Landowners and Concerned Citizens for License Compliance

March 1, 2013

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: Relicensing of the Northfield Mountain Pumped Storage Project (FERC No. 2485-063 and the Turners Falls project (FERC no. 1889-08
Comments on the Preliminary Application Document, Scoping Document 1, and Study Requests

Dear Secretary Bose:

The Landowners and Concerned Citizens for License Compliance consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion. It has been said during the relicensing process that mitigation strategies must await studies to determine the causes of erosion. This is an old discussion that seemed to be resolved decades ago with licensee acknowledgement that much of the erosion problems are a result of project operations.

Some of our members filed a letter to the FERC Secretary on May 16, 2008 documenting landowner concerns having been continuous since 1972, starting with letters to the then Federal Power Commission (FPC). This filing also contained a chronology by previous landowners of thirty-five years of advocacy by concerned landowners and public agencies, that began with the activation of Northfield Mountain Pumped Storage Project in 1972, to address streambank erosion on the Connecticut River.

This chronology excerpts a July 12, 1976 Northeast Utilities letter to the FPC stating that: "Early in the planning stages of the Northfield Project, it was recognized that increased fluctuations on water levels in the Turners Falls Pond would cause damage to trees along the river's edge….Since the initial operation of the Project in late 1972, Northeast Utilities has been aware of bank erosion and has been monitoring a number of these areas along the pond."

A similar viewpoint is contained in the March 1977 "Streambank Erosion Control Evaluation and Demonstration Projects (Section 32) in New England," Haverhill, New Hampshire and Northfield, Massachusetts by the Department of the Army, New England

Division, Corps of Engineers, Waltham, Mass. It states on page 16: "Northeast Utilities (NU) constructed a pump-storage electric facility at Northfield Mountain which uses the Turners Falls pool as the lower impoundment. Turners Falls pool was raised 5.5 feet in 1973 and this area is one of the most actively eroding reaches of the Connecticut River today. The Corps has submitted a project proposal within the pool for construction under Section 32. NU acknowledges that much of the problem is a result of power pool operations."

The LCCLC has been and continues to be concerned with the frequent and significant water level fluctuation associate with the operation of the Northfield Mountain Pumped Storage and Turners Falls projects, which result in streambank erosion and impacts to water quality, threatened and endangered species, fisheries, and riparian and littoral habitat. In particular, we believe that the Northfield Mountain Pumped Storage project and its operational use of the Connecticut River have been a long-term experiment that has resulted in significant adverse environmental impacts. We now have an opportunity to seriously consider the benefits of halting the use of the Connecticut River as the lower reservoir and creating a closed-loop lower reservoir which would address most of the environmental impacts and specific resource concerns raised by Federal and state agencies and stakeholders.

The LCCLC presented a photographic record of the erosion just upstream and across from the tailrace to the assembled FERC staff at the Scoping Meeting on January 30, 2013. Our scoping meeting presentation demonstrated why the current and previous owners of this conservation land have been so persistent in drawing FERC's attention to the severity of erosion of our riverbanks and why the current restoration effort is several decades too late. In 1960 an Oak tree on the featured riverbanks stood approximately 30' from the top edge of the bank. It is now less than 6' from the top edge of the heavily eroded bank. This tree marks the site of Cross Section 8A that has been used by the Licensees over the years to monitor erosion in the Turners Falls Pool on the Connecticut River. So, quantitative data should be available to document this erosion, which we have previously placed in an information request to FERC.

Preliminary Application Document (PAD)

The 2008 Full River Reconnaissance (FRR) stated that the rate of erosion is decreasing in the Turners Falls Pool in the Connecticut River, which FirstLight continues to maintain in Section 4.2.4.1 of the PAD under FRR Studies. This contention is in spite of numerous challenges by the Connecticut River Streambank Erosion Committee (CRSEC) and professional studies commissioned by LCCLC, all of which have been filed with FERC and made a part of the licensing proceeding.

For reasons articulated in previous correspondence with FERC, we are concerned with the applicant's plan to use information from the earlier Full River Reconnaissance (FRR) studies (2001, 2004 and 2008) and the Riverbank Erosion Comparison along the Connecticut River (2012) report, which the applicant updated to PAD 5.2.1 at the Scoping Meeting. We are currently working with the applicant and the Connecticut

River Streambank Erosion Committee to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR. This initiative and an outline for a Hydrologic, Hydraulic, and Geomorphic Analysis of Erosion in the Turners Falls Impoundment were also added to the PAD 5.2.1 at the Scoping Meeting. However, the Erosion Study has not been shared so the CRSEC and the LCCLC are not able to provide specific comments other than we hope that the findings and recommendations for further study found in detail in the 2007 Field Geology Services report, cited but only selectively referenced in PAD 4.2.4.3, are reflected in the proposed study.

We appreciate the opportunity to submit our comments on the Preliminary Application Document (PAD), Scoping Document 1, and eight Study Requests. Study Requests that we support are summarized by Scoping Document 1 resource areas. The full narratives of the studies that we are requesting to be undertaken may be found in the Appendix.

Scoping Document 1

3.5 Alternatives to the Proposed Action

On page 8 of the Scoping Document, the text reads that "[i]n accordance with NEPA, the environmental analysis will consider the following alternatives, at a minimum: (1) the no-action alternative, (2) the applicant's proposed action, and (3) alternatives to the proposed action." The LCCLC strongly urges the FERC staff to consider a closed-loop alternative for the lower reservoir serving the pumped storage project and requests that the applicant complete a study of this alternative to the proposed action.

6.0 Request for Information and Studies (See Appendix for full Studies)

Geology and Soil Resources

The LCCLC is primarily concerned with the various effects of erosion of the riverbanks in the Turners Falls Pool. With this in mind, we request that the 1999 Erosion Control Plan for the Turners Falls Pool of the Connecticut River be continued and a Full River Reconnaissance be conducted every 3-5 years with improved methodology that is documented with a Quality Assurance Project Plan. Our concerns relate to the environmental effects of the frequent and significant water level fluctuations and river flow dynamics resulting from the operation of the Northfield Mountain Pump Storage Project and the Turners Falls Dam. These concerns include riverbank stability, shoreline habitat, farmland, wetlands, riparian and littoral habitat, and water quality. We request that the following studies be conducted to address our concerns on these issues: (Full narratives are to be found in the Appendix.)

- **Study of Shoreline Erosion Caused by Northfield Mountain Pumped Storage (NMPS) Operations. (See Study Request #1a)**
- **Study the Impact of Operations of the Northfield Mountain Pumped Storage Project and Turners Falls Dam on Sedimentation and Sediment Transport in the Connecticut River (#2a)**

- **Study of the Feasibility of Converting the Northfield Mountain Pumped Storage (NMPS) Facility to a Closed-loop or Partially Closed-loop System (#3a)**
- **Study Climate Change as it Relates to Continued Operation of Northfield Mountain Pumped Storage and Turners Falls Projects (#4a)**

Water Resources

Many residents in the Turners Falls Pool are riverside dwellers and express on-going concern for what they observe happening to the River on a daily basis. Residents report that swimming and boating have become increasingly unpleasant, and at times water levels are so low as to ground boats. Our River has historically provided diverse recreational opportunities with benefits to our regional economy. The Town of Gill's 2011 Open Space and Recreation Plan Public Survey results, on recreational use by Town residents, show that 90% of the respondents use the Connecticut River and Barton Cove for recreation at least yearly. With this in mind, the LCCLC wishes to explore levels of turbidity and suspended sediment in the river and what fluctuations in the water levels might have on the spread of exotic and invasive species, such as water chestnuts, and thus requests the following studies:

- **Study the Impact of Operations of the Northfield Mountain Pumped Storage Project and Turners Falls Dam on Sedimentation and Sediment Transport in the Connecticut River (#2a)**
- **Water Quality Monitoring in the Turners Falls Impoundment and Downstream of the Turners Falls Project (#5a)**
- **Quantify the Impacts of Water Level Fluctuations on Riparian and Aquatic Vegetation Including Invasive Species and their Associated Habitats in the Turners Falls Dam project Impoundment (#6a)**
- **Model River Flows and Water Levels Upstream and Downstream from the Turners Falls Project Dam Generating Stations and Integration of Project Modeling with Upstream and Downstream Project Operations (#8a)**

Socioeconomic Resources

The loss of agricultural and conservation land from soil erosion and the impact of the Turners Falls Dam on recreational use of the river are two major impacts on the socioeconomic resources from the Projects. The LCCLC is increasingly aware of the costs of the two Projects to the riverbanks, the habitat and water quality. The relicensing process is a once-in-a-lifetime opportunity to ensure that impacts on these areas are fully understood and defined, and that subsequent relevant resource management goals and public interest considerations are effectively addressed.

Consideration of all possible solutions to these questions is in order, from investigating a full-closed loop system to any number of partial-loop systems, thereby eliminating some of the negative consequences.

With this in mind we request:

- **Study of the Feasibility of Converting the Northfield Mountain Pumped Storage (NMPS) Facility to a Closed-loop or Partially Closed-loop System (#3a)**
- **Study Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects (#4a)**

Aquatic Resources

The LCCLC wishes to conserve, protect, and enhance habitats for fish, wildlife, and plants. The fact that land directly across from the NMPS tailrace (the old Stacey's Ferry Landing) and upstream has been eroding since the project went into operation, serves to heighten our concern that Project operations negatively affect resident and migratory fish species.

With this the mind we request the following studies:

- **Impacts of Water Level Fluctuations on Riparian and Aquatic Vegetation Including Invasive Species and their Associated Habitats in the Turners Falls Dam Project Impoundment (#6a)**
- **Model Flows in the Northfield Mountain Pumped Storage Project Discharge Tailrace and Connecticut River 1 Kilometer Upstream and Downstream of the Discharge Using Two-Dimensional Computational Fluid Dynamics (CFD) Model Techniques (#7a)**
- **Model River Flows and Water Levels Upstream and Downstream from the Turners Falls Project Dam Generating Stations and Integration of Project Modeling with Upstream and Downstream Project Operations (#8a)**

We appreciate the opportunity to provide comments on the PAD, Scoping Document 1, and to submit Study Requests. We look forward to continuing our active engagement in the relicensing of the Connecticut River projects.

