

# Ebbs and flows of a Cape Cod tide mill: investment, innovation and community

Timothy J. Richards

## Introduction

In the early years of 17th-century European settlement in New England, the colonists sought to recreate a primarily agrarian economy, with grains as a dietary staple. Converting that grain to flour posed an immediate challenge; grinding flour by hand diverted scarce labour from other essential tasks. Towns responded with an early form of industrial policy. To attract experienced millers and promote the construction of mills, towns offered subsidies, shares of the flour produced (tolling), tax benefits and exemptions from military and civil service.<sup>1</sup>

The earliest grist mills in New England were windmills. By 1633, however, the colonists had added waterpower to the mix. In areas with few free-flowing streams, waterfalls, or rapids, they took advantage of the region's two-to-four-metre tides and numerous tidal creeks to apply another European technology, that of tide-powered mills.<sup>2</sup>

This article examines a tide mill that operated in the Cape Cod town of Truro from before 1790 until approximately 1860. The story of the Truro Tide Mill includes details of daily activity that can illuminate our understanding of mills in general. The story also includes unique elements introduced by the individuals who built, rebuilt and operated the mill. This article will consider the Truro Tide Mill's place alongside and relative financial value as compared with windmills; how the owners addressed a technology gap through the installation of a new waterwheel; the owners' response to financial, legal and

environmental challenges; the possible use of ownership shares as a form of currency, and causes of the mill's decline.

An 1884 history describes the Truro Tide Mill and provides the outline for this article:

*"...in the latter part of the [18th] century – a water mill, for grinding, was erected on the south side of the Pamet river, and in 1844 a better one was erected upon the site, which in its turn was abandoned before 1860 and taken down."*<sup>3</sup>

## Origins

*"a water mill, for grinding was erected..."*

Before 1790, the people of Truro relied on three windmills to grind their maize and rye. However, they would have been familiar with tide mills, which operated in neighbouring towns.<sup>4</sup> Truro mariners also routinely sailed along the U.S. east coast and to southern Europe. In those areas, they would probably have seen tide mills at work and met the millers. Two considerations may have inspired a group of Truro citizens to build their own tide mill. First, the investors might have seen a business opportunity in guaranteeing dependable, predictable milling services. As J.T. Trowbridge notes: "...tide mills offered the unique advantage of a water supply that was entirely dependable..."



**Fig. 1.** Windmill built in Plymouth in 1680 (photograph by Margaret E. Clarke, 2022).



**Fig. 2.** Artist's rendition of the Truro Tide Mill circa 1845 (drawing by Andrew Richards, 2021).

Compared to windmills, tide mills had the obvious advantage of not depending on the strength or direction of the wind on a given day...<sup>5</sup> Secondly, many food supplies arrived in Truro by ship.<sup>6</sup> Unground grain from those vessels could easily be transferred to a tide mill by boat. By contrast, to reach the town's windmills, grain would have to be transported by wagon over sandy roads. The investors might, therefore, have identified imported grain as a source of baseline business for a tide mill. At the same time, from a municipal perspective, these advantages meant that a tide mill could complement the existing windmills, making the town's stock of milling services more available, predictable, and accessible.

Before 1790 a group of founding proprietors agreed to build a tide mill. As their site, they selected the headwaters of a creek to the south of Pamet Harbor. Without consulting the Commonwealth of Massachusetts, the proprietors constructed a dam across the creek, creating 'Mill Pond' upstream of the dam and 'Mill Creek' below the dam. High ground bounded Mill Pond on three sides, forming a four-hectare reservoir at high tide. Into the dam they incorporated tide gates and, at the northwestern end of the dam, a sluiceway. Downstream of the sluiceway they erected the mill building.

Each proprietor owned a percentage of the complex, including the mill, pond, and dam. This ownership structure mirrored the share ownership used for some Truro windmills, fishing vessels and other businesses from that period.<sup>7</sup> There are no known descriptions of the mill, except that it featured an external, vertical wheel. An 1840 deed defines one particular boundary as "...on a direct course for the Water Mill Wheel..."<sup>8</sup> In addition, an 1841 map identifies the mill's location with a whimsical sketch of the wheel. Most small New England tide mills of that era with vertical wheels utilized undershot wheels, so it is likely that the Truro Tide Mill's initial wheel was an undershot.



*Fig. 3. The Blish Tide Mill in Barnstable, Massachusetts (photograph reproduced from the Tide Mill Institute database, courtesy of Tide Mill Institute, 2022).*



*Fig. 4. 1795 Map of Truro (detail) showing location of the tide mill (from Digital Commonwealth).*

