STATE INNOVATION PILOT GRANT PROGRAM
Submission of the Commonwealth of Massachusetts

Project Summary

Summary of Project

Massachusetts is proposing to try an innovative approach to achieving water quality standards in the Assabet River, which is listed as impaired under section 303(d) for nutrients. Because the data obtained thus far in our TMDL process demonstrates that point source control alone will not be enough to achieve water quality standards, we are, along with a consortium of communities along the river and a local environmental group, exploring alternatives to focusing exclusively on point source controls. These alternatives include dam removal, sediment removal/control, nonpoint source controls and possibly groundwater recharge. The existence of a consortium of communities in the watershed, together with a well developed model established in connection with the preparation of a TMDL, make this an excellent candidate for a truly watershed based permit that is well outside the established box and that would provide a model for future watershed based permitting.

Applicant Information

Title	Assabet Watershed Innovative Permitting
Applicant	Massachusetts Department of Environmental Protection
Contact	Dennis Dunn, 627 Main Street, Worcester, MA 01608 Phone: (508) 767-2874 email: Dennis.Dunn@state.ma.us
Program	This project is not being funded by another Federal program. The U.S.G.S. is assisting with data collection activities and the EPA Region 1 is assisting with analytical support from their Chelmsford laboratory.
Flexibility	No regulatory flexibility is anticipated to be needed to implement this project
Support	The Commissioner of the Department of Environmental Protection supports the submission of this project for the Commonwealth of Massachusetts. EPA Region 1 and local stakeholders are also participating and support the project.

Summary Budget Information

Amount	The dollar amount requested from EPA is $100,000.
State	The dollar amount of State funding offered by the State is a 50% match or $100,000.
Total	The total project budget is $200,000.

Project Narrative

Background

The Massachusetts Department of Environmental Protection (DEP), EPA Region 1 (EPA), Assabet River Consortium, and Organization for the Assabet River (OAR) are actively participating in evaluating potential options to eliminate or dramatically reduce eutrophication to the Assabet River. Detailed studies conducted to date indicate that multiple solutions will be needed beyond typical point source controls to address this problem. As such, DEP and EPA are exploring watershed based solutions and using a watershed permitting approach to allow for the use of innovative incentives for the point source dischargers and creative solutions to achieve water quality standards in ways that would not be possible with more traditional approaches.

The Assabet River is dominated by Publicly Owned Treatment Works (POTWs), both in flows and nutrients loads during low flow conditions. Preliminary evaluations conducted by DEP and OAR in 1998 and 1999 indicated that water quality conditions in the River were being negatively impacted due to excessive vegetative growth and that the POTWs generally accounted for approximately 60-80% of the river flow during the summer months. Given the preliminary evaluations DEP, EPA, OAR, and a group of watershed communities embarked on a detailed analysis to document actual water quality conditions, evaluate what actions are needed to meet water quality standards, and to identify and assess both current and future wastewater and water supply needs in the affected communities.

It was also apparent at that time that major financial sources were going to be necessary to conduct the detailed assessment and evaluation activities and that traditional sources and mechanisms were not going to sufficient to obtain the necessary funding and expertise. To this end, an innovative watershed based approach was developed to not only coordinate all aspects of the project but also build local and state support for funding and decision-making. First, all aspects of the project were coordinated through the SuAsCo River Watershed Team. The SuAsCo (which stands for Sudbury, Assabet, and Concord Rivers) Watershed Team was one of twenty-seven watershed teams in Massachusetts that were developed through the Massachusetts Watershed Initiative in the late 1990's. Each team is lead by a watershed team leader funded through the MA Executive Office of Environmental Affairs (EOEA). The primary goal of the team and its leader was, in simple terms, to establish a communication vehicle and partnership with local stakeholders such as environmental groups, municipal government, local business and industry, as well as with federal and state agencies to identify, prioritize, and address watershed issues. Once prioritized a concerted and coordinated approach is used to try to build consensus on actions to be taken and obtain necessary funding to achieve those actions. As a result, all aspects of the project are not only open to the public but included the public review of all project components and in the decision-making process.