Respectfully Submitted,

/s/Michael Bathory, Member
Landowners and Concerned Citizens for License Compliance
144 River Road
Gill, MA 01354
mjbathory@comcast.net

cc: John Howard, First Light Hydro generating Company
Robert McCollum, MA Department of Environmental Protection
Peggy Sloan, Franklin Regional Planning Board
Tom Miner, Connecticut River Streambank Erosion Committee
Ken Hogan, Federal Energy Regulatory Commission
Congressman James McGovern
Jennifer Soper, MA Department of Conservation and Recreation
Paul Jahnige, MA Department of Conservation and Recreation

Appendix
Landowners and Concerned Citizens for License Compliance - Study Requests

Numerical listing of Study Requests with full Studies to follow:

Study Request 1a: Study of Shoreline Erosion Caused by Northfield Mountain Pumped Storage (NMPS) Operations.

Study Request 2a: Study the Impact of Operations of the Northfield Mountain Pumped Storage Project and Turners Falls Dam on Sedimentation and Sediment Transport in the Connecticut River

Study Request 3s: Study of the Feasibility of Converting the Northfield Mountain Pumped Storage (NMPS) Facility to a Closed-loop or Partially Closed-loop System

Study Request 4a: Study Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects

Study Request 5a: Water Quality Monitoring in the Turners Falls Impoundment and Downstream of the Turners Falls Project

Study Request 6a: Quantify the Impacts of Water Level Fluctuations on Riparian and Aquatic Vegetation Including Invasive Species and their Associated Habitats in the Turners Falls Dam project Impoundment

Study Request 7a: Model Flows in the Northfield Mountain Pumped Storage Project Discharge Tailrace and Connecticut River 1 Kilometer Upstream and Downstream of the Discharge Using Two-Dimensional Computational Fluid Dynamics (CFD) Model Techniques

Study Request 8a: Model River Flows and Water Levels Upstream and Downstream from the Turners Falls Project Dam Generating Stations and Integration of Project Modeling with Upstream and Downstream Project Operations

Study Request 1a - Study of Shoreline Erosion Caused by Northfield Mountain Pumped Storage (NMPS) Operations

Development of the current configuration of the Northfield Mountain Pumped Storage project included raising the dam height at Turners Falls by 5.9 feet in 1970 in preparation for NMPS operations. Operations began in 1972; since then all project operations have operated under this raised dam environment. The additional 5.9 foot in elevation changed the elevation of the Turners Falls impoundment, which extends some 20 miles upstream. The increase in river elevation also resulted in motorized boat traffic becoming more popular and makes the use of larger boats more possible. The presence of motorized recreational boats increases wake energy that can accelerate bank erosion rates.

The operation of NMPS causes alterations to the river as a direct feature of plant functionality. The alterations include: 1) daily fluctuating pond levels which at times in some places can exceed six feet (the license allows fluctuations up to 9 feet measured at an undisclosed location near and upstream of the Turners Falls dam), 2) altered flow and velocity profiles of river and 3) changes to the downstream hydrograph. Elevation data for the river in Appendix E of the PAD indicate that stage changes of 2 to 3 feet during the summer of 2012 were not uncommon.

Raising the level of the river can saturate bank soils. These same soils can quickly become dewatered when the river is lowered by the NMPS pumping cycle. Repeated saturation and dewatering of banks can lead to bank instability which in turn can lead to bank failure and eroded material entering the river. See Field (2007)[1] for an extended discussion on bank erosion and failure mechanics. Elevated levels of turbidity and suspended solids in the water column can diminish rearing and migratory habitat for fish. When too much fine grain material is deposited on channel bed substrates, particularly those substrates used for spawning, spawning success of resident and migratory fish is compromised, potentially reducing recruitment and carrying capacity.

Goals and Objectives

The goals of this study request would be to determine the environmental effects of the presence and operation of the licensed facilities on river bank stability, shoreline habitat, agricultural farmland, wetland resources, bed substrate, and water quality in the Turners Falls impoundment. We recognize that data from other studies will be made available and we think that the data from these other studies could be used to help meet the objectives of this study request.
Objectives of the study include the following:

1. Calculate the total volume of eroded material, calculate resulting nutrient loading of eroded material, and document and describe the three dimensional changes to

[1] Field Geology Services. (2007). *Fluvial geomorphology study of the Turners Falls Pool on the Connecticut River between Turners Falls, MA and Vernon, VT*. Prepared for Northfield Mountain Pumped Storage Project. Farmington, ME: Field Geology Services.

the bank, including lateral bank recession, changes to bank slope, and the presence and subsequent inundation of pre-project beaches and shoreline since the Turners Falls Dam was raised and the Northfield Mountain Pumped Storage facility came on-line.

2. Document and describe the changes to banks upstream and downstream of riverbank restoration projects, including bank recession.
3. Identify the changes that have occurred to bed substrate as a result of fine grain material being eroded from the banks and being deposited on the channel bed.

Relevant Resource Management Goals and Public Interest Considerations

Our management goal is to ensure high quality habitat for migratory diadromous fish. Shortnose sturgeon, American shad and American eel all require suitable spawning, rearing, migratory and foraging habitat. Eroding banks and subsequent increases in turbidity and deposition of fine grained material onto bed substrates in the Turners Falls impoundment, the bypass reach and downstream of the Turners Falls project reduces the quality of habitat for these species. Elevated levels of suspended sediment are associated with a diminution in water quality which also affects the quality of habitat encountered by trust resource species.

In addition to habitat effects, soil erosion contributes to nutrient loading. In 2001, the U.S. EPA approved New York and Connecticut's Long Island Sound (LIS) dissolved oxygen TMDL. As a result, the New England Interstate Water Pollution Control Commission (NEIWPCC) established the Connecticut River Workgroup and the Connecticut River Nitrogen Project. This project is a cooperative effort involving staff from NEIWPCC, the states of Connecticut, Massachusetts, New Hampshire, and Vermont, and EPA's Region 1 and Long Island Sound (LIS) offices. All are working together to develop scientifically-defensible nitrogen load allocations, as well as an implementation strategy, for the Connecticut River Basin in Massachusetts, New Hampshire, and Vermont that are consistent with TMDL allocations established for LIS. Since its inception, the Connecticut River Workgroup has participated in a number of projects to better understand nitrogen loading, transport, and reductions in erosion.

Public Interest Considerations if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to

carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information and Need for Additional Information

The PAD makes reference to several studies in section 4.2.4 including the Erosion Control Plan (Simons & Associates, 1999), previous Full River Reconnaissance studies (1998, 2001 – maps but no report generated, 2004, and 2008), Field Geology Services' 2007 fluvial geomorphic investigation of the Turners Fall impoundment, and 2012 investigations by Simons & Associates.
Field Geology Services' 2007 investigation provided several good recommendations for future work in section 9.3 of its report which, if implemented, could provide for: a) an improved understanding of the causes of erosion; b) more accurate monitoring of erosion; and c) more successful bank stabilization efforts. This document is a good point of reference. The Simons & Associates' (2012) documents are qualitative and based on several unstated assumptions that may not be valid. Full River Reconnaissance efforts have been undertaken using varying methodologies, making for difficult comparisons from one report to the other.

We believe that these existing studies do have data that can be useful if certain new analyses are undertaken. These analyses of existing data would help fill in our gaps of understanding of bank erosion in the Turners Fall impoundment. We are also asking for some additional field collected data. With the existing information, it should be possible to better display what changes have occurred to streambanks over time. Current Geographic Information System (GIS) software allows for various types of data to be assembled into a map and into a database such that change over time analysis can be conducted fairly easily. The change over time analysis is a critical analysis that is needed, and was already started under Field (2007).

Photos that have been taken at or near the same location but at different times exist. For example, the last three Full River Reconnaissance efforts have included continuous videotaping of the riverbanks with locational information. With these data, "snapshots" of the bank at various locations could be extracted and compared over time. Field (2007) photo locations could be re-shot as well. This existing information should be presented such that it is easy to discern where the photo was taken and what changes have occurred over time. A comparison of the bank every 100 ft could be compared over the years.

Historic aerial photography for the Turners Fall impoundment should be gathered and analyzed. Examples of good photographic datasets include the Field 2007 appendices and 1929 aerials. The location of the shoreline over time should be noted such that it is

easy to discern where bank retreat has been most severe and where the river has been relatively stable since the earliest aerial photograph was taken.

Very little turbidity data for the Turners Falls impoundment, the bypass reach or stretches of the Connecticut River downstream of the Turners Fall project exist. Thus far, implementation of the *Northfield Mountain Pumped Storage Project Sediment Management Plan* (revised February 15, 2012) has yielded few results, and many technological difficulties (see *2012 Sediment Management Plan – 2012 Summary of Annual Monitoring* dated November 30, 2012). Suspended sediment monitoring equipment is installed at the Route 10 Bridge upstream of the project and inside the powerhouse, theoretically taking readings representative of pumping and discharging through the turbines. An analysis of how turbidity might change relative to rapidly changing impoundment levels would be very useful information.

Nexus to Project Operations and Effects

The construction of the NMPS project was contingent upon the Turners Falls project raising the dam crest elevation by 5.9 feet. The NMPS project operations rely on the Turners Falls impoundment as the source of water to be pumped up and then discharged back into the river through turbines. The importance of this river reach to the NMPS operation is made clear by FirstLight's reference to this portion of the river as the "lower reservoir." Daily pumping and discharging changes the ponded elevation of the Connecticut River which in turn leads to bank material that repeatedly becomes saturated and then dewatered. Weakened bank material can then become eroded and the fine grain material from the banks can enter the water column and be transported in suspension in the river and eventually settle onto bed material. The raising of the Turners Falls impoundment also made recreational boating more popular, including the introduction of large, high-horsepower powerboats that were not previously present. Because of the fluctuating water levels, boat wakes impact the shoreline to a much greater extent than would occur if levels were more constant, thus exacerbating both the effects of the wakes and the fluctuating levels. For these reasons, erosion caused or contributed by NMPS project operation can negatively affect spawning, rearing and migratory habitat for trust species and the endangered shortnose sturgeon. The requested study will help inform the Commission when contemplating mitigation measures and or operational modifications.

Proposed Methodology

1. This study should determine the net soil loss in cubic yards between 1970 and the present; a density estimate of the eroded material should also be provided. Provide an analysis of where the greatest loss has occurred, location of proximity to the tailrace, soil type, riparian land use, and vegetative cover in that area. Calculate nutrient loadings (nitrogen and phosphorus compounds) to the river system based on soil loss.

