Mill. Roller mills had the advantage of being very efficient and much less costly to operate and maintain than millstones. Roller mills ended the era of stone grinding grain although there is some indication that a set of millstones was maintained for the manufacture of animal feed prior to the introduction of chopper mills.



In these early 1900s photos (c.1900 and c.1905) we see millstones sitting in front of the mill, the one in the left photo perhaps a granite stone and the ones in the right photo a set of French burrstones. At this point in time, wheat is being ground by roller mills, not millstones. Photos from DMS digital archives.

In 1923 a new chopper mill (a Champion Grinder) was installed on a newly lowered husk (lowered in 1922 to the elevation of the first floor). The production of animal feed for the local market was more lucrative than the production of flour which now faced competition from large factories. Flour production ceased sometime between 1939 and 1944. The feed mills and sawmill stopped operation in 1949 (the sawmill may have seen some sporadic local use after that) and the owner, Hastings Steele, operated a feed store from the mill, and also sold Robin Hood flour, until 1960.

When the mill closed in 1960 it was a much changed place from the original 1810-11 mill, although most of the original 1810-11 building remained intact. The mill we see today is a result of major restoration done by the Delta Mill Society. That is a story unto itself and will only be briefly summarized here.

When the mill was deeded in 1963 to the four trustees who were to form the Delta Mill Society, they sought expert advice on how to restore the mill in a heritage appropriate manner. Little was known about the exact history of the mill, it was believed to have been built in about 1800 as a rebuild of the original Abel Stevens mill. It was even thought that part of the building was sitting on "quick sand" – a reason for the cracking in some of the walls. A detailed examination in 1972 showed it to be fully sitting on bedrock (to the relief of all).

Initial restoration of the mill had to wait until the Delta Mill Society was incorporated in 1972. From 1972 to 1975 what can be characterized as rescue restoration was done. Sections of rotted floor were replaced, the stonework was stabilized, support was added under the mill, the windows (woodwork) was repaired and painted and the roof was repaired.

Major restoration was to come later when a funding opportunity through Parks Canada, their cost sharing program for privately held National Historic Sites, was established in 1986. A requirement of that program was to have a detailed conservation report. The Delta Mill Society formed a restoration committee in 1987 and started fundraising for the restoration work. In 1994 the DMS hired the Cataraqui Archaeology Research Foundation (CARF) to conduct an initial archaeological investigation of the mill.

In 1996, heritage consultant André Scheinman was hired to produce the conservation report for the mill. André was assisted by the restoration committee of the DMS; Peggy Fry, David Mess and Art Shaw and also by Anna Greenhorn and Myrla Saunders. He benefitted greatly from the historical files of the DMS that had been compiled by Sue Warren. Manuel Stevens, the regional planner for Parks Canada, helped André identify what would be required on the part of Parks Canada in order for the DMS to get funding.

In 1999 CARF was hired again to do more archaeology, taking advantage of a dewatered channel that marked the start of restoration.

Scheinman's report formed the foundation of the required restoration work. Restoring a mill that had seen many changes over its 150 year operation history is a challenge. An added complication was opening the mill to the public, certain building code requirements, such as two exits from every floor, had to be adhered to. As detailed in the conservation report, the mill had seen many changes over the years, so there was a certain amount of flexibility in how the restoration should be done. Part of the history of the mill is its evolution over time, keeping up the current milling technology.

Some decisions were made for financial and practical purposes. For instance it was determined early on to leave the husk where it was (its 1922 lowered elevation). Raising it back to its presumed 1810-11 position would have required removal of the section of the 2nd floor above the husk area. The "original" husk itself was in poor shape, it had been rebuilt at least 3 times during its life and wouldn't be able to support millstones unless completely rebuilt again. Also, from a visitor point of view, leaving it on the main floor provided for much better viewing and interpretation.

The main goal with the 1999-2003 work was to restore the building so that is was structurally sound, able to be safely opened to the public and to leave options open for future restoration of the mill as an operating mill (which was a 200th anniversary (2010) goal of the DMS). The DMS, under President Art Shaw, was directly involved in all aspects of the restoration.

Stantec Consulting Ltd. of Kingston was hired in 1998 by the DMS to prepare and evaluate the tenders for the restoration work. The winning tender for was A. Santin Mason Contractor Ltd. Work proceeded from 1999 to 2003 in four phases (each with its own funding, the DMS was still raising funds during the restoration process). In the end, the 1999-2003 restoration ended up costing $1,171,920 with Parks Canada contributing $466,000, the Province of Ontario $100,000 and the remaining $605,920 coming from the Delta Mill Society – which was quite an amazing feat for a small volunteer organization.