Relative to the Assabet River issues, the SuAsCo watershed team identified the Assabet River nutrient problem as its highest priority and requested additional state

funding (which was not otherwise available) to collect the necessary data and document water quality conditions. The actions of the team resulted in DEP contracting with ENSR Consulting to conduct detailed water quality studies during 1999 and 2000. OAR and the local communities also participated in data collection activities at that time. OAR assisted in collecting in-stream data and the communities increased data collection frequency in their effluent discharges. The studies documented that the river is supersaturated with nutrients and heavily impaired by aquatic vegetation caused by excessive nutrient loading. In addition, the studies found that designated uses of the river are not being fully met. Finally, the studies also identified that, during the summer months of those years, the existing POTW discharges generally account for 60-80% of the river flows and up to 90% during low flow periods and that the vast majority of the nutrient loads were originating from the four large POTWs on the river. In response to the preliminary data from 1999, DEP requested that all POTWs maximize their current facilities to remove phosphorous in their discharges and to immediately increase the frequency of monitoring their effluent to determine system loadings necessary for detailed water quality modeling. As a result the treatment facilities decreased the phosphorous concentration in their effluent by 25% to 50%.

In addition to the above, it became readily apparent that not only was a nutrient TMDL evaluation necessary but also it was imperative that the communities begin concurrently with developing a comprehensive watershed management evaluation to evaluate and document each community water and wastewater need, and to also evaluate watershed issues on a whole that may be impacting water quality and quantity. Although SRF loans were available for this purpose it was apparent that each community individually would not achieve enough priority points in the SRF program to be eligible for funding. Given this issue, the communities identified and implemented another innovative approach. That approach was to form a cooperative made up of six communities (Westborough, Shrewsbury, Marlboro, Northboro, Hudson and Maynard) now called the Assabet River Consortium that when combined resulted in high priority points in the SRF program and the award by DEP of a $3.5 Million loan for this purpose. This is the first time this approach has ever been used in MA by affected communities or DEP.

Four phases for this evaluation were identified as follows:

Phase 1 – Needs Analysis
Phase 2 – Treatment Options Analysis
Phase 3 – Costs and Land Disposal Evaluation
Phase 4 – Design of Recommended Plan

Presently Phases 1 & 2 have been completed and Phase 3 is about to commence.

With the data obtained from the 1999 and 2000 studies, DEP was also able to obtain additional funding (with support from the watershed team) to begin development of a comprehensive water quality model. The model (HSPF) was calibrated and validated in 2001 and 2002 on prior water quality survey data and flow regimes and is now being

used to evaluate different water quality management options and to explore possible alternative options and necessary reductions from both point and non-point sources. Model runs to achieve improvements in water quality indicate that dramatic reductions in phosphorus discharges from the POTWs will be necessary, but also show that POTW discharge reductions, even to zero phosphorus, although improving water quality conditions, do not achieve water quality goals when ambient phosphorous concentrations are reduced. The reason for this is that sediment phosphorus contributions become a more significant factor at low ambient concentrations than currently exist in the nutrient saturated system. Given this, future permit conditions may possibly include requirements on the POTWs to significantly reduce phosphorous concentrations in their effluent to 0.2 mg/l or less and incorporate additional requirements to address sediment phosphorous release in downstream impoundments. The goal of the permit(s) would be to eliminate minimum dissolved oxygen violations in the river and to significantly reduce large diurnal dissolved oxygen fluctuations, in-stream phosphorous concentrations and total biomass in downstream impoundments and slow moving sections of the river that presently impede the designated uses of primary and secondary contact recreation and aesthetics. This type of approach will likely require an adaptive management approach to monitor the effectiveness of each action on water quality goals.

To briefly summarize what has been done to date DEP, OAR, EPA Region 1, the EOEA Watershed Team, and the Assabet River Consortium have used an innovative approach since 1998 to conduct detailed water quality sampling, develop, calibrate and validate a comprehensive water quality model and evaluate a number of different options for reducing phosphorous loadings and achieving water quality objectives in the Assabet River. In addition, six Assabet River communities used an innovative approach, a first in Massachusetts, to jointly form a watershed consortium which allowed them to obtain funding to evaluate future needs and determine costs associated with various treatment and management alternatives. To date, this innovative approach has resulted in the expenditure of approximately $650,000 in state-only funding for monitoring, modeling and assessment activities and an additional $3.5Million in SRF funds for watershed and community evaluations.

Next Steps

Making the point sources spend the money to get to the lowest possible (or even below what some argue is presently technically possible) phosphorus discharge will require very large expenditures of money that may ultimately be insufficient to achieve water quality goals and designated uses. It will also likely invite appeals and delay while the appeals are litigated.

