Planning Assistance to States

Assabet River, Massachusetts
Sediment and Dam Removal Feasibility Study

September 2010

US Army Corps
of Engineers
New England District

EXECUTIVE SUMMARY

This investigation was conducted by the New England District of the U.S. Army Corps of Engineers (Corps) under the Planning Assistance to States (PAS) Program as authorized in Public Law 93-251 and amended in subsequent legislation. The study was performed through a 50/50 cost sharing agreement with the Massachusetts Department of Environmental Protection (MassDEP). The MassDEP entered into a Memorandum of Understanding (MOU) with the six Assabet River Consortium communities (Westborough, Shrewsbury, Northborough, Marlborough, Hudson, and Maynard) for the sediment and dam removal study. The MOU established a Study Coordination Team (SCT) made up of twelve members, six from the communities and six selected by MassDEP including the Organization for the Assabet River (OAR), to collaborate in the study effort**.**

Purpose

The purpose of this study is to provide planning assistance (planning level engineering and scientific information) to MassDEP on the potential feasibility of sediment and dam removal to reduce internal recycling of phosphorus (sediment phosphorus flux) in the Assabet River. The first part of the study focused on reductions in internal phosphorus recycling from sediment for sediment and dam removal measures. The second part of the study focused on engineering and environmental considerations for hypothetical dam removal.

If in the future a proponent steps forward who wishes to pursue dam removal, then there would be a detailed environmental assessment and permitting process involved at all levels of government – local, state, and Federal.

The following six dams on the river, and the associated sediment behind them, were considered in the planning study:

- Aluminum City Dam, Northborough
- Allen Street Dam, Northborough
- Hudson Dam, Hudson
- Gleasondale Dam, Stow
- Ben Smith Dam, Maynard
- Powdermill Dam, Acton

Background

MassDEP in 2004 prepared a "Total Maximum Daily Load for Phosphorus" (TMDL) for the river to address the problem of eutrophication throughout the Assabet River system in response to high levels of phosphorus. The TMDL required implementation of measures to decrease phosphorus loading to the river and adopted an adaptive management approach in accordance with EPA approved procedures. The TMDL for the river can be viewed at http://www.state.ma.us/dep/water/resources/tmdls.htm#suasco.

Studies by MassDEP have determined that the Assabet River experiences the effects of eutrophication due to excessive nutrient loadings (particularly phosphorus) from wastewater treatment facilities (WWTFs), nonpoint sources, and sediment phosphors flux and that nuisance aquatic vegetation related to eutrophication impairs designated uses as defined by State Water Quality Standards including recreation, aesthetics, and fish and wildlife habitat.

Phase 1 of the TMDL required that the four WWTFs discharging to the Assabet River decrease the total phosphorus in their effluent to 0.1 mg/l (April to October) and 1.0 mg/l (November to March). The 0.1 mg/l requirement resulted in the need to add new phosphorus removal technology at the same time as doing significant facility upgrades. These upgrades are currently being implemented and paid for by the communities that own or use the WWTFs.

Phase 2 of the TMDL required additional projects be implemented to continue to decrease total phosphorus loading to the river. The MassDEP 2004 phosphorus TMDL indicated that to achieve compliance with water quality standards a 90 percent reduction in sediment phosphorus flux was needed in addition to Phase 1 WWTF improvements. Potential options identified in the 2004 TMDL to achieve the 90 percent sediment phosphorus flux reduction included sediment and/or dam removal on the Assabet River.

The Corps "Planning Assistance to States Study" study is a follow-on effort to the MassDEP 2004 TMDL to provide additional information on the feasibility of sediment and dam removal to decrease sediment phosphorus flux.

Modeling and Modeling Results

In the first part of the study the Corps contracted with the engineering firm of Camp, Dresser, and McKee (CDM) to perform data collection and computer modeling. Computer models used are listed below and an analysis is provided in the CDM "Modeling Report" dated June 2008.

- HEC-RAS model was used to examine the effect of dam removal on water surface elevations.
- HEC-6 model used to simulate the movement of sediment following dam removal, and changes to the riverbed profile following dredging.
- HSPF model was used to qualitatively assess either positive or negative changes in water quality associated with the measure (dam removal and dredging).
- A spreadsheet model, based on equations from the US-EPA QUAL2K model, was used to understand the dynamics of phosphorus flux in the system.

The following summarizes the results of that analysis.