Official Opening of the Restored Mill– May 15, 2004

With restoration complete, the mill was officially re-opened to the public. Original trustee, Elizabeth (Beth) Robinson, prepares to cut the ribbon. To her left is Jim Jordan, local MP and to her right is Bob Runciman, local MPP and Ron Holman, Mayor of the Township of Rideau Lakes.

With the mill restored, work proceeded under curator Paul George in developing high quality interpretation of the mill. The mill was themed, based on owners and milling technology, and high quality interpretation panels were installed. Guided tour interpretation was created by long-time DMS volunteer, Anna Greenhorn.

The DMS at that time also pursued a second goal, to have the mill operating by its 200th anniversary in 2010. Ideas of operating the mill using water were quickly quashed, water rights had reverted in the early 1960s to the government of Ontario and the construction of a new dam upstream of the bridge in 1962 made bringing a full head of water to the mill difficult. The only way to do it would be to build a stop-log dam in front of the MNR bywash, clearly something MNR wasn't keen on doing.

An original size waterwheel, assumed to be about 12 feet in diameter, was also precluded due to the extreme cost of that option which, in addition to the cost of the wheel, would have included the cost of a full archaeological study of the "wheel pit". So a decision was made by the DMS to install a smaller waterwheel, which didn't have any impact on the wheel pit, as an interpretation tool. This wheel was installed in 2007.

Making the mill "operating", actually able to produce flour, was more difficult. All the original equipment was long since gone, items in the mill, such as a bolter (non working), dated to a much later period. The millstones were gone (most sold when the mill converted to roller mills in the late 1800s). A few stones were donated to the mill, we received one stone in 1974, two more in 1975 (from Brewers Mill) and the DMS also received a French burrstone in 1975. Specifics aren't noted, but at least two of the stones were granite (now on display at the mill).

A search for proper equipment ended in Quebec when old milling equipment came up for sale. This was purchased by the DMS in 2008 and included a pair of French burrstones (which had been operating up until sold) and a 14 foot long, period correct (late 1700s, early 1800s), bolter.

The original husk, which had been modified several times, was in no condition to be rebuilt so a decision was made to build a new husk that could properly support the millstones which were to be operated using a robust (and reliable) electric motor (see photos in the building the husk section). What remains of the original husk timbers are stored in the DMS artefact collection. In October 2010 our "new" 200-year-old millstones produced the first stone-ground flour made in the mill in over 100 years.

Today we have the mill open to the public from Victoria Day to Labour Day and on many special event days outside of that period. Our miller, Chris Wooding, operates an organic farm on which he grows a heritage wheat, Red Fife (developed in Ontario in 1842), which was a very popular bread making wheat in the mid-late 1800s. He mills his wheat, using our 200-year-old burrstones, several times a season.

Oliver Evans

Oliver Evans (1755 – 1819) was an American inventor, sometimes known as the "Watt of America" for his work on high pressure steam engines. However, his greatest impact was arguably his design for an automatic mill. It was the adoption of his inventions for gristmills that revolutionized the flour industry.

"Oliver Evans, the Watt of America"

Image from Wikipedia. Engraving by W.G.Jackman.

When Evans, originally a wheelwright, turned his attention to milling, it was a slow, manually intensive process that often resulted in poor quality of flour. In 1783, two of Evans brothers set about to build a gristmill on their family's property on Red Clay Creek near Newport, Delaware. They brought in Oliver to oversee the construction of the mill. The mill opened in 1785 as a conventional mill, but over the next few years Oliver tinkered in the mill, developing improvements that cut down on the amount of labour required and improving the quality of the flour.

Part of Oliver's genius was not simply the individual improvements, but how they worked together in an integrated fashion. He saw milling not as a series of individual processes, but as a linked series of processes, each supporting the other. By 1788 he had developed a working automatic mill. However his ideas weren't understood by most millers and he had trouble finding someone who would support his new milling concepts. But in 1789 he found millers, the Ellicott brothers, in Maryland, who took up Evans offer to refit a mill with the automatic process. While doing this he perfected further aspects of his automatic mill.

In 1790 he moved to Wilmington, Delaware and found another miller who was keen on adopting Evans' system. The retrofitted mill was a great success and soon other millers in the area adopted Evans' improvements. This started the ball rolling for Evans' milling improvements to be adopted throughout the U.S.

Evans had taken out state patents on his inventions, and with the introduction of the Federal patent system in 1790, he applied for a federal patent for his system, receiving the third patent issues by the new Federal patent office.

His new milling system was gaining traction, in 1791 for instance, George Washington, who was the President of the United States at the time, had his gristmill at Mount Vernon converted to the Evans system.