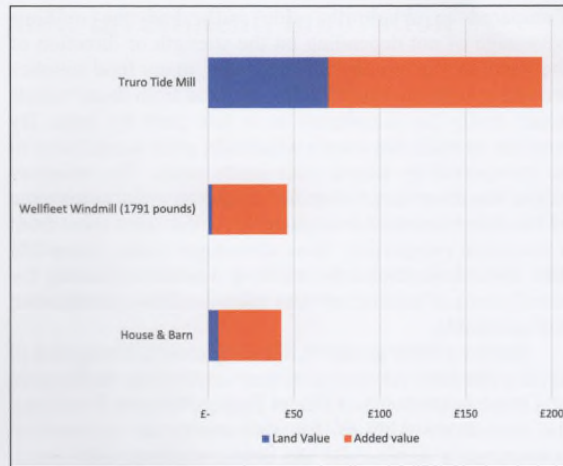


*Fig. 5. Google maps image of the tide mill site. The red circle indicates the location of the mill building, with the mill pond to the right. The dam is beneath the road leading past the mill site.*



**Figs. 6a.** 1841 Map including an image of vertical water wheel (Davis, 1841), **6b.** detail.

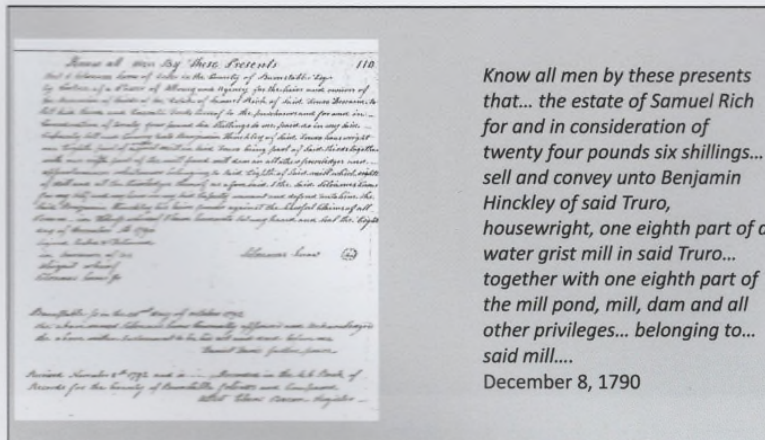
In 1790, one mill proprietor, Samuel Rich, passed away. Rich's estate sold his one eighth share in the mill complex to housewright Benjamin Hinckley for twenty-four pounds, six shillings.<sup>9</sup> The entire mill complex was thus valued at 194.4 pounds.



**Fig. 7.** Tide Mill value compared with nearby windmill and house (data compiled by the author from Barnstable County Registry of Deeds).

To put this valuation in perspective, in 1789 a house, barn and three acres of land in the nearby town of Orleans sold for 42 pounds, 12 shillings.<sup>10</sup> Salt meadow adjoining the mill pond sold for about 7 pounds per acre between 1787 and 1790 (a high value, probably due to its use in producing salt hay).<sup>11</sup> In utilizing expensive property for (and building) the complex, the proprietors were betting that their mill could attract enough business to justify a substantial initial investment.<sup>12</sup> As it turned out, when the value of the land is subtracted, the investment created 120 pounds of new value (or 'milling value') and increased the selling price of the area by 2.7 times. Moreover, after converting 1801 dollars to 1791 pounds,<sup>13</sup> the tide mill's milling value was approximately three times the milling value of a Wellfleet windmill that sold in 1801/1802.<sup>14</sup> While little is known of the size and condition of the Wellfleet windmill, the tide mill's dependability and logistical convenience would help account for this difference.

Based on their selling prices, the Truro Tide Mill was expected to yield about three times the earnings of the



**Fig. 8.** 1790 deed for sale of 1/8 of the Truro Tide Mill (Barnstable County Registry of Deeds, book 999111, p.110).

Wellfleet windmill. If the two facilities achieved similar financial margins, the tide mill ground roughly three times as much grain as the windmill. By enlisting the power of the tides to meet Truro's milling requirements, Samuel Rich, Benjamin Hinckley, and their fellow tide mill proprietors enjoyed more than possible accolades, tax benefits and perks. They also enjoyed the financial benefits of creating and owning the most valuable mill in the area.

### Building a Better Mill

*"In 1844 a better [tide mill] was erected upon the site..."*

Between 1790 and 1820, Truro's population remained stable at about 1,200 residents.<sup>15</sup> After 1820, however, the town's Pamet Harbor emerged as a leading port in the mackerel and cod fisheries and Truro entered a period of growth. The town's population leapt to 1,547 in 1830 and rose steadily to 2,051 by 1850.<sup>16</sup> More mouths to feed meant more demand for flour. It was not assured, however, that the 50-year-old tide mill could retain its share of that new business.

In 1840 Truro continued to support three windmills and the tide mill, with four millers and \$2,500 of total capital invested in the mills.<sup>17</sup> Truro windmills built in the 19th century incorporated longer, more efficient blades, increasing their grinding capacity and allowing them to operate over a wider range of wind conditions.<sup>18</sup> Meanwhile, the tide mill aged and its value declined. When Benjamin Hinckley, Jr. (son of Benjamin Hinckley) died in 1840, he owned one quarter of the mill complex. His estate appraised that stake at \$60.<sup>19</sup> This valued the entire mill complex at only \$240, as compared with approximately \$1,000 in 1790.<sup>20</sup>

Moreover, Captain Michael Collins, who also owned one quarter of the tide mill and on whose land some or all of the mill may have been located, had died in 1837. Collins' estate would not be settled until 1864 although, at least initially, his wife Tamsin Collins likely controlled that one quarter