Sediment Dredging Alone

Dredging of sediment from behind dams was considered to decrease sediment phosphorus flux. However, dredging alone would at best achieve only short-term (~ two to four years) reductions in sediment-phosphorus release and the increased hydraulic residence time in the impoundments would likely do more to stimulate biomass growth than the reduction in sediment phosphorus loading would inhibit it. Therefore dredging alone was not considered to be a viable control measure.

Sediment Deactivation

Sediment deactivation was also considered to decrease sediment phosphorus flux. This measure is generally used in lakes. The approach is to apply a chemical (aluminum, iron or calcium salts have been used) so that the chemical both scavenges inorganic phosphorus in the water column and then seal the sediment to hinder the recycling of sediment phosphorous into the water column. In the Assabet, however, it was estimated that there would be fairly rapid (2-5 years) phosphorus replenishment from the settling of biomass and in-stream phosphorus contributions to the sediment. Sediment de-activation is not considered to be a viable long-term measure.

Planned WWTF Improvements

Modeling results suggest that significant strides will be made toward the TMDL goal of 90% reduction in sediment phosphorus flux and overall improved water quality when the current planned improvements are in place at the WWTFs. Planned reductions in phosphorus discharges from WWTFs and the goal of a 90 percent reduction in sediment phosphorus release are not independent; the planned improvements at WWTFs are likely to collectively yield a significant reduction in sediment phosphorus flux.

Dam Removal and Planned WWTF Phosphorus Reductions

Dam removal in combination with planned reductions in WWTF was also considered. Expected water quality improvements include higher minimum dissolved oxygen levels, lower ranges of diurnal DO fluctuation, fewer and less severe occurrences of DO super-saturation, cooler water temperatures, and less nuisance aquatic vegetation.

Modeling results indicated that the potential removal of Ben Smith dam would contribute to achievement of water quality goals through reductions in sediment phosphorus flux because the biomass growth and settling that ultimately drives the sediment flux would decrease with dam removal.

Modeling results also indicated that potential removal Hudson and Gleasondale dams would also contribute incrementally to these goals. Removal of the two most upstream dams in this study, Aluminum City and Allen Street, would result in water quality improvements in stream reaches affected by the existing impoundments, but would have minimal effects on downstream water quality. Similarly, removal of Powdermill dam would have only localized benefits.

Dredging of any or all of the impoundments is suggested only to control sediment movement following dam removal; and as noted above it has no significant long term water quality benefits by itself.

Estimated Reductions in Sediment Phosphorus Flux

The modeling analysis indicated that the planned WWTF improvements would result in a 60 percent reduction in P-Load and potential dam removals would provide another 20 percent reduction. The estimated 20 percent is a conservative estimate and the percent reduction from dam removal may be greater. With both planned WWTF improvements and dam removals the sediment phosphorus flux reduction is estimated to be approximately 80 percent, near the TMDL target of 90 percent reduction.

Adaptive Management Approach

During this study additional data was collected by CDM on sediment P-flux in the Assabet River to help understand the nature of sediment phosphorus flux. Both the sediment phosphorus flux field data collected, as well as the mass balance (spreadsheet) model of sediment-phosphorous flux, led to better understanding of the seasonality associated with sediment phosphorus flux. Results indicate that the sediment response to a change in overlying water phosphorus concentration is fairly short (several seasons).

This realization supports the adaptive management approach adopted by MassDEP in the 2004 TMDL. Also as there are inherent limitations and uncertainties of predictive modeling of a

dynamic physical, chemical, and biological system, the accuracy and effectiveness of target reductions could be confirmed by monitoring.

Seasonal WWTF Discharge Limit

Although consideration of lower WWTF winter P-discharge limits was not specifically part of this study, the P-flux model based on limited laboratory data indicated that winter P-loading may have an effect on summer sediment flux rates. If this is confirmed, the additional reductions in phosphorus levels in WWTF discharges during the non-growing season (below the current planned limit of 1mg/L) may make a significant contribution to achieving water quality standards, especially if only limited or no dam removal is undertaken. Further study is necessary to better understand this issue.

An additional consideration of the modeling study was that if no other improvements were implemented, further reductions in summer P discharge limits, below 0.1 mg/L, would not contribute significantly to further reduction in sediment phosphorus flux. This is because the analysis indicated that the winter instream phosphorus concentration has a strong effect on the P-flux the following summer. Therefore, if the summer P discharge limits were decreased below 0.1 mg/L without any further reduction in winter limits, the P-flux in the summer would still be "controlled" by the winter instream phosphorus concentration.