In 1793, Evans sold his interest in the Red Clay Creek mill and moved to Philadelphia where he opened up a store for milling supplies (millstones, bolting cloths) and to promote his automatic milling process. It was at that time that he started to put down his ideas on paper, initially intending to create a pamphlet to help millers. This, by 1795 ended up as a book, "The

Young Mill-Wright and Miller's Guide" that not only explained the automatic milling process, but also contained a great deal of practical information about hydraulics and physics as it applied to mills. It also included a section titled "The Practical Mill-wright" by Thomas Ellicott, one of the millers with whom Evans' had worked with in 1789 to retrofit a mill with the automatic process.

The book was self published by Evans and sold by subscription. Subscribers (listed in the 1795 edition of the book) included George Washington and Thomas Jefferson. The initial book was not a financial success, it left Evans in debt at the time. But as the adoption of his automatic milling process spread, licensing fees started to produce a good revenue stream for Evans. A second edition of his book was printed in 1807, this time published as a regular book. The book continued to be published after Evans death in 1819, the final, fifteenth edition, published in 1860.

Evans is known as the Watt of America due to his work on steam engines. He turned his attention to this in 1801. At the time, it was the likes of James Watt in England who were pioneering steam power. But Watt was concentrating his efforts on low pressure steam engines which were very large and heavy, a poor power to weight ratio. Evans saw the future in high pressure steam, even though it was very dangerous since it was difficult with period technology to build a steam containment system. Evans worked around those problems receiving a patent for a high pressure steam engine in 1804. He continued to work on steam power, refining his designs. He even came up with the first known self-propelled amphibious vehicle, a high pressure steam-powered wheeled dredging barge (although it is disputed whether it actually was able to move under its own steam power).

Evans was a man ahead of his time, a true visionary and genius. By his own count he had eighty inventions – some practical, some not. His attention turned in his later years to defending his patents (mostly the automatic mill patents) in court from unauthorized use – he became a bit obsessed with this.

In the end it was his contributions to the milling industry that had the greatest and longest lasting impact, dramatically changing how gristmills operated.

A Chronology of the Old Stone Mill

- **1793 –** Abel Stevens journeyed from Vermont to Canada and explores the area around Plum Hollow Creek in June. He petitions the government for land in that area in December 1793. He might have known about the area from his older brother, Roger Stevens, who settled on the Rideau River near Merrickville (a few km upstream) in 1790 and built the first mill there.
- **February 1794 –** Abel Stevens together with six families (his own and 5 others) journey from Vermont to the Delta area. They build a rough road from Brockville to the Plum Hollow area for their oxen drawn wagons. Stevens is said to have had a yoke of oxen, a cow and a horse along with his family and household possessions. He also brought in mill irons. The families settled on the upper parts of Plum Hollow Creek. Stevens petitions for all the land around Delta. They are squatters, surveys have yet to be done, no land has been granted. Stevens is after both the land around Delta, including the water power of the rapids, plus the Great Falls at Lyndhurst and the iron deposits in the area (his main objective in fact, one he was never to obtain) The iron and falls were previously known, they were first sought after by Edward Jessop back in 1784.
- **Summer 1794 –** surveyor William Fortune runs first survey lines into area what was to become Bastard Township.
- **March 1795 –** Stevens lists names of 24 heads of families who he has settled in the area (to reinforce his petitions for land grants). His is identifying his location as Stevenstown in these petitions (in reference to the township, not a village). He notes in some petitions that he has brought in "mill irons" and is ready to erect a mill.
- **1795 –** surveyor Lewis Grant does initial surveys in the area (from Gananoque up to Sand Lake on the Rideau).
- **1796 –** sufficient surveying of Bastard Township is done by Lewis Grant to allow Stevens to be granted his land.
- **1796 –**Stevens is granted land on June 2, 1796 which includes the rapids between Upper and Lower Beverley lakes (he was granted 5 lots; 3 in area of Delta, 2 over the upper portion of Upper Beverley Lake, which nominally would have been 200 acres each, 1000 acres in total – but the land grant shows 700 acres due to some of the land being covered with water). At some point after this, Abel Stevens, or his cousin William Stevens, build a wooden sawmill at the rapids. The mill is noted in Grant's 1797 survey as "Wm. Stevens Mill".
- **1796 to 1798 –** at some point in this time period Stevens has a road built from Delta to Lyndhurst (he's still after the rights to the Great Falls and iron deposits near Lyndhurst).
- **1797 –** Lewis Grant completes his survey of Bastard Township and produces a map – it is the first known map that shows a mill in Delta.
- **1797 to 1803 –** at some point Stevens adds a grist mill to his sawmill (most likely powered by the same waterwheel). A 1799 deed references "Abel Stevens & Nicholas Mattice mills" (plural mills). Mattice was either a business partner or lease holder with Stevens.
- **1798 –** Abel Stevens and Matthew Howard have a road built from Lyndhurst to Kingston Mills (to the front road leading to Kingston Mills). This is part of Stevens' continued effort to get the rights from the government to establish a foundry at Lyndhurst.
- **1803 to 1808 –** Stevens' mill is leased to Nicholas Mattice. Shows as a grist mill with 2 runs of stones and a sawmill.
- **1808 –** there are now two separate mills operating in Stevenstown. The second is owned by Abel Stevens Jr., on property his father sold to him in 1799 – likely located near Hicock pond on Foundry Creek (aka Cowans Creek, aka Robertson Creek).
- **June 1808 –** Abel Stevens sells his wooden mills and surrounding property to William Jones for £375.