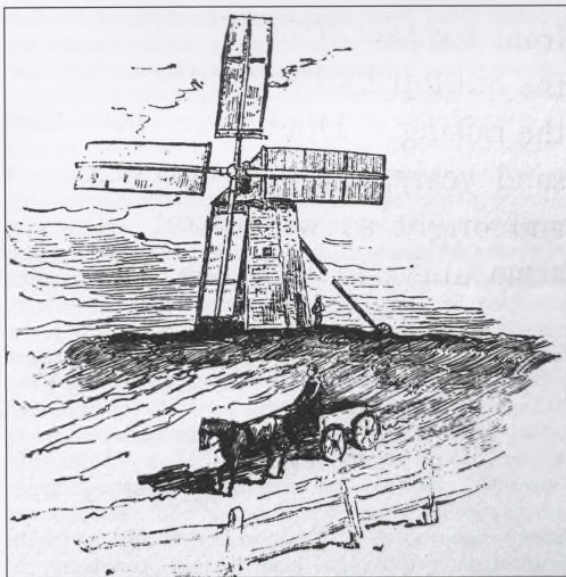


Fig. 10. Windmill built in Truro in 1811 (Rich, 1888 p.469).

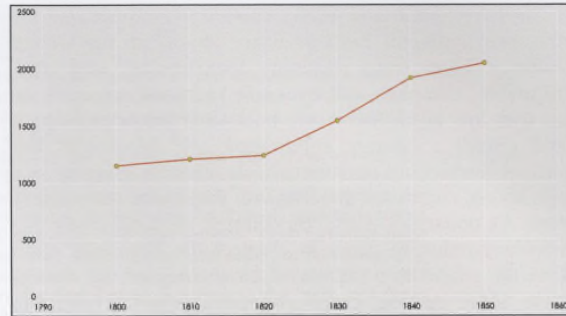


Fig. 9. Truro Population 1800-1850 (Holmes, Hertz, Mulholland, 1998 p.41).

ownership.<sup>21</sup> With an ownership transition, rapidly expanding demand for flour, a depreciated mill and increased competition, the period around 1840 represented an inflexion point for the Truro Tide Mill. The remaining and new proprietors could have chosen to close the mill; they could have continued to operate the mill in its existing condition, or they could make substantial investments to upgrade the mill.

The proprietors' deliberations took place during a time of dramatic advances in water wheel technology. Driven by demand for industrial power and facilitated by improved iron casting capabilities, between 1800 and 1840, U.S. inventors developed (or adapted from European designs) at least six types of early hydraulic turbines, with many local variations. These designs included reaction and impulse water wheels that achieved higher efficiencies than undershot wheels.<sup>22</sup> In 1830, Calvin Wing of Gardiner, Maine patented a reaction wheel that was widely publicised and adopted, including at Boston's City Mills tide mills in 1831.<sup>23</sup> In Ohio, brothers Zebulon and Austin Parker developed a reaction wheel known as a 'helical sluice', for which they received patents in 1829 and 1840.<sup>24</sup>

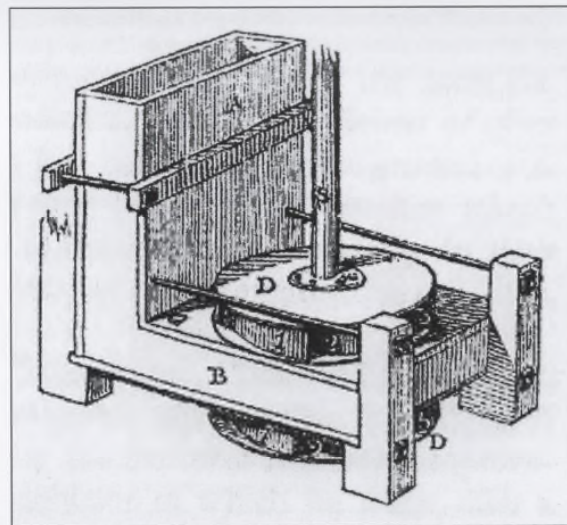


Fig. 11. The Wing Reaction Wheel (Journal of the Franklin Institute from Hunter, 1979 p.304).

Between 1830 and 1860, reaction wheels became the “the most common form of water motor” in the United States.<sup>25</sup> They were relatively inexpensive<sup>26</sup> and also “[d]urable, compact, quick-running, adapted especially to use with low heads and where backwater was a problem... [and could]... operate submerged....”<sup>27</sup> Moreover, the vertical shafts from reaction wheels, already spinning at a high speed, connected directly with the runner stone above them. An undershot wheel, by contrast, required costly and efficiency-reducing gears to connect the horizontal shaft from the wheel to a vertical shaft that turned the runner stone. Most reaction wheels converted potential energy to actual power at 30 to 40 percent efficiencies, and the early Parker helical sluice achieved 62 to 68 percent efficiency.<sup>28</sup>

It appears that into this mix stepped Anthony Snow Collins, a man who would shape the remaining chapters in the Truro Tide Mill’s history. Born in Portugal in 1806, to presumably Portuguese parents, Collins’ original middle and surnames were almost certainly not Snow or Collins. He arrived in Truro before 1825, likely by joining the crew of a vessel manned by Truro mariners.<sup>29</sup> Collins enjoyed a close relationship with Michael Collins and his wife Tamsin.<sup>30</sup> Moreover, in 1827 Anthony Snow Collins married original proprietor Benjamin Hinckley’s grand-daughter Thankful, a recently-widowed neighbour of the Collins family. Anthony Snow Collins thus had ties to two proprietors who between them owned half of the mill complex and who passed away in 1837 and 1840 respectively.

