TO: Public Comments Portal. Massachusetts Energy & Environmental Affairs
Project 16731 - Talbot Mills Dam Removal
https://eeaonline.eea.state.ma.us/EEA/PublicComment/UI/searchcomment

FROM: Robert M. Thorson

SUBJECT: Public Comment as *pro bono* scholarly engagement

DATE: July 21, 2023

Though I strongly support the removal of the Talbot Dam at Billerica, MA, I have concerns that the "Previous Work" sections of the many reports and memos have ignored three previous exhaustive studies of the river system associated with the "Flowage Controversy" between 1858-1862. These are summarized and explained in the book cited below:

The Boatman: Henry David Thoreau's River Years by Robert M. Thorson
Cambridge: Harvard University Press, 2017

THE FLOWAGE CONTROVERSY

One of these, ***Report of Experiments and Observations on the Concord and Sudbury Rivers, in the Year 1861*** by Alvord, Daniel W., Storrow, Charles S. and Shedd, Herbert J. (published in 1862 in Boston by William White, printer to the state), involved 35,000 measurements taken in 1861 by 46 paid observers over a period of months from 34 stations located along the full length of the Concord-Sudbury segments as far south as Beaver Hole Meadows that were linked to a careful re-survey of the river. This study reports the results of a series of drawdown experiments (lowering and raising the flood pool of the lower impoundment) linked to a series of longitudinal stage profiles for various flood and drought conditions. This report provide hard, quantitative, evidence for how the river behaved under conditions similar to what might happen if and when the Billerica dam is removed. Quoting that report: "A drop [of the dam level] of 16 1/2 inches at low flow will, in the ordinary summer conditions of the river, reduce the level 8 inches at the fordway, 6 1/4 inches at Barretts Bar, and disappear above Robbins Bar." [quoted on page 224 of *The Boatman*]

A previous, and even more extensive 607-page report written by a special committee of the Massachusetts Senate and House recommended tearing town the Talbot Dam in 1861 to "improve" by upstream by enhancing the drainage and decreasing the wetness. ***Report of the Joint Special Committee Upon the Subject of the Flowage of Meadows on Concord and Sudbury Rivers, January 28, 1860*** by the Massachusetts Joint Special Committee, Boston: William White, Printer to the State, 1860. This report provides the broadest context.

The more scientifically rigorous published understanding of the river system in the 19th century is the ***Journal*** and archive of Henry David Thoreau. He spent 18 months of field research on a river system he had studied for the previous ten years and lived on for a lifetime. In 2017 I published a summary of his work under the title: *The Boatman,* cited above.

The dearth of attention to the historical record in the review process provides serious gaps in our understanding of what might happen if and when the Talbot Dam is removed. Consider this one example.

Page 18 of the ***Expanded Environmental Notification Form*** prepared by Gomez and Sullivan for CRT Development Realty, LLC, to facilitate review by the MEPA Office of Energy and Environmental Affairs (dated June 15, 2023) presents a yes/no question: "*Is the project site located wholly or partially within a defined river corridor of a federally designated Wild and Scenic River or a state designated Scenic River.*" The provided answer is "Construction activities associated with the proposed dam removal will not directly impact the Wild and Scenic designated segment of the rivers; however, water level will be slightly lowered after the dam removal as far upstream as the first dams on the Sudbury and Assabet Rivers. Reductions in water surface elevation will be limited to less than 0.3 feet (3.6 inches) for modeled flows ranging from the 7Q10 drought to the 500-year (0.2% AEP) flood.

I find the response wanting for several reasons.

First, the response must be (and is) a clear "no" because there is only a binary yes/no choice. Second, the question is explicitly a matter of location, not potential upstream impact. In the response text, the answer is "not directly," which implies an indirect yes. The reported "reductions in water surface elevations" of 3.6 inches or less are based on forward modeling. In contrast, quantitative measurements based on the 1861 hydraulic experiments report that: "A drop [of the Talbot Dam water level] of 16 1/2 inches at low flow will, in the ordinary summer conditions of the river, reduce the level 8 inches at the fordway, 6 1/4 inches at Barretts Bar (nearly twice that of forward modeling) and disappear above Robbins Bar."