- **1809 –** Stevens' old grist mill, now Jones' grist mill, is shown being operated by Ira Schofield.
- **1810** – neither Jones or Schofield are shown operating a gristmill (Schofield is operating a sawmill) – however they are shown as operating a Merchant Shop & Storehouse. Speculation is that the old Stevens' wooden mill burned down sometime prior (maybe late 1809). Anecdotal history (Hiel Sliter) has the Stevens' wooden mill burning down twice.
- **March 1810 – construction of the Old Stone Mill begins.**
- **1811 –** construction of the stone mill is likely completed sometime this year**.**
- **1812** – the newly constructed stone mill opens – it has 2 runs of stones and a sawmill (wooden structure beside the mill – needed to be adjacent to get power from the waterwheel in the mill). Ira Schofield is listed as the miller.
- **1812 - 1817** – millers show as either Ira Schofield (1812), William Jones and Ira Schofield (1813-15 & 1817) or William Jones (1816).
- **c.1815 –** a map shows the mill's location as "Jones & Schofield"
- **1816** – Stone Mills is referenced in a letter as having about 20 houses – an 1816 map shows 10 buildings in the "village," including the Old Stone Mill.
- **1817** – in the Statistical Account of Upper Canada for 1817 the mill is described as *"unquestionably the best building of the kind in Upper Canada"* That same account shows that the village of Stone Mills had 3 stores and a blacksmith shop.
- **1818 - 1819 –** miller shown as James Schofield Jr.
- **1819 –** Jones mortgages the mill to his brothers Charles and Jonas Jones for £ 1,358.
- **1820 - 1825** – miller shown as William Jones.
- **1826** – not operating.
- **1827 - 1828 –** J.K. Hartwell & Schofield (James Jr.?) millers.
- **1828** – a map shows that "Beverly is composed of abt. 30 houses".
- **1829** – ? (no info).
- **1830** – not operating.
- **1830** – marble cutting may have started near this time by Christopher Allyn who moved to Beverley c.1830. The cutter cut marble blanks for use as tombstones. The marble cutter was located in the wooden building housing the sawmill (see note for 1835).
- **1831** – William Jones dies. Mill & property goes to his brother Charles Jones who then sells it (4 shilling) to William Jones' widow, Amelia. Amelia sells it to **Henry Jones** (deed for that, £500, not done until January 1836).
- **1832 - 1834 –** mill leased to Edward Matson by Henry Jones. Shown only as grist mill (no sawmill listed for Matson – the sawmill was likely leased separately as the 1835 sale notice indicates).
- **1835 –** mill put up for sale by Henry Jones **–** a sale notice dated Sept 17, 1835 states in part *"The mills consist of a Stone Grist Mill, 60 by 40 feet, three stories high, with one run of Stones in operation, and sufficient room to place one or two run more;- a large wooden building in which there is a Saw Mill, a Mill for cutting, and polishing marble, and a Carding Machine:- with Mill Yard and out Buildings; the last mentioned Mills are rented at £50 per annum, the lease expires on 5th March 1837; the Grist Mill is not at present leased or occupied; …"* It is presumed that this is origin of the incorrect dimensions of the mill unless they were including the width of the buffer wall (~7') – the stone building is actually 50' x 35'.
- **1836** – mill purchased by **James and Amelia Macdonell** (Amelia was the widow of William Jones). Not operating that year.
- **1837 – 1847** – operated by **James Macdonell** with 2 runs of stones, except for 1837 to 1839 when he had 3 runs of stones. Sawmill reappears in the records in 1844 (leased to someone else prior to that).