The 1850 census identifies Collins’ profession as “miller” and by the 1860s, he owned the largest share of the mill complex. It is likely, therefore, that Collins assumed the leading interest in the Truro Tide Mill after 1840 from, or with the support of, the estates of Benjamin Hinckley, Jr. and Michael Collins. Between 1830 and 1840, Collins would have observed his friends and neighbours building new businesses at the harbour, including a shipyard, stores, a sail loft, wharves, saltworks, and fish packing.<sup>31</sup> Collins could also have sailed on one of three packets connecting Truro to Boston, where he might have seen Wing reaction wheels in service. After 1840, the 34-year-old Collins and his co-owners must have felt the urge to join the wave of new investment, particularly because they could apply the latest water wheel technology to enhance the mill’s capabilities. The proprietors’ ability to fund that investment, however, was compromised by a personal and financial tragedy. In April 1841 Collins mortgaged his home and other property to the newly established Truro Fire and Marine Insurance Company for \$250.<sup>32</sup> At least seven other tide mill owners<sup>33</sup> mortgaged their houses with the same company. These mortgages appear to have represented their investment in the company. Then, weeks after the insurance company recorded the mortgages, disaster struck. On 3 October 1841, a powerful storm surprised the fishing fleet on George’s Bank. Eight Truro vessels were lost; fifty-seven Truro men and boys died. Resulting claims bankrupted the Truro Fire and Marine Insurance Company and “[t]he stockholders were obliged to pay the face of their notes without receiving a single dividend.”<sup>34</sup>

Eventually, the tide mill proprietors moved on from the loss of friends and family members, and from their own financial losses. Three years after the tragedy, they completed a new mill. The ‘better mill’ seems to have incorporated a horizontal water wheel, likely a reaction wheel, the ‘most

common’ water wheel installed between 1830 and 1860. An 1864 deed further supports this likelihood by referring to a “spout through the dike.”<sup>35</sup> The term ‘spout’ implies a system to direct water into a horizontal wheel (though not necessarily a reaction wheel). Moreover, no known document after 1844 refers to a vertical wheel, suggesting that the new wheel was invisible from outside of the mill building. The upgrade would have increased the mill’s power, extended its operating hours per tidal cycle (because a reaction wheel could operate while submerged during a portion of the incoming tide) and reduced the number of days when ice would impede its operation (because the mill building would protect a horizontal wheel from freezing).<sup>36</sup>

The 1840s upgrades, however, extended beyond the physical aspects of the mill. The mill’s legal situation also required improvement; the original proprietors had dammed a tidal creek without Commonwealth authorization. Town authorities and the proprietors lived with the ambiguity of an unauthorized dam for over fifty years. What then prompted the decision to address this issue at roughly the same time as the mill upgrade? One possibility is that the proprietors became concerned that their investment in a new mill could face a legal challenge. Some citizens believed that dams across tributary creeks (such as Mill Creek) reduced tidal flows and contributed to the encroachment of sandbars into the Pamet Harbor channel.<sup>37</sup> Another, not mutually exclusive, possibility is that the town wished to build Mill Pond Road but would not build on an unauthorized dam. To rectify the situation, former Truro selectman Allen Hinkley (not a close relative of Benjamin Hinckley) “and others” petitioned the Massachusetts legislature to legalize the mill operation. A second supportive petition attracted 151 signatures.<sup>38</sup> In 1847, the legislature authorized the “doings of the owners...in constructing and continuing [the] dam.” Such an outcome and the number of supporters for the effort indicates that the tide mill enjoyed widespread approval and that few Truro residents had serious concerns about the potential link between the dam and shoaling of the channel.

Mill Pond Road was completed on top of the dam between 1848 and 1858, supporting the theory that the legislation was a prerequisite for building that road. The proprietors then entered into an agreement with the town for maintenance of the dam and road.<sup>39</sup> Between 1840 and 1845 Collins had served as the surveyor of roads for an area including Mill Pond, so he would have been well positioned to arrange for that agreement.<sup>40</sup> The arrangement presumably benefitted both the proprietors and the town, and that may have been important to the proprietors as they sought to finance a new mill while recovering from the failure of the insurance company. Beyond any contracts with the town, an observation by historian Millie Stewart hints at how the funding might have taken place. In studying tide mill ownership records in Arrowsic, Maine, Stewart noted that the owners of some mills regularly transferred shares in the mills between themselves, “perhaps as a way of balancing the books after a season’s work [in lieu of cash].”<sup>41</sup> The Truro Tide Mill owners too may have used ownership shares as currency. Before 1844, there is no evidence that the carpenter John C. Knowles owned shares in the mill. By the 1860s, however, Knowles owned seven shares, second only to Collins. It is possible that Knowles built the new mill and that the proprietors paid him with shares in the complex.