Massachusetts proposes to substantially reduce the discharges of phosphorus from the POTWs and involve the towns in a search for more effective, and possibly less expensive alternatives such as control of nonpoint sources, removal of dams, removal and/or treatment of sediments, and potentially groundwater recharge of wastewater and/or storm water to impacted tributaries. As previously stated, model results indicate that control of sediment phosphorous flux combined with reductions in phosphorus

discharge may be more effective in achieving water quality goals than even more severe reductions of phosphorus from the POTWs alone. This holistic approach to the river is watershed planning in the best sense and it increases the likelihood of eventually achieving water quality goals through innovative permitting. Furthermore, it creates opportunities to address other watershed issues, such as diminished flow in the headwaters, and builds a partnership of river advocates, dischargers and local, state and federal levels of government.

We are now in the process of finalizing additional model runs to determine what the best combination of options might be for achieving water quality standards. Because approximately 60% of the Assabet River is impounded and model results indicate sediment plays a significant role in the system at low ambient concentrations, focus is now turning toward evaluating options to treat or remove sediment and/or the removal of a number of dams on the river. As a result the project team (OAR, DEP, EPA, Consortium, and MA Riverways Program) have jointly identified additional activities that need to be conducted so that informative decisions can be made. Those activities include but are not limited to, evaluating the chemical and physical characteristics of the sediment in each impoundment, evaluating sediment transport and potential impacts to habitat, identifying the technical and legal issues associated with potential dam removal, and making additional model runs based upon new data once collected. The project team conservatively estimates that the cost of this work will range from $450,000 -$500,000. Given the projected costs the project team met in February 03 and prioritized the activities. As a result it was determined that the most important step was to characterize the physical and chemical characteristics of the sediment in the Assabet impoundments so that data could be used in the future to assess sediment transport and dam removal options. Additional uses of the data include, but are not limited to, determining the amount of sediment phosphorous with depth and the quantity of sediment that would have to be inactivated or removed to reduce ambient phosphorous to the water column, to obtain better estimates of sediment phosphorous release in critical impoundment areas (to assist with model validation), and to determine disposal alternatives based on a comparison of sediment quality to regulatory criteria. The team estimates that the cost of this activity alone would be approximately $200,000. After these steps are taken the next phase of activity would evaluate sediment transport and its impact on habitat, potential dam removal options and using all the available data from both phases, conduct a cost effectiveness analysis of sediment /dam removal options vs. the cost of effluent control technologies. In addition, sediment removal/treatment and disposal costs would be defined. We conservatively estimate that this phase of the work will cost an additional $250,000. Once completed the end result would be a determination of the most environmentally beneficial, technically feasible, and cost effective phosphorous control options.

Our proposal at this time is to use the $100,000 innovations grant funding, matched by an additional $100,000 in state funds to collect the necessary sediment data identified in the initial phase above and do some additional model runs (as necessary) to continue our detailed investigation of the best options, with a goal of developing a final permit conditions at the end of 2003 or early to mid 2004. Those conditions are likely to

include point source limitations and some combination of nonpoint source, dam removal and sediment control options. The Consortium is now in Phase 3 of the planning process (alternatives review) and that process will continue on its current schedule. This proposal would supplement, the community planning process that is currently on going. A detailed scope of work for this grant is provided in attachment 1 that outlines how the grant funds will be used.

This approach will be transferable to other basins and other states not in its specifics – the combination of dam removal, point source control, sediment control etc – but in concept; it will provide a real life example of a holistic watershed approach to permitting that better achieves real and measurable environmental results through innovative approaches.

Project schedule and time frame

We are now in the process of conducting additional modeling runs for this river to see which scenarios, and in what combination, appear to offer the greatest probability of achieving water quality standards and are most cost effective. The modeling to date has been encouraging for development of innovative permitting options; while straight NPDES point source reductions do not achieve water quality standards; point source reductions in combination with sediment control are very promising. We are undertaking further evaluation of sediment quality and will follow with additional evaluations investigating dam removal, recharge and combinations of the above, to see which options look most promising, and which should be investigated in greater detail to determine if they are feasible and how much they would cost.

As previously mentioned this project is already well underway. A consortium of communities has been formed, has retained a contractor to do planning, and has completed the first two phases of its evaluations. Phase 1 considered the towns' likely needs for water and wastewater services. Phase 2 looked at treatment options, including some groundwater disposal, and preliminary costs associated with those options. In addition, we are well into the preparation of a TMDL for this River, including the development of a model to predict responses to various treatment and control options. In short, this is not a hypothetical exercise, but a project that is already on track and will be completed in a relatively near future.