- **1848 – 1849 –** James dies in 1847 and his wife **Amelia Macdonell** continues to operate the mill.
- **1850 – Walter Denaut** purchased the mill in February 1850. He pays of the mortgages on the mill and starts extensive repairs. The mill in 1850 is shown with 2 runs of stones and a sawmill. Records show £ 2,600 worth of work in 1851.
- **c.1850s –** Denaut creates Miller's Room on 2nd Floor.
- **1850s –** Denaut builds a one storey **stone carriage shed** with a **brick hall** upper storey beside the Old Stone Mill (today's Mill Drive Shed).
- **c. early 1860s –** Denaut builds the **turbine shed**, installs **two 48" Swain turbines** and rebuilds the **wooden sawmill** onto the back side of the turbine shed (over the bywash). The sawmill is powered by the downstream turbine.
- **c.1870s** – a **smutter** may have been added to the mill during the Denaut era (uncertain).
- **1889 – Walter Denaut dies** (March) and the mill goes to his wife Carolyn. His son, **James L.S. Denaut** operates the mill.
- **1893 – George Haskin** buys the mill for $6,000 on October 5, 1893.
- **1893 - 1899 –** likely at some point in this time period, George Haskin installs the **Roller Mill**. The National Historic Site of Canada designation for the mill uses 1893 as the installation date.
- **1899 - 1903 –** Haskin installs and operates the mill with a **steam boiler** (located in the north end of the turbine shed). It was likely supplemental power to the turbines (i.e. in times of low water).
- **1904 –** for reasons unknown the **steam boiler is removed** at about this time.
- **1913 – Hastings Steele** and **James Huffman** (brother-in-law) purchase the mill for $8,000 on March 14, 1913.
- **1914 –** Steele's partnership with Huffman is **dissolved** (apparently Steele bought out Huffman).
- **1914 - 1921 –** Steele is in partnership with **Omer P. Arnold**
- **c.1922 –** the husk is lowered, rebuilt at the level of the first floor.
- **c.1923 – a chopper** ("Champion Grinder") to make animal feed is installed.
- **c.1920s – Drive shed** is sold and a forge subsequently installed in it.
- **c.1920s – Salt shed** (to store salt for livestock) built between mill and drive shed.
- **1929 –** Steele installs a **dynamo** in the mill when the Lyndhurst power plant is shut down by Ontario Hydro. Likely only lasted until Delta and Lyndhurst were connected to the Ontario Hydro grid (c. late 1929).
- **1939 - 1944 – flour production ceased** in this period. The mill was producing flour in 1939, but no longer in 1944. Some use a date of **1942** (splitting the difference) as the end of flour production, but the exact year is presently uncertain.
- **1949 – last year the feed mill and sawmill are operated**. Of note both were powered by the turbines which were still in operation. Steele continues to operate a feed store.
- **1960 –** the **feed store is closed** and the **mill shuttered**.
- **c.1960 – second storey of carriage shed demolished** by owner Gordon Grey and replaced with smaller wooden frame second storey.
- **c.1960 – salt shed** (between mill and drive shed) removed.
- **1962 – new dam** built upstream of mill by MNR. Mill no longer used as a dam.
- **1963 –** the old stone road bridge is demolished and replaced by current **concrete road bridge**.
- **1963 – Hastings Steele deeds the mill, for the sum of $1, to four trustees**: Mildred Sweet, Albert Frye, Elizabeth Robinson, and Robert Tuck. Steele's wish was that the mill be preserved and become open to the public as a museum of milling technology.
- **1963 - 1972 –** the four trustees remain owners but form an informal **Delta Mill Society**.