Potential Dam and Sediment Removal

The second part of the "Planning Assistance to States Study" study focused on feasibility of dam removal including engineering considerations and identification of some of the environmental impacts that would be associated with a potential dam removal project.

This study was not meant to be an Environmental Impact Assessment document of dam removal nor is it a Corps decision document. There are many permits and environmental studies at all levels of government that would apply to a dam removal project if a dam removal proponent were to step forward. Federal laws such as the National Environmental Policy Act, the Clean Water Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the National Historic Preservations Act, (to name a few) as well as Massachusetts and local laws and regulations would provide the framework for the detailed evaluation of potential projects if any are proposed in the future.

The planning study identified engineering and environmental issues related to dam removal and these are summarized below.

Sediment Quantity and Sediment Management

The Assabet River Study dams have been in place since the late 1800s and early 1900s and as a result sediments have accumulated behind these dams. If the dams are removed some of this material would reposition within the channel and some would move downstream. The quantity of sediment that would move downstream in a short period of time following dam removal was estimated using the HEC 6 computer model. Sediment volume estimates to be managed ranged from 1,300 to 67,600 cubic yards for Aluminum City and Ben Smith dams, respectively.

Also review of sediment quality data indicated that some of the sediments contain contaminants that may limit disposal options. It is suggested that additional sediment sampling and testing be performed if further studies of dam removals are undertaken. Suggested detailed sampling plans for Assabet River sediments above the dams are provided in the CDM 2008 "Assabet River Sediment Management Plan" report. These sampling plans do not address environmental or health risk assessments of sediments currently under water that could be exposed by dam removal. It is possible that these types of studies may be requested by regulatory agencies as part of future work on dam removal feasibility.

Construction Cost Estimates for Dam Removal

Construction cost estimates for hypothetical dam removal, prepared by CDM in 2008, ranged from about 1 million dollars for the Aluminum City dam to 12 million dollars for Ben Smith dam. In addition to construction costs, costs for a dam removal project would include environmental studies and public review, design, permitting, and project management. These costs are not estimated at this time and would vary depending on the entity that might implement a potential dam removal project. Also there would be real estate costs associated with implementation including items such as cost of the purchase of the dam, permanent or temporary construction easements, and purchase of land in fee as determined to be needed for a project. Also increases in sediment volumes that need to be managed and disposal constraints due to contaminants would increase construction cost estimates.

Target Fish Community Analyses

A target fish community (TFC) can be used as a guide to identify the composition of a healthy fish community for large streams and small rivers in the New England region and can guide and help evaluate river rehabilitation.

The existing fish community (EFC) in the Assabet is not consistent with the target fish community (TFC) considered for the river. Current fish species composition consists primarily of macrohabitat generalists and pollution tolerant species. The overall dominance of macrohabitat generalists and lack of fluvial specialist is directly related to the effect of the dams and the creation of impoundments in what naturally would be free flowing stretches of river.

The current fish population is dominated by more pollution tolerant species (e.g. white sucker and bluegill). It is expected that removing dams on the Assabet River and improving water quality would provide habitat that would support the increase in fluvial dependent and fluvial specialist species consistent with the considered target fish community (TFC) for this river.

Over the long term, removing dams on the Assabet would also provide for the future restoration of the migratory corridor on the Assabet and provide access to spawning grounds and nursery habitat for anadromous species when passage is provided at the Talbot Dam in Billerica.

If in the future dam removal were considered further, additional studies of fish populations on the river would be useful to assess changes that would take place.

Impact of Dam Removal on Water Surface Elevations

Computer modeling of the Assabet River included an examination of the effect of dam removals on water surface elevations. Changes were calculated using the HEC-RAS computer model developed for the study. The HEC-RAS model results indicate that dam removal significantly lowers the water surface elevations behind the dams.

Recreation

If the dams on the Assabet River were to be removed this would impact the recreational uses that rely on the impoundments and the deeper water depth provide by the impoundments. Recreational activities on the impoundments include canoeing, kayaking, fishing, ice skating, cross-country skiing and enjoyment of the open water environment. A detailed evaluation of recreational impacts was not part of this study but would be needed if dam removal is considered further. A recreational use survey would be valuable to document the many recreational uses of the river.