2. Obtain copies of the original survey plans for the project, and complete a new survey using the same landmarks used previously. The Field (2007) report states

on page 11 that the original survey plans of the river are still retained by Ainsworth and Associates, Inc. of Greenfield MA. Use pre-operation aerial photos and current aerial photos to complete a 10-foot topographic map of the section of river between Turners Falls Dam and Vernon Dam and the 200-foot buffer regulated under the Massachusetts Rivers Protection Act. The Field (2007) report on page 11 states that Eastern Topographics, Inc. determined that sufficient information is known about the 1961 aerial photos (e.g., height of airplane) to create a 10-foot topographic map of that time period, and that 1961 aerial photos could be accurately overlayed with recent aerial photos. Field (2007) states that this analysis would enable a more reliable determination of small-scale shifts in channel position and changes in bank height that may have resulted from the erosion of a low bench that previously existed along portions of the river. Among other things, create a single map showing areas of erosion and deposition, and also overlay the Field report's hydraulic modeling analysis of the river channel.

3. With respect to the January 22, 2013 submittal from FirstLight to FERC regarding its long term monitoring transects in the Turners Fall impoundment, we ask that any data errors (as discussed in Field, 2007) and problems that have occurred over the years at each site be mentioned. We also ask that an analysis for each cross section extending to the top of the bank and including a portion of the floodplain be provided.
4. Take the information presented in Figure 4.2.3-1 "Soils in the vicinity of Turners Falls and Northfield Mountain projects" in the PAD and convert from 63 categories to just a few that are defined in a key that will allow readers to understand which soils are easily erodible, which aren't, and where there is bedrock along the banks.
5. Complete detailed surficial mapping (topographic map or LIDAR) to identify the various geomorphic surfaces, height of benches/terraces above the river level, and types of sediments underlaying the surfaces. This will allow one to determine how erosion varies with geomorphic conditions. One could then normalize the amount of erosion to a specific type of bank material/geomorphic surface/terrace.
6. Another information request covers the range of daily water level fluctuations. In this study request, we ask for an analysis on the degree to which boat wakes increase that fluctuation range. The task would be to observe boat wakes under a range of boat sizes and flow rates on the river. We recommend implementation of the 2007 Field report recommendation that states, "A more thorough study of boat waves is merited to better document how many boats use the Turners Falls Pool, how fast they travel, the type and size of waves they produce, and their impact on shoreline erosion."

A component of this study request is not necessarily for new data, but for existing data to be presented in a more clear, coherent and comprehensive manner. All existing photographs of banks that have been collected either by FirstLight, on behalf of FirstLight or on behalf of the Franklin Regional Council of Governments' (FRCOG) Streambank Erosion Committee should be georeferenced in such a way that it is easy to discern where the photograph was taken and the date should be easily discernible as well. These photos should be presented in a manner that makes it easy to visually see how a

particular section of bank has changed over time. Providing geographic context for photographic data of river banks and making these photos comparable over time should be standard practice. The 2007 Field report contains the following recommendation on page 47: "An attempt should be made to overlay the 1961 aerial photographs with a current flight and to create a topographic map from the 1961 flight. The feasibility of this effort has been confirmed by Eastern Topographics, Inc. This effort will identify the previous extent of the low bench and identify areas of the most significant bank recession the past 45 years." Given that this statement was written in 2007, we request that that the analysis is extended to current conditions.

Given the complexity of this study request and the expertise necessary to implement it, we request that the FRCOG and the mandatory conditioning agencies be involved with the selection of the hired consultant.

Level of Effort and Cost

The level of effort to compile existing information and to make the data available in a map and searching for existing bed substrate material data should not take more than a few days. The level of effort for the bed sampling work will vary based upon how much existing historic information exists. Much of the effort of this study request is essentially office work that compiles and better presents existing data. While an estimate on the amount of field time required is difficult to make, we estimate that up to two weeks of field work could be required and that some of the data collection could be done while other field studies are occurring.

Study Request 2a – Study the Impact of Operations of the Northfield Mountain Pumped Storage Project and Turners Falls Dam on Sedimentation and Sediment Transport in the Connecticut River

Goals and Objectives

The goal of this study request is to provide hydraulic and sediment transport modeling of both the intake and discharge conditions (current and proposed) at the Northfield Mountain Pumped Storage Project. The results of the study should provide information sufficient to enable MA DEP staff and stakeholders to understand current and proposed effects on water level fluctuations and relate to potential increase in sedimentation to the Connecticut River. MA DEP staff and stakeholders should be able to identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce riverbank erosion within the impoundment. In addition, an assessment of means to minimize the sediment load passing through the Turners Falls Canal during and after maintenance drawdowns should be conducted.

The specific objectives of this study are as follows:

- Assess hydraulic and sediment dynamics in the Connecticut River from Vernon Dam to Turners Falls Dam, the upper reservoir at Northfield Mountain, and downstream of the Turners Falls Dam.

- Identify management measures to minimize erosion and sedimentation.

- Determine areas of sediment deposition and beach formation in the Project Area and 1 km downstream of Cabot Station and describe habitat features of these areas, recreational uses and effects on invasive species, if any. Habitat areas include but are not limited to coves (e.g. Barton Cove), back channels, islands, wetland habitats, shorelines, shoals, deep water areas and channels.

- Identify management measures to mitigate for substrate (habitat) impacts and recreational impacts in sediment-starved areas below the dam and sediment accumulation areas upstream of the dam.

Relevant Resource Management Goals and Public Interest Considerations

The resource management goal is to ensure that the Connecticut River, which is designated as a Class B river for its entire length in Massachusetts, meets its designated uses of habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Class B waters must also have consistently good aesthetic value and meet minimum criteria for numerous water quality indicators to achieve compliance with the standards set forth in the regulations. The other resource management goal is to protect prime farmland soils, which are eroding, and riparian habitat. Eco-based tourism

is important to the economy of Franklin County so maintaining the water quality of the river and protecting scenic landscapes along the river from erosion are important.

Public Interest Considerations if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information and Need for Additional Information

The PAD provides a summary of the work that has been done to characterize streambank conditions of the Turners Falls Impoundment, to understand the causes of erosion, and to identify the most appropriate approaches for bank stabilization. There has been no work undertaken to gather and assess the data that this study request would provide. Implementation of the *Northfield Mountain Pumped Storage Project Sediment Management Plan* (revised February 15, 2012) was begun in 2011 and is scheduled to end in 2014. This is a limited study related to sediment problems in the upper reservoir, not the entire river.

Nexus to Project Operations and Effects

The Turners Falls and Northfield Mountain Pumped Storage projects operate in a peaking mode, with allowable impoundment fluctuations of up to 9 feet, with the intent to continue as such. It is proposed to evaluate increasing the volume of flow from the Northfield Mountain Pumped Storage Project through increased use of the upper reservoir, which is expected to result in additional water level fluctuations. Upstream hydroelectric facilities also operate in a peaking mode of operation. Periodically, the upper reservoir at Northfield Mountain and the power canal at the Turners Falls dam need

to be dewatered for maintenance purposes. Historically, both procedures have resulted in the discharge of large quantities of sediment. Sediment from shoreline erosion and riverbank failure is one of the major contributors that negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat. Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion.

The Proposed Massachusetts Year 2012 Integrated List of Waters shows two river segments, from the VT/NH state line to the Turners Falls dam (MA34-01 & MA34-02) impaired and considered a "Water Requiring a TMDL" due to "Other flow regime alterations", "Alteration in stream-side or littoral vegetative covers" and "PCB in Fish Tissue". In addition, the segment below the Turners Falls dam to the confluence with the Deerfield River (MA34-03) is impaired by these causes as well as total suspended solids.

Proposed Methodology

We concur with the proposed methodology developed by the MA Department of Environmental Protection, which is consistent with accepted practices:

Assess hydraulic and sediment dynamics

- FirstLight to continue implementing the Northfield Mountain Pumped Storage Project Sedimentation Management Plan over the full range of river flows and pumping/generating cycles. An unfulfilled task in the Plan is to develop a correlation over the full range of flow conditions between the overall suspended sediment transport through the entire cross section of the river compared to the continuous sampling at the single fixed location. Environmental Protection Agency approval of a Quality Assurance Project Plan is required for valid data acquisition.
- Provide data on the daily water level fluctuation changes from the past five years from stations listed in the PAD, and estimate fluctuations within Turners Pool assuming proposed operations and hydraulic conditions.
- Identify the most appropriate techniques for bank stabilization given the existing and proposed hydraulic conditions.

Determine areas of sediment deposition in the Project Area

- Field (2007) conducted a bathymetric study as part of his report. Use previous bathymetric data, if available (Field 2007 recommends putting additional effort into finding a bathymetric survey from 1913 that was partially shown in Reid 1990), and current bathymetric information to look at areas of sediment accumulation. Determine areas of sediment deposition in the Project Area and 1 km downstream of Cabot Station and describe habitat features of these areas. Habitat areas include but are not limited to coves (e.g., Barton Cove), back

channels, islands, wetland habitats, shorelines, shoals, deep water areas and channels.

- Identify recreational uses and impacts in areas known to be impacted by accumulated sediment, such as Barton Cove.
- Identify invasive species (plant or animal) present in the reaches and determine if erosion and sedimentation in any way contributes to the establishment and/or proliferation of these species.
    - Investigate the formation of beaches using remote sensing, LIDAR at low pool levels or some other mapping technique to understand the processes of beach deposition the distribution of beaches in the pool, the impact of beach deposition on habitat and species, and how can this be related to operation of NMPS.
    - Evaluate management strategies to address the release of accumulated sediment through Northfield Mountain Project works during upper reservoir drawdown or dewatering activities. FirstLight should specifically evaluate the feasibility of the installation of a physical barrier across the bottom of the intake channel designed to prevent the migration of sediment during future drawdowns of the upper reservoir
- Evaluate management strategies to minimize flow fluctuations within Turners Pool including coordination with upstream users.
- Evaluate management strategies to minimize sediment released through spillway gates and the log sluice located near the bottom of the forebay adjacent to the Cabot Powerhouse during canal dewatering activities.
- Identify a prioritized list of locations for bank stabilization projects in the Project Area
- Develop a map of land owned by FirstLight within 200 feet of the Connecticut River with an overlay of land use and vegetation cover. Provide land use options aimed at reducing bank erosion.