- **1968 –** floor of **wooden sawmill** collapses – the superstructure of the sawmill appears to have been previously removed sometime prior to this (early 1960s?).
- **1970 –** The Old Stone Mill in Delta is designated a **National Historic Site of Canada.**
- **1972 – "The Delta Mill Society" is incorporated** in Ontario as a non-profit organization and given charitable status on August 17, 1972.
- **1972 –** on September 5, 1972, the **mill is deeded** from the original 4 trustees to the newly incorporated **"The Delta Mill Society"**. The incorporation allows work to start on rescue rehabilitation.
- **1972-1974 – essential structural repairs (rescue rehabilitation)** were carried out on the Mill - this project included general masonry repair, re-roofing with new cedar shakes, jacking of floors to level, replacement of windows, sash and glazing, and structural framing stabilization.
- **1973 –** The Old Stone Mill receives its **National Historic Site Plaque**.
- **1974-75 –** MNR seals the old bywash with **concrete**. Part of buffer wall (in front of the turbine raceway) and all elements of original bywash (i.e. stop-log dam) are removed.
- **1978 –** The Old Stone Mill is **designated under the Ontario Heritage Act**.
- **1983 –** The Old Stone Mill NHS opened to the public as a museum of milling technology and industrial heritage.
- **1992 –** The DMS purchases the **mill drive shed**.
- **1994-1999 – Extensive archaeology and research** is done in preparation for a large scale restoration program. Two archaeological reports plus a detailed conservation report (see Bibliography).
- **1994 (Dec) –** The DMS purchases the **Old Town Hall** from the Corporation of the Township of Bastard and South Burgess.
- **1999-2003 –an extensive renovation program** is done on the Old Stone Mill costing $1,171,920 with Parks Canada contributing $466,000, the Province of Ontario $100,000 and the remaining $605,920 coming from the Delta Mill Society. Entire building stabilized, stonework redone, new timbers and flooring where required. Work done based on 1996 conservation report.
- **1999 –** The **Old Town Hall is turned into a museum** (Museum of Industrial Technology) while the mill is closed for restoration (exhibits in mill moved to hall).
- **2000 –** The Delta Mill Society publishes a book ***"A History of the Old Stone Mill, Delta, Ontario"***, by Paul S. Fritz.
- **2004-2007 –** extensive high quality **interpretive signage,** created under the direction of Curator Paul George, is added to the interior of the mill.
- **2006 –** The Delta Mill Society published a book ***"A History of Grist Milling in Delta"***, by Wade Ranford.
- **2007 –** a **wooden waterwheel** (electric sump pump powered) is installed in the mill.
- **2008 – period milling equipment** (a pair of French burr millstones, vat and grain hopper, grain cleaner (Vac-A-Way seed cleaner), smutter and 14 foot long bolter) are purchased by the DMS from Rene Proulx of St. Sylvere, Québec.
- **2009-2010 –** a new exhibit for the 3rd floor is designed and installed.
- **2010 – a new husk is built** and **the millstones and bolter** (both electric powered) are installed. In October 2010 the mill makes its first stone ground flour in over 100 years.
- **2013 – The Old Town Hall** undergoes renovations.

The Owners

In some cases it's hard to distinguish an owner from a miller (sometimes one in the same, sometimes different) in the historic records. Thanks to Wade Ranford for figuring this out.

1810-1817:	**William Jones** possibly with **Ira Schofield**. The business/owner relationship between Jones and Schofield is uncertain. Likely that Jones was owner with a business relationship with Schofield – but records are unclear. Schofield left Delta (moved to London, Ontario area) in 1818.
1818-1831:	**William Jones.** Leased in 1827-28 to J.K. Hartwell and James Schofield Jr.
1831:	**Charles Jones**, then to **Amelia Jones** then to **Henry Jones**
1832-1836	**Henry Jones**. Leased to Edward Matson from 1832-1834
1836-1847:	**James and Amelia Macdonell** (Amelia is William Jones' widow – shown as Amelia Jones above)
1847-1850:	**Amelia Macdonell** (a widow again)
1850-1889:	**Walter H. Denaut**
1889-1893:	**Carolyn Denaut** (Walter's wife) or James L.S. Denaut (Walter's son – appears that he was operating the mill in this period but it was likely owned by his mother)
1893-1913:	**George Haskin**
1913-1914:	**Hastings Steele** and **James Huffman**
1915-1921:	**Hastings Steele** and **Omer P. Arnold**
1921-1963:	**Hastings Steele**. He was assisted by his son, W.R. Steele in the 1920s & 30s.
1963-1972:	**Mildred Sweet, Albert Frye, Elizabeth Robinson**, and **Robert Tuck** (as trustees)
1972-present:	**The Delta Mill Society**

Glossary of Terms

Barter Milling: see Custom Milling.

Bedstone: The bottom stone of a pair of millstones. The bedstone remains stationary during the grinding process.

Bolter: A machine which separated flour into different grades of fineness.

Bran: The hard outer layer of grain. In our bolter it is too coarse to fall through the screens (100, 50 and 30 mesh) and falls out a chute at the far end of the bolter.

Burr Stone (Burrstone, Buhrstone): A type of siliceous (quartz-flooded) sedimentary rock, locally known as "pierre meulière," quarried at Ferte-sous-Jouarre near Paris, France, and used to make millstones. The millstones constructed of this very hard stone were of the highest quality. The first reference is in 1614 to "Burrs of Millstones" – the use of the spelling buhr starts in the early 1800s. It's unclear if "burr" refers to the roughness of the stone – it was this original roughness, due to cavities in the stone, that did the grinding before the idea of cutting grooves in the stones came along – or whether it referred to the individual pieces of stone used to make up the millstone, as later usage of the term suggests.