Water Supply

The Town of Stow relies on the Assabet River at both Gleasondale dam and the Ben Smith dam as a source of water for fire protection for the surrounding communities. Also some businesses along the river rely on the river as a source of irrigation. In addition there are fire ponds and wells adjacent to the river that would need to be considered. If dam removal were considered further then water supply uses would need to be considered in more detail to determine the impact of dam removal and mitigation plans would also need to be developed as appropriate.

Mill Pond at Clock Tower Place

If Ben Smith dam were to be removed then the Assabet River water level at the current canal intake point would drop such that water would no longer flow by gravity into the mill pond at Clock Tower Place. Options would need to be evaluated to provide water to the mill pond.

Flood Levels

Removing dams would lower water levels in the Assabet River. Storage behind the dams is small and would not be entirely lost if the dams are removed, because the dams are located at natural restrictions in the river, the effects of dam removal on downstream peak flows would be small. Future studies would be needed to determine if it is necessary to leave part of the abutments in place to further restrict flood flows such that there is no increase in downstream peak discharges; however, the elimination of the pools behind the dams would mean that the same storage as before dam removal can be achieved at a lower water level.

Wetlands Impacts

Many of the wetlands along the Assabet River exist because of the water backed up by the dams. The planning level analysis determined that there would be both changes in wetland types and a loss of wetlands as a result of dam removal. The largest changes in wetlands would occur behind Ben Smith, Gleasondale, and Hudson dams. If a potential dam removal project were to be considered further, wetlands impacts and potential mitigation would need to be assessed. Wetlands are regulated under both Federal and state laws.

Wildlife and Rare Species Habitat

Wildlife habitat includes open water areas, wetlands, and upland forest. These areas provide valuable habitat for a variety of invertebrates, amphibians, reptiles, birds, and mammals. The Massachusetts Natural Heritage Program has identified areas within the Assabet River watershed as potential habitat for rare species. Further detailed studies and assessments of wildlife resources and impacts would be needed if a dam removal project were to be considered.

Cultural Resources

All of the dams have identified cultural resource value. Ben Smith, Gleasondale, Hudson, and Allen Street dams are contributing elements to historic districts that are eligible for or listed with the National Register of Historic Places and removal would be an adverse impact and require further studies and documentation of the resources. Further study would also be required of Aluminum City to determine significance. Also, all potential removals would require further consideration of archaeological resources as areas in the vicinity of the river were used prior to European settlement by native groups dating back to 8,000 BP (before present).

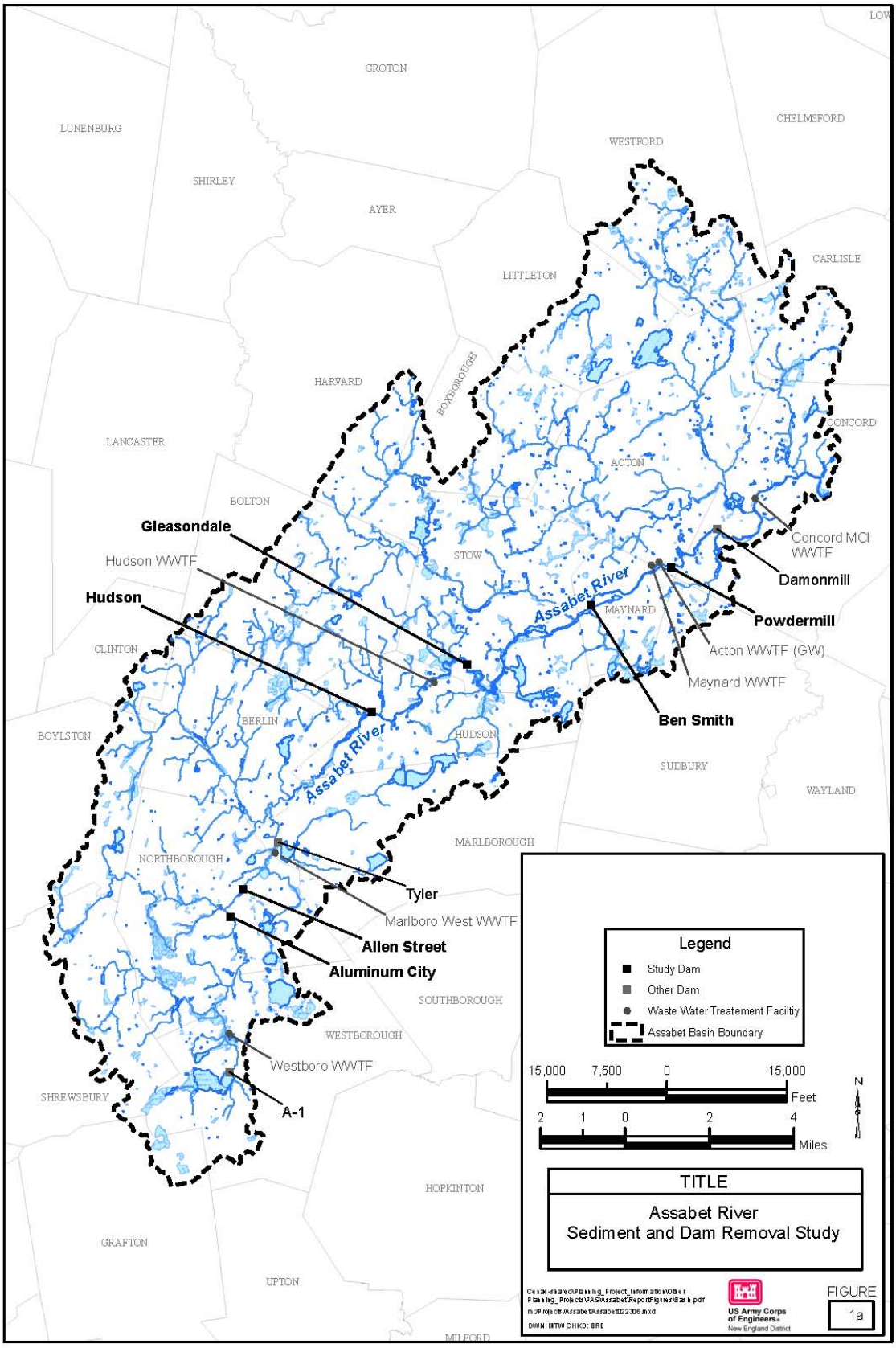
All dam removal projects would be subject to consultation and review by the Massachusetts State Historic Preservation Officer and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officer (THPO), as well as the Mashpee Wampanoag THPO.