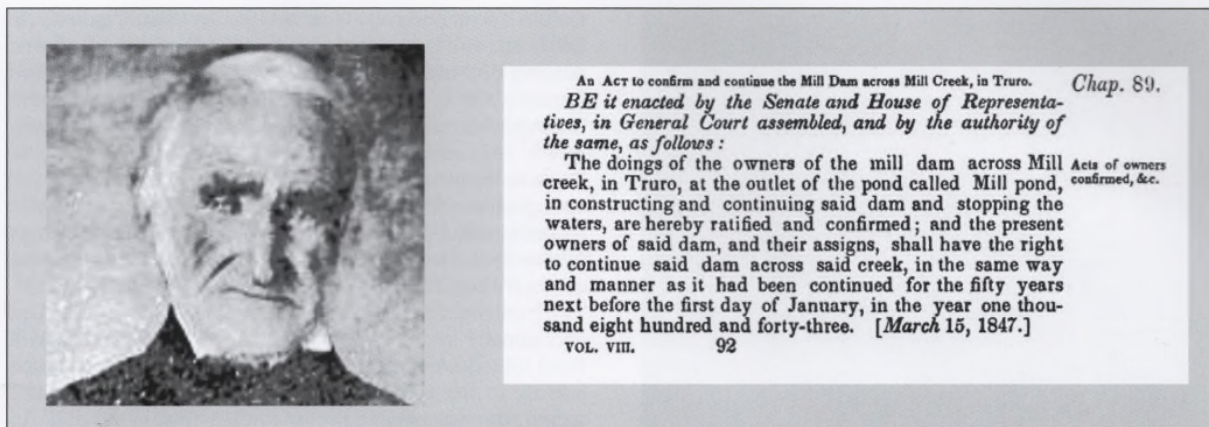


Fig. 12. Allen Hinckley and the 1847 Legislation from Secretary of the Commonwealth of Massachusetts, (photograph from MyHeritage entry on Deacon A. Hinckley, 2022).

Similarly, when Allen Hinckley died in 1860, he owned one share in the tide mill. The proprietors may have compensated Hinckley for his efforts with the legislature by granting him a share of their business. Finally, by the early 1860s, two men who in the 1850s married women close to Collins owned single shares in the mill complex.<sup>42</sup> These shares might well have been wedding gifts from Collins. To facilitate the use of ownership shares as currency, the proprietors may have split existing stakes in the business into smaller units. Pre-1844 probate records describe shares of the complex in terms such as one quarter or one eighth. In 1861, however, there were 41 shares.

The owners' decision to re-invest in the mill proved successful for more than a dozen years. The value of the mill reflected substantial business success, rebounding from \$240 in 1840<sup>43</sup> to as much as \$1,500 in 1848.<sup>44</sup> After the upgrade and through at least 1855, the mill supported Collins as a miller.<sup>45</sup> By the end of the 1840s, therefore, the Truro Tide Mill had emerged transformed from a period of uncertainty; rebuilt, more powerful, more available, on a solid legal basis, and with new leadership.

### Final Years

*"Abandoned... and taken down"*

Ultimately, small-scale grist mills powered by the tide had little place in the industrializing economy of the late 19th century. By mid-century, larger mills on the mainland with modern equipment (some hydropower, some steam) achieved economies of scale that allowed them to outcompete smaller, local tide mills. Steam-powered trains and ships could also transport the products of those factories rapidly and inexpensively. The demise of the Truro Tide Mill, however, occurred earlier than that of most other tide mills and resulted primarily from local conditions. Storm clouds might have been observed on the horizon, even as the proprietors upgraded the mill. Truro grain production, for instance, began to decline after 1845.<sup>46</sup> Millers should have been the first to spot this trend, but perhaps it was not apparent by 1844. Furthermore, by 1839 at least one Truro merchant began to sell flour shipped from distant locations such as Ohio,

Richmond and Philadelphia.<sup>47</sup> Another local threat certainly commanded attention. The fishing industry, central to the Truro economy, depended on a navigable harbour. Although 19<sup>th</sup> century authors describe the harbour as "excellent between the years of 1830 and 1845,"<sup>48</sup> sandbars became an increasing issue. Simultaneously, the latest fishing schooners were larger than their predecessors and required deeper water. As early as 1839, the town "solicited Government aid for the construction of a breakwater."<sup>49</sup>

The end, however, came rapidly. The failure of an 1854 effort to preserve the channel undermined faith in the harbour's future<sup>50</sup> as shoaling intensified. In 1856, the mill's value had fallen to 40% of its 1848 peak.<sup>51</sup> The mill continued to pay dividends to its owners, but payments from 1857 to 1859 amounted to only 54 cents per share.<sup>52</sup> By 1865, only ten fishing vessels and 150 fishermen operated from Truro.<sup>53</sup> Truro's population followed the fortunes of the fishing industry, dropping by one third from 1850 to 1860. Most businesses at the harbour closed.<sup>54</sup>