Bywash: a by-pass channel to control excess water flow. A weir (water control structure) is often located at the head of a bywash – usually using "stoplogs" (horizontal timbers stacked on each other that can be lifted in or out of the weir) to control water level.

Chop Mill (aka Feed Mill): using a grinder to chop up dried whole ears of corn, wheat, or rye, including the unhulled grains, some stems, and the husks, to create animal feed (horses, chickens, calves, etc.).

Conveyor: The conveyor, was designed to move grain or flour horizontally from one place to the next. It was essentially a large wooden screw (auger) set in a trough. It uses the principles of an Archimedes screw and is still used today to move coarse materials (today called a screw conveyor). As it turned the grain or flour was moved along the trough to the desired location.

Custom (aka Barter) Milling: milling flour for the farmer who supplied the wheat. The miller retained 1/12th of the grain as payment for his services, returning the other 11/12 (minus milling losses) to the miller as flour. The 1/12 was prescribed by law (1792) in Ontario. This applied to early mills and was in contrast to a merchant mill. At some point the system changed. By the mid-1830s, custom milling was to give the farmer 1 bushel of fine flour for every 5 bushels of grain delivered to the mill.

Descender: a wide belt that moved the flour in a downward direction. The belt was moved by the weight of the flour (gravity), and carried the flour along with it.

Dressing Stones: sharpening the furrows (grooves) in the stones and making sure the lands (flat areas between the furrows) are perfectly flat.

Drill: an endless belt with flaps attached. The flaps swept the flour or grain along in a horizontal trough.

Elevator: the elevator is an endless leather belt with small wooden or tin buckets attached. The belt was attached to pulleys at the top and bottom and was used to lift grain and flour in the buckets attached to the belt. The elevator moves the grain or flour from one floor to the next.

Feed Mill (aka Chop Mill): milling grains (i.e. corn, oats) for animal feed.

Flume: a wooden trough or enclosed structure that carried water to the waterwheel. This is different than a sluice which is an excavated channel to carry water (either a bare channel or lined with wood). A flume was often an elevated structure.

Furrows: The grooves that were cut into the millstone to cut the grain. The geometry and spacing of these in the runner stone and bedstone created a cutting action.

Grist: any grain that has been separated from its chaff and is ready for grinding.

Head Gate: a water control gate at the head (start) of the raceway.

Head race: the part of the raceway ahead (upstream) of the waterwheel or turbine.

Head of Water (aka hydraulic head): the difference in elevation between the level of the mill pond at the headrace of the mill and the level of water in the tailrace. Determines (along with volume of water) how much power a waterwheel or turbine can provide.

Hopper Boy: a shallow round container within which, a rake was attached at the bottom of a vertical shaft with arms that extended outwards from the centre. The rake stirred the flour as it cooled to prevent it from clumping together.

Husk (hurst or hursting): the robust timber framework on which the millstones sit. They keep the millstones level and isolate the vibration of the stones from the building (to prevent shaking the building apart).

Lands: the flat high area between the furrows (grooves) of a millstone. The lands grind the grain after the furrows have cut it.

Mason: a person who works with stone as a building material.

Merchant Milling: when grain is purchased outright from the farmer (as opposed to custom milling where the mill takes 1/12 of the grain as payment) and the flour bolted to produce the fine flour required for export. All the flour is sold by the miller.

Middlings: the coarse starchy particles of wheat and the fine bran. They were originally used for animal feed. Oliver Evans recommended re-grinding these and blending into fine flour. In our bolter they are the 50 mesh (50 openings per inch) separation.

Millbill (aka Miller's Pick): A steel adze fixed in a wooden handle, used for dressing millstones.

Mill Irons: the parts of a sawmill that cannot be made from wood, for example the saw blade, the bull wheel (winch used to haul in the logs), gig wheel (used to drive the blade up and down if it was a vertical blade) and gudgeons. These heavy items were transported into a site (i.e. rapids in virgin forest) by a miller looking to build a new mill. Abel Stevens mentions mill irons several times in his petitions to government.

Millpond: water, usually impounded by a dam, used to power a waterwheel or turbine for a mill. The level (height) of the millpond compared to the water level exiting the mill (after going through the waterwheel or turbine), together with volume and rate of flow, determines the available power. Upper Beverley Lake is the millpond for the Old Stone Mill.

Millwright: a person who designs and builds mills and maintains milling machinery. Usually skilled at carpentry in addition to mill specific skills.

Raceway: the channel in which water flows to and past the power generating device – a waterwheel or turbine.

Runner Stone: The top stone in a set of millstones. It rotated over the stationary bedstone. Oliver Evans recommended a rotation rate of about 97 rpm for a five foot stone. We use a rotation rate of about 92 rpm for our four foot stone so that we don't overheat the flour. Merchant mills used a higher rpm rate, 120 rpm was common for a 4 foot stone.