Public Review

The Corps and MassDEP held two public meetings in November of 2009 to inform local stakeholders of the study findings. Comment letters demonstrate that many in the local communities and stakeholders value the existing impoundments and dams for many reasons including: recreation, aesthetics, wetlands, fish and wildlife communities, historic and cultural significance, and as a water source for fire protection and irrigation.

Stakeholders are concerned about the potential public health risk of exposure to sediments currently under water, the cost of a dam removal project including the potential cost of sediment management, disruption during construction, potential impact on the real estate values of adjacent homes, potential impacts to business or local residents that rely on the impoundments or groundwater near the river as a source of water, potential increase in flood risk, and loss of recreation associated with the impoundments. There were many letters received opposing dam removal on the Assabet River. Stakeholders are strongly opposed to further consideration of Ben Smith dam removal.

Comment letters also raised the issues of wastewater treatment plant permitting, year round phosphorus limits, and an adaptive management approach to improve water quality in the Assabet River. Comments made at the first public meeting by several municipal officials supported an adaptive management approach that considered winter time phosphorus reductions and monitoring prior to considering additional upgrades and/or potential dam removal. Comments received on the draft and responses are included in Appendix K.


GROTON
LUNENBURG
SHIRLEY
AYER
WESTFORD
CHELMSFORD
LITTLETON
CARLISLE
HARVARD
BOXBOROUGH
CONCORD
LANCASTER
ACTON
BOLTON
STOW
MAYNARD
CLINTON
BERLIN
HUDSON
BOYLSTON
SUDBURY
WAYLAND
MARLBOROUGH
NORTHBOROUGH
SOUTHBOROUGH
WESTBOROUGH
SHREWSBURY
HOPKINTON
GRAFTON
UPTON
MILFORD
Gleasondale
Hudson WWTF
Hudson
Assabet River
Concord MCI WWTF
Damonmill
Powdermill
Acton WWTF (GW)
Maynard WWTF
Ben Smith
Tyler
Marlboro West WWTF
Allen Street
Aluminum City
Westboro WWTF
A-1
Legend
Study Dam
Other Dam
Waste Water Treatement Facility
Assabet Basin Boundary
15,000 7,500 0 15,000
Feet
2 1 0 2 4
Miles
N
TITLE
Assabet River
Sediment and Dam Removal Study
US Army Corps of Engineers
New England District
FIGURE
1a