The tide mill too ceased operation, or at least scaled back dramatically. By the 1860 federal census, the only miller in Truro operated a windmill.<sup>55</sup> That census recorded

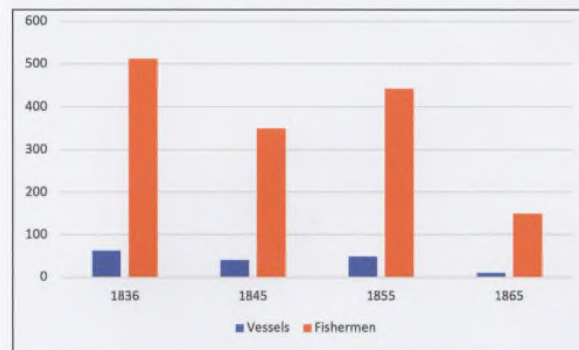
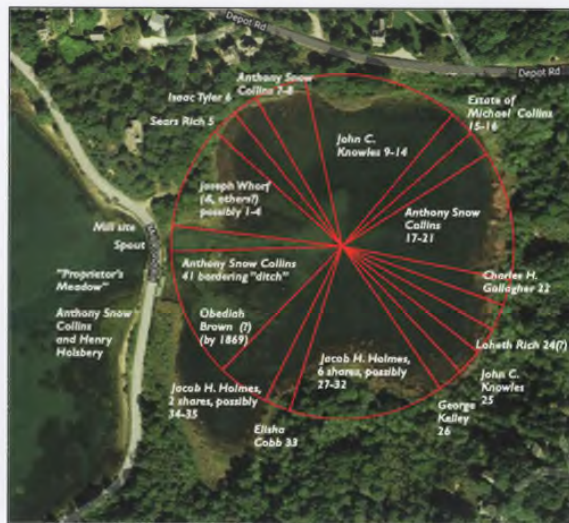


Fig. 13. Fishing vessels and Fishermen operating out of Truro (data compiled by the author from Bowman 1933, DeWitt, Francis, Secretary of the Commonwealth 1856, Palfrey, John G., Secretary of the Commonwealth 1846, Warner, Oliver, Secretary of the Commonwealth 1866).



**Fig. 14.** Ownership of the Mill Pond c. 1863 (information compiled by the author from Barnstable County Registry of Deeds and records in a private collection).



**Fig. 15.** Charles W. Snow removing the millstones (photograph from Snow family history in Highland House, Truro Historical Society, Truro, MA).



**Fig. 16.** A mill stone from the Truro Tide Mill, now a gravestone (photograph by the author, 2020).

Collins' profession as "seaman" rather than "miller." In 1861, six mill proprietors jointly sold 8 of the 41 shares, pegging the value of the mill complex at only about \$120.<sup>56</sup> Between 1861 and 1864 the mill pond was sub-divided through a 'Deed of Division' that converted the proprietors' shares into individually-owned pie-slices of the pond. Because the proprietors could sell or cultivate these lots, this arrangement allowed a dissolution of the mill business while retaining some value for the proprietors. Eventually, some of the owners converted their slices into a "profitable cranberry bog".<sup>57</sup>

Nonetheless the Truro Tide Mill may have operated occasionally into the mid-1860s. The 1864 sale of one Mill Pond lot required the buyer to maintain the dam and a ditch leading to the spout.<sup>58</sup> This time-consuming maintenance would seem intended to preserve water flow to the mill. An 1867 deed, however, provides a definitive end point for the mill's operations, referring to Mill Pond as "formerly the mill pond".<sup>59</sup> The mill building appears to have stood until 1878 because property boundaries in deeds up to that year reference the mill,<sup>60</sup> but the building must have been dismantled or moved between 1878 and the completion of Hurd's history in 1884. Over 150 mortared foundation stones remain in the vicinity of the mill location, although there is no definitive evidence that these stones came from the mill. The tide mill's millstones remained on the site until the early 20th century when one of Collins' successors as a Surveyor of Roads, Charles W. Snow, removed them.<sup>61</sup> Many millstones enjoy second careers as doorsteps. Snow, however, found a different application for one of the tide millstones, repurposing it as the tombstone beneath which he, his wife Abbie and his daughter Anna are buried. The dam built before 1790 remains in place beneath Mill Pond Road and the pond behind the dam covers essentially the same area it did in 1790.

### Recovering History

The only published works that refer to the Truro Tide Mill are the Hurd and Deyo histories, a 2007 history by Richard F. Whalen and a memoir by Anthony L. Marshall.<sup>62</sup> By 2013, a study on increasing tidal flows into the pond described the history of Mill Pond without mentioning the mill.<sup>63</sup> Perhaps this limited recognition stems from the fact that Collins, Knowles and their fellow owners had little interest in recording what they perceived as a business failure. Moreover, many of those who might have told the mill's story were part of the late nineteenth century exodus from the town and the couple most associated with the mill, Anthony Snow Collins and Thankful Collins, had no children who might have preserved the mill's history.