<u>Management measures to change sediment flow below and above the dam.</u>

- Any historic information of existing bed substrate material in the Turners Falls impoundment, bypass reach or downstream of the project should be collected and assembled. To the extent possible, the location of each sample should be made available on a map. The request for new data would stem from being able to make any valid comparison to changes in bed substrate at a given location, assuming the historic data exist.
- Identify measures that could be taken to mitigate impacts to recreational use, habitat, or invasive species from sedimentation.
- Identify measures that could be taken to change or mitigate sediment starved reaches below the Turners Falls dam.

Level of Effort and Cost

Many erosion studies have already been conducted and the cost of expanding the scope of some should be reasonable. A Full River Reconnaissance under the *Erosion Control Plan for the Turners Falls Pool of the Connecticut River* (Simons & Associates, Inc. dated

June 15, 1999) is scheduled for 2013 and could accomplish many of the objectives listed above.

Study Request 3a - Study the Feasibility of Converting the Northfield Mountain Pumped Storage (NMPS) Facility to a Closed-loop or Partially Closed-loop System

Building and operating the Northfield Mountain Pumped Storage project required the Turners Falls Dam be raised 5.9 feet. The Turners Falls impoundment of the Connecticut River acts as the lower reservoir and is subject to large sub-daily fluctuations in water level. The collateral environmental consequences of using the Connecticut River during the pumping and generation cycles for the last 40 years are not fully understood, but have likely contributed to extensive erosion of streambanks, downstream sedimentation, entrainment of large numbers of resident and migratory fishes, and destruction of important spawning and nursery habitat, both within the Turners Falls Pool and downstream. Intrinsic consequences include radical fluctuations in the hydrograph at a sub-daily level, which also negatively impact recreation, habitat, and likely disrupt key life history stages of resident and migratory fishes, benthic invertebrates, and macrophytes. The vast majority of proposed new pumped storage projects currently being considered by FERC are closed-loop because of a growing consensus that open-cycle pumped storage causes unacceptable environmental damage.

Resource agencies have identified restoration of a more natural hydrograph to the Connecticut River as a key management goal, and view the current relicensing process for five projects on the Connecticut River mainstem as an opportunity to achieve this. Converting to closed-loop or partial closed-loop would allow the restoration of ecological flows to the Connecticut River, and provide much greater flexibility in operational guidance for both NMPS and the other hydropower stations on the Connecticut River. It will also eliminate or partially eliminate many of the environmental concerns expressed by Federal and state agencies and other stakeholders, which are outlined in the numerous study requests and comment letters that FERC will receive on the NMPS project and the other four hydropower projects.

Goals and Objectives

The goal of this study request is to provide resource managers, stakeholders, and the licensee with an analysis of possible options for converting the plant to a close-loop or partially closed-loop system.

The objectives of this study request would be to determine:

- Candidate locations for placement of a lower reservoir
- Costs and logistics of construction and modification of the current facility to convert to a closed-loop or partially closed-loop system
- Projected savings associated with eliminating need for ongoing mitigation measures, both for stabilizing river banks as well as likely modification to operations that the facility that will be required to implement in order to protect habitat and native fauna.
- Other ancillary costs or savings, such as eliminating requested studies, operational changes, or mitigation measures

Relevant Resource Management Goals and Public Interest Considerations

The resource management goal is to ensure high quality habitat for migratory diadromous fish. Shortnose sturgeon, American shad, blueback herring, and American eel all require suitable spawning, rearing, migratory and foraging habitat. Eroding banks and subsequent increases in turbidity and deposition of fine grained material onto bed substrates in the Turners Falls impoundment, the bypass reach and downstream of the Turners Falls project reduces the quality of habitat for these species. Elevated levels of suspended sediment are associated with a diminution in water quality that also affects the quality of habitat encountered by endangered species. Entrainment into the facility could be lethal to any of these fish. Juvenile and larval stages of resident and migratory species, including rare, threatened, and endangered species of vertebrates and invertebrates are particularly vulnerable to entrainment. This damage is aggravated by the repeated cycling of the facility—unlike standard hydro, where organisms are likely only exposed to passage events a single time and may bypass the system safely, NMPS continuously recycles river water, and therefore increases the risk of exposure to entrainment and death.

Public Interest Considerations if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information and Need for Additional Information

Some data on environmental effects of NMPS and facilities that use fresh or salt water for generation and/or cooling are widely available and consistently point to these types of facilities as damaging to native and migratory fauna. Once plentiful populations of blueback herring have been entirely eliminated from this portion of the Connecticut

River. Populations of American eel are in steep decline throughout this reach, and American shad that initially used fish passage facilities downstream of NMPS have experienced dramatic reductions above Turners Falls Dam.

Section 4.4.6 of the PAD (page 4-146) discusses entrainment at Northfield Mountain of migratory fish species. Previous studies estimated 28.6% of Atlantic salmon entrained, which was reduced to 6.7% after the installation of a guide net only during upstream passage season. LMS Engineers estimated in 1993 that the facility impacted 0 to 12.4% of adult American shad passing the water intake. No studies have looked at impacts to resident fish or other migratory fish or other times of the year, but several study request address this information gap.

Other facilities in the region (Brayton Point Power Station, a coal plant in Mt. Hope Bay) have been required by EPA to switch from open- to closed cycle at very significant cost because of the extensive damage done to fragile habitats by open-cycle pumping.

Streambank erosion has been a major concern since NMPS began operation in 1972. Section 4.2.4 of the PAD summarizes the extensive work that has been done to study and mitigate erosion along the river banks. Significant loss of agricultural land has resulted from unnatural river fluctuations and increased boat wakes from a raised impoundment, and in some cases poor mitigation efforts like helicopter removal of trees along the banks. Since 1996, the licensee has reportedly spent $750,000 - $1,000,000 annually on erosion control measures. In some cases, these projects will need to be re-done in the future. Converting the plant to closed-loop operation could provide significant cost savings over the life of the upcoming license, eliminating erosion control projects, proposed studies related to use of the Connecticut River as a lower reservoir, and any mitigation or operational changes that may be contemplated as a result of relicensing.

Nexus to Project Operations and Effects

In conjunction with other study requests, parties to the relicensing process will be reviewing data and considering operation and facility conditions that will best achieve the balance between natural resource protection, property and infrastructure protection, and power generation. Making the plant closed-loop or partially closed-loop is one important consideration to the scenario and would eliminate any operation changes that might result from concerns about fishery resources, water quality effects, and farmland losses.

Proposed Methodology

- Collate existing geological and hydrologic information of areas surrounding Northfield Mountain, including preliminary design plans for suitable facilities able to accommodate the existing and proposed discharge. These plans should include any and all possible locations, including modifications to infrastructure near the current outfall, and any other locations that could accommodate the necessary volume of water.

- Provide an engineering analysis of structural modifications necessary to accommodate a full or partial lower reservoir in an alternate nearby location.
- Provide information on whether and how a smaller lower reservoir, with ties to the Connecticut River, would act as a buffer to river level fluctuations and change the hydrologic pattern of flow on the Connecticut River in the Turners Falls pool (fluctuations), the water quality effects, and decrease the possibility of entrainment.
- Provide an analysis on water losses from evaporation and leakage and how much make-up water would be needed during normal operations by season or month.
- Identify and make available any similar studies conducted during the planning phase of the existing facility in the 1960's or any other time.
- Provide a cost estimate of each option considered and evaluated.
- Provide an itemized cost estimate of how halting the use of the Connecticut River as a lower reservoir would affect other costs, such as eliminating the erosion control program, any ancillary changes to generation at Turners Falls Dam and NMPS, and fish protection measures.

These methods are consistent with accepted practice for weighing costs and benefits of environmental impacts.

Level of Effort and Cost

The level of effort to compile existing information and to make the data available in a map should be low. Development of contingency scenarios would be low. The majority of the effort of this study request is essentially office work, with some engineering and design work required to scope likely costs of various scenarios.

Study Request 4a - Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects

Goals and Objectives

The goal of this study is to determine how climate change relates to the continued operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls projects.

The objectives of this study are:

1. Quantify the amount of thermal loading contributed by each respective impoundment (including the NMPS upper reservoir).
2. Using climate change prediction models, calculate how much warmer the project impoundments are projected to get in the next 30-50 years.
3. Model the effect of various project modifications on river temperature under current conditions and climate change predictions (e.g., converting to run-of-river, deep-water releases, dam removal, large-scale riparian revegetation, etc.).
4. Using climate change prediction models, determine if the projects actually provide an environmental benefit with respect to mitigating against climate change impacts (vis a vis warming of air and water temperatures) by producing low greenhouse gas emitting energy. The Northfield Mountain Pump Storage assessment must be based on net energy production (i.e., NMPS generates1,143,038 MWh annually, but consumes 1,567,506 in its pumping operations; for a net consumption of 424,468 MWh annually).
5. Determine how climate change predictions will impact management of high flow events at the three projects and evaluate if changes to dam structures would mitigate adverse impacts of the existing flood management protocols.

Resource Management Goals

The Landowners and Concerned Citizens for License Compliance (LCCLC) supports the United State Fish and Wildlife Service' (Service) goals. The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to climate change, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize deep headpond drawdowns associated with the loss of stanchion logs during high flow events, which are predicted to increase due to climate change.
3. Minimize project-related sources of thermal increases to Connecticut River waters to mitigate against predicted climate change impacts.

The Service, along with the National Oceanic and Atmospheric Administration (NOAA) and the Association of Fish and Wildlife Agencies developed a draft *National Fish, Wildlife and Plants Climate Adaptation Strategy* in 2012. The public comment period closed on March 5, 2012, and the agencies are working to finalize the document. Goal #7 of the Strategy calls for reducing non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate. The Strategy notes that some stressors (such as habitat loss and fragmentation and pollution) "are not only some of the things decision makers can control, they are also likely to interact with climate change to magnify negative impacts on fish, wildlife, and plants."

Goal #7 contains a number of strategies and associated actions, including:
Strategy 7.1: Slow and reverse habitat loss and fragmentation
Actions:

- Consider application of offsite habitat banking linked to climate change habitat priorities as a tool to compensate for unavoidable onsite impacts and to promote habitat conservation or restoration in desirable locations
- Identify options for redesign and removal of existing structures/barriers where there is the greatest potential to restore natural processes.

Strategy 7.2: Slow, mitigate, and reverse where feasible ecosystem degradation from anthropogenic sources through…water resource planning, pollution abatement…
Actions:

- Work with water resource planners to identify potentially conflicting needs and opportunities to minimize ecosystem degradation resulting from development and land and water use.
- Reduce existing pollution and contaminants and increase monitoring of air and water pollution.
- Increase restoration, enhancement, and conservation of riparian zones and buffers in agricultural and urban areas to minimize non-point source pollution.