Third, the question being asked is ambiguous. The 1999 designation of the Concord, Sudbury, and Assabet River units of the National Wildlife Refuge as "Wild and Scenic Rivers" was due in large part to the legacy impacts of a series of dams culminating in what is now called the Talbot Dam. In a process-response cascade: (1) Dam construction (2) created a flat reservoir, which (3) submerged the Fordway, which (4) reduced the hydraulic efficiency of this channel during floods, which (5) raised the flood stages and extended the flood durations for upriver reaches, which (6) raised the base level for sedimentation at the mouth's of the more powerful (unit stream power) Assabet River and Pantry Brook, which (7) created and(or) raised, and(or) enhanced, and(or) strengthened bars of gravel and sand (Barretts Bar, boat-place bar, Robbins Bar), which (8) raised the thalwegs of the rivers crossing these bars, which (9) became the outlets for base-flow and drought discharges, which (10) backed up water on the meadows to a higher level than before, which (11) compromised the agricultural utility of the meadows, which (12) led to their general abandonment, which (13) led to the creation of riparian wetlands claimed as wildlife refuges in the 20th century. In short, construction of the dams made the natural meadows wetter to the point that they had to be abandoned for utility other than as wetland refuges.

Given that dam constructions in the 18th and 19th centuries caused such a dramatic changes in upstream meadows, and given that the 1860 Special Committee concluded that removal of the dam would reverse many of these perceived negative changes, the fundamental question for us today is whether removal of the dams will cause a reversion back to the original, drier conditions? This may be an example of fluvial hysteresis, in which forward and backward processes follow different pathways.

Consider this climate change scenario. If drainage through the Fordway is enhanced by dam removal, then locally intense storms in the Assabet watershed could cause its stage to crest before still water in the Concord River backs behind the hydraulic dam at the Fordway to reach the mouth of the Assabet. This transient inequality in stage may focus erosive stream power on the sand-gravel-filled channel on what Thoreau called the Rapids Reach between the Assabet bar and Barretts Bars, steepening its gradient and bringing many tons of sediment into the lower river. Conceivably, this steeper reach on the Rapid Reach could then headcut southward into the Sudbury and westward into the Assabet, propogating upstream to dry the meadows more than in the last two centuries.

FROM *THE BOATMAN*

The *Journal* of Henry David Thoreau for May 17, 1860 reports on the Fordway. [quoted in *The Boatman,* 232] "'That it is not used as a fordway of late years' Thoreau concluded, was the single 'best evidence that the water is deeper there than formerly.'" The "water lines" on the rocks there do not lie."

"Quantitative proof came from the drawdown experiments...Dropping the dam pool 16 1/2 inches brought the water level at the Fordway down by half that amount, proving bottom-up control by the dam. When the dam pool was allowed to come back up, the result was a much gentler gradient and a stagnant channel at depth, both of which reduced the hydraulic efficiency of Musketaquid's natural outlet. This meant higher and longer-lasting floods, which meant higher gravel bars at the T-junction [confluence of Assabet and Sudbury at Egg Rock].

Figure 23 on page 225 reproduces a portion of an extensive data set from the 1861 report by Alvord, Storrow, and Shedd. Regarding this illustration: "a river's base flow discharge takes place within channels set by high-flow conditions...the three most important sediment bars (Barretts, boat-place, and Robbins) were submerged and being shaped by the August [16-17] flood...When the flood subsided, each bar became a sediment dam that created an upstream lakelike reach that kept the water high on the meadows."

SELECTED RESPONSES TO REPORTS

Upstream Extension of Hydraulic Model Memo Hydraulic Models - Gomez and Sullivan, Jill Griffiths, PE, June 30, 2022

Why is the probabilistic "500-year flood" still being used when climate change has negated the fundamental assumption of statistical stationarity required for the prediction?

Page 4 reports that there will be "no significant changes to water surface elevations or average channel velocities within the Assabet and Sudbury Rivers." This is based on forward modeling. Why not examine the historic reports? Above the Fordway, the water surface elevations for different flood stages are set by fluvial geomorphic responses to flood events.

Page 4 reports a "drop in surface elevations... upstream of Fordway," will be very low, "0.34 feet (4.1 inches) for the 7Q10 drought flow, and 0.13 feet (1.6 inches) for the median annual flow" when the historic record shows a greater amount.

Conceptual Sediment Management Plan

To my understanding, the sediment being managed is only that limnic sediment of the lower reservoir, and only that above peat of glacial material. The fact is that the entire length of the rivers except for rare bedrock reaches is sedimentary and available for erosion. For example, the loose sandy sediment on which Concord was founded is still sediment available for the sediment budget of the river. And much of the current sediment on bars above and below the Assabet junction originated as sediment pollution from upstream reaches on that river. This is labile sediment that could be reactivated again.

The formula for the sediment delivery ratio used in the model *My Watershed* has only one variable, that of watershed area, when, in fact, dozens of factors are involved. Hydraulically, much of the lower river is lake-like, which captures and holds sediment.