Yet, the Truro Tide Mill deserves recognition. The story of the mill is the story of several generations of owners who saw opportunities, were prepared to take risks and who grappled creatively with major challenges. In doing so, the mill's proprietors engaged tidal power to fill a community need for reliable milling services. They also broke new ground, at least in local terms. They appear to have applied advanced 19th-century technology to improve their milling capabilities. They boldly addressed a legal and environmental liability by obtaining Commonwealth blessing for their dam. They divided the mill complex into

increasing numbers of shares, spreading ownership widely within the town, and probably also used those shares for payments and gifts. Finally, at the time of the mill's demise, they converted shares in the enterprise into specific slices of property, allowing the dissolution of the business while retaining some value for each proprietor.

Fortunately, from the records these individuals left behind, we can discern some of their struggles and successes and we can incorporate the mill's recovered history into a broader understanding of milling on the American east coast from the late 18th through the mid-19th century.

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*The author can be reached by mail at 1791 Crestwood Drive, NW; Washington, DC; USA; 20011 or by email at [timjrichards57@gmail.com](mailto:timjrichards57@gmail.com).*

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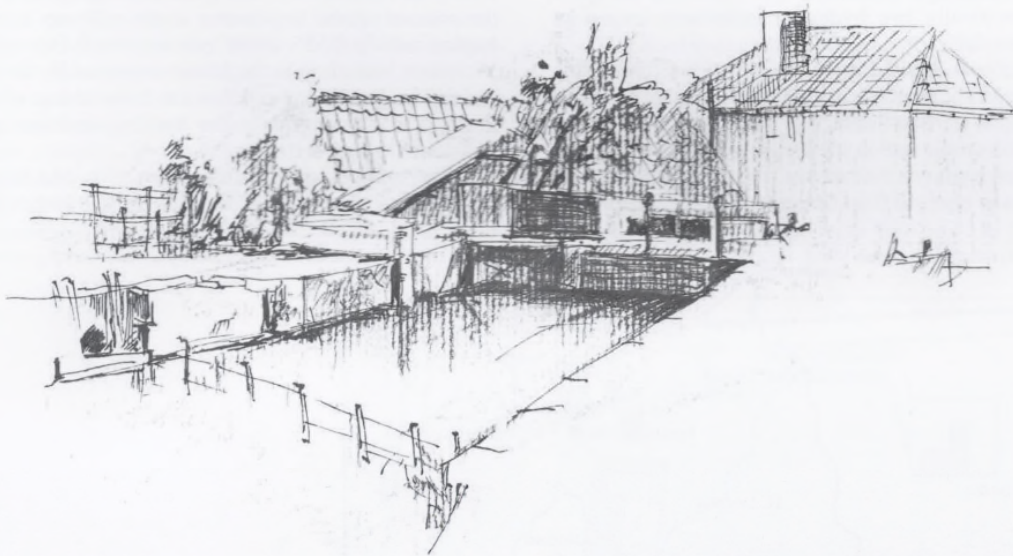
## References