The Service's study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Considerations if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Project.

Existing Information

The PADs contains no information relative to climate change and how climate change predictions may impact future operation of the hydroelectric plants, nor of how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

TransCanada's PADs provide a summary of water quality data collected in 2012. Table 1 below is a synthesis of the temperature data collected by TransCanada. It should be noted that the upper and mid-impoundment stations at each project represent the average of temperature readings taken over the entire water column, while the continuous loggers (Lower Cont. and TR) were located near the water surface. These data indicate that from the upstream end of the Wilder headpond to the Vernon tailrace, water temperature increased approximately 6°C.

Table 1. Median water temperature at monitoring stations located within the impoundments and tailraces of the three hydropower projects.

	Median Water Temperature °C			
Project	Upper Imp.	Mid-Imp.	Lower Cont.	TR
Wilder	20.86	21.83	24.08	23.59
BF	22.43	23.67	24.86	24.38
Vernon	23.81	24.49	26.73	26.35

Relative to existing flood management protocols at each station, TransCanada's PADs identify that all three dams utilize stanchion bays (two at Vernon, three at Bellows Falls, and four at Wilder). When inflows to each dam reach certain levels, the stanchion bays are removed, and cannot be replaced until inflows subside. The depth of these bays and the flows they are removed at are outlined in Table 2, below.

Table 2. Summary of pertinent stanchion bay Information for the Vernon, Bellows Falls, and Wilder projects.

Project	Stanchion Height (feet)	Flow Triggering Complete Stanchion Removal
Wilder	17	145,000 cfs
BF	13	50,000 cfs
Vernon	10	105,000 cfs

The PADs provide no information on the history of stanchion removal at any of the projects (frequency, duration, timing), nor a discussion of how predicted climate change might alter management of the stanchion bays in the future (with respect to the frequency and seasonality of occurrence). There also is no discussion of potential impacts to headpond resources that occurs as a result of stanchion bay removal. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations with respect to the Service's management goals and objectives, including those identified in the Climate Adaptation Strategy document.

Data provided by the National Oceanic and Atmospheric Administration, Climate Data Center, illustrates long-term increasing air temperatures in the Northeast (Figure 1). Long-term, monthly mean water temperature data for the Vernon Dam impoundment, monitored by Vermont Yankee, has shown significant differences over time (ANOVA analyses, $P < 0.05$) that when plotted and further analyzed by linear regression, show a significant increasing trend for the period 1974 – 2011 for the months of January, September, and October (Figure 2). These analyses were performed with data from Vermont Yankee, analyzed by the Massachusetts Department of Environmental Protection.

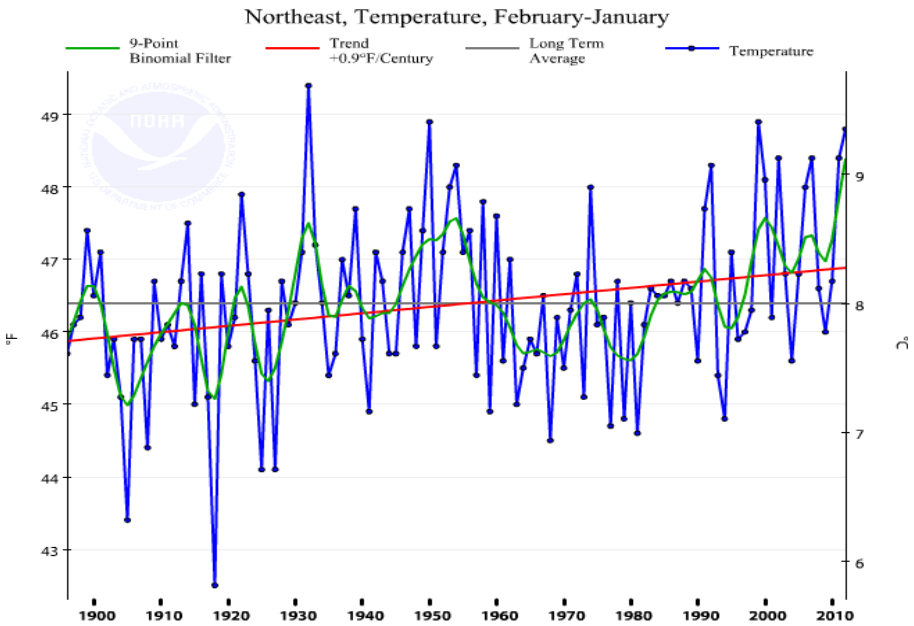

Figure 1. NOAA National Climate Data Center, Northeast 12-month average temperature for the period 1896 through 2012 (October).

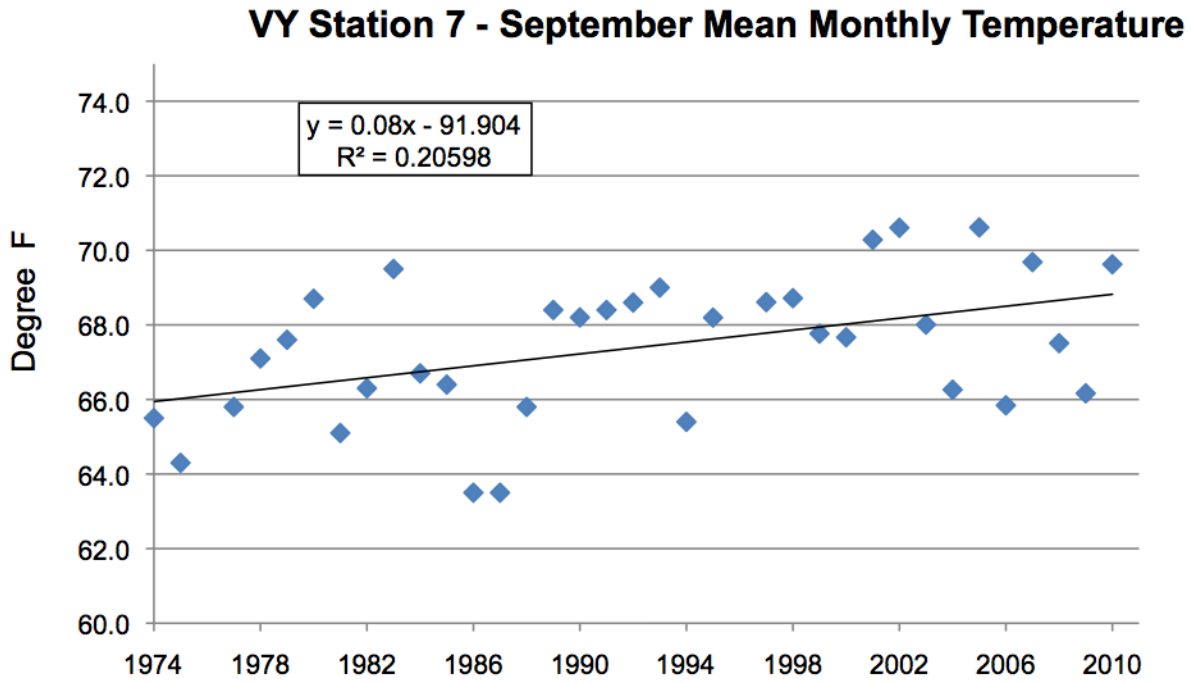

Figure 2. A plot of September's mean temperatures for Vermont Yankees' Station 7 (excludes outlier 1996 data point) for the period 1974 through 2011.

The PAD for Turners Falls and Northfield Mountain Pump Storage projects provides a summary of existing water quality data compiled by FirstLight, including water temperature data obtained from the Service. The PAD also notes a 1991 study by the former licensee that modeled thermal effects of pumping to the upper reservoir. That model reported a maximum temperature difference attributable to NMPS operation of 0.21°C in the Turners Falls reach of the Connecticut River in low flow (4,000 CFS) simulation.

Nexus to Project Operations and Effects

The four mainstem projects have very long impoundments capable of storing large volumes of water (Table 3, below). These impoundments effectively have converted large portions of the Connecticut River into a series of in-river "lakes." Because water velocities slow in these impounded sections of river, it allows for increased thermal loading and resultant higher water surface temperatures than in free-flowing sections of river.

Table 3. Relevant characteristics of the reservoirs behind the Wilder, Bellows Falls, Vernon, Turners Falls dams and NMPS.

Project	Headpond Length (miles)	Gross Storage Volume (acre-ft.)	Average Depth (ft.)	Surface Area (acres)	Flushing Rate (days)
Wilder	45	34,350	11	3,100	3
BF	26	26,900	10	2,804	<2
Vernon	26	40,000	16	2,550	2
Turners	20	21,500		2,110	
NMPS	n.a.	17,,050		246	n.a.

Depending on where the hydropower intakes withdraw water, these warmer surface waters may be discharged downstream, raising the temperature of those waters as well (the data in Table 1 above suggest that the projects do draw water from the upper levels of the reservoirs). This effect may be felt for miles downstream. If there are a series of impoundments (like on the Connecticut River), the cumulative impact is an overall warming of the river. Even small run-of-river dams have been shown to elevate downstream water temperature (Lessard and Hayes 2003; Saila et al. 2005). The most recent climate change prediction models specific to the northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and an increase in the incidence of short term droughts (Karl et al. 2009).

Resource concerns related to this project effect include the potential impacts to populations (reductions in abundance, structure, condition) or loss of species not tolerant of increases in temperature and other effects related to physiology such as energetic costs with warmer temperatures (Leggett 2004). As one example, American shad restoration target numbers for fish passage at mainstem dams into upstream historic habitat could be negatively impacted from artificially increased water temperatures. Water temperature has been identified as a factor in the timing (i.e., duration) of this species migration, as well as its role in gonad development and spawning (Glebe and Leggett 1981; Leggett 2004). These factors can be logical reasoned to potentially result in accelerated rates of energy reserve use and a reduced migration window, possibly reducing the ability of fish to reach up-river habitats and further reducing the ability to survive downstream outmigration.

With respect to project operations during high flow events, all TransCanada projects have stanchion bays that are used to manage water during high flow events. Each time these stanchion bays are removed, the headponds are lowered substantially (from 10 to 17 feet, depending on the project) and must remain lowered until inflows subside. Depending on the timing and duration of these deep drawdowns, headpond resources could be negatively impacted.