We propose to continue the model runs over the next two to three months to identify the potential options that may arise, and combinations of options, that appear most promising for achieving water quality standards. [Note: we can provide much more detailed information on the model runs done to date, and the options under consideration if more background is needed.] While the communities investigate costs for POTW treatment options, we would propose, on a parallel track, to use these funds to have a contractor investigate sediment quality and quantity to determine if unconventional options are possible to achieve water quality standards. We would then hope to develop

detailed information on both feasibility and costs for the range of treatment and control options for purposes of writing the NPDES permits in late 2003 to early to mid 2004. We note that the time to implementation of the selected options may vary. Although the funding is requested for the purpose of evaluating and selecting the best package of options, which should occur by 2004, some options will take longer to implement than others. Until the options are selected, we cannot say what the actual implementation schedule in the permit might be. An estimated schedule of all project elements is provided in attachment 2. It is emphasized that these are estimates based upon the actions taken and proposed at this time. Final timelines may be different

Threshold factors

This proposal meets both threshold factors: 1) it is for research and investigation under the Clean Water Act section 104(b)(3) and advances the state of knowledge and leads to measurable results, and 2) it targets one of the priority areas (restore and maintain water quality).

Program criteria

Priority area. This project addresses a priority environmental area: restore and maintain water quality. It is being implemented through a close collaboration among EPA Region 1, the Army Corps of Engineers, U.S. Geological Survey, technical consultants, State of Massachusetts, the six communities along the Assabet River, and the local watershed association, all who are jointly looking for solutions that can achieve water quality goals. Some of the sub basins in this watershed are also stressed for water quantity, a factor that we are planning to take into consideration as we assess the best combination of options to achieve water quality standards.

Incentives. The Assabet River proposal tests an innovative incentive in permitting: allowing the towns to adopt a point source control strategy that is more cost effective while doing a better job at achieving the end point of water quality standards. Providing funding for exploration of the feasibility and costs of the alternatives, which is what this funding will help to achieve. It will also provide additional incentives to the communities to participate in this innovative approach.

Transferability. States are desperate for examples of real watershed permitting, especially ones that include point, non-point and innovative structural changes in one package that can be enforceable and results-driven. We are relatively close to permit issuance in this basin; providing funding to fully examine innovative alternatives prior to final permitting would allow us to craft a permit that could serve as a model elsewhere in Massachusetts and in other states.

Measures and Accountability. The approach outlined here is designed to create measurable change in water quality for which the participants will be accountable through the permitting process in combination with commitments made by state and federal government. The short-term result will be issuance of permits based on good

science and carefully considered investigation of the options, which alone will be inspiring to other states experimenting with watershed approaches to permitting. Over the longer run, we will achieve measurable improvements in water quality in the Assabet River by meeting dissolved oxygen standards and reducing diurnal fluctuations, in-stream phosphorous concentrations and biomass within the Assabet River System.

Public Participation. As previously discussed the entire project including this portion has involved not only several federal and state agencies but also local environmental groups and a consortium of local municipalities. All parties have participated in the process since the beginning and have actively been involved with the design of all project elements.

Proposal budget

	Total Project Costs	Proposed State Leverage Funds	EPA Funding
Contractual	$ 200,000	$100,000*	$100,000**

* Includes $100,000 in state capital funding for TMDL development. Not included is additional state salary in in-kind contribution from state for project review, planning and assessment for TMDL development and innovative solution evaluation.

** Funding for contractor for sediment data collection, assessment of sediment quality and quantity and for additional model runs to determine best alternatives.

Attachment #1

Scope of Work for Assabet River Basin Sediment Studies

Assabet River Basin Sediment Studies

Joint Proposal of MA DEP and U.S. Geological Survey
Water Resources Division
Northborough, Massachusetts

PROBLEM

Nutrient TMDLs are being developed for numerous streams in Massachusetts that have similar water-quality-impairment issues to those of the Assabet. Recent TMDL modeling studies of the Assabet River have documented the extent of eutrophication of the river's impoundments and free-flowing reaches, and indicated that phosphorus releases from bed sediments may continue to promote excessive plant growth in the river, even after loads from wastewater treatment plants and other point sources are eliminated. Consequently, attainment of water-quality standards may require removal of the bed sediments, chemical treatment to immobilize sediment phosphorus, and/or dam removal or breaching to increase flows. Selection of the most cost-effective course of action will require more detailed information on the distribution, transport, and internal cycling of phosphorus between sediments and surface water. This information can then be used to judge whether annual fluxes of sediment phosphorus in the river are of sufficient magnitude to require dredging, or if dam removal or breaching can be used to achieve water-quality and other environmental goals.