Run of Stones: A run is a single set (runner and bedstone) of millstones.

Shorts: coarse flour consisting of germ, coarsely ground endosperm, and some finely ground bran. It is produced from the 30 mesh (30 openings per inch) screen in our bolter.

Smutter: a cleaning device for grain, to remove dirt and "smut" which is a pathogenic plant fungus found on grain. It contained a bin in which wheeled flails would knock the grain around, dislodging dirt and smut. The grain was then winnowed with a fan to remove light particles.

Sluiceway: an artificial channel (excavated or wooden) carrying water. The amount of water in the sluiceway usually controlled by a sluice gate. It is different than a flume which was an enclosed wooden structure, often elevated, that carried water.

Superfine Flour – the fine portion of flour consisting mostly of the endosperm of the wheat kernel. It is naturally light coloured. Superfine was the official name for fine portion of the ground flour. In our bolter it is produced with a 100 mesh screen (100 openings per inch), with some also coming out in the next 50 mesh screen (there is a transition between fine and middlings). In general the sorting from a bolter is fine, middlings, shorts and bran.

Stop logs – squared timbers stacked on top of each other in a holding mechanism (weir) to dam water and control the water level upstream of the dam/weir. Timbers (stop logs) were put in or lifted out to raise or lower the water level ahead of the weir (the MNR dam by the bridge in Delta has stop logs).

Tail Race: the part of the raceway below the waterwheel or turbine

Tentering: the process of raising and lowering the runner stone to adjust the gap between it and the bedstone.

Trash Grate or Trash Rack: a grate placed in front of a raceway entrance to keep out debris.

Treenail – essentially a dowel with a pointed end used to join two pieces of wood. You can see the ends of "treenails" sticking out of the ridgepole of the Old Stone Mill.

Turbines: a metal device with horizontal impellers used to capture the force of running water. More efficient than a wooden waterwheel and less expensive to operate.

Voussoir: wedge shaped stones that make up an arch. The central voussoir in an arch is known as a keystone.

Weir: a water control structure at the head of a bywash. Incorporates a method to control how much water is let into the bywash (i.e. horizontal squared timbers known as "stoplogs"). Usually operates as an overflow system (the height of the top log set to desired height of mill pond). It's also a flood control mechanism, allowing headwaters to be lowered in advance of anticipated flooding.

Selected Bibliography

Bazely, Susan M., and Susan Noakes, ***The Delta Mill Wheelpit Excavation, BdGa-34, Public Archaeology Program***, Cataraqui Archaeological Research Foundation & The Delta Mill Society, 1994.

Evans, Oliver, ***The Young Mill-Wright and Miller's Guide***, Oliver Evans, Philadelphia, 1795 (PDF available from the Internet Archives).

Fritz, Paul S., ***A History of the Old Stone Mill, Delta, Ontario***, The Delta Mill Society, 2000

George, Paul, per comm. 2017.

Hazen, Theodore R., www.angelfire.com/journal/pondlilymill/

Leung, Felicity L., G***rist and Flour Mills of Ontario, from Millstones to Rollers, 1780s-1880s***. History and Archaeology 53, Parks Canada, 1981 – reprinted by the Society for the Preservation of Old Mills, 1997.

Lockwood, Glenn J, ***Kitley, 1795-1975,*** G. Lockwood & J. Munro, St. Lawrence Printing Co., Prescott, Ontario, 1974.

Lockwood, Glenn J, ***The Rear of Leeds & Lansdowne, The Making of Community on the Gananoque River Frontier, 1796-1996***, The Corporation of the Township of Rear of Leeds and Lansdowne, 1996. (PDF available from the Internet Archives).

Moore, Jonathan, ***Archaeology at the Delta Mill National Historic Site, BdGa-34, 1999, Delta, Ontario***, Cataraqui Archaeological Research Foundation, 1999.

Scheinman, André, William Trick and M.D. Smith, ***Delta Mill Conservation Report***, May 6, 1996.

Shaw, Art, per comm., 2017, 2018.

Ranford, Wade, ***A History of Grist Milling in Delta,*** The Delta Mill Society, 2006.

Watson, Ken W., ***Tour Guide Manual and History of the Old Stone Mill NHS, v.1.5,*** The Delta Mill Society, 2018 **(PDF** available on DMS website).

Wikipedia, Oliver Evans entry (en.wikipedia.org/wiki/Oliver_Evans).

Warren, Sue, per comm., 2018

Wooding, Chris, per comm., 2017, 2018.

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