All of the dams also contain other mechanisms for managing flows, such as tainter gates, sluice gates, roller gates, skimmer gates and hydraulic flood gates. All of these gates have an advantage over stanchion bays in that they do not require flows to subside significantly before they can be closed to return impoundment levels back to normal. One climate change prediction for the northeast is that we will see more frequent high

precipitation events which will result in high flow conditions on rivers. Therefore, it is likely that the stanchion bay removal protocol will have to be employed more frequently in the future.

Methodology Consistent with Accepted Practice

1. In order to quantify the amount of thermal loading contributed by each respective impoundment, detailed bathymetry will need to be collected. This bathymetry, combined with storage volume, tributary hydrology, and project operations, should be used to calculate the thermal loading of each headpond. The individual and cumulative increase in surface water temperature due to the impoundments should then be used to predict future warming based on climate change models.
2. Analyze different mitigation strategies to understand which have the greatest benefit in terms of building resilience against the impacts of climate change on water temperature. Potential scenarios to analyze include converting the projects to run-of-river, implementing deep-water releases, removing one or more dams, conducting large-scale riparian revegetation, etc.).
3. Input to climate change models the amount of GHG emissions that would be generated if fossil fuel plants were producing the equivalent amount of net energy as the five hydropower projects to determine the impact on air and surface water temperatures.
4. Climate change prediction model output should be assessed to determine if the frequency and timing of high flow events is likely to change in the future. If high flow events that necessitate initiating the stanchion bay removal protocol are predicted to increase in frequency and/or shift in timing, the applicant should evaluate structural and/or operational alternatives that would mitigate adverse impacts of the existing flood management protocols.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the thermal loading analysis would be low to moderate. Collecting bathymetry in the three TransCanada headponds would take two staff less than one week to collect (it took the Kansas Biological Survey two days to collect bathymetry at a 3,500 acre lake; Jakubauskas et al. 2011). Bathymetry for the Turners Falls pool and NMPS upper reservoir already exist. The remaining work would be desk-based; loading relevant information into an appropriate thermal loading model to compute the estimated thermal loading of each headpond and then comparing this information to surface water data from climate change prediction models.

The high flow flood protocol study is a desktop analysis that should require low cost and effort. Climate change models already exist and that output would be downloaded and analyzed. The remaining analysis requires a review of alternative means of managing flows without the use of stanchion bays.

The applicants did not propose any studies to meet this need in the PAD.

Literature Cited:

Jakubauskas, M., J. deNoyelles, E. A. Martinko. 2011. Bathymetric and Sediment Survey of Elk City Reservoir, Montgomery County, Kansas. Applied Science and Technology for Reservoir Assessment (ASTRA) Program, Lawrence, KS. Report No. 2010-01

Glebe, B. D. and W. C. Leggett. 1981. Latitudinal differences in energy allocation and use during the freshwater migration of American shad and their life history consequences. Canadian Journal of Fisheries and Aquatic Sciences 38, 806-820

Karl, T.R., Melillo, J.M., and T.C. Peterson. 2009. Global Climate Change Impacts in the United States. Cambridge University Press.

Leggett, W. C. 2004. The American shad, with special reference to its migration and population dynamics in the Connecticut River. Pages 181-238 in P. M. Jacobson, D. A. Dixon, W.C.

Leggett, B.C. Marcy, Jr., and R.R. Massengill, editors. The Connecticut River Ecological Study (1965-1973) revisited: ecology of the lower Connecticut River 1973-2003. American Fisheries Society. Monograph 9, Bethesda, MD.

Lessard, J.L. and D.B. Hayes. 2003. Effects of elevated water temperature on fish and Macroinvertebrate communities below small dams. River Research and Applications.

Saila, S.B., Poyer, D., and D. Aube. 2005. Small dams and habitat quality in low order streams. Wood-Pawcatuck Watershed Association. April 29, 2005. 16 pp.

Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82 (10.88), Washington D.C.

Study Request 5a - Water Quality Monitoring in the Turners Falls Impoundment and Downstream of the Turners Falls Project

Goals and Objectives

Determine the current water quality of the Connecticut River within the Turners Falls impoundment. The results of the study should provide information sufficient to enable mandatory conditioning agency staff to understand water quality conditions at the project. The study plan for the water quality monitoring should be developed in consultation with the U.S. Fish and Wildlife Service (USFWS) and the Massachusetts Department of Environmental Protection (MA DEP).

The specific objectives of this study are as follows:

- Characterize water quality in the Turners Falls impoundment, bypass reach, canal and below the confluence of the bypass reach and canal discharge.
- Evaluate the potential effects of project operation on water quality parameters such as temperature, dissolved oxygen, total suspended sediment and turbidity in conjunction with various other water uses.
- Determine the level of contamination in sediment impeded by Turners Falls dam.
- Collect continuous temperature, dissolved oxygen, total suspended sediment and turbidity data during the summer period and under various hydropower operating conditions at the Northfield Mountain Project.

Relevant Resource Management Goals and Public Interest Considerations

The resource management goal is to ensure that the Connecticut River, which is designated as a Class B river for its entire length in Massachusetts, meets its designated uses of habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Class B waters must also have consistently good aesthetic value and meet minimum criteria for numerous water quality indicators to achieve compliance with the standards set forth in the regulations. The other resource management goal is to protect prime farmland soils, which are eroding, and riparian habitat. Eco-based tourism is important to the economy of Franklin County so maintaining the water quality of the river for boaters and kayakers is important, too.

Public Interest Considerations if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC,

including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information and Need for Additional Information

The PAD provides a summary of existing water quality data. While a number of monitoring efforts have taken place and include sample sites within the project boundary, none of those studies was designed to comprehensively investigate whether all relevant project areas currently meet Class B standards: The Massachusetts DEP's Connecticut River watershed assessment monitoring occurred in 2003, it had only two stations located within the project area (both upstream of the Turners Falls dam) and only collected five to six samples from late April to early October. The Connecticut River Watershed Council's volunteer monitoring program only had one sample site within the project area (at Barton's Cove in the Turners Falls impoundment) and while those data are more recent, only three samples were collected in 2007 and only six samples in 2008 (over the course of three to four months each year). The U.S. Geological Survey's long-term water quality monitoring station located downstream of the Cabot Station tailrace only collects information roughly once per month (and no dissolved oxygen data are provided).

No directed, site-specific surveys have been conducted to determine whether waters within the Project area meet state standards. This information gap needs to be filled so that resource agencies can evaluate properly the potential impact of project operations on water quality.

Nexus to Project Operations and Effects

The project creates a 20-mile-long impoundment where there would naturally be a free-flowing river. It currently operates in a peaking mode, with allowable river fluctuations of up to 9 feet, with proposals to continue as such. Portions of the impoundment are nearly 100 feet-deep. There is a 2.7 mile-long reach of river bypassed by the Turners Falls power canal with only a nominal seasonal release required (equal to 0.05 cfsm). The below-project flow requirement is equal to 0.20 cfm (1,433 cfs). Water quality is directly affected by the operating mode of a hydropower project. Impoundments can stratify, resulting in a near-hypoxic hympolimnion. If the project intake draws off of these deep

waters then it could cause low dissolved oxygen levels downstream from the project discharge.

The Landowners and Concerned Citizens for License Compliance requests that the applicant conduct a water quality survey of the impoundment, bypass reach and tailrace reach in order to determine whether state water quality standards are being met under all currently-licensed operating conditions (i.e., during periods of generation and non-generation). Results of the survey would be used, in conjunction with other studies requested herein, to determine an appropriate below-Project flow prescription, bypass reach flow(s), and to recommend an appropriate water level management protocol for the impoundment (e.g., limiting impoundment fluctuations to protect water quality). Operation of upstream hydroelectric projects as well as the Turners Falls Project and Northfield Mountain Project may impact water quality through the use of water for hydropower generation.

Methodology Consistent with Accepted Practice

Turners Falls: Water quality samples should be collected from a minimum of six locations: upstream of the impoundment, at a deep location within the impoundment, in the forebay near the intake, in the bypass reach, in the canal near Cabot Station and downstream of the confluence of the Cabot Station discharge and the bypass reach but upstream of the confluence with the Deerfield River. In order to ensure that data are collected under "worst case" conditions (low flow, high temperature, antecedent of any significant rainfall event), we recommend deploying continuous data loggers at all six locations, with biweekly vertical profiles taken at the deep impoundment location from June 1 through September 30. Results should include date, time of sampling, sunrise time, GPS location, generation status (estimated flow through canal and bypass reach), precipitation data, water temperature, DO concentration and percent saturation.

In addition, impoundment sediment adjacent to the Turners Falls dam should be analyzed for metals and polychlorinated biphenyls.

A proposed water quality sampling plan should be submitted to USFWS and MADEP for approval. A section on quality assurance and quality control must be included.

If river flow and temperature conditions are representative of an "average" or "low" water year, then one year of data collection should be sufficient to perform the study. If conditions are not representative (i.e., a "wet" or cool year) then a second year of data collection may be necessary.

Northfield Mountain: The water quality study will include two components: a) continuous dissolved oxygen and temperature monitoring at specific locations in the Northfield Mountain Project area and b) monthly *in-situ* dissolved oxygen, temperature profiles, total suspended solids and turbidity within the Northfield Mountain Upper Reservoir. It is anticipated that the study will be conducted from approximately June 1 through September 30.

Level of Effort and Cost

Cost would depend on the specific methodology chosen. If continuous data loggers are installed at all six locations and biweekly vertical profiles taken at the deep impoundment location from June 1 through September 30 then the estimated cost of the water quality study is approximately $55,000, including at least one full year of data collection. It is expected to take two technicians approximately one day to deploy the loggers, eight days to collect the vertical profiles, one day to remove the loggers, one day to download the data, and five days to write the report.

In the PAD, the applicant proposes to assess the effects of the Turners Falls and NFMPS project operations on dissolved oxygen and temperature by continuously monitoring DO and temperature at locations within the project areas and gathering vertical profiles within the TF impoundment and NFMPS upper reservoir.

Study Request 6a – Quantify the Impacts of Water Level Fluctuations on Riparian and Aquatic Vegetation Including Invasive Species and their Associated Habitats in the Turners Falls Dam Project Impoundment

Conduct a study to quantify the impacts of river level fluctuations due to project operations on riparian, wetland, Emergent Aquatic Vegetation (EAV), Submerged Aquatic Vegetation (SAV), littoral zone and shallow water aquatic habitats in the Turners Falls Dam impoundment.