- (Mitchum, 1970) and (Gilbert, 1977). Mitchum quotes minutes from a 1711 town meeting, two years after Truro's incorporation: "...if Thomas Paine should set up and maintain a grist mill within said town he should take three quarts toll out of every bushel of Indian corn [maize] that should be ground in said mill and two quarts out of every bushel of English corn [presumably wheat and rye] so ground and the town to give said Paine sixty pounds toward the building of said mill." (Winthrop, 1825) p 116; (Safford, 1922) p 1241.
- (Hurd, 1884) Identical language appears in (Deyo, 1890)
- (Whitman, 1794) "[In Wellfleet] We have for grinding [grain] into meal five wind mills and one tide mill."
- (Trowbridge, 1999)
- (Holmes, Hertz, Mulholland, 1998) p 41 and (Whitman, 1794)
- (Rich, 1888) p 471.
- (Barnstable County Registry of Deeds) Book 25, p 200.
- (Barnstable County Registry of Deeds) Book 999111, page 110. Hinkley may have already owned one eighth of the complex because his son Benjamin Hinckley, Jr. later owned one quarter of the shares. If so, Hinkley's carpentry skills would have been called upon in building the mill.
- (Barnstable County Registry of Deeds) Book 999081 p 213.
- (Barnstable County Registry of Deeds) See Book 999111 pages 111 and 245
- (Trowbridge, 1999) Tide mills generally required a greater initial investment than windmills: "[Windmills] were often cheaper to locate and build than water mills because no dam was needed; however, they were usually more expensive to keep in good working order over the long term."
- (Measuring Worth Foundation , 2022)
- (Barnstable County Registry of Deeds) Book 999122 pp 125, 126.
- (Holmes, Hertz, Mulholland, 1998) p 41.
- (Holmes, Hertz, Mulholland, 1998) p 41.
- (United States Census, 1840)
- One windmill that operated in Truro when the tide mill was built has approximately 7.6 meter blades. Based on estimates from an illustration in Rich (p 469) an early 19<sup>th</sup> century Truro windmill had 8.8 meter blades, which would generate about 33% more power than 7.6 meter blades.
- (Barnstable County Probate Court)
- (Measuring Worth Foundation , 2022)
- (Barnstable County Probate Court)
- (Safford, 1922) p 1242 and (Hunter, 1979) pp 303-305.
- (Malone, 2022)
- (Hunter, 1979) pp 308-310.
- (Layton, 1992) Chapter 4.
- (Layton, 1992) Hunter estimates pricing of a Parker Turbine at \$75 to \$125, p 310. Professor Patrick Malone found records indicating that the total cost of an early Wing reaction wheel installed at the City Mills in 1831 was \$450 (probably including installation and other costs) but a second wheel was expected to be placed "in operation at considerably less expense." *Material from Massachusetts Historical Society, Boston and Roxbury Mill Corporation records, BRMC Supt. Report by Nicolson, Jan. 1832. MHS BRMC box 2, folder 26.* Professor Malone also determined that these reaction wheels were Wing wheels based on a c 1841 deposition contained in the Special Collections of the Baker Library at Harvard Business School. (Malone, 2022) Safford et al note that the license to use one reaction wheel design was priced at \$20 (before materials and labor.) pp 1248-1249.
- (Hunter, 1979) p 304.
- (Hunter, 1979) p 304 and p 312.
- (Rich, 1888) pp 420 and 495.
- Four points support this conclusion: (1) Anthony Snow Collins adopted the name Collins; (2) Tamsin Collins' father was Deacon Anthony Snow, who died in 1816 and her brother, Anthony Snow, Jr., died in 1796; (3) the three witnesses to Michael Collins' will were Anthony Snow Collins, Thankful Collins and Benjamin Hinckley; and (4) Michael Collins' son Benjamin appointed Anthony Snow Collins as his representative in a dispute over Michael Collins' estate.
- (Rich, 1888), (Hurd, 1884), (Holmes, Hertz, Mulholland, 1998)
- (Barnstable County Registry of Deeds) Book 27, p 128.
- On September 7, 1841, the Truro Fire and Marine Insurance Company recorded 89 mortgages with the Barnstable County Registry of Deeds. The list of investors included Collins, Nehemiah Mayo, Samuel B. Rich, John Kiley, Henry Holsbery, Sears Rich, John Mayo and Richard Stevens, all tide mill owners, at least by the 1860s.
- (Rich, 1888) p 432.
- (Barnstable County Registry of Deeds) Book 86, p 252.
- (Hunter, 1979)
- (Kane, 1989) Kane cites a 1909 address by John B. Dyer: "The harbor began to shallow. Dykes across the nooks and coves lessened the run of water in and out of the harbor, and the fishing industry was doomed." p 49.
- (Barnstable Patriot, 1847)
- (Barnstable County Registry of Deeds) Book 86, p 252.
- (W.B. Nickerson Cape Cod History Archives at Cape Cod Community College, 1840-1850)
- (Warren, 2022)
- In 1853, Isaac Tyler married Collins' niece Thankful H. Holsberry. In 1856, sailmaker Charles H. Gallagher married 18-year-old Lucy Ellen Rich, who had lived with the Collins since at least 1850.
- (Barnstable County Probate Court) Estate of Benjamin Hinckley, Jr., 1840.
- (Zilliax, 2022) Atkins Dyer purchased one share in the mill in 1848 for \$36.50. The \$1,500 value assumes that there were 41 shares at that time, as there were in 1861.
- (Massachusetts Census, 1855)

46. (Palfrey, John G.; Secretary of the Commonwealth, 1846) p 323; (DeWitt, Francis, Secretary of the Commonwealth, 1856) p 16
47. (Captain Michael Snow, 1839-1842)
48. (Hurd, 1884)
49. (Massachusetts Historical Commission , 1984) p 12.
50. (Massachusetts Historical Commission , 1984)
51. (Zilliax, 2022) In 1856, the estate of Atkins Dyer valued his share at \$15, which would yield a \$625 total value. See also: (Barnstable County Probate Court) Estate of John Mayo, Jr., 1856. In Mayo's estate, one share was valued at just \$10.
52. (Zilliax, 2022)
53. (Warner, Oliver; Secretary of the Commonwealth, 1866)
54. (Hurd, 1884)
55. Isaac Small operated a windmill until it closed in 1866. (Barnstable Patriot, 1866)
56. (Zilliax, 2022) an 1861 deed describes the sale of eight shares by six owners; in the same year a share in the estate of Allen Hinckley was similarly valued, (Barnstable County Probate Court) 1861.
57. (Deyo, 1890) p 928.
58. (Barnstable County Registry of Deeds) Book 86, p 252.
59. (Barnstable County Registry of Deeds) Book 93, p 101.
60. (Barnstable County Registry of Deeds) Book 132, p 255 references a boundary running "Easterly by the old Mill."
61. (Marshall, 1974)
62. (Marshall, 1974)
63. (Louis Berger and Associates, 2013)

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### *Bulgarian mid-term tour*



*Sandeva Kashita watermill, Kalofer, viewed from the mill leat. Sketch by Johan De Punt.*