Consideration of the options and implications of phosphorus management in the Assabet River first calls for thorough sediment mapping followed by chemical and physical analysis of impounded sediment samples obtained by coring. The results of these studies will have a number of uses. The complete chemical analyses will provide information on the concentrations and distribution of contaminants that may rule out particular sediment-management options, such as dam breaching to allow sediments to redistribute downstream. The data will also provide a picture of the vertical distribution of phosphorus throughout a given impoundment and the information needed to design additional studies intended to examine the availability of sediment phosphorus in the Assabet River Basin. This information will be crucial to understanding what steps may be most effective in managing phosphorus.

PROJECT PURPOSE AND OBJECTIVES

This project will map the areal extent and depth of sediments in six Assabet River impoundments running from Northborough to Acton: 1. Rt. 20 Northborough (referred to here as the Aluminum City dam/impoundment); 2. Allen Street impoundment (Northborough); 3. Rt. 85 Hudson impoundment; 4. Gleasondale impoundment (Stow); 5. Ben Smith impoundment (Maynard); and 6. Powdermill impoundment (Acton). In addition, samples will be collected from sediment cores from all impoundments and analyzed for organic contaminants, trace metals (including phosphorus), reactive sulfide, and Extractable Petroleum Hydrocarbons (EPH). The purpose of these analyses is to determine the concentrations of contaminants and to obtain data on the distribution of

potentially biologically active phosphorus that may be present in the impoundments. Since the dam-breaching option to allow sediment redistribution depends on chemical and physical characterization, sub samples will be stored for future particle-size analysis. If chemical analysis determines that the sediments are too toxic to allow their redistribution downstream, there will be no need for particle-size analysis. Finally, at least one of the impoundments, possibly the Hudson impoundment, will be the focus of a study to determine the contribution of phosphorus to the water column from bed sediments in impoundments on the Assabet River. This impoundment will be monitored to determine the extent of development of hypoxic conditions and phosphorus release from the associated sediments.

Objective 1. Map the extent and depth of sediments in the impoundments. Determine total sediment volume.

Objective 2. Collect sediment samples by coring for: (1) organic analysis, (2) trace metal analysis, (3) EPH analysis, (4) reactive sulfide analysis, and (4) grain-size analysis.

Objective 3. Monitor hypoxic zones and sample for phosphorus

Objective 4. Analyze data and prepare report.

APPROACH

Sediment quantity, quality, and distribution

In order to plan for sample collection, sediment mapping must be completed first. Mapping, sediment sampling and analysis, and data interpretation will follow the procedures and protocols that the USGS Massachusetts-Rhode Island District has developed in cooperation with Massachusetts State agencies and other Federal agencies (Zimmerman and Breault, 2003; Breault and others, 2000). In short, after the bathymetry and sediment extent have been determined manually using a probe and GPS unit, the data will be interpreted and maps created using the Triangular Irregular Network tools of a Geographic Information System. After completing the maps, a predetermined number of coring locations will be randomly selected from areas where sediments have been deposited. Pairs of cores will be collected in approximately the following numbers: Aluminum City (4), Allen Street (4), Hudson (7), Gleasondale (12), Ben Smith (18), and Powdermill (12). It is anticipated that the cores will sample the full depth of the sediments. Total numbers of cores and samples may be affected by the number of analyses that the USEPA agrees to perform.

In general, to provide subsamples for analyses of organic compounds and metals, the entirety of one of each pair of cores will be extruded into a Teflon bag and thoroughly homogenized. However, some of these cores (one at Aluminum City, one at Allen Street, two at Hudson, two at Gleasondale, five at Ben Smith, and four at Powdermill) will,

instead, be sectioned into three parts to provide a measure of the variability with depth of the concentrations of analytes; the top section of each of these cores will represent the chemical composition of the sediment surface; each subsection will be homogenized in the same manner as the whole cores. Subsamples from all these homogenized samples will be sent to laboratories for analysis. Duplicate samples from approximately 20 percent of the samples will be included as quality-control samples.