Goals and Objectives

The goal of this study is to obtain baseline information on riparian, wetland, emergent and submerged aquatic vegetation, and associated shallow water aquatic habitats (subject to operational inundation and exposure to near exposure) known to occur in the project area. Information would be used to determine whether riparian, wetland, EAV and SAV, littoral, and shallow water (e.g., mid river bars and shoals) habitats are impacted by current water level fluctuations permitted under the Turners Falls and Northfield projects' licenses and whether these vegetation types and shallow water habitats can be protected and restored by modifications to project operations or other mitigation measures. This analysis needs to take into account existing and potential future limits on pond level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes under a new licenses of the Turners Falls and upstream projects. This information is needed to determine whether the projects' operation affects plants, habitat, and wildlife in the project area, whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigative measures, and whether there is any unique or important shoreline or aquatic habitats that should be protected.

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Relevant Resource Management Goals and Public Interest Considerations

Protect and restore native riparian, wetland, EAV, SAV, littoral and shallow water habitat (i.e., spawning and or nursery areas for aquatic organisms) in the Turners Falls impoundment.

Public Interest Considerations if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information and Need for Additional Information

Existing information in the PAD does not quantify EAV and SAV in this area, or other shallow aquatic habitat types and physical features (e.g., depths, substrates, wood structure) that are the environment for aquatic biota in the project area. The PAD does provide some limited monitoring data for 2012 (2 locations) on water surface elevations that show daily fluctuations, in the upper third of this impoundment, that varied over 4 feet on a daily cycling frequency, with fluctuations generally in the 2 foot range in low flow months for the data provided in the PAD. The current license does permit a greater

pool elevation operational fluctuation, up to a 9 foot change in elevation, based on the Turners Falls Dam water elevation. In the PAD it is noted these operational fluctuations under most circumstances at the Turners Falls Dam are within 3.5 feet.

In the PAD it is noted that FirstLight would like to expand its NMPS upper reservoir capacity (by up to 24%). How this may affect project operations and the habitats noted in this request is unknown. It is also noted that water is typically pumped to the upper reservoir in evening and generation back to the river occurs once to twice daily, in daytime hours, based upon power needs and power value. Under current license conditions, provided set thresholds for minimum flow and Turners Dam current license elevations are met, the NMPS may operate with no restriction in timing, frequency, or magnitude for pumping or generation. No data were provided on the operation of the NMPS plant over time relative to data on pumping and generation on an hourly basis, averaged values were provided over monthly periods. It is unclear what the actual timing, frequency and magnitude of these NMPS operations are over the course of a year and how that relates to: aquatic plant species establishment, growth, survival, littoral zone or other shallow water habitat fish spawning periods and their effects on these fishes (reproduction success and subsequent recruitment, e.g., bass and fall fish nests) in available and utilized habitat, and how the quantity and quality of these shallow water habitats are effected by project operational manipulation/alteration, as currently permitted or proposed.

The PAD provides lists of plant and wildlife species whose native ranges overlap with the project area, but it does not provide any baseline information on known occurrences of these species in the wetlands, riparian, littoral and shallow water habitats, within or adjacent to, the project area. Plant and wildlife occurring in these habitats may benefit from protection, mitigation, and enhancement (PMEs) measures, given the potential effects of continuing the current semiautomatic peaking operating regime. In addition, a large scale sediment discharge from NMPS resulted in regulatory actions by FERC, the EPA and MADEP in 2010. Continuing and as yet unresolved management plan measures relative to sediment and NMPS project operations, are further concerns for shallow water, littoral zone, and wetland habitats.

The Atlantic States Marine Fisheries Commission, Atlantic Coast Diadromous Fish Habitat: A Review of utilization, threats, recommendations for conservation, and research needs (ASMFC 2009)[2], contains a review of habitat information for these species. Recommendations in this report include: Maintain water quality and suitable habitat for all life stages of diadromous species in all rivers with populations of diadromous species.

Nexus to Project Operations and Effects

Water level fluctuations due to project operations could affect EAV and SAV habitat as well as the quantity and quality littoral and shallow water habitat. These operational

[2] Atlantic States Marine Fisheries Commission. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations, for conservation, and research needs. Habitat Management Series #9. Washington, D.C.

water level fluctuation effects are expected to impact fish species use of these habitats and may affect spawning fishes reproductive success and subsequent population recruitment including but not limited to American shad, blueback herring, sea lamprey, fall fish, and bluegill, which spawn in mid to late spring through early summer in areas subject to daily or more frequent water level fluctuations.

The current operating mode, as well as the unknowns with proposed upper reservoir expansion, may affect wetland riparian, littoral and other shallow water habitats and promote the introduction and expansion of invasive plant species through fluctuating water levels. A study that explains the relationship between the proposed mode of operation and the type and quantity or wetland, riparian, littoral, shallow water habitats, and invasive species affected would help inform a decision on the need for protection and/or control of these resources in the license.

Methodology Consistent with Accepted Practice

The PAD currently contains maps portraying general wetland types from the Cabot Station tailrace upstream to the Vernon Dam. In addition, we understand that recent bathymetry exists for the Turners Falls impoundment (Field, 2007). The proposed study should utilize this existing information in conjunction with field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

- Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings);
- Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
- Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
- Predominate land use(s) associated with each cover type;
- Wildlife sightings should be noted;
- Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.

Level of Effort and Cost

In the PAD, First Light identified impacts of the project operations on wetlands, riparian and littoral zone habitat as a potential issue to be addressed in relicensing, and proposed wetland vegetation mapping. However, additional analysis as described above is needed to understand the impacts of the project on these resources and habitats.

A wetlands, riparian, littoral/shallow water, invasive species inventory, of the scope envisioned, would likely require 6-8 months to complete and cost $40,000 to $50,000.

Study Request 7a - Model flows in the Northfield Mountain Pumped Storage Project discharge tailrace and Connecticut River 1 kilometer upstream and downstream of the discharge using two-dimensional Computational Fluid Dynamics (CFD) model techniques.

Goals and Objectives

The goal of this study is to determine the potential impacts (both project-specific and cumulative) of the Northfield Mountain Pump Storage Project operations (pumping and generating) on the zone of passage for migratory fish near the Northfield Mountain turbine discharge/pump intake, on natural flow regimes in the area of the Connecticut River immediately upstream and downstream of the project, on the potential for entrainment during pumping operations, on the potential for creating flow reversals in Connecticut River during pumping cycles that may confuse migratory fish attempting to pass the project, and on bank erosion on both sides of the river in the vicinity of the tailrace.

Specific objectives of the study include:

- Develop a 2-dimensional CFD modeling capability for the area of the Northfield Mountain discharge and tailrace, along with the full width of the Connecticut River 1km upstream and 1 km downstream of the discharge.

- Model flow characteristics upstream and downstream of the project under existing project operations (pumping and generating) and at several representative river flow levels, as well as proposed operations such as those proposed in section 3.4.4 of the PAD, and any other modifications under consideration, to assess potential impacts to fish and wildlife resources, recreational use, agricultural resources, and historical resources.

- Assess velocities at and in proximity to the Northfield Mountain intake/discharge structure, when pumping or generating and their potential to interfere with fish migration.

- Assess the potential for velocity barriers in the mainstem river resulting from pumping and generation flows at the project, alone or in combination with generation flows from the upstream Vernon Project.

- Assess potential for Northfield Mountain project operations to create undesirable attraction flows to the intake/discharge that may result in entrainment or delay of migratory fish.

- Assess the potential of a mainstem instream local flow reversal associated with pumping operations to impact migrating fish. The Connecticut River in the area of the Northfield Mountain tailrace has been said to flow upstream potentially confusing migratory fish keying in to flow as a directional aid to upstream or

downstream migration, causing delay and additional "fish" energy expense and possible entrainment.

- Model and then evaluate flow characteristics under alternative project operations with potential measures to avoid, minimize, or mitigate impacts to fish and wildlife resources.
- Assess the potential for unnatural flows and eddies in the main-stem associated with pumping or generation at the Northfield Mountain Project to impact bank erosion and recreational use.

Resource Management Goals

The Landowners and Concerned Citizens for License Compliance supports the U.S. Fish and Wildlife Service's goals. The mission of the U.S. Fish and Wildlife Service (Service) is to work with others to protect, conserve and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American public. Service trust resources include wetlands, endangered species, and migratory species, all of which have been documented to occur in the project area. The Service is also working with a number of federal, state, local, non-governmental organizations, and the public to restore and enhance trust resources in the Connecticut River Basin through comprehensive management plans and cooperative agreements. Instream flow is an important riverine habitat characteristic that can have a great impact on aquatic habitat for fish, wildlife, and plants. Flow is an important directional guidance cue for instream navigation and attraction to fishway entrances for migratory fish.

Public Interest Consideration if Requester is not a Resource Agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information

No project specific information exists that will allow for a comprehensive assessment of existing project operations (pumping and generating flows) on Connecticut River flows and on fish and aquatic organisms in the project area upstream and downstream of the project in the Connecticut River. Preliminary results from an ongoing study of radio-tagged American shad by the USFWS and USGS Conte lab indictate that shad are exposed to the intakes and some individuals spend substantial amounts of time in the vicinity of the intakes. The PAD does not contain any information or tool that will allow for predictions of impacts of alternative project operations, or potential mitigation measures to protect or enhance aquatic fish and wildlife resources.

As part of Field (2007; see appendix 4), a "Connecticut River Hydraulic Analysis – Vernon Dam to Turners Falls Dam" was completed by Woodlot Alternatives in July 2007. For this analysis, a 2-dimensional flow model was developed for the entire Turners Falls impoundment. This study was geared towards looking at shear stresses from high-flow events, and did not focus in detail around the tailrace or examine how pumping and generation may affect flows in the vicinity of the tailrace under a variety of flows.

As a result of the hydraulic analysis, Field (2007) on page 20 states that "While erosion does occur where high flow velocities and shear stresses approach near the bank, significant amounts of erosion also occur where flow velocitieis near the bank are low." No specific examination was done in the report on the ±1 km area near the tailrace and existing erosion sites. Banks immediately upstream and downstream and across river have all required bank stabilization projects over the last 15 years, in some cases needing several repairs.

Nexus to Project Operations and Effects

Existing project operations have a direct impact on instream flow and aquatic habitat in the pump/discharge area of the Connecticut River. The PAD in section 3.2.2 says that the velocity at the trash racks when operating at full capacity is 20,000 cfs and maximum pumping conditions are 15,200 cfs. Annual flow duration curves shown for below the Vernon Dam submitted in the PAD section 4.3.1.2 (for years 1944-1973; recent and near project flows are not available; see p. 459) indicate that river flows are $\leq$ 20,000 cfs more than 85% of the time. Flows released from the project must therefore influence flow patterns and velocities in the Connecticut River, particularly at flows below some unknown threshold level.

Recreational users of the Connecticut River in the Turners Falls impoundment have anecdotally described flow reversals in the mainstem river. Discharges from the project could potentially be larger than river flows or at least act like a major tributary to the Connecticut River. Project flows may influence the availability and extent of upstream and downstream migration zones, or may confuse fish and delay migration. Project flows may also impact stream banks in ways that natural river flow (or flows affected by upstream hydropower facilities) does not, and may also impact recreational use of the river.

Proposed Methodology

CFD modeling is consistent with generally accepted practice, and has been used to assess proposed modifications to the Holyoke Dam fish passage facilities, upstream of the intakes and downstream of the dam, as well as at hydroelectric projects on the Susquehanna River to assess existing and proposed project operations, and develop mitigation measures for fish and wildlife resources.

Level of Effort/Cost, and Why Alternative Studies will not suffice

This study will require a detailed elevation map of the study area upstream and downstream of the Northfield Mountain project. Information already exists in historic construction files for the project, the hydraulic analysis included in Appendix 4 of Field (2007), and possibly in conjunction with work done after the 2010 maintenance procedures that resulted a portion of the river being dredged after a large sediment dump) that are in the possession of the applicant. Additional elevation data will likely need to be collected in the field using standard survey techniques. Elevation data will then need to be entered into a CFD modeling program. The CFD computer program will need to simulate existing project operations that include all potential variations of pumping and generating, and static operation. No project specific instream flow analysis tool has been developed for the Northfield Mountain project that will allow for assessment of existing operations and alternative operational impacts on instream flow and aquatic habitat for fish and wildlife resources. The computer model, once built, can be used to simulate flow conditions in the vicinity of the project during migratory fish passage and can be used together with behavior studies (i.e., telemetry studies and entrainment studies requested herein) to assess the impacts of varying project operations or potential mitigation operations and measures on fish migration and aquatic habitat. We know of no other tool that will provide for these types of assessments. Cost is expected to be moderate to high.

Study Request 8a. Model River Flows and Water Levels Upstream and Downstream from the Turners Falls Project Dam Generating Stations and Integration of Project Modeling with Upstream and Downstream Project Operations

Develop a river flow model(s) that are designed to evaluate the hydrologic changes to the river caused by the physical presence and operation of the Turners Falls Hydroelectric Project and the interrelationships between the operation of all five hydroelectric projects up for relicensing (i.e., P-1889 Turners Falls Hydroelectric Project, P-2485 Northfield Mountain Pumped Storage, P-1904 Vernon Hydroelectric Project, P-1855 Bellows Hydroelectric Project, P-1892 Wilder Hydroelectric Project) and river inflows. The flow studies should assess the following topics:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Turners Falls Project impoundment and discharges from the Turners Falls Dam and generating facilities and the upstream and downstream hydroelectric projects. Data inputs to and outputs from the model(s) should include:
    a. Withdrawals from the Turners Falls impoundment by the Northfield Mountain Pumped Storage Project, FERC No. 2485,
    b. Discharges to the Turners Falls impoundment by the Northfield Mountain Pumped Storage Project,
    c. Discharges into the Turners Falls impoundment from the Vernon Project, FERC No. 1904 and other sources.
    d. Existing and potential discharges from the Turners Falls Project generating facilities and spill flows.
    e. Existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Turners Falls impoundment and downstream flows from the project
    f. Existing and potential required minimum flows and/or other operation requirements at each of the four upstream projects.
    g. Minimum discharge flows ranging between 2,500 and 6,300 cfs in the bypass reach from April 15th through June 22nd to support spawning, rearing, and outmigration of shortnose sturgeon at Rock Dam.

2. Document how the existing and potential outflow characteristics from the four upstream projects affect the operation of the Turners Falls Project including downstream flow releases and Turners Falls impoundment levels.

3. Assess how the operation of the existing Turners Falls Project and upstream projects affect Holyoke Project (P-2004) operations including:
    a. How Turners Falls Project flow fluctuations affect Holyoke impoundment water levels, with emphasis on the influence on the water levels on listed Puritan tiger beetle habitat at Rainbow Beach in Northampton, MA. and assess what changes would be needed in Turners Falls operations to stabilize water levels at Rainbow Beach.

b. How Turners Falls Project operations affect Holyoke Project discharges and what changes in Turners Falls operations would be needed to reduce fluctuations in the discharges from the Holyoke Project.

4. To the extent predictable and practical, incorporate the potential effects of climate change on project operations over the course of the license.

Goals and Objectives

Determine the extent of alteration of river hydrology caused by operation of the project and the interactions between upstream project operations, Turners Falls operations and downstream operations at the Holyoke Project. The models will provide necessary information on what changes can be made to each of the five project's flow releases and/or water levels restrictions, and how those changes affect downstream resources.

Specifically, for the Turners Falls Project continuous minimum discharge flows in the Turners Falls bypass reach need to be no less than 2,500 cfs during shortnose sturgeon spawning, rearing, and outmigration (April 15th – June 22nd). Incorporating these parameters into the model will inform what changes, if any, need to be made to operations of upstream projects to accommodate such flows.

As other specific modifications of the operations of each of the projects are identified based on results of other requested studies, these desired conditions will need to be input into the models to assess how each change affects that project and other project operations and the implications of those changes on other resources and/or the ability to achieve desired operational changes at other projects.

Resource Management Goals

The Landowners and Concerned Citizens for License Compliance support the goals of the U.S. Fish and Wildlife Service (Service). The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.
3. Assist FERC to ensure that the continued operation of the facility is not likely to jeopardize the continued existence of shortnose sturgeon.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.

3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.
4. Ensure that project operations are not likely to jeopardize the continued existence of shortnose sturgeon.
5. Avoid or minimize the current negative effect of project operations on shortnose sturgeon spawning and rearing within the Montague spawning area (i.e. Rock Dam and Cabot Station spawning sites and associated early life stage rearing areas).

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest considerations if requester in not a resource agency

The Landowners and Concerned Citizens for License Compliance (LCCLC) consists primarily of Gill and Northfield farm and conservation landowners who organized after seeing our riverbanks continue to wash down the Connecticut River in the Turners Falls Pool. Current and previous landowners have consistently advocated for more and better work to stabilize and repair areas of bank erosion with numerous filings to FERC, including professional studies commissioned by LCCLC, all of which have been made a part of the licensing proceeding.

The LCCLC has active members on the Franklin Regional Council of Governments' (FRCOG) Ad Hoc committee, the Connecticut River Streambank Erosion Committee (CRSEC). The CRSEC was convened in 1994 to bring together the Northfield Mountain Pumped Storage Project operator, state and municipal entities, landowners, and NGO's to carry out bioengineering projects to stabilize and repair areas of bank erosion. We are currently working with the FirstLight and the CRSEC to develop a suitable Quality Assurance Project Plan (QAPP) and appropriate methodology for the 2013 FRR.

The LCCLC looks forward to continuing our active engagement in the relicensing of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects

Existing Information

Available information in the PAD does not indicate how project operations have altered downstream hydrology, which may affect resident and migratory fish, macroinvertebrates, rare, threatened, and endangered species, aquatic plants and other biota and natural processes in the Connecticut River from below the Vernon Dam downstream to the Holyoke Dam.

Information in the PAD also does not reflect data analyzed in Kynard et al. 2012, which identifies minimum discharge thresholds for shortnose sturgeon spawning and rearing at

the Rock Dam spawning site. Spawning success was observed at Rock Dam when discharge was between 2,500 cfs and 22,000 cfs during the spawning period (April 27–May 22nd) (Kynard et al. 2012, chapter 3). In 1995 at the Cabot spawning area, the greatest level of spawning and spawning success occurred (i.e., 21 late stage females present, 342 ELS captured, spawning period was 17 days) even though no spawning was detected at Rock Dam (Kynard et al. 2012, chapter 3). Discharges in 1995 at Rock Dam had dropped below 2,500 cfs by March 26th (Kynard et al. 2012, chapter 3), showing that even though 1995 saw the largest number of pre-spawning adults, none spawned at Rock Dam. This may indicate the need to have adequate flow well in advanced of spawning. Discharge reductions at the Rock Dam site that occurred during spawning caused females to leave the spawning cite and not return even if flow increased to acceptable levels later during the spawning period. Researchers observed that substrate did not change during fluctuating flows and thus cessation of spawning is likely due to velocities falling below the range preferred by females. Given the current flow dynamics at Rock Dam, spawning does not occur most years (Kynard et al. 2012, chapter 3). These data represent the best available scientific information and indicates that the current minimum flow thresholds at the project are not adequate for the protection of endangered shortnose sturgeon. All modeling efforts described above must incorporate the identified minimum flow and temporal parameters.

Nexus to Project Operations and Effects

The Turners Falls Project is currently operated with a seasonally-varying minimum bypass flow (400 cfs from 5/1 through 7/15, then 120 cfs through the winter until river temperature rises to ≥ 7°C) and year-round minimum flow below the projects of 1,433 cfs. The project operates as a daily peaking project, often with large, rapid, daily flow fluctuations between the minimum and project capacity (15,928 cfs) and fluctuations in headpond elevation (175’ to 186’ MSL). These changes affect biotic habitat and biota upstream and downstream of the project. Project operations and potential changes to operations to mitigate impacts are influenced by inflows and operations of upstream peaking projects and the Northfield Mountain Pumped Storage Project operations and potential changes in operations of each project could affect the ability to achieve desired operational changes at other projects. Results of river flow analyses will be used to develop flow-related license requirements and/or other mitigation measures.

Methodology Consistent with Accepted Practice

River hydrology statistics and modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Level of effort and cost of model development are expected to be moderate but to be valuable in developing license conditions, the model(s) will need to be run under various scenarios throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. Therefore, ongoing consultation and re-running of the model(s) are likely to be needed

throughout the relicensing process. The modeling exercise will also require coordination and cooperation between First Light and the upstream licensee to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size (e.g., Conowingo, FERC No. 405).

Document Content(s)