In order to obtain data on the vertical distribution of phosphorus and for future particle-size analysis, samples will be taken from approximately 5 levels within the second of the pair of cores from each location. The primary criterion for selection of a sample will be visual observation of change in quality of the sample. The percentage of a core that the sample represents will be noted. Core length will also be a factor in deciding the number of samples collected. Part of each of these approximately 5 sections will be archived for future particle-size analysis. Another part of these samples will be sent to a contract laboratory for analysis for total phosphorus and total organic carbon.

Sediment samples will be sent to the USEPA Region I laboratory in Chelmsford, Mass., for analyses of organic compounds and metals. The EPH and reactive sulfide testing will be performed by New England Testing, a State-certified contract laboratory that has previously been used in similar local studies. Samples for total phosphorus and total organic carbon analyses will be sent to XRAL Laboratories. In addition to analyzing the extra QC samples that are submitted to them, these laboratories all have their own internal QA/QC procedures. If the various analyses show that the sediment quality is sufficiently good that dam removal or breaching is an option, samples collected for particle-size analyses for use by planners will be sent to a USGS sediment laboratory. These results can be used to model the effects of releasing the sediments as a result of dam removal or partial breaching.

Dissolved-oxygen and sediment-phosphorus-release dynamics

Significant release of phosphorus from bed sediments should occur only when the immediately overlying water is anoxic. This assumed anoxic condition would likely occur in the deeper parts of impoundments during summer and early autumn low-flow periods and perhaps in areas where floating macrophytes (for example, *Lemna* sp.) completely cover the surface of a section of an impoundment; the combination of BOD in the water column and blocking out of light needed to support oxygen-yielding photosynthesis by algae could create this situation. Phosphorus released into the anoxic bottom layers will be distributed throughout the water column by advective mixing whenever flows increase, for example, in response to summer storms or to winds. A concentration gradient across the sediment-water interface is assumed, but in a system that already transports a high concentration of phosphorus from wastewater-treatment plants such a gradient may not exist or may not be apparent. The contribution of this sediment source to the total phosphorus load would depend, not only on benthic flux rates, but also on the volume of anoxic water, the aerial extent of anoxia, and the frequency of mixing during the low-flow periods.

The Scope of Work, previously developed by the DEP, addresses a number of questions about water quality in the Assabet River Basin and calls for a limited number of measurements of benthic phosphorus flux rates using the same methodology that was used in the previous TMDL study (ENSR International, 2001). The data in the TMDL report presented a mixed bag for interpretation. The movement of ortho-phosphorus to and from the sediments depended variously on time of year, temperature, and dissolved oxygen concentrations. Based on phosphorus release in anoxic, experimental laboratory conditions, as much as 17 percent of the water-column phosphorus could be sediment-derived. And, the report noted, anoxic conditions did not seem commonplace in the impoundments.

An alternative to repeating the TMDL experiments or to setting up *in situ* experiments to directly measure benthic flux rates (which are notoriously expensive, highly variable in space and time, and difficult to do, in any case) would be to map areas of hypoxia as they develop and, then, sample phosphorus concentrations at and just below the sediment surface as well as in other parts of the hypoxic zone. Different phosphorus species would be analyzed to determine the proportion of labile (available for plant uptake) phosphate. Estimates of sediment phosphorus fluxes obtained in this way would be inherently more realistic than direct measurements made under laboratory conditions. And, the relative extent of DO depletion in an impoundment would be ascertained.

From July to August, the impoundments will be surveyed weekly to determine the onset of hypoxia or anoxia wherever it may occur. When the DO falls below a predetermined concentration, say 3.0 mg/l in the water column, the stagnant hypoxic or anoxic zones will be mapped and water samples will be collected from the surficial sediment pore water and other low DO waters. Zones may occur in open water or below beds of macrophytes. As quality control, additional samples will be collected from a nearby area that is not experiencing low DO conditions. The samples will be analyzed for total phosphorus, dissolved phosphorus, and ortho phosphorus. This process will be followed repeatedly during the study period. Data will be compared to determine if the phosphorus concentrations differ between the low DO areas and others with relatively high DO concentrations as well as to determine if there is substantial, or measurable, net release of phosphorus from the sediments.

Objective 1

Task 1. Reconnaissance
Task 2. Sediment and bathymetry mapping

Objective 2

Task 1. Due diligence review
Task 2. QAPP preparation
Task 3. Sediment sample collection
Task 4. Sediment analysis

Objective 3

Task 1. Monitor impoundment for hypoxic conditions
Task 2. Collect samples for phosphorus analysis

Objective 4

Task 1. Data analysis and interpretation
Task 2. Report preparation

REPORTS

After the data have been returned, they will be analyzed and interpreted by USGS hydrologists. The final report will consist of a Water-Resources Investigations Report that will contain individual page-size maps depicting the impoundments' bathymetry and sediment extent, analysis and interpretation of the results of the sediment chemical analyses, and discussion and analysis of the results of the dissolved-oxygen and phosphorus dynamics part of the study. The analytical data, perhaps including the particle-size analysis, will be interpreted and described in the report in a manner that will be of most use to regulators and scientists alike, for example, Breault and others (2000) and Zimmerman and Breault (2003).

RELEVANCE AND BENEFITS

This project reflects draft actions proposed for the USGS role in river science. These actions include improving understanding of the effects of changes in sediment flux, habitat change and environmental restoration, and biological responses to changes in material flux. In order to comply with TMDLs, towns along the Assabet River face expenditures of millions of dollars to upgrade existing wastewater-treatment plants. The results of the dissoved-oxygen and phosphorus dynmics study will aid regulators and planners to determine how much the upgrading may improve water quality. The methods and approaches used in the Assabet should readily transfer to TMDL studies in other streams in Massachusetts and New England.

PROJECT PERSONNEL AND RESPONSIBILITIES

Marc Zimmerman, U.S.G.S. hydrologist will serve as project chief, managing all aspects of project and coauthoring the final report. Jason Sorensen, hydrologist, will direct and perform field work and coauthor the final report. An additional hydrologist or hydrologic technician will assist with field work. A GIS specialist will create bathymetric and sediment maps.

REFERENCES CITED

Breault, R.F., Reisig, K.R., Barlow, L.K., and Weiskel, P.K., 2000, Distribution and potential for adverse biological effects of inorganic elements and organic compounds in bottom sediment, lower Charles River, Massachusetts, U.S. Geological Survey Water-Resources Investigations Report 00-4180, 70 p.

ENSR International, 2001, SuAsCo Watershed Assabet River TMDL Study, Phase One: Assessment, Final Report, variously paged.

Zimmerman, M.J. and Breault, R.F., 2003, Sediment quantity and quality in three impoundments in Massachusetts, U.S. Geological Survey Water-Resources Investigations Report 03-4013, 36 p.

Attachment #2

Estimated Project Time Schedules & Components

Estimated Assabet River Schedule for Nutrient Evaluation Projects[1]

TASKS

	1999 -2001	Jan-03	Mar-03	Jun-03	Sep-03	Dec-03	Jan-04	Mar-04	Jun-04	Sep-04	Dec-04	Mar-05	Jun-05	Sep-05
WATER COLUMN DATA COLLECTION	>>>>>>>	*												
MODEL (HSPF) CALIBRATION	>>>>>>>	*												
MODEL RUNS: ALTERNATIVES	>>>>>>>													
MEPA REVIEW														
PHASE 1: Needs Analysis	>>>>>>>	*												
PHASE 2 Treatment Alternative Option Evaluation	>>>>>>>	*												
PHASE 3: Treatment Costs and Land disposal Evaluation														
PHASE 4: Design														
SEDIMENT EVALUATION - Phase 1														
EXTENT AND QUALITY														
EVALUATION														
DRAFT REPORT														
FINAL REPORT: SED QUALITY/QUANTITY									*					
OPTIMIZATION: EXISTING TREATMENT	>>>>>>>													
TMDL REPORT DEVELOPMENT														
NPDES PERMIT														
DRAFT														
FINAL										*				
SEDIMENT EVALUATION - PHASE 2	(See footnote 2)													
DAM REMOVAL														
SEDIMENT TRANSPORT														
COST EFECTIVENESS EVALUATION														

>>>>>>> EARLIER START * COMPLETION

NOTE: Shaded areas indicate activities that complement the sediment evaluation effort. Time estimates are approximate.

Footnote #1 – This table represents best estimate of timelines as of April 2003. Timelines may change in the future.

Footnote #2 - The timeline for Phase 2 of the sediment work will depend on the results of phase 1 and availability